Part D. Chapter 1: Food and Nutrient Intakes, and Health: Current Status and Trends

INTRODUCTION

Humans require a wide range of essential micronutrients and macronutrients for normal growth and development and to support healthy aging throughout the life cycle. Essential nutrients, including most vitamins, minerals, amino acids and fatty acids, water and fiber, must be obtained through foods and beverages because they cannot for the most part be endogenously synthesized, or are not endogenously synthesized in adequate amounts to need recommended intakes. Understanding the extent to which the U.S. population and various age, sex, and racial/ethnic groups within the population achieve nutrient intake requirements through available food and beverage intake, including foods and beverages[*] that are enriched or fortified, is an important task of the DGAC. Notably, the DGAC considers that the primary source of nutrients should come from foods and beverages. Nutrient-dense forms of foods (those providing substantial amounts of vitamins, minerals and other nutrients and relatively few calories) are recommended to ensure optimal nutrient intake without exceeding calorie intake or reaching excess or potentially toxic levels of certain nutrients.

In the process of evaluating adequacy of nutrient intake of the U.S. population, the DGAC identified two levels of "Nutrients of Concern". Shortfall nutrients are those that may be underconsumed relative to the Estimated Average Requirement (EAR) or Adequate Intake (AI). Overconsumed nutrients are those that are consumed in amounts above the Tolerable Upper Limit of Intake (UL)[1] or other nationally recognized standard.[2] Nutrients of Public Health Concern were those shortfall or overconsumed nutrients that also had evidence of under- or overconsumption through biochemical nutritional status indicators[3] plus evidence that the nutrient inadequacy or nutrient excess is directly related to a specific health condition. This information is critical in determining where dietary intake improvements may be warranted that will benefit the health of the population. The 2015 DGAC recognizes that the 2010 DGAC specifically addressed whether or not multivitamins provided health benefits. The 2015 DGAC did not specifically address multivitamins, but recognizes that some dietary supplements may be recommended for some populations or life-cycle phases (pregnancy, for example).

In addition, many foods contain constituents that enable them to be produced, preserved, and thus widely available year round. Some of these ingredients, such as sodium, are used to make foods shelf stable and can help ensure food availability and food security for the population as a whole.[4] Other ingredients, such as added sugars, are used as a food preservative and to enhance palatability. Despite the functional nature of both sodium and added sugars in the food supply, excess consumption of these

[*] Note: The DGAC considered foods and beverages in its review of intake data. Throughout this chapter, references to "foods" should be taken to mean "foods and beverages."

dietary constituents poses potential health risks and was of particular concern to the DGAC. This chapter reviews data on intakes of sodium, added sugars and saturated fat; other chapters consider sodium, added sugars, and saturated fat from additional perspectives (see ***Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance)*** including health outcomes. The food supply also contains ingredients that are both naturally occurring and also added to foods and beverages, such as caffeine, that have generated considerable attention in recent years. This chapter examines intake levels across age and sex groups of the U.S. population; ***Part D. Chapter 5: Food Sustainability and Safety*** considers several safety aspects of caffeine consumption.

The U.S. food supply is complex. Tens of thousands of foods and food products are available in a variety of forms. Some foods are whole foods that are often eaten alone without additions, such as fruit and milk, while others, such as sandwiches and mixed dishes, are mixtures of multiple components from more than one food group.

The DGAC recognizes the importance of understanding the totality of food and beverage intake at the level of food groups and basic ingredients (e.g., fruit, vegetables, whole grains, refined grains, dairy, protein foods) as well as at the level of foods as they are typically consumed, called food categories (e.g., pizza, pasta dishes, burgers, sandwiches) and how these contribute to nutrient adequacy or nutrient excess. To better understand current food intakes of the U.S. population, the Committee reviewed data on several issues, such as which of these food groups (e.g., refined grains) and food categories (e.g., sandwiches, beverages, snacks and sweets) contribute the most energy (calories), sodium, and saturated fat.

Understanding the totality of food and beverage intake also involved acknowledging that individuals purchase and procure food in a diverse array of locations, including large grocery stores, convenience stores, schools, the workplace, quick-serve restaurants, and sit-down restaurants. The DGAC examined the diet quality of the foods and meals at each major procurement point, as it is important to understand not only where foods are purchased or obtained, but also the extent to which they contribute to the overall nutritional adequacy and nutritional quality of the diet. This information may be relevant to guidance for federal nutrition programs. The DGAC also considered the diet quality of foods prepared and purchased at places such as supermarkets, but consumed at home. For example, many supermarkets have salad bars and hot food bars, but these foods are then consumed at home. However, on examination, it was determined that these types of data were not available. The DGAC also examined eating behaviors, such as meal skipping, and identifying which nutrients and how much energy are consumed at specific eating occasions and locations, because an understanding of these behaviors can help inform public policy and population as well as individual guidance.

The DGAC considered the composition of dietary patterns that were found to be linked to health outcomes in ***Part D. Chapter 2: Dietary Patterns, Foods and Nutrients, and Health Outcomes***. Understanding the characteristics of diets characterized as “Healthy U.S.” or “Mediterranean-style”

dietary patterns and others patterns found to have health benefits, will provide specific, healthful food and beverage-based guidance for the U.S. population. These patterns are defined using dietary quality/adherence indices, [e.g., Healthy Eating Index (HEI)], based upon data-driven approaches (e.g., cluster or factor analysis), or may be self-identified patterns (e.g., vegetarian).

To address the issues described above, the DGAC presents the current status and trends in nutrient, food, food group, and food category intakes, and describes major sources of energy, sodium, added sugar, and saturated fat, and dietary pattern intake among representative samples of the U.S. population from the National Health and Nutrition Examination Survey (NHANES) What we Eat in America (WWEIA) dietary survey.[5] We also describe eating behaviors, such as number of meals per day, diet quality of foods, location of food purchase and consumption and diet quality of foods based on location where the food was purchased or consumed.

Finally, we describe the prevalence of diet-related health outcomes in the U.S. population, including obesity, diabetes, cardiovascular diseases, certain cancers, osteoporosis, congenital anomalies and psychological health (including mental health), and neurological illness (such as Alzheimer's Disease). The examination of diet-related health outcomes was more extensive than in earlier DGAC reports. The high rates of the chronic conditions and the presence of other less common, but important diet-related health problems, provided compelling reasons to study them in greater detail. These data provide a backdrop for other chapters, particularly those which examine the strength of associations between diet and health outcomes (***Part D. Chapter 2: Dietary Patterns, Foods and Nutrients, and Health Outcomes***) and methods for improving disease risk outcomes and improving health at individual (***Part D. Chapter 2: Dietary Patterns, Foods and Nutrients, and Health Outcomes*** and ***Part D. Chapter 3: Individual Diet and Physical Activity Behavior Change*** and population levels (***Part D. Chapter 4:Food Environment and Settings***).

One of the overarching motivations for this broad examination of nutrient intake, food group and food category intake, and food purchase location is to better understand the relationship of food intake (both inadequacy and excess) and the food environment to nutrition-related health conditions. This comprehensive evaluation of food and nutrient intakes by the U.S. population (and various subgroups) along with the food and eating environment enables the consideration of factors on a broad scale that may facilitate behavior change and adoption of healthy eating practices in the population at large. Taken together, these dimensions of our analysis inform the remaining chapters in the report, which, taken together, will provide the contextual and scientific foundation for the 2015 Dietary Guidelines for Americans.

LIST OF QUESTIONS

Nutrient Intake and Nutrients of Concern

1. What are current consumption patterns of nutrients from foods and beverages by the U.S. population?
2. Of the nutrients that are underconsumed or overconsumed, including over the Tolerable Upper Limit of Intake (UL), which present a substantial public health concern?
    a. What would be the effect on food choices and overall nutrient adequacy of limiting saturated fatty acids to 6 percent of total calories by substituting mono- and polyunsaturated fatty acids?
3. Is there evidence of overconsumption of any micronutrients from consumption of fortified foods and supplements?
4. What is the level of caffeine intake derived from foods and beverages on the basis of Institute of Medicine (IOM) Dietary Reference Intakes age and sex categories in the U.S. population?
5. How well do updated USDA Food Patterns meet IOM Dietary Reference Intakes and 2010 Dietary Guidelines recommendations? How do the recommended amounts of food groups compare to current distributions of usual intakes for the U.S. population?
    a. How well do the USDA Food Patterns meet the nutritional needs of children 2 to 5 years of age and how do the recommended amounts compare to their current intakes? Given the relatively small empty calorie limit for this age group, how much flexibility is possible in food choices?
6. Can vitamin D Estimated Average Requirements (EARs) and/or Recommended Dietary Allowances (RDAs) be met with careful food choices following recommended amounts from each food group in the USDA Food Patterns? How restricted would food choices be, and how much of the vitamin D would need to come from fortified dairy and other food products?

Food Groups—Current Intakes and Trends

7. What are current consumption patterns of USDA Food Pattern food groups by the U.S. population?
    a. What is the contribution of whole grain foods, fruits and vegetables, and other food groups to (1) total fiber intake and (2) total nutrient intake in the USDA Food Patterns? What is the contribution of fruit and vegetables to current nutrient intake (focus on nutrients of concern, including fiber)?
    b. What would be the impact on the adequacy of the patterns if (1) no dairy foods were consumed, (2) if calcium was obtained from nondairy sources (including fortified foods), and (3) if the proportions of milk and yogurt to cheese were modified? What is the relationship between changes in types of beverages consumed (milk compared with sugar-sweetened beverages) and diet quality?
8. What are the trends in USDA Food Pattern food group consumption by the U.S. population?

Food Categories—Current Intakes and Sources of Energy, Nutrient, and Food Group Intakes

9. What are the current consumption patterns by food categories (i.e., foods as consumed) by the U.S. population?
10. What are the top foods contributing to energy intake by the U.S. population?
11. What are the top foods contributing to sodium, saturated fat, and added sugars intake by the U.S. population?
    a. What is the current contribution of fruit products with added sugars to intake of added sugars?
    b. What is the current contribution of vegetable products with added sodium to intake of sodium?
    c. What is the current contribution of refined grains to intake of added sugars, saturated fat, some forms of polyunsaturated fat, and sodium?
    d. What are the sources of caffeine from foods and beverages on the basis of age and sex subgroups?
12. What is the contribution of beverage types to energy intake by the U.S. population?

Eating Behaviors—Current Status and Trends

13. What are the current status and trends in the number of daily eating occasions and frequency of meal skipping? How do diet quality and energy content vary based on eating occasion?
14. What are the current status and trends in the location of meal and snack consumption and sources of food and beverages consumed at home and away from home? How do diet quality and energy content vary based on the food and beverage source?

Prevalence of Health Conditions and Trends

15. What is the current prevalence of overweight/obesity and distribution of body weight, body mass index (BMI) and abdominal obesity in the U.S. population and in specific age, sex, race/ethnicity and income groups? What are the trends in prevalence?
16. What is the relative prevalence of metabolic and cardiovascular risk factors (i.e., blood pressure, blood lipids, and diabetes) by BMI/waist circumference in the U.S. population and specific population groups?
17. What are the current rates of nutrition-related health outcomes (i.e., incidence of and mortality from cancer [breast, lung, colorectal and prostate] and prevalence of cardiovascular disease (CVD),

high blood pressure, diabetes, bone health, congenital anomalies, and neurological and psychological illness) in the overall U.S. population?

Dietary Patterns Composition

18. What is the composition of dietary patterns with evidence of positive health outcomes (e.g., Mediterranean-style patterns, Dietary Approaches to Stop Hypertension (DASH)-style patterns, patterns that closely align with the Healthy Eating Index, and vegetarian patterns) and of patterns commonly consumed in the United States? What are the similarities (and differences) within and among the dietary patterns with evidence of positive health outcomes and the commonly consumed dietary patterns?
19. To what extent does the U.S. population consume a dietary pattern that is similar to those observed to have positive health benefits (e.g., Mediterranean-style patterns, Dietary Approaches to Stop Hypertension (DASH)-style patterns, patterns that closely align with the Healthy Eating Index, and vegetarian patterns) overall and by age/sex and race/ethnic groups?
20. Using the Food Pattern Modeling process, can healthy eating patterns for vegetarians and for those who want to follow a Mediterranean-style dietary pattern be developed? How do these patterns differ from the USDA Food Patterns previously updated for use by the 2015 DGAC?

METHODOLOGY

To address questions on the current status and trends in food and nutrient intakes, the prevalence of diet-related chronic diseases in the U.S. population, and the composition of healthful dietary patterns, the DGAC relied on analysis of data from several sources and food pattern modeling analyses. Many of the questions relied on analysis of data from What We Eat in America (WWEIA), the dietary component of the National Health and Nutrition Examination Survey (NHANES), using either existing data tables or new analyses conducted by the Data Analysis Team (DAT) upon request of the DGAC (see ***Part C. Methodology***, Data Analyses section, and ***Appendix E-4: NHANES Data Used in DGAC Data Analyses***). Existing data tables were used when available to answer questions about nutrient intake, food group intake, and meal and snack consumption. In some cases, new analyses were conducted by DAT agencies to provide additional information on food or nutrient intake, for example, by specific population groups, such as pregnant women, or information on potential overconsumption of nutrients when supplement intake is considered. New WWEIA/NHANES data analyses also were used to answer questions about food category intakes, the energy content and nutrient density of foods by point of purchase and location of consumption, and the food choices of self-identified vegetarians.

Data from the U.S. Centers for Disease Control and Prevention (CDC) NHANES data tables and from the peer-reviewed literature, also were the source of information on prevalence of health conditions, including body weight status, lipid profiles, high blood pressure, and diabetes. In addition, NHANES

data on biochemical indicators of diet and nutrition in the U.S. population were used to help determine nutrients that may be of public health concern. To supplement data from NHANES, additional data sources were drawn upon to answer questions on the prevalence of health conditions, including the National Health Interview Survey, the National Cancer Institute's Surveillance Epidemiology and End Results (SEER) cancer registry statistics, SEARCH for Diabetes in Youth Study (SEARCH), and heart disease and stroke statistics from the 2014 report of the American Heart Association.[6]

Some of the questions posed by the DGAC were best addressed by Food Pattern Modeling (see ***Part C. Methodology***, Special Analyses Using the USDA Food Patterns section). These included questions about the nutrient adequacy of the USDA Food Patterns, modifications of the patterns for specific population groups or to meet specific nutrient targets, and the nutrients provided by various food groups in the Patterns. In some cases, questions could be answered with modeling analyses that had been conducted for the 2005 or 2010 DGACs, and so the results of these analyses were brought forward. The modeling process also was used to develop new USDA Food Patterns based on different types of evidence: Healthy Vegetarian Patterns that take into account food choices of self-identified vegetarians, and Healthy Mediterranean-style Patterns that take into account food group intakes from studies using a Med-diet index to assess dietary patterns. The latter were compiled and summarized to answer the questions addressed on dietary patterns composition. The food group content of dietary patterns reviewed by the DGAC and found to have health benefits formed the basis for answering these questions. WWEIA food group intakes and USDA Food Pattern recommendations were compared with the food group intake data from the healthy dietary patterns as part of the answer for these questions.

The DGAC took the strengths and limitations of data analyses into account in formulating conclusion statements. The grading rubric used for questions answered using NEL systematic reviews do not apply to questions answered using data analyses. Therefore, these conclusions were not graded.

NUTRIENT INTAKE AND NUTRIENTS OF CONCERN

An overarching premise of the DGAC is that that the *Dietary Guidelines for Americans* should provide food-based guidance for obtaining the nutrients needed for optimal reproductive health, growth and development, healthy aging, and well-being across the lifespan (ages 2 years and older). Specific nutrient intake requirements are established for each sex and life-stage group by the Food and Nutrition Board of the Institute of Medicine[7] and as such, this DGAC report did not reevaluate IOM recommendations or make independent specific nutrient recommendations. Rather, the DGAC reviewed nutrient intake and biochemical measures of nutritional status and potential nutrient-related health outcomes to identify "shortfall nutrients" and "overconsumed nutrients", and then determined whether these nutrients should be designated as "nutrients of public health concern."

"Shortfall nutrients" are those that may be underconsumed either across the population or in specific groups relative to IOM-based standards, such as the Estimated Average Requirement (EAR) or the Adequate Intake (AI). The EAR is the best measure of population adequacy of nutrient intake as is it is "the average daily intake level estimated to meet the requirement of half of the healthy individuals in a particular life stage and gender group."[7 p.3] The EAR is used to estimate the prevalence of inadequate intakes within a group. The AI is "a recommended average daily nutrient intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate—used when an RDA cannot be determined."[7 p.3] A high prevalence of inadequate intake either across the U.S. population or in specific groups constitutes a shortfall nutrient.

Overconsumed nutrients are those that may be overconsumed either across the population or in specific groups related to IOM-based standards such as the Tolerable Upper Limit of Intake (UL) or other expert group standards. A high prevalence of excess intake either across the U.S. population or in specific group constitutes an overconsumed nutrient.

"Nutrients of concern" are those nutrients that may pose a substantial public health concern and the DGAC divided them into two categories—those of concern due to overconsumption and those of concern due to underconsumption. To be identified as a nutrient of concern, the DGAC used the totality of evidence, evaluating data on nutrient intake and corroborating it with biochemical markers of nutritional status, where available, and evidence for associations with health outcomes to establish nutrients of concern.

Designation as a nutrient of concern for either under- or overconsumption is intended to communicate some level of risk for which the U.S. population may need to modify eating habits. Dietary guidance can then be formulated to assist individuals in increasing or decreasing nutrients that are under- or overconsumed.

Question1: What are current consumption patterns of nutrients from foods and beverages by the U.S. population?

Source of evidence: Data analysis

Conclusion

Nutrient intake data from a representative sample of the U.S. population ages 2 years and older indicate that: vitamin A, vitamin D, vitamin E, folate, vitamin C, calcium, and magnesium are underconsumed relative to the EAR. Iron is under-consumed by adolescent and premenopausal females, including women who are pregnant. Potassium and fiber are underconsumed relative to the AI. Sodium and saturated fat are overconsumed relative to the UL or other standards for maximal intake.

Implications

A dietary pattern emphasizing a variety of nutrient-dense foods will help shift individual and population consumption toward recommended intake levels for nutrients of public health concern.

The U.S. population should increase consumption of foods rich in vitamin A, vitamin D, vitamin E, folate, vitamin C, calcium, and magnesium. Adolescent and premenopausal females should increase consumption of foods rich in iron. Heme iron from lean meats is highly bioavailable, hence, an excellent source.[8] A diet emphasizing a variety of nutrient-dense foods will help shift consumption toward the recommended intake levels of these shortfall nutrients. The U.S. population should increase consumption of foods rich in potassium and fiber. A diet emphasizing a variety of nutrient-dense foods will help ensure optimal intake of these shortfall nutrients. In particular, fruit, vegetables and whole grains are excellent sources of vitamin A, C, folate, fiber, magnesium and potassium. The U.S. population should make concerted and focused efforts to decrease consumption of sodium and saturated fat.

The USDA Food Patterns provide guidance for consumption of a nutrient-dense, energy-balanced diet. Implementation of eating a healthy diet that is energy balanced while providing sufficient intake of shortfall nutrients without exceeding intake of overconsumed nutrients can be achieved through a variety of successful behavioral approaches as described in ***Part D. Chapter 3: Individual Diet and Physical Activity Behavior Change***. Environmental and policy approaches are also important in helping the U.S. population achieve a healthy diet (see also ***Part D. Chapter 4: Food Environment and Settings***). Federal nutrition assistance programs are a key aspect of providing critical nutrients for growth, development and long-term health for children, those with limited income and older Americans.

Review of the Evidence

To determine nutritional adequacy, the DGAC used 2007-2010 NHANES/WWEIA data to examine the intake distributions for 11 vitamins (vitamin A, vitamin B_6, vitamin B_{12}, vitamin C, vitamin D, vitamin E, vitamin K, folate, thiamin, niacin, and riboflavin), nine minerals (calcium, copper, iron, magnesium, phosphorous, potassium, selenium, sodium, and zinc), energy, macronutrients (total fat, saturated fat, polyunsaturated fat [including 18:2 and 18:3], protein, carbohydrate), and other compounds or components (fiber, carotenoids [alpha-carotene, beta-carotene, lycopene, lutein + zeaxanthin], caffeine, cholesterol, and choline) (see ***Appendix E-2.1: Usual intake distributions, 2007-2010, by age/sex groups***). The DGAC compared the intake estimates across the population age distribution to the Dietary Reference Intakes. The committee used data from foods and beverages as well as foods and beverages plus dietary supplements when supplement data were available. For nutrients with an EAR, the DGAC considered shortfall nutrients to be those where a substantial proportion of either the total population or specific age and sex subgroups had intake estimates below

the EAR. Although multiple approaches can be used to estimate the prevalence of nutrient inadequacy in a population, the DGAC used the EAR cut point method.[7] Figure D1.1 shows the percent of the U.S. population with usual intakes below the EAR. From Figure D1.1, the DGAC determined that vitamin D, vitamin E, magnesium, calcium, vitamin A and vitamin C were shortfall nutrients and that there may be a high prevalence of inadequate dietary intake of these nutrients.

Of the nutrients with an AI (vitamin K, choline, dietary fiber, and potassium), the DGAC determined that a low proportion of the population had fiber and potassium intakes above the AI and so potassium and fiber were therefore considered to be underconsumed (Figure D1.2).

Sodium and saturated fat were examined as potentially overconsumed nutrients in relation to the UL (for sodium), and the maximum level from the 2010 Dietary Guidelines of less than 10 percent of calories from saturated fat (for saturated fat). From 63 percent to 91 percent of females and 81 percent to 97 percent of males consumed more than the UL for sodium (Figure D1.3). From 67 percent to 92 percent of females and from 57 percent to 84 percent of males consumed more than 10 percent of calories from saturated fat (Figure D1.4). Therefore, sodium and saturated fat were both determined to be overconsumed by the U.S. population (see ***Appendix E-2.1: Usual intake distributions, 2007-2010, by age/sex groups*** and ***Appendix E-2.2: Usual intake distributions as a percent of energy for fatty acids and macronutrients, 2007-2010, by age/sex groups***).

The DGAC examined population intakes of specific nutrients by age, sex, race/ethnicity, pregnancy status, and acculturation status.

Age and Sex

In addition to the age groups shown in Figures D1.1 and D1.2, the DGAC was interested in understanding the intake of shortfall nutrients in older adults (71 to 79 years and 80 years and older). Calcium intake from foods and beverages did not meet the EAR for older persons, where 71 percent of males and 81 percent of females ages 71 years and older had intakes below the EAR. For these analyses calcium from dietary supplements was also considered. When total intake of foods + beverage + dietary supplements containing calcium was considered, then the proportion of the older adults below the EAR improved to 55 percent for men and 49 percent for women over the age of 71 years. For vitamin D intakes from food and beverages only, about 93 percent of older males and more than 97 percent of older females had intakes below the EAR. Similar to the findings for calcium, intakes improved when considering total intake from foods and beverages plus dietary supplements. The proportions of older adult below the EAR dropped to 52 percent for both males and females older than 71 years.

Fiber was a shortfall nutrient for older adults, where only 4 percent of men and 13 percent of women had a dietary intake of fiber above the AI. Potassium also was a shortfall nutrient for both older males and females, where less than 3 percent of both groups had intakes above the AI. Use of dietary

supplements containing potassium did not change the proportion of the older adults with intakes above the AI.

Protein was not identified as a shortfall nutrient for the overall older adult population but it should be noted that 6 percent of men older than 80 years and 11 percent of women older than 80 years old had protein intakes that were below the protein EAR (g/kg/body weight).

The sample size for the older participants in WWEIA 2007-2010 is small compared to other age groupings in the survey sample and despite the excellent population weights used in the WWEIA dataset, the estimates should be viewed with caution because of the limited sample (see ***Appendix E-2.3 Usual nutrient intakes for individuals age 71 years and older***).

Race/Ethnicity

The DGAC examined the shortfall nutrients by race/ethnicity using the following groups: non-Hispanic white, non-Hispanic Black, Mexican-American, and all Hispanic combined (other race/ethnic subgroups not available). For certain shortfall nutrients, non-Hispanic whites have the highest intakes. These include vitamin A, vitamin E, magnesium, folate, iron, potassium, vitamin D, and calcium. Mexican-Americans have the highest intakes of fiber, while all Hispanics combined have the highest intakes of vitamin C. Non-Hispanic Blacks have the lowest intake for most of the shortfall nutrients (Table D1.1). We note that evaluation of intakes relative to the EAR or AI are the most appropriate for assessment of populations, instead of the mean intakes, but for the race/ethnicity groups, only the mean data are available.

Pregnancy

Many of the shortfall nutrients in the general population also were shortfall nutrients among women who are pregnant. Among this group, 26 percent were below the EAR for vitamin A intake and 30 percent had vitamin C intakes below the EAR. For vitamin D, 90 percent had intakes below the EAR and for vitamin E, 94 percent had intakes below the EAR. Calcium intake was also low, where 24 percent had intakes below the EAR, and for folate, 29 percent had intakes below the EAR. Notably, 96 percent of women who were pregnant had iron intakes below the EAR (Table D1.2 and ***Appendix E-2.4: Usual intake distributions, 2007-2010, for pregnant and non-pregnant women in the U.S. ages 19-50 years***).

Fiber was a shortfall nutrient for women who were pregnant, as only 8 percent had fiber intakes above the AI. For potassium only 3 percent had intakes above the AI (Table D1.2).

It is important to note that the sample size for women who were pregnant in WWEIA 2007-2010 is very small (n=133 respondents), so the estimates should be interpreted with caution and the generalizability of the data to all women in the United States who were pregnant is limited.

Acculturation

The U.S. population is highly diverse in terms of race, ethnicity, and cultural origin. Many people immigrate to the United States from all over the world and each comes with distinct dietary habits and cultural beliefs about food and food patterns.[9] Acculturation is defined as the process by which immigrants adopt the attitudes, values, customs, beliefs, and behaviors of a new culture. Acculturation is the gradual exchange between immigrants' original attitudes and behavior and those of the host culture. [10, 11] The DGAC appreciates that many immigrants have difficulties purchasing and preparing foods familiar to them either because the ingredients are not available or the ingredients may be too expensive. A large and growing body of research suggests that the extent of an individual or family's acculturation status may be a predictor of dietary intake and that together, diet and acculturation status may influence health status or disease risk.[9, 10, 12, 13] For this reason, the DGAC felt it was important to examine dietary intake by acculturation status, particularly for shortfall nutrients and nutrients of concern. Additional information on acculturation and diet appears in Part D. Chapter 3: Individual Diet and Physical Activity Behavior Change.

NHANES collects data on some of the variables that can be used to create an acculturation variable, including whether respondents were born outside the United States in a Spanish-speaking country or born outside the United States in a non-Spanish speaking country, their race/ethnicity, and number of years they have resided in the United States.[14] Upon reviewing the data, however, the DGAC found that the sample size was far too small to create meaningful variables to indicate "low acculturation status" or "high acculturation status." The DGAC views this lack of ability to analyze the WWEIA data by acculturation status as a limitation of the available data. It is a very important area that needs further research, particularly when informing nutrition programs for new residents of the United States.

Food Insecurity Status

Readers are referred to ***Part D. Chapter 3: Individual Diet and Physical Activity Behavior Change*** and ***Part D. Chapter 5: Food Sustainability and Safety*** for more detailed discussions of food insecurity and food security issues. For this section of the report, the DGAC determined that it was important to evaluate nutrient intake, particularly for the shortfall nutrients by income status, which can be a marker of food insecurity. For these data analyses, we used the standard cutpoints of less than 131 percent of the poverty index, 131 to 185 percent of the poverty index and more than 185 percent of the poverty index and examined calcium, potassium, fiber and vitamin D (Table D1.3). In general, respondents (all ages 2 years and older) from households with higher income (more than 185 percent of the poverty index) had higher intakes of calcium, potassium, fiber, and vitamin D. Notably, in some of the very young age groups (2 to 5 years), intakes of potassium, fiber, and vitamin D were comparable across income groups, while calcium was highest in those coming from households at the 131 to 185 percent of the poverty index ratio. It may be that many of the households of lower income with small children are receiving important benefits from federal nutrition assistance programs, which could be helping to generate comparability in the intake of shortfall nutrients across the income groups.

For additional details on this body of evidence, visit:

- Appendix E-2.1: Usual intake distributions, 2007-2010, by age/sex groups
- Appendix E-2.2: Usual intake distributions as a percent of energy for fatty acids and macronutrients, 2007-2010, by age/sex groups
- Appendix E-2.3: Usual intakes for Individuals age 71 and older
- Appendix E-2.4: Usual intake distributions, 2007-2010, for pregnant and non-pregnant women in the U.S. ages 19-50 years
- Mean intake of nutrients, 2003-2004, 2005-2006, 2007-2008, and 2009-2010, by race/ethnicity and by percent of the poverty threshold. Available from: http://seprl.ars.usda.gov/Services/docs.htm?docid=18349.
- Usual intake of selected nutrients, 2001-2002, 2003-2006, or 2005-2006, by age/sex groups. Available from: http://seprl.ars.usda.gov/Services/docs.htm?docid=22659.

Question 2: Of the nutrients that are underconsumed or overconsumed, including over the Tolerable Upper Limit of Intake (UL), which present a substantial public health concern?

Source of evidence: Data analysis

Conclusion

Nutrient intake data, together with nutritional biomarker and health outcomes data indicate that vitamin D, calcium, potassium, and fiber are underconsumed and may pose a public health concern. Iron also is a nutrient of public health concern for adolescent and premenopausal females.

Nutrient intake data, together with nutritional biomarker and health outcomes data indicate that sodium and saturated fat are overconsumed and may pose a public health concern.

Implications

The DGAC recommends that strategies be developed and implemented at both the individual and the population level to improve intake of nutrients of public health concern.

Review of the Evidence

These conclusions were reached using a 3-pronged approach, including analysis of data from What We Eat in America, NHANES dietary survey (2007-2010) (see ***Appendix E-2.1: Usual intake distributions, 2007-2010, by age/sex groups***), the Second National Report on Biochemical Indices of Diet and Nutrition in the U.S. Population, Centers for Disease Control and Prevention, 2012,[3] and data on the prevalence of health conditions, from the CDC. The DGAC used the totality of evidence from these sources.

Nutrients of Concern for Underconsumption

Vitamin D. Vitamin D is unequivocally essential for skeletal health.[15] The 2010 IOM report on Dietary Reference Intakes for calcium and vitamin D[15] established new DRIs for vitamin D based on established and consistent evidence for vitamin D's role in skeletal health. Numerous other functions exist for vitamin D, including its role as a transcription factor for more than 200 genes, roles in apoptosis and cellular proliferation, and a growing body of evidence supporting vitamin D's role in preventing cancer, cardiovascular disease, and other chronic diseases.[16-25]

The IOM's rationale for setting the DRI was limited to vitamin D's role in skeletal health, as the evidence for the other diseases was not sufficiently mature at the time of the committee's evidence review. Therefore, any interpretations for vitamin D intake and its classification as a shortfall nutrient and a nutrient of public health concern are restricted to this role in skeletal health. Given the high prevalence of osteoporosis and low bone density, particularly in the older women (see Question 17, on health conditions, below) and due to vitamin D's critical role in bone health, the Committee determined that vitamin D should be classified as an underconsumed nutrient of public health concern.

Vitamin D can be obtained from the diet by consuming fluid milk and some milk products (e.g., some yogurts), fortified juices, finfish, fortified breakfast cereals and some fortified grain products as well as dietary supplements (Table D1.4 and ***Appendix E-3.3: Meeting Vitamin D Recommended Intakes in USDA Food Patterns***). Vitamin D also is synthesized endogenously through cutaneous exposure to ultraviolet-B sunlight. The primary biomarker to assess vitamin D status is serum/plasma 25(OH)D concentrations. This biomarker represents dietary intake plus endogenous synthesis.

Dietary intake of vitamin D in the United States is low and well below the EAR values (Figure D1.1) for all age and sex groups. In addition, independent evidence of nutrient shortfall comes from data demonstrating low serum/plasma 25-hydroxyvitamin D concentrations from the CDC biomarker data, particularly for young adults (ages 20 to 39 years), middle-aged adults (ages 40 to 59 years), non-Hispanic Blacks and Mexican-Americans (Table D1.5). The correlation of dietary intake with the serum measures of 25-hydroxyvitamin D) is modest. In addition several factors predict serum concentrations of nutrients in addition to dietary intake.[19] The DGAC and other expert panels, including the IOM, acknowledge that while numerous variables, including sun exposure and endogenous synthesis, are strong predictors of serum vitamin D status, dietary intake of vitamin D is a critical contributor to vitamin D status.[26, 27] Further, while there is some degree of unexplained variation in serum/plasma 25-hydroxyvitamin D concentrations, the biomarker is still important for evaluating vitamin D inadequacy. Various statistical approaches have been used to evaluate and confirm population inadequacy using the biomarker data. [28] Of note, the CDC biomarker data reviewed by the DGAC should be interpreted knowing that the NHANES Mobile Examination Clinics do not sample residents of northern climates in winter months due to variable sunshine exposure and the possibility that high levels of sunshine exposure may be overrepresented in NHANES. In other words,

higher values in the dataset may be over-represented due to the summer blood draws, when 25-OHD tends to be higher from sun exposure and deficiencies may be under represented. [15p.471-473]

The DGAC's decision to classify vitamin D as a nutrient of concern is similar to the conclusion reached by the U.S. Food and Drug Administration (FDA), which designated vitamin D as a nutrient of "public health significance" in its recent review of evidence in publishing a Proposed Rule on the Nutrition Facts label.[29] In addition, multiple national and international groups, including the American Academy of Pediatrics (AAP),[30] the Endocrine Society[31] and the National Osteoporosis Foundation [32] have recommended that strategies to achieve the RDA or higher levels of vitamin D intake could include consumption of fortified foods, broadening the range of dairy products that are fortified, and consideration, in some cases, of the use of a vitamin D supplement or a multivitamin including vitamin D. Such a use is especially appropriate where sunshine exposure is more limited due to climate or sunblock use.

Calcium. Calcium plays a major role in skeletal health and also is essential for proper functioning of the circulatory system, nerve transmission, muscle contractility, cell signaling pathways, and vascular integrity.[15] Dietary calcium is obtained from fluid milk and milk products, fortified juices, and some plant foods, including soy and soy products and vegetables (see Table D1.6 and ***Appendix E-3.2: Food Group Contributions***). However, the bioavailability of calcium from plant foods is lower than from animal foods, such as dairy.

The DGAC reviewed the dietary intake data from WWEIA. Intakes of calcium were often far below the EAR, especially among adolescent girls and adults (Figure D1.1). Even though a reliable biomarker for calcium does not exist, because of its strong link to health outcomes and the risks associated with osteoporosis (see Question 17 on health conditions, below), the DGAC designated calcium as a nutrient of public health concern for underconsumption. In addition, the DGAC also notes that calcium is an underconsumed nutrient of public health concern among pregnant women. This conclusion concurs with the FDA's review that designated calcium as a nutrient of "public health significance" in its recent review of evidence in publishing a Proposed Rule on the Nutrition Facts label.[29]

Strategies to improve calcium intake include increased dairy or fortified products that are important sources of calcium. Concern about the safety of calcium supplements and a relative lack of data about the health benefits of such supplements limit recommendations to use supplementation as a strategy to meet the RDA for calcium, compared to using fortified foods.

The subgroups of particular concern with regard to intake are preadolescent and adolescent females, pregnant females, and middle aged and older females (see Question 1, above).

Potassium. Potassium is the major intracellular cation and it plays critical roles in muscle function, cardiac function, and regulation of blood pressure. Potassium adequacy is also critical for health, as deficiency adversely affects numerous organ systems including the musculoskeletal, renal, and cardiovascular systems. The primary biomarker to assess potassium intake is urinary potassium, and these data are not available in the CDC biomarker dataset. The DGAC designated potassium as a nutrient of public health concern due to its general under consumption relative to the AI across the U.S. population and its association with hypertension and cardiovascular diseases, two common adverse diet-related health outcomes in the United States (see Question 17on health conditions, below). This conclusion concurs with the FDA's review that designated potassium as a nutrient of "public health significance" in its recent review of evidence in publishing a Proposed Rule on the Nutrition Facts label.[29] Even though underconsumption was evident across the population (see Question 1, above), there is a particular concern for middle-aged and older adults, who are at increased risk for cardiovascular diseases (see Question 17). Fruits, vegetables, and legumes are all important sources of potassium (Table D1.7).

Fiber. Dietary fibers are non-digestible carbohydrates, primarily from plant foods, such as whole grains, legumes, fruits and vegetables (Table D1.8). The most important and well-recognized role for fiber is in colonic health and maintenance of proper laxation, but a growing body of evidence also suggests that fiber may play a role in preventing coronary heart disease, colorectal and other cancers, type 2 diabetes, and obesity.[33] The AI for fiber is based on an intake level associated with the greatest reduction in the risk of coronary heart disease. There are no available biomarkers for fiber intake, so the designation as a nutrient of public health concern is based on the very low dietary intakes across all sectors of the U.S. population and its important contribution to health. Because the average intake levels of dietary fiber are half the recommended levels, achieving the recommendation requires selecting high-fiber cereals and whole grains and -meeting current recommendations for fruits and vegetables.

Iron. Iron is an essential mineral whose primary function is to transport oxygen in the blood. Inadequate iron status in the form of iron deficiency anemia leads to poor growth and development and the potential for cognitive deficits in children. Excellent sources of heme iron include red meats, enriched cereal grains, and fortified breakfast cereals (Table D1.9). Dietary intake estimates, together with the CDC nutritional biomarker data indicate that iron is a nutrient of concern for children, premenopausal females, and during pregnancy. Among women who are pregnant, 96 percent are below the EAR for iron intake. Serum ferritin is the biochemical marker used by NHANES and the CDC to evaluate iron status in the U.S. population. These data show that children and women of childbearing age are at risk of iron deficiency anemia. Risk of iron deficiency anemia also is higher among Mexican-American and non-Hispanic Black women than among non-Hispanic white women.[3] Taken together, the DGAC concluded that iron was an underconsumed nutrient of public health concern for adolescent and premenopausal women and women who are pregnant. This conclusion concurs with the

FDA's designated iron as a nutrient of "public health significance" in its recent review of evidence in publishing a Proposed Rule on the Nutrition Facts label.[29]

Nutrients of concern for overconsumption

Sodium. Sodium is the major cation in extracellular fluid that maintains extracelluar fluid volume and plasma volume. It also functions in membrane potential activation and active transport of molecules across cell membranes. In excess, sodium is associated with several adverse health events, particularly hypertension.[34] The DGAC treated sodium as a cross-cutting topic for dietary intake and health outcomes, and a sodium working group was convened. Details on sodium, including dietary sources and health outcomes-related data are found in ***Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance*****)**. Current sodium intakes of the U.S. population far exceed the UL for all age and sex groups (Figure D1.3). Due to the critical link of sodium intake to health and that intake exceed recommendations, sodium was designated as a nutrient of public health concern for overconsumption across the entire U.S. population.

Saturated fat. The DGAC used the 2013 American Heart Association/American College of Cardiology (AHA/ACC) report on lifestyle management to reduce CVD risk[2] for its evaluation of saturated fat intake. The DGAC concurred with the AHA/ACC report that saturated fat intake exceeds current recommendations in the United States and that lower levels of consumption would further reduce the population level risk of CVD. The DGAC also convened a working group on saturated fat (see ***Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance*** for details). In addition, the DGAC conducted food pattern modeling to demonstrate the dietary changes that would be necessary to have diets with various levels of saturated fat as a percent of total energy (see USDA Food Patterns Modeling Report in ***Appendix E-3.5: Reducing Saturated Fats in the USDA Food Patterns***). It is important to note that the median intake of saturated fat in the United States was 11.1 percent of total energy for all age groups in the 2007-2010 WWEIA data. However, a large majority (71 percent) of the total population consumed more than 10 percent of calories from saturated fat, with a range by age group from 57 percent to 92 percent (Figure D1.4). Further, 65 percent to 69 percent of the age groups at highest risk of CVD (males and females older than age 50 years) had intakes more than 10 percent of total calories were from saturated fat, the DGAC concluded that the U.S. population should continue to monitor saturated fat intake. Saturated fat is still a nutrient of concern for overconsumption, particularly for those older than the age of 50 years.

Cholesterol. Previously, the Dietary Guidelines for Americans recommended that cholesterol intake be limited to no more than 300 mg/day. The 2015 DGAC will not bring forward this recommendation because available evidence shows no appreciable relationship between consumption of dietary cholesterol and serum cholesterol, consistent with the conclusions of the AHA/ACC report.[2, 35] Cholesterol is not a nutrient of concern for overconsumption.

For additional details on this body of evidence, visit:

- CDC report, Second National Report on Biochemical Indicators of Diet and Nutrition in the U.S. Population 2012. Available from: http://www.cdc.gov/nutritionreport/pdf/Nutrition_Book_complete508_final.pdf.
- Food Labeling: Revision of the Nutrition and Supplement Facts Labels; Proposed Rule. Available from: http://www.gpo.gov/fdsys/pkg/FR-2014-03-03/pdf/2014-04387.pdf.
- Appendix E-3.2: Food Group Contributions to Nutrients in the USDA Food Patterns and Current Nutrient Intakes
- Appendix E-3.3: Meeting Vitamin D Recommended Intakes in USDA Food Patterns
- Appendix E-3.5: Reducing Saturated Fats in the USDA Food Patterns

Question 3: Is there evidence of overconsumption of any micronutrients from consumption of fortified foods and supplements?

Source of evidence: Data analysis

Conclusion

Dietary patterns among Americans, including typical use of fortified foods, rarely lead to overconsumption of folate, calcium, iron, or vitamin D. However, each of these nutrients, as well as other nutrients, are overconsumed in some supplement users, especially those taking high-dose supplements.

Implications

The public may safely use dietary supplements containing RDA level of nutrients, so long as total intake from diet plus supplements does not exceed the UL. Use of products with high doses of nutrients, such that total intake exceeds the UL, should be discussed with a Registered Dietitian or other qualified health care provider.

Supplement users should seek guidance about factors such as whether the amount of nutrients in supplements exceeds the UL for those nutrients. Monitoring of dietary patterns in supplement users should continue to be done, with attention paid to the highest risk groups, such as children and women who are pregnant.

Review of the Evidence

These conclusions were based on analysis of usual intake data for selected nutrients from foods and supplements from WWEIA, NHANES dietary survey (2007-2010) (see ***Appendix E-2.5: Usual intake distributions for supplement users for folate, folic acid, vitamin D, calcium, and iron, 2007-2010, by age/sex groups*** and ***Appendix E-2.6: Usual intake distributions for non-supplement users for folate,***

685 ***folic acid, vitamin D, calcium, and iron, 2007-2010, by age/sex groups***). Nutrients were selected if
686 the DGAC had identified them as a shortfall nutrient and if supplemental intake data were available in
687 WWEIA (Figure D1.5). When possible the total nutrient exposure was considered (food +
688 supplements). The overconsumed nutrients (saturated fat and sodium) are not contained in most dietary
689 supplements so that overconsumed nutrients were not considered for this question.
690
691 **Folate.** The use of supplemental folic acid exceeds the established UL in a small proportion of
692 children, especially those younger than age 9 years. However, this UL is not based on clinical toxicity
693 data in this population and exceeding the UL is primarily associated with supplement use.[36] The risk
694 associated with usual folate intakes among children in the United States is considered low, but caution
695 should be used in advising supplements for children younger than age 9 years.
696
697 **Calcium.** Dietary calcium intake greater than 2000 mg/day (UL) are seen in up to about 20 percent of
698 females, and 15 percent of adult males older than age 50 years. These high intakes are driven primarily
699 by a historical perspective that very high calcium supplement usage may decrease the risk of
700 osteoporosis. Concern exists about the safety of such high intakes and the possible association with
701 CVD risk and little, if any, current evidence supports intakes of calcium above the UL for the purpose
702 of decreasing osteoporosis.[15] Of note, the World Health Organization recommends high dose calcium
703 supplementation (1.5-2 g/day) to prevent hypertensive disorders of pregnancy.[37] This recommendation
704 is not widely followed among low-risk women in the United States. However, use of calcium
705 supplements does not appear to pose a health risk related to overconsumption of calcium.[37]
706
707 **Iron.** In adults of all ages, a small proportion of iron supplement users have intakes above the UL.
708 Concerns related both to cardiovascular health and oxidant damage exist, but are not well-defined. Iron
709 supplementation is very common during early childhood and pregnancy, but is unlikely to pose a
710 health risk.[8]
711
712 **Vitamin D.** Overconsumption of vitamin D occurs when individuals take high dose supplements,
713 usually over a long period of time.[15] The UL of 4000 IU/day is commonly exceeded by individuals
714 with or without the guidance of a physician.[15] In general, it is unlikely that most supplement users, who
715 limit themselves to 10,000 IU/day or less, will have any evidence of toxicity, but a greater risk may
716 exist among some groups, including small children. Those who take high dose supplements often have
717 their serum/plasma 25-hydroxyvitamin D concentrations monitored and this can be helpful although no
718 clearly toxic level of 25-hydroxyvitamin D in the blood is known. Overall, the population risk of
719 overconsumption of vitamin D leading to toxic effects, including hypercalcemia or other clinical
720 symptoms, is uncommon.[38]
721
722 ***For additional details on this body of evidence, visit:***

723 • Appendix E-2.5: Usual intake distributions for supplement users for folate, folic acid, vitamin D,
724 calcium, and iron, 2007-2010, by age/sex groups

- Appendix E-2.6: Usual intake distributions for non-supplement users for folate, folic acid, vitamin D, calcium, and iron, 2007-2010, by age/sex groups

Question 4: What is the level of caffeine intake derived from foods and beverages on the basis of Institute of Medicine (IOM) Dietary Reference Intakes age and sex categories in the U.S. population?

Source of evidence: Data analysis

Conclusion

In general, intakes of caffeine do not exceed what is currently considered safe levels in any age group. Some young adults may have moderately high intakes. There is less certainty about the safe level of intake in children and adolescents. However, routine consumption patterns do not suggest that excessive intakes are common in these groups.

Implications

The public may safely consume caffeine-containing beverages, such as coffee and tea. However, children, adolescents, and women who are pregnant or considering pregnancy should not consume very high levels of caffeine from beverages or supplements (e.g., energy shots, fortified foods).

Monitoring of caffeine intake should be continued with special attention to high-risk groups, including children and women who are pregnant. Families should monitor caffeine intake in children, and high-dose caffeine supplementations should not be used.

For additional details on caffeine safety please see ***Part D. Chapter 5: Food Sustainability and Safety.***

Review of the Evidence

These conclusions were reached based on analysis of usual intake data from the WWEIA, NHANES dietary survey (2007-2010). Data on intakes of caffeine show that intakes in adults (Figure D1.6) peak at ages 31 to 70 years, and that younger adults (ages 19 to 30 years), older adults (71 years and older), have lower intakes. Relatively few individuals (less than 10 percent) have intakes above 400 mg/day (see ***Appendix E-2.1: Usual intake distributions, 2007-2010, by age/sex groups***), which is a level set as a moderate intake by some groups, including Health Canada.

In children, caffeine intakes increase with age (Figure D1.7) with median intakes remaining below 100 mg/day in adolescents (14 to 18 years). Recommended intakes from Health Canada of no more than 2.5 mg/kg/day, or about 85 mg/day total in children ages 10 to 12 years [39] are not exceeded by most children and adolescents although recent data indicates that as many as 10 percent of children and adolescents ages 12 to 19 years exceed this intake level.[40] These data demonstrate that caregivers

should monitor caffeine intake in children and exercise caution with respect to time-dependent changes in caffeine intake.

For additional details on this body of evidence, visit:

- Appendix E-2.1: Usual intake distributions, 2007-2010 by age/sex groups

Question 5: How well do updated USDA Food Patterns♦ meet IOM Dietary Reference Intakes and 2010 Dietary Guidelines recommendations? How do the recommended amounts of food groups compare to current distributions of usual intakes for the U.S. population?

Source of evidence: Food Pattern Modeling

Conclusion

USDA Food Patterns across a broad range of ages and energy intake meet most goals for nutrient adequacy. The nutrients of public health concern for which the patterns do not meet recommendations are potassium and vitamin D. Recommended amounts of food groups and their component subgroups fall within the broad range of usual food group intake distributions for the U.S. population.

Implications

The USDA Food Patterns provide guidance for consuming a nutrient-dense, energy-balanced diet. To achieve nutrient adequacy, the U.S. population should be advised to consume dietary patterns consistent with the USDA Food Patterns.

Continued vigilance is needed to ensure that food intake patterns meet but do not exceed DRI targets in all age groups. The Patterns meet recommended intake levels or limits for almost all nutrients, including the following nutrients of concern: calcium, fiber, iron, sodium, and saturated fat. Two nutrients of concern (potassium and vitamin D) are not provided in recommended levels by the Patterns. Therefore, potassium and vitamin D intakes require assessment both of individual intake and population intake patterns of foods or supplements to ensure that needs for physiological functioning are met. Meeting the needs for these nutrients may require careful attention to excellent natural sources, food enriched or fortified with the nutrients, or, in some cases, consideration of supplements.

♦ The USDA Food Patterns referred to in this question are the same as the "Healthy U.S.-style Food Pattern" described later in this chapter (see Question 20). We use the term USDA Food Patterns in this question because the development of the Healthy U.S.-style Food Pattern and two related USDA Food Patterns had not occurred when the Committee addressed this question.

Following the recommended food intake pattern increases intakes of whole grains, vegetables, fruits, and fat-free/low fat dairy and thus increases the likelihood of meeting recommendations for these food groups while decreasing intake of the food components refined grains, solid fats, and added sugars. Following the recommended pattern also decreases intake of the nutrients sodium and saturated fat.

In some situations, specific foods or dietary supplements may be used to increase underconsumed nutrient intakes not met through the USDA Food Patterns.

Review of the Evidence

These conclusions were reached based on the results of the Food Pattern Modeling Report on Adequacy of the USDA Food Patterns. The USDA Food Patterns are intended to represent the types and amounts of foods that will provide nutrients sufficient to meet IOM nutrient recommendations and Dietary Guidelines for Americans recommendations. The Food Patterns are updated every 5 years during the deliberations of the Dietary Guidelines Advisory Committee, and are presented to the Committee for their assessment of the Food Patterns' adequacy. As part of the update, amounts recommended from each food group may be modified to reach all or most of the specified goals. In addition, the amounts from each food group are compared to usual dietary intake patterns of the U.S. population, and are kept within the normal range of consumption. The current analysis, using the 2010 USDA Food Patterns as a baseline, found that the recommended amounts of each food group met almost all nutrient goals and were within the normal range of consumption. Therefore, no updates to the food group amounts from 2010 were needed.

As shown in Figure D1.8, for many nutrients, amounts of a nutrient in the patterns are well above the RDA or AI. Protein, phosphorus, zinc, copper, selenium, manganese, vitamin C, thiamin, riboflavin, niacin, vitamin K, folate, vitamin B_6, and vitamin B12 are above the goal amounts for all age/sex groups.

In contrast, some nutrients are just above the RDA or AI, or marginally below (90 to 100%) goal amounts for several age/sex groups. These include calcium, iron, and magnesium. The percents of the RDA shown in Figure D1.8 are for the lowest calorie level assigned to these age/sex groups—the level applicable for a sedentary/less active physical activity level.

The nutrients for which adequacy goals are not met in almost all patterns are potassium, vitamin D, vitamin E, and choline. Due to the new higher RDA for vitamin D that was recommended by the 2011 Committee to Review Dietary Reference Intakes for vitamin D and calcium,[15] amounts in the patterns are a much smaller percentage of the RDA than previously, and no pattern meets the EAR for vitamin D. To determine if vitamin D recommendations could be met while following the food group recommendations of the USDA Food Patterns, thorough, careful selection of specific foods within each food group, an additional modeling analysis was conducted and reported below (see Question 6).

The USDA Food Intake patterns provide a healthy pattern of food choices and to accomplish this, these patterns deviate from typical food intakes in a number of ways. To ensure that the patterns do not deviate too far beyond the range of what the U.S. population could feasibly consume, the recommended intake amounts in the patterns from each food group or subgroup plus oils were compared to the median and either the 5th or 95th percentile of usual intakes of the population, from WWEIA/NHANES 2007-2010.[41] Table A6 of the Adequacy of the USDA Food Patterns Modeling Report (see ***Appendix E-3.1***, Table A6) shows the comparison of food group recommended intakes to median and 95th percentile intakes.

For underconsumed food groups, such as fruits and vegetables, recommended amounts in the patterns are generally between the median and 95th percentiles of usual intakes. (see ***Appendix E-3.1: Adequacy of the USDA Food Patterns***, Table A6) This indicates that the Food Patterns recommend amounts within the broad intake range for the population. However, for some specific food groups and some age/sex groups, such as vegetables for males ages 14 to 18 years, food group amounts in the Patterns are somewhat above the 95th percentile of usual intake. One exception to this is whole grain recommendations in the Patterns, which are well above the 95th percentile of usual intakes for all age/sex groups. Conversely, refined grain recommendations in the patterns are very low compared to usual intakes—about the 5th percentile of intake for most age/sex groups. This indicates that a major shift from refined to whole grains is needed in order to meet recommendations.

For Food Pattern components that are overconsumed, the limits in the patterns for maximum solid fat and added sugars (see Questions 7 and 8 for more information on solid fats and added sugars) also are very low compared to usual intake amounts—at approximately the 5th percentile of usual intakes for most age/sex groups, and less than the 5th percentile of usual intakes for boys and girls ages 2 to 13 years. (see ***Appendix E-3.1: Adequacy of the USDA Food Patterns***, Table A6)

An additional modeling analysis was conducted to answer the questions: How well do the USDA Food Patterns meet the nutritional needs of children ages 2 to 5 years and how do the recommended amounts compare to their current intakes? Given the relatively small empty calorie limit for this age group, how much flexibility is possible in food choices? (see ***Appendix E-3.4: USDA Food Patterns—Adequacy for Young Children***)

The nutritional needs and the diets of young children are different in some important ways from the nutritional needs and diets of older children and adults. Therefore, this modeling analysis focused on the adequacy of the Patterns for young children, given these differences. Nutrient profiles for the Dairy and Fruit groups were adjusted to better reflect the food choices within these groups of young children. The adjusted Dairy group nutrient profile for young children is based on 70 percent fluid milk, 25 percent cheese, 3.5 percent yogurt, and 1.5 percent soymilk. In contrast, the profile for the overall population is based on 51 percent fluid milk, 45 percent cheese, 2.5 percent yogurt, and 1.5 percent soymilk. In addition, 1 percent milk rather than fat-free milk was used as the representative food for

fluid milk. The adjusted Fruit group nutrient profile for young children is based on 42 percent fruit juice and 58 percent whole fruit. In contrast, overall population intake is about 33 percent juice and 67 percent whole fruit. With these adjustments, the adequacy of the Patterns did not change, but amounts of potassium, vitamins D, A, C, and folate increased slightly, and sodium decreased slightly. The amounts recommended in the USDA Food Patterns fall within the broad range of usual intakes by this age group for most food groups and subgroups (see ***Appendix E-3.1: Adequacy of the USDA Food Patterns,*** Table A6).

In addition, the young children's nutrient profiles were higher in energy, mainly due to the use of 1 percent rather than fat-free milk. Therefore, the amount of calories that could be allowed from solid fats and added sugars was adjusted down to keep the Patterns isocaloric. This resulted in limited flexibility in food choices when following the Patterns, especially for children ages 4 and 5 years for whom 2½ cup equivalents (cup eqs) from the Dairy group is recommended (the Patterns for children ages 2 and 3 years recommend 2 cup eqs). Options tested to increase flexibility in food choices included a small reduction of 1/2 ounce eq in the amount of Protein Foods, or a change from 1 percent milk to fat-free milk at 4 years of age. These changes did not result in lower nutrient adequacy levels.

For additional details on this body of evidence, visit:

- Appendix E-3.1: Adequacy of the USDA Food Patterns
- Appendix E-3.4: USDA Food Patterns—Adequacy for Young Children

Question 6: Can vitamin D Estimated Average Requirements and/or Recommended Dietary Allowances be met with careful food choices following recommended amounts from each food group in the USDA Food Patterns? How restricted would food choices be, and how much of the vitamin D would need to come from fortified dairy and other food products?

Source of evidence: Food Pattern Modeling

Conclusion

Through the use of a diet rich in seafood and fortified foods, EAR, but not RDA, levels of vitamin D can be achieved. Additional fortification or supplementation strategies would be needed to reach RDA levels of vitamin D intake consistently, especially in individuals with low intakes of fish/seafood or fortified dairy foods, other fortified foods (e.g. breakfast cereals) and beverages.

Implications

Diet is an important aspect of achieving vitamin D intake targets. The U.S. population should be encouraged to choose foods and beverages fortified with vitamin D. When needed, supplementation can be considered to achieve RDA intakes of vitamin D.

Review of the Evidence

These conclusions were reached based on the results of the Food Pattern Modeling Report titled "Meeting Vitamin D Recommended Intakes in USDA Food Patterns" (see ***Appendix E-3.3***). It may be difficult for individuals to reach the RDA intake of vitamin D from food, including food as it is currently fortified in the United States. The RDA was established by the Institute of Medicine on the assumption of minimal or no sunshine exposure. This was done even though the majority (up to 80 to 90 percent in some parts of the United States) of vitamin D in the body is derived from conversion by solar radiation of pre-vitamin D in the skin. However, during the winter, in much of the United States, this conversion is minimal and furthermore, recommendations for sunscreen use have limited the degree to which one can safely ensure sunshine exposure as a source of vitamin D.

Vitamin D exposure, and likely status, is assessed generally through serum/plasma 25-hydroxyvitamin D concentrations. However, this test is not recommended for routine screening of the entire population[30-32, 42, 43] due to costs and challenges in obtaining measurements throughout the year and interpreting results in populations, including those who are obese. Because many non-screened individuals will still need to reach the RDA for vitamin D, supplement use may be considered for this purpose.

For additional details on this body of evidence, visit:

- Appendix E-3.3 Meeting Vitamin D Recommended Intakes in USDA Food Patterns

FOOD GROUPS--CURRENT INTAKES AND TRENDS

Introduction

As noted for Questions 5 and 6, to help the U.S. population meet recommended dietary goals and improve their health and well-being, the USDA recommends a food-based, total diet approach for meeting the U.S. Dietary Guidelines.[44, 45]

The USDA Food Patterns have changed over time to be consistent with emerging science that is presented in each issuance of the Guidelines. The current USDA Food Patterns identify amounts of foods to consume from five major food groups (fruits, vegetables, grains, protein foods, and dairy) and

their sub-groups (dark green vegetables, orange and red vegetables, starchy vegetables, other vegetables, beans and peas, whole grains, enriched/refined grains, meat/poultry/eggs, nuts, seeds, soy products, seafood) and are based on nutrient-dense foods.[44, 45] In 2010, the DGAC developed a vegetarian adaptation of the Food Patterns to provide guidance for consumers wishing to follow a vegetarian diet. For 2015, the DGAC developed a new Healthy Vegetarian Food Pattern based on food intakes of vegetarians. The 2015 DGAC also provided a Mediterranean-style Food Pattern due to the data supporting the health-related benefits of a Mediterranean-style diet (see Dietary Patterns section, Question 20, and ***Part D. Chapter 2: Dietary Patterns, Foods and Nutrients, and Health Outcomes***). The food groups chosen for all the Patterns include primarily nutrient-dense foods. The patterns are intended to meet the RDA for nutrients so that nutritional adequacy is met without exceeding recommended energy intake. They also are designed so that they are below the 2010 DGA limits for sodium and saturated fat. Recommended amounts to consume from each food group differ depending on an individual's energy and nutrient needs. Patterns are provided for 12 different calorie levels (Table D1.10) and assignment to one of these calorie levels is based on age, sex, and activity level (Table D1.11). In addition, the Patterns provide for limited amounts of solid fats and added sugars. The complete Food Pattern modeling report (including a listing of the nutrients considered for the Patterns) is found in ***Appendix E3.1***, and details on the methods used to derive the Patterns have been published.[44, 46, 47]

Question 7: What are current consumption patterns of USDA Food Pattern food groups by the U.S. population?

Source of evidence: Data analysis

Conclusion

Positive, healthy eating habits provide an excellent foundation for a lifetime of healthy eating. Many young children start out eating very well, particularly with regard to intakes of fruit and dairy foods. Unfortunately, many of these early life healthy habits seem to disappear as children reach school age and beyond. Across all age and sex groups, the vast majority of the U.S. population does not meet recommended intakes for fruit, vegetables, whole grains, and dairy food groups. Each of these food groups are excellent sources of shortfall nutrients and underconsumed nutrients of public health concern. Across all age and sex groups, the vast majority of the U.S. population exceeds recommended intakes of refined grains, solid fats, and added sugars.

Implications

To realize the numerous health benefits from dietary patterns that are higher in fruit, vegetables, whole grains, lean protein, and non-fat and low-fat dairy (see ***Part D. Chapter 2: Dietary Patterns, Foods and Nutrients, and Health Outcomes*** for details on the health benefits for dietary patterns with these characteristics), action is needed across all sectors of food production, distribution, and consumption

and at individual behavioral and population levels. Individuals, families, schools, worksites, healthcare and public health settings, restaurants, and other food establishments must work together to ensure that all segments of the population can:

- Increase intake of underconsumed food groups and nutrient-dense foods, while maintaining energy balance, and without increasing saturated fat, sodium, and added sugars

Given the complexity of dietary behavior change, consumers will need access to evidence-based educational resources and intervention programs and services in public health and healthcare settings to facilitate adoption and maintenance of healthy dietary behaviors. (See ***Part D. Chapter 3: Individual Diet and Physical Activity Behavior Change*** for discussion of what works at the level of individual behavior change and ***Part D. Chapter 4: Food Environment and Settings*** for discussion of population change through environmental strategies.)

Within the Dairy and Vegetable groups, the following dietary changes in particular will help increase intake of shortfall nutrients and will decrease intake of overconsumed nutrients by the U.S. population:

- Increasing low-fat/fat-free fluid milk and yogurt and decreasing cheese would result in higher intakes of magnesium, potassium, vitamin A, and vitamin D while simultaneously decreasing the intake of sodium and saturated fat.
- Replacing soft drinks and other sugar-sweetened beverages (including sports drinks) with non-fat fluid milk would substantially reduce added sugars and empty calories and increase the intake of shortfall nutrients, including calcium, vitamin D, and magnesium.
- Consuming all vegetables, including starchy vegetables, with minimal additions of salt and solid fat will help minimize intake of overconsumed nutrients – sodium and saturated fat.

Review of the Evidence

This question was answered using data from the WWEIA, NHANES dietary survey (2007-2010) and the National Cancer Institute's examination of the usual intake distributions and percent of the U.S. population meeting USDA Food Pattern recommendations for their age and sex. [41, 48, 49] It is important to note that the Dietary Guidelines for Americans are established only for those ages 2 years and older. However, the WWEIA, NHANES sample includes persons from birth. The NHANES data are presented in these specific age groups that cannot be further divided.

Fruit. When consumed in the amounts recommended in the USDA Food Patterns, fruit contributes substantial amounts of two nutrients of public health concern: fiber and potassium. (Whole fruit and fruit juice provide about 16 percent of dietary fiber and 17 percent of potassium in the Food Patterns (see ***Appendix E-3.2: Food Group Contributions to Nutrients in USDA Food Patterns and Current Nutrient Intakes***).

The majority of children ages 1 to 3 years and 4 to 8 years meet the recommended intakes for total fruit, which is 1 cup and 1 to 1.5 cups per day, respectively. Among older children (boys and girls ages 9 to 13 years), adolescents, and adults of all ages (both men and women), few people consume the recommended daily amounts, which range from 1.5 to 2 cups for older children and adolescents to 1.5 to 2.5 cups for adults (Figure D1.9). Among the overall U.S. population, approximately 15 percent meet the daily fruit intake recommendation while nearly 80 percent do not meet the recommendation.

More than half of the daily fruit intake for all age and sex groups in the U.S. population (ages 1 year and older) comes from whole fruit (Figure D1.10). Among both boys and girls ages 1 to 3 years, whole fruit comprises slightly more than half of the daily fruit intake and the remainder is consumed though 100% fruit juice. The American Academy of Pediatrics (2001)[50] recommends that young children limit their juice intake to 4 to 6 ounces per day. Six ounces of juice is 0.75 cups; the average juice intakes fall within this recommended limit suggesting that juice is not overconsumed among many young children. Among children ages 4 to 8 and 9 to 13 years, fruit intake includes both 100% juice and whole fruit, but whole fruit comprises the majority of intake. Among middle aged and older adults, most of the fruit intake is from whole fruit, albeit below recommended levels, rather than 100% juice.

Vegetables. Vegetables are excellent sources of many shortfall nutrients and nutrients of public health concern. When vegetables are consumed in the amounts recommended in the USDA Food Patterns, vegetables contribute the following (expressed as averages over all the calorie levels): fiber (38 percent), potassium (36 percent), iron (19 percent), folate (23 percent), and vitamin A as provitamin A carotenoids (34 percent). Note that select vegetables do contribute to calcium intake, including spinach, collard greens, turnip greens, but these vegetables are often consumed in smaller amounts than is needed to be considered important sources of calcium (Table D1.6 and ***Appendix E-3.2: Food Group Contributions to Nutrients in the USDA Food Patterns and Current Nutrient Intakes***).

The U.S. population consumes few vegetables (Figure D1.11). Only 10 percent and 15 percent of boys and girls ages 1 to 3 years, respectively, consume the recommended 1 cup of vegetables per day. For children ages 4 to 8 years, less than 5 percent consume the recommended amount of 1.5 to 2 cups of vegetables per day. Vegetable consumption is lowest among boys ages 9 to 13 years (1 percent consume the recommended 2 to 2.5 cups per day) and girls ages 14 to 18 years (less than 1 percent consume the recommended 2 to 2.5 cups/day). Vegetable intakes increase slightly during the adult years, but intakes are still very low. Among young adult males and females ages 19 to 30 years, less than 10 percent meet the 2 to 3.5 cups/day recommendation. Intakes increase only slightly in subsequent age decades (31 to 50 years). Middle aged adults (51 to 70 years) are somewhat closer to the goal as they have the highest vegetable intakes. Even so, only about 20 percent of men and about 30 percent of women meet the daily recommendation of 2 to 3.5 cups per day. Although these intake levels are still below optimal, the positive gains in vegetable consumption are noteworthy. However, vegetable intakes fall again among older adults (71 years and older), with less than 20 percent of men

and women meeting intake recommendations. Overall, nearly 90 percent of the U.S. population does not meet daily vegetable intake recommendations.

The USDA Food Pattern food group for vegetables includes five subgroups: dark green vegetables, red and orange vegetables, beans and peas, starchy vegetables, and other vegetables. The U.S. population does not meet intake recommendations for any of these vegetable subgroups (Figures D1.12 to D1.16). More than 80 percent of the U.S. population does not meet the intake recommendation for dark green vegetables, starchy vegetables, and beans and peas, while more than 90 percent do not meet the recommended intakes for red and orange vegetables. "Other vegetables" (Figure D1.16) is a broad group that includes iceberg lettuce, green beans, cucumbers, celery, onions, summer squash, mushrooms, and avocados. More than 50 percent of males and females ages 51 to 70 years meet or exceed the recommended intake amounts of other vegetables and among all ages, nearly 40 percent meet or exceed the recommended intake. Intake of "other vegetables" is more likely to meet recommendations than the other four subgroups, but consumers should be encouraged to increase intake of all vegetables. To meet total vegetable recommendations, higher intakes of all vegetable subgroups are needed, particularly those subgroups where intake is minimal, such as dark green and orange and red vegetables, which are excellent sources of vitamin C, folate, magnesium, and potassium.

Potatoes (white potatoes) are the most commonly consumed single vegetable, and make up about 80 percent of all starchy vegetable consumption.[51] They account for 25 percent of all vegetable consumption and are a good source of both potassium and fiber. Among children and adolescents ages 2 to 19 years, they account for 28 percent to 35 percent of total vegetable consumption, with a higher percentage of vegetables consumed as potatoes among boys than girls in each age category. Potatoes are consumed in a variety of forms, with about 31 percent being boiled (including mashed and in dishes such as potato salad, soups, and stews), 22 percent as chips, sticks, or puffs, 19 percent as French fries, 17 percent as baked, and 12 percent as home fries or hash browns.

Grains (whole and refined). The 2010 Dietary Guidelines for Americans recommended that half of all grain intake should come from whole grains. The 2015 DGAC brings forward this recommendation and here we give rationale and results to support this decision. The background and summary of previous food pattern modeling with respect to grains is important to present here so as to provide context for the 2015 DGAC recommendations.

Whole grains are those "foods made from the entire grain seed, usually called the kernel, which consists of the bran, germ and endosperm. If the kernel has been cracked, crushed or flaked, it must retain nearly the same relative proportions of bran, germ and endosperm as the original grain in order to be called whole grain."[52p134] Examples of whole grains are brown rice, popcorn, bulgur, whole wheat, oats, and barley. If whole grains were consumed in the amounts recommended in the Food Patterns, whole grains would provide substantial percentages of several key nutrients, such as about 32

percent of dietary fiber, 42 percent of iron, 35 percent of folate, 29 percent of magnesium, and 16 percent of vitamin A (see ***E-3.2: Food Group Contributions to Nutrients in USDA Food Patterns and Current Nutrient Intakes***).

Across all ages and both sexes, the U.S. population does not meet the goal for whole grain intake, as nearly 100 percent of the population consumes amounts that are below the recommended intake levels (Figure D1.17), which range from 1.5 ounce equivalents (oz eq) for young children up to 3 to 3.5 oz eqs for older children and adolescent and adult females. Adolescent and adult males are advised to consume 3 to 4 oz eqs per day. The inadequate intake of whole grains leads to underconsumption of several shortfall nutrients and nutrients of public health concern. Refined grains, such as white flour and products made with white flour, white rice, and de-germed cornmeal, are part of the intake recommendation because they are commonly enriched with iron and several B vitamins, including thiamin, niacin, and riboflavin (e.g., enriched flour, 21 CFR 137.165).[53p.452] Since 1998, enriched grains also have been fortified with folic acid and are thus an important source of folic acid for women of childbearing potential.[53, 54] The effect of the folic acid fortification on the health status of the U.S. population was extensively reviewed by the 2010 DGAC and so was not re-reviewed by the 2015 DGAC. The 2010 DGAC concluded that strong and consistent evidence demonstrates a large reduction in the incidence of neural tube defects (NTDs) in the United States and Canada following mandatory folic acid fortification. They also found only limited evidence to suggest a decline in stroke mortality in the United States and Canada and an increase in colorectal cancer in those countries following mandatory folic acid fortification. Due to the very limited evidence, cause and effect cannot be attributed for folic acid fortification and either stroke or colorectal cancer incidence. The 2015 DGAC brings forward those results with no notable changes in the interpretation of the data presented in 2010. Despite the B vitamins and iron that can be obtained from enriched and fortified refined grains, products made with refined grains also may be a source of excess calories and added sugars. (See Question 11c, food categories, below, and added sugars discussion in ***Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance.***) Figure D1.18, documents that the U.S. population consumes far too many refined grains. In the overall population for all ages and for both males and females, about 19 percent meet the recommendation for refined grains, while more than 70 percent exceed the recommendation. Intake of refined grains is particularly high among boys and girls ages 4 to 8 years and girls ages 9 to 13 years.

Due to the overconsumption of refined grains and the underconsumption of whole grains relative to the 2010 recommendation that "half of all grain intake should come from whole grains," the DGAC decided that it was important to examine the impact on nutrient intake if: (1) refined/enriched grains intake were reduced to no more than 25 percent or 15 percent of the total grains intake; and (2) overall grain intake were reduced. The Committee relied on food pattern modeling analyses conducted by the 2005 and 2010 DGACs to answer these questions, and brings forward their recommendations, as reiterated below.

The key finding from the 2010 DGAC modeling report was: "As shown by food pattern modeling, consumption of all grains as whole grains, without including any fortified whole grain products, would lower dietary folate and iron intake levels to less than adequate amounts for individuals in population groups who may be at high risk for inadequate intakes of these nutrients. Individuals are encouraged to consume most of their grains as fiber-rich whole grains, and when doing so, should select some of these fiber-rich whole grains as products that have been fortified with folic acid and possibly other nutrients". [55p146]

In its analysis, the 2005 DGAC reported that non-whole grains contributed important amounts of certain nutrients to the dietary patterns, including folate, iron, calcium, fiber, thiamin, riboflavin and niacin.[56append G-2] The 2005 DGAC concluded that including only 3 oz eqs of whole grains, with no non-whole grains, in the food patterns would lower intake of many of these key nutrients and perhaps place certain individuals at risk of nutrient inadequacy. However, the 2010 DGAC found that consuming all grains as whole grains would provide for nutrient adequacy in the patterns if fortified ready to eat (RTE) whole grain breakfast cereals were substituted for RTE refined grain breakfast.[55app E.7] The 2015 DGAC concluded that consumption of only whole grains with no replacement or substitution would result in nutrient shortfalls.

Dairy. Dairy foods in the USDA Food Patterns include fluid milk, cheese, yogurt, ice cream, milk-based replacement meals and milk products, including fortified soymilk, but do not include almond or other plant-based "milk-type" products. Dairy foods are excellent sources of nutrients of public health concern, including vitamin D, calcium, and potassium. Consumption of dairy foods provides numerous health benefits including lower risk of diabetes, metabolic syndrome, cardiovascular disease and obesity.[57-62] When consumed in the amounts recommended by the Food Patterns, on average across the calorie levels, dairy foods contribute about 67 percent of calcium, 64 percent of vitamin D, and 17 percent of magnesium (see ***Appendix E-3.2: Food Group Contributions to Nutrients in the USDA Food Patterns and Current Nutrient Intakes***). The Patterns recommend consumption of low-fat and fat-free foods in the Dairy group to ensure intake of these key nutrients while minimizing intake of saturated fat, which is a nutrient of concern for overconsumption.[44]

More than 60 percent of young boys and girls ages 1 to 3 years meet or exceed the recommended intake of 2 cup eqs per day, with most of this intake coming in the form of fluid milk (see Figure D1.19 and Appendix E-3.4: USDA Food Patterns—Adequacy for Young Children). Intake falls in older children to about 30 percent of boys and girls meeting or exceeding the recommended 2.5 cup eqs per day for those ages 4 to 8 years and 3 cup eqs per day for children ages 9 to 13 years. About 30 percent of adolescent boys meet or exceed the recommended 3 cup eqs per day, but less than 10 percent of adolescent females meet or exceed this recommendation. An age-related decline in dairy intake appears to begin in adolescence and intakes persist at very low levels among adult females across the age distribution. Less than 5 percent of adult females consume the recommended 3 cup

equivalents per day. Overall, more than 80 percent of the entire U.S. population does not meet the daily dairy intake recommendation.

To determine the extent to which individuals could meet recommendations for calcium and other shortfall nutrients intake, given various levels of dairy foods in the Food Patterns, the 2015 DGAC conducted a food pattern modeling analysis (see ***Appendix E-3: Dairy Group and Alternatives***). The DGAC considered nutrient adequacy of the Food Patterns under the following scenarios: 1) no dairy was consumed; 2) calcium was obtained from non-dairy sources (including fortified foods); and 3) the proportions of yogurt and cheese in the patterns were modified. The DGAC further evaluated the relationship between changes in the types of beverages consumed (milk, fruit juices, fruit drinks and sports beverages) and diet quality.

If no dairy is consumed, the modeling analysis shows that levels of calcium, magnesium, iron, vitamin A and riboflavin, drop below 100 percent of goals, and intake levels of potassium, vitamin D and choline also drop substantially. When no dairy is consumed, calcium intake levels drop by 68 to 88 percent in all age and sex groups, while vitamin D intake is lowered by 20 to 30 percent (see ***Appendix E-3.6: Dairy Group and Alternatives***, Table 2). Most of the milk alternatives are fortified with calcium, so similar amounts of calcium can be obtained from fortified rice, soy and almond milks, and fortified juices, but absorption of calcium is less efficient from plant beverages.[63] Magnesium intake also is comparable from plant-based milk alternatives. However, vitamin D and potassium amounts vary across these milk alternatives (see ***Appendix E-3.6: Dairy Group and Alternatives***, Table 3). Calorie levels also are higher for most of the plant-based alternative milk products for a given calcium intake level. In other words, to obtain a comparable amount of calcium as one cup eq for non-fat fluid milk, the portion size required to meet the calcium intake need results in higher energy intake (see ***Appendix E-3.6: Dairy Group and Alternatives***, Table 4).

Currently, the U.S. population consumes the recommended 3 cup equivalents/day as 53 percent fluid milk, 45 percent cheese, and 2 percent as yogurt. Through the food pattern modeling, the DGAC examined the effect on nutrient intake if fluid milk were to be increased and cheese decreased. Increasing the proportion of fat-free milk, while decreasing the proportion of cheese, would increase the intake of magnesium, potassium, vitamin A, vitamin D and would decrease intake of sodium and saturated fat (see ***Appendix E-3.6: Dairy Group and Alternatives***, Table 5). A potential approach to increasing intake of shortfall nutrients and nutrients of public health concern while simultaneously decreasing intake of overconsumed nutrients of public health concern would be to increase intake of fat-free or low-fat fluid milk in lieu of cheese.

If milk is completely eliminated from the diet and replaced by soft drinks, fruit drinks, sports beverages, and other sugar-sweetened beverages, diet quality deteriorates significantly, making it very hard for individuals to meet nutrient recommendations (see ***Appendix E-3.6: Dairy Group and***

Alternatives, Table 6). Indeed, among U.S. adolescents' milk consumption is very low as are intakes of the "shortfall" nutrients.

Protein Foods. Protein Foods comprise a broad group of foods including meat, poultry, fish/seafood, eggs, soy,[∞] nuts, and seeds. Dairy also contains protein, but since it has its own food group, its nutrient contributions are counted in its own group. The inclusion of both animal and non-animal protein foods allows vegetarian options to be accommodated. In addition to providing essential amino acids, some protein foods are important sources of iron, and iron is a shortfall nutrient and nutrient of public health concern among adolescent and adult females. Meat foods in the protein group provide heme iron, which is more bioavailable than non-heme plant-derived iron. Heme iron is especially important for young children and women who are pregnant.

Nearly 80 percent of boys and 75 percent of girls ages 1 to 3 years meet or exceed the protein foods recommendation of 2 ounce equivalents per day (Figure D1.20). Similarly, more than 60 percent of boys and girls ages 4 to 8 years meet or exceed the recommended intake of 3 to 4 oz eqs/day. Intake declines somewhat for boys and girls ages 9 to 13 years, as approximately 40 percent and 45 percent meet or exceed the recommended 3 ounce equivalents/day. Although nearly 60 percent of adolescent males ages 14 to 18 years meet the 5.5 to 6.5 oz eq/day recommendation, less than 25 percent of females ages 14 to 18 meet their 5-5.5 oz eq/day recommendation. Intakes begin to increase again for adult males across the age distribution, and about 62 percent of males ages 31 to 50 and 78 percent of males 51 to 70 years meet the 5.5-6.5 oz eq/day intake recommendation. For adult females ages 19 to 30 years, slightly more than 40 percent meet the 5 to 5.5 oz eq/day recommendation and approximately 50 percent of those ages 31 to 50 and about 50 percent of those 51 to 70 years meet the recommendation. Protein foods intake declines in both men and women older than age 71 years; about 30 percent of women and about 50 percent of men meet the recommendation. Across all age groups and in both males and females, nearly 60 percent of the U.S. population meets the protein foods intake recommendation. Although some groups in the U.S. population do not consume recommended amounts from the protein foods group, intakes of protein (as grams/day) are adequate across the population and protein is not a shortfall nutrient. Notably, protein intake also comes from dairy and grains in addition to the foods included in the protein foods group.

Most of the protein foods intake across all age groups and for both males and females comes from meat, poultry, and eggs (Figure D1.21). Nearly 80 percent of the U.S. population meets the intake recommendation for this protein foods subgroup (although less so for adolescent girls and older women).

[∞] Soy foods in the Protein Foods group include foods and ingredients such as tofu, soy noodles, soy flours, and soy protein isolates. Fortified soymilk is part of the Dairy group. Edamame and whole soybeans are part of the vegetable legume subgroup.

In 2010, the DGAC recommended that seafood intake be increased to eight ounces per week for adults. In reviewing the WWEIA/NHANES data, the DGAC 2015 found that the U.S. population has low seafood intake. Across all age groups and for both males and females, only 10 percent of the population meets the 2010 intake recommendations (Figure D1.22). Intake is highest in adult men and women, but remains very low. In the highest intake group, males ages 51 to 70 years, 21 percent of the population meets the intake recommendation.

In addition to reviewing WWEIA/NHANES data, the 2015 DGAC considered the potential influence on diet quality of substituting seafood for terrestrial animal foods (e.g., beef, poultry, pork, game meats). This question was addressed by the 2010 DGAC through a modeling analysis, and the 2015 DGAC decided to bring forward those modeling results. These results indicate seafood could be increased to 8 ounces/week (for adults) with no negative impact on nutrient adequacy.[55app E3.10] This 8 oz amount contributes energy, protein, selenium, vitamin D, and vitamin B-12. With respect to fatty acids, fish is rich in the long-chain eicosapentanoic acid (EPA) and docosahexonoic acid (DHA) and has a higher proportion of total fatty acids coming from polyunsaturated and monounsaturated fatty acids relative to saturated fatty acids. The 2015 DGAC also has examined the sustainability of fish production and consumption, and these results are discussed in ***Part D. Chapter 5: Food Sustainability and Safety***.

Nuts, seeds, and soy. Nuts, seeds, and soy provide protein, selenium, polyunsaturated fatty acids, fiber, magnesium, and zinc. Nuts, seeds, and soy are less commonly consumed protein foods (Figure D1.23). Even so, overall approximately 40 percent of the U.S. population meets or exceeds the food pattern recommended intake of these protein foods.

Empty calories. Solid fats that occur naturally in foods such as meat, dairy, and some tropical foods (e.g., coconut), and sugars that are added to foods either by the consumer or by food manufacturers are referred to as "empty calories" because both provide calories, but few or no nutrients. For the purposes of the USDA Food Pattern Food Groups, the term solid fats and added sugars is an analytic grouping, but going forward for 2015, the DGAC has elected to use the term "empty calories."

Calories from solid fats and added sugars are included for the USDA Food Patterns because they are a component of the diet that should be limited because they are not nutrient-dense and the solid fats contribute to saturated fat intake, which is overconsumed in the U.S. population (see Nutrient Intake/Nutrients of Concern section, Questions 1 and 2). Solid fats and added sugars are not food groups on their own, as are protein foods, dairy, grains, fruits, and vegetables, but they are included in the Food Patterns because they are an integral component of many foods consumed by the U.S. population either because they occur naturally (in the case of some solid fats) or they are added to foods, such as added sugars or fat added during processing, cooking, or other aspects of food preparation. Additional details about added sugars and saturated fat are provided in ***Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance***.

Because added sugars and solid fats are not nutrient dense and solid fats contribute to saturated fat intake, the USDA Food Patterns recommend that intake be limited. The guidance on the approximate amounts of solid fats and added sugars that can be part of a healthful diet is as follows: children ages 2 to 8 years: 120 calories/day; children 9 to 13 years: 120 to 250 calories/day; girls ages 14 to 18 years: 120 to 250 calories/day; boys ages 14 to 18: 160 to 330 calories/day; adult women: 120 to 250 calories/day; and adult men: 160 to 330 calories/day. Intake limits varies by age and sex and are based on residual calories after all food group intakes are met. The intake limits include solid fats and added sugars from all sources in the diet: from sugar in sugar-sweetened beverages, including coffee and tea, and breakfast cereals, to solid fats in burgers, sandwiches, and pizza, to the combination of solid fats and added sugars in snacks and desserts such as cookies, cakes, ice cream, and donuts. Question 11 of the Food Categories section of this Chapter provides information on food sources of solid fats and added sugars**.**

The intake of solid fats and added sugars is very high across all age groups and for both males and females in the United States, with nearly 90 percent exceeding the recommended daily limits (Figure D.1.24). Particularly noteworthy is that nearly 100 percent of boys and girls ages 1 to 3 and 4 to 8 years exceed the recommended limit for solid fats and added sugars (see ***Part B. Chapter 6: Cross Cutting Topics of Public Health Importance***).

For additional details on this body of evidence, visit:

- Usual Dietary Intakes: Food Intakes, U.S. Population, 2007-10: Applied Research Program. National Cancer Institute; [updated May 22, 2014]. Available from: http://appliedresearch.cancer.gov/diet/usualintakes/pop/2007-10/.
- Appendix E-3.2 USDA Food Pattern Modeling Report: Food Group Contributions
- Appendix E3.6 USDA Food Pattern Modeling Report: Dairy Group and Alternatives
- Food Patterns Equivalent Intakes from Food: Consumed per Individual, 2009-10. U.S. Department of Agriculture, Agricultural Research Service, Food Surveys Research Group. Available from: http://seprl.ars.usda.gov/Services/docs.htm?docid=23868.
- Seafood Food Pattern Modeling Report for the 2010 Dietary Guidelines Advisory Committee. USDA and HHS, 2010, Appendix E 3.10 USDA and HHS, 2010, Appendix E 3.10. Available from: http://www.cnpp.usda.gov/sites/default/files/dietary_guidelines_for_americans/AppendixE-3-10-Seafood.pdf.
- Replacing all Non-Whole Grains with Whole Grains Food Pattern Modeling Report for the 2010 Dietary Guidelines Advisory Committee. USDA and HHS, 2010, Appendix E3.7. Available from: http://www.cnpp.usda.gov/sites/default/files/dietary_guidelines_for_americans/AppendixE-3-7-Grains.pdf.

- Alternatives for Enriched Grains in Food Intake Patterns Analysis for the 2005 Dietary Guidelines Advisory Committee. U.S. HHS and USDA, 2005, appendix G-2. Available from: http://www.health.gov/dietaryguidelines/dga2005/report/HTML/G2_Analyses.htm#alternativegrain.

Question 8: What are the trends in USDA Food Pattern food group consumption by the U.S. population?

Source of Evidence: Data analysis

Conclusion

The U.S. population has made few dietary changes over time:

- Fruit intake has remained low but stable.
- Vegetable intake has declined, particularly among children of all ages, adolescents, and young adult males.
- Whole grain intake has slightly increased between 2001-2004 and 2007-2010, particularly among middle aged and older adults.
- Dairy intake has been relatively constant over time, but has decreased for girls ages 4 to 8 years and young adult males, and has increased for adults ages 51 to 70 years.
- Added sugars intake has decreased for both males and females across all age groups between 2001-2004 and 2007-2010, but intakes still exceed the limit in the USDA food patterns.

Implications

Individuals and families must make conscious and focused decisions about choosing nutrient-dense foods. In addition, to continue progress toward consumption of a healthy diet among all age and sex groups, action is needed along the entire food processing, delivery, and service supply chain in order to provide the U.S. population with affordable and accessible foods that are nutrient dense and low in added sugars and sodium.

Poor nutritional intake is linked to numerous diet-related chronic diseases (see ***Part D. Chapter 2: Dietary Patterns, Foods and Nutrients, and Health Outcomes***) and the prevalence of these conditions is too high in the United States (see Health Conditions section, Questions 15 to 17, below). The health of the nation hinges in part on improving dietary intake at individual and population levels, and changes in line with those suggested here could have a measurable positive impact on the health of the population.

Given the complexity of dietary behavior change, consumers will need access to evidence-based educational resources and intervention programs and services in public health and healthcare settings to facilitate adoption and maintenance of healthy dietary behaviors. (See ***Part D. Chapter 3: Individual Diet and Physical Activity Behavior Change*** for discussion of what works at the level of individual behavior change.) In addition, these efforts should be complemented with research-driven environmental strategies that make access to affordable healthy foods possible in retail, community, worksite, and educational settings. (See ***Part D. Chapter 4: Food Environment and Settings*** for discussion of effective environmental approaches to promote dietary change across the lifespan.)

Review of the Evidence

This question was answered using data from WWEIA, NHANES dietary survey data and the National Cancer Institute's examination of usual intake distributions for 2001-2004[64] and 2007-2010.[41]

Fruit. Fruit intake remained relatively stable across the 2001-2004 and 2007-2010 time periods (Figure D1.25). The only group with significant changes over time was males ages 31 to 50 years, for whom mean fruit intake decreased.

Vegetables. Vegetable intake declined from 2001-2004 to 2007-2010 (Figure D1.26). Across the overall population, the mean daily vegetable intake significantly declined. Significant declines in mean intake occurred among males ages 1 to 3, 4 to 8, 9 to 13, 14 to 18, and 19 to 30 years. For females, significant decreases in mean vegetable intake occurred for those ages 1 to 3, 4 to 8, and 9 to 13 years.

Grains (whole and refined). Whole grain intake significantly increased among the overall population between 2001-2004 and 2007-2010 (Figure D1.27). Among males, significant increases in mean intake occurred for those ages 1 to 3, 4 to 8, 14 to 18, 31 to 50, and 51 to 70 years. Among females, significant increases in mean whole grain intake occurred for those ages 9 to 13, 19 to 30, 31 to 50, 51 to 70, and 71 years and older (Figure D1.27). Similarly, refined grain intake has declined in all age and sex groups between 2001-2004 and 2007-2010 (Figure D1.28).

Dairy. Dairy intake remained stable over the entire population between 2001-2004 and 2007-2010 (Figure D1.29). Significant declines in mean daily intake occurred between the two time periods for males ages 19 to 30 years and females ages 4 to 8 years. Significant increases in mean daily dairy intake occurred for both males and females ages 51 to 70 years.

Protein Foods. Protein food intake remained relatively stable for the U.S. population between 2001-2004 and 2007-2010 (Figure D1.30). Females ages 31 to 50 and 51 to 70 years had significantly higher mean intake in 2007-2010 compared to 2001-2004. These were the only groups with any significant change over time.

Added Sugars. Some improvements have been made in added sugars intake, with noticeable declines in mean intakes for all age groups and among both males and females when comparing 2007-2010 data with 2001-2004 data (Figure D1.31). As seen in Figure D1.31, intakes of added sugars are still very high, however, and are well above recommended limits, but the improvements provide some optimism for improved diets.

For additional details on this body of evidence, visit:

- Usual Dietary Intakes: Food Intakes, US Population, 2007-10: Applied Research Program. National Cancer Institute; [updated May 22, 2014]. Available from: http://appliedresearch.cancer.gov/diet/usualintakes/pop/2007-10/.

- Usual Dietary Intakes: Food Intakes, US Population, 2001-04: Applied Research Program. National Cancer Institute; [updated April 2, 2014]. Available from: http://appliedresearch.cancer.gov/diet/usualintakes/pop/2001-04/.

FOOD CATEGORIES—CURRENT INTAKES AND SOURCES OF ENERGY, NUTRIENT, AND FOOD GROUP INTAKES

The food sources of nutrients and the patterns in which they are consumed are informative in identifying strategies to modify dietary intake and eating behaviors and help Americans to choose and consume higher quality diets. We examined four questions related to the foods that are top contributors to intakes of energy, food groups, and selected nutrients in the U.S. diet. This section describes those food sources and the implications for meeting recommended or optimal intakes of various food groups and nutrients.

Question 9: What are current consumption patterns by food categories (i.e., foods as consumed) in the U.S. population?

Source of evidence: Data analysis

Conclusion

The mixed dishes food category, which includes foods commonly used as entrees, such as sandwiches, burgers, pizza, pasta or rice mixed dishes, stir-fries, soups, and meat or poultry mixed dishes, is the major contributor to three USDA Food Pattern food groups—grains, vegetables, and protein foods. Fruit and fluid milk intake are seldom consumed as part of mixed dishes. The mixed dishes food category contributes heavily to intake of energy, saturated fat, and sodium; however, mixed dishes do provide vegetables, fiber, grains, and dairy.

Implications

An important strategy for meeting recommended intake levels of calories, saturated fat, and sodium is to change the composition of mixed dishes that are high in calories, saturated fat, and sodium to better meet these nutrition goals. Food manufacturers and the food service sector (e.g., restaurants, schools) should reformulate mixed dishes to improve their nutritional profiles. Americans should be encouraged to modify recipes to lower the sodium and saturated fat content when cooking, to use appropriate portion sizes, and choose reformulated mixed dish options when available.

Review of the Evidence

These conclusions were reached by examining data from the WWEIA Food Categories for the NHANES 2009-2010 dietary survey.[65] The WWEIA Food Categories provide an application that allows analysts to examine foods and beverages as consumed in the U.S. diet. Each food or beverage item (as consumed) that is included in WWEIA is placed in one of 150 mutually exclusive food categories. The focus of this categorization system is on grouping similar foods and beverages together based on usage and nutrient content.

An adaptation of the food categories was used by the 2015 DGAC for this analysis related to the "sandwiches and burgers" and "salads" categories. We placed all food items reported to be eaten as a sandwich, burger, taco, or salad item into the "sandwiches and burgers" or the "salads" categories regardless of whether the components were reported as separated ingredients or as a single combined item. For example, a food reported as a "cheeseburger" (a single item) would always be classified in the category of "burgers, sandwiches, and tacos," but a food reported as the individual food items of a hamburger bun, a hamburger patty, and cheese, eaten as a combination, would have been classified in the categories of "rolls and buns," "ground meat," and "cheese." The adaptation recoded these individually reported foods that were eaten in combination to "burgers, sandwiches, and tacos." By doing this, the categories used for this analysis more fully represented foods as consumed rather than as ingredients.

The 150 categories from WWEIA were condensed into 9 major and 32 sub-categories for analysis of the percent of total intake for energy, nutrients, and food groups from each major and sub-category (see ***Appendix E-2.7: Major categories and subcategories used in DGAC analyses of WWEIA Food Categories***). Analysis was conducted for the population ages 2 and older as a whole; analysis of the percent of energy intake also was conducted for males and females ages 2 to 5, 6 to 11, 12 to 19, 20 to 40, 41 to 50, 51 to 70, and 71 years and older; for race/ethnic groups including Non-Hispanic Whites, Non-Hispanic Blacks, and Hispanics ages 2 years and older; and for those with incomes less than or equal to 185 percent, or greater than 185 percent of the Poverty Index Ratio by three age groups: 2 to 11, 12 to 19, and 20 years and older.

WWEIA data show that Americans consume a substantial amount of foods in the form of mixed dishes (Figure D1.32). More specifically, 31 percent of vegetables, 45 percent of grains, 30 percent of dairy, and 45 percent of protein foods come from mixed dishes. Mixed dishes (which include foods such as sandwiches, burgers, pizza, pasta or rice mixed dishes, stir-fries, soups, and meat or poultry mixed dishes) make up 28 percent of total energy intake. Of note, only small amounts of fruits (1 percent) and fluid milk (3 percent) are consumed in mixed dishes—most are consumed as single food items, such as an apple or glass of milk (see ***Appendix E-2.8: Percent of total food group intake, 2009-2010, for U.S. population ages 2 years and older, from WWEIA Food Categories***).

When mixed dishes contribute to dairy foods, the majority of intake is in the form of cheese. Data show that about two-thirds of all cheese intake is from mixed dishes such as pizza, burgers, sandwiches, and casseroles. Given that cheese is generally higher in saturated fat and sodium and lower in potassium and vitamin D than is fluid milk (see Question 7b, above, and ***Appendix E-3.6: Dairy Group and Alternatives***), modifying the types of cheese products used in these mixed dishes to lower fat and sodium versions would improve their nutritional profile.

When mixed dishes contribute to the grains group, a larger percentage of refined (48 percent) than whole (19 percent) grains are consumed as part of these dishes. Substitution of whole for refined grains in mixed dishes such as burgers, sandwiches, pizza, and casseroles containing pasta or rice could improve the nutritional profile of grains that are consumed this way.

Although mixed dishes account for a substantial amount of intake of some overconsumed nutrients (43 percent of sodium, 36 percent of saturated fat), they also account for 28 percent of fiber, 29 percent of calcium, 24 percent of potassium, and 16 percent of vitamin D, all of which are underconsumed nutrients. Other food categories that contribute substantially to overall energy, sodium, saturated fat, and added sugars intake are discussed in the following two questions—Question 10: "What are the top foods contributing to energy intake in the U.S. population?" and Question 11: "What are the top foods contributing to sodium, saturated fat, and added sugars intake in the U.S. population?"

For additional details on this body of evidence, visit:

- What We Eat in America. Food Categories for the NHANES 2009-2010 dietary survey. Available from: http://seprl.ars.usda.gov/Services/docs.htm?docid=23429.
- Appendix E-2.7: Major categories and subcategories used in DGAC Analyses of WWEIA Food Categories
- Appendix E-2.8: Percent of total food group intake, 2009-10 for U.S. population ages 2 years and older

Question 10: What are the top foods contributing to energy intake in the U.S. population?

Source of evidence: Data Analysis

Conclusion

Seventy-five percent of total energy intake in the U.S. population comes from 16 of the 32 food sub-categories, with mixed dishes, snacks and sweets, and beverages together contributing to more than half (56 percent) of energy intake in the U.S. population.

Implications

The foods with the highest contribution to energy intake are burgers, sandwiches, and tacos; desserts and sweet snacks; and sugar-sweetened beverages. Given the link to energy intake, reduced consumption of these foods and beverages or modifying the ways these foods are prepared, as well as consumption of smaller portion sizes, may help prevent excess weight gain or may help with weight reduction.

Public health strategies (e.g., programs, regulations, and policies) and product reformulation are needed to help individuals achieve recommendations.

Review of the Evidence

These conclusions were reached by examining data from the WWEIA Food Categories for the NHANES 2009-2010 dietary survey,[65] as described in relation to question 9 (current consumption patterns by food categories in the U.S. population).

The top foods contributing to energy intake in the U.S. population are concentrated in several food categories, as shown in Figure D1.33. Three food categories account for more than half (56 percent) of all energy consumed: 1) Mixed dishes (which include foods such as sandwiches, burgers, pizza, pasta or rice mixed dishes, stir-fries, soups, and meat or poultry mixed dishes); 2) snacks and sweets, which includes foods such as chips, cakes, pies, cookies, doughnuts, ice cream, and candy.), and 3) beverages other than milk and 100% fruit juice (such as soft drinks, fruit drinks, coffee and tea, and alcoholic beverages)

Examining energy intake from the more specific 32 food subcategories shows that almost half of total energy intake comes from just 7 of these sub-categories (Table D1.12): Burgers and sandwiches (13.8 percent); desserts and sweet snacks (8.5 percent); sugar-sweetened beverages (6.5 percent); rice, pasta, and grain-based mixed dishes (5.5 percent); chips, crackers, and savory snacks (4.6 percent); pizza (4.3 percent); and meat, poultry, and seafood mixed dishes (3.9 percent). Further examination of the 32 subcategories shows that 75 percent of all energy intake comes from the 7 subcategories previously

described, plus vegetables (including starchy vegetables), alcoholic beverages, yeast breads and tortillas, whole and 2 percent milk and yogurt, breakfast cereals and bars, poultry, and candy and sugars.

As noted in Question 9, (current consumption patterns by food categories in the U.S. population), some of the food sub-categories that provide substantial amounts of energy also provide underconsumed food groups and nutrients. On the other hand, several of these subcategories, notably desserts and sweet snacks and sugar-sweetened beverages, tend to contribute to energy intake with little contribution to underconsumed food groups (see ***Appendix E-2.8: Percent of total food group intake, 2009-2010, for the U.S. population ages 2 years and older, from WWEIA Food Categories***) and nutrients (see ***Appendix E-2.9: Percent of total energy and nutrient intake, 2009-2010, for the U.S. population ages 2 years and older, from WWEIA Food Categories***), but major contributions to one or more overconsumed food components (see Question 11: What are the top foods contributing to sodium, saturated fat, and added sugars intake in the U.S. population?)

Analysis of the food sources of energy by age and sex groups showed the expected higher percent of energy from dairy among children, especially young children, but no other major differences. Analysis by racial/ethnic groups and by income groups did not show major differences (see ***Appendix 2.10: Percent of total energy intake, 2009-2010, for age/sex groups of the U.S. population, from WWEIA Food Categories***, ***Appendix E-2.11: Percent of total energy intake, 2009-2010, for racial/ethnic groups of the U.S. population, from WWEIA Food Categories***, and ***Appendix E-2.12: Percent of total energy intake, 2009-2010, for age/income groups of the U.S. population, from WWEIA Food Categories***).

For additional details on this body of evidence, visit:

- What We Eat in America. Food Categories for the NHANES 2009-10 dietary survey. Available from: http://seprl.ars.usda.gov/Services/docs.htm?docid=23429.
- Appendix E-2.7: Major categories and subcategories used in DGAC Analyses of WWEIA Food Categories
- Appendix E-2.8: Percent of total food group intake, 2009-2010, for U.S. population ages 2 years and older, from WWEIA Food Categories
- Appendix E-2.9: Percent of total energy and nutrient intake, 2009-2010, for the U.S. population ages 2 years and older, from WWEIA Food Categories
- Appendix E-2.10: Percent of total energy intake, 2009-2010, for age/sex groups of the U.S. population, from WWEIA Food Categories
- Appendix E-2.11: Percent of total energy intake, 2009-2010, for racial/ethnic groups of the U.S. population, from WWEIA Food Categories
- Appendix E-2.12: Percent of total energy intake, 2009-2010, for age/income groups of the U.S. population, from WWEIA Food Categories

Question 11: What are the top foods contributing to sodium, saturated fat, and added sugars intake in the U.S. population?

Source of Evidence: Data analysis

Conclusion

Mixed dishes are the largest contributor to intake of sodium (44 percent) and saturated fat (38 percent). Sodium and saturated fat have both been identified as nutrients of concern for overconsumption. Within mixed dishes, the sub-category of burgers and sandwiches is the largest contributor for both nutrients.

Sodium is ubiquitous in the food supply and many food categories contribute to intake. Beverages supply 47 percent of added sugars intake.

Snacks and sweets also are a major contributor to added sugars (31 percent) and saturated fat intake (18 percent).

Implications

To decrease dietary intake from added sugars, the U.S. population should reduce consumption of sugar-sweetened beverages and of desserts and sweet snacks.

The U.S. population can use a variety of strategies to reduce consumption of sodium, saturated fat, and added sugars, including smaller portion sizes, reduced frequency of consumption, and recipe modification.

Given the ubiquity of sodium in the food supply, concerted efforts to reduce sodium in commercially prepared and processed foods, as well as encouragement of home cooking using recipes with small amounts of sodium are needed to decrease intake toward recommended levels.

Review of the Evidence

These conclusions were reached by examining data from the WWEIA Food Categories for the NHANES 2009-2010 dietary survey,[65] as described in relation to Question 9 (current consumption patterns by food categories in the U.S. population).

The category of mixed dishes contributes substantially more saturated fat (36 percent) and sodium (43 percent) to diets of the U.S. population than does any other category. Within this category, the largest share of both saturated fat (19 percent) and sodium (21 percent) comes from the subcategory of

burgers, sandwiches, and tacos. The other subcategories that also contribute notable amounts of saturated fat and sodium are pizza (approximately 6 percent for both); rice, pasta, and other grain-based mixed dishes (5 percent and 7 percent); and meat, poultry, and seafood mixed dishes (5 percent and 7 percent). Soups contribute a notable amount of sodium (4 percent) but less saturated fat (1 percent). (Figures D1.34 and D1.35).

Other food categories contributing substantial amounts of saturated fat include snacks and sweets (18 percent), protein foods (15 percent), and dairy (13 percent). Within snacks and sweets, the subcategory providing the largest share is desserts and sweet snacks (12 percent). Within protein foods, saturated fat comes from meats, in general (3 percent), deli and cured meats and poultry (3 percent), poultry (3 percent), and eggs (3 percent), with seafood and nuts, seeds, and soy each contributing less than 3 percent. Within the dairy category, higher fat (whole and 2 percent) milk and yogurt (7 percent) and cheese (4 percent) contribute the most saturated fat.

Sodium is more ubiquitous in the food supply than are other nutrients, and the food categories contributing the highest amounts of sodium include protein foods (14 percent), grains (11 percent), vegetables (11 percent), and snacks and sweets (8 percent). Sodium is distributed throughout many food categories and subcategories with the exception of fruits and fruit juice, which are notably low in sodium (0.1 percent).

The distribution of added sugars in foods as consumed differs from saturated fat and sodium (Figure D1.36) The vast majority of added sugars intake comes from the major categories of beverages (not including milk and 100% fruit juice) (47 percent) and snacks and sweets (31 percent). Grains, including breakfast cereals and bars, contribute 8 percent, mixed dishes contribute 6 percent, and dairy, including sweetened flavored milks and yogurts contribute only 4 percent of total added sugars intake (see ***Appendix E-2.8: Percent of total food group intake, 2009-2010, for the U.S. population ages 2 years and older, from WWEIA Food Categories***).

Four additional questions were examined using the WWEIA Food Categories data. They are:

11a. What is the current contribution of fruit products with added sugars to intake of added sugars?

11b. What is the current contribution of vegetable products with added sodium to intake of sodium?

11c. What is the current contribution of refined grains to intake of added sugars, saturated fat, some forms of polyunsaturated fat, and sodium?

11d. What are the sources of caffeine from foods and beverages on the basis of age and sex categories?

With regard to Question 11a, the DGAC found that:

- Less than 1 percent of total added sugars come from fruits and 100% fruit juice foods (including fresh, canned, frozen, dried fruit and fruit salads) (see ***Appendix E-2.8: Percent of***

total food group intake, 2009-2010, for the U.S. population ages 2 years and older, from WWEIA Food Categories).

With regard to Question 11b, the DGAC found that:

- 11 percent of total sodium comes from all vegetables (with starchy vegetables), including beans and peas, vegetable mixtures, lettuce salads, pasta sauces, and vegetable juice (see ***Appendix E-2.9: Percent of total energy and nutrient intake, 2009-2010, for the U.S. population ages 2 years and older, from WWEIA Food Categories***).
- When vegetables are categorized by starchy or non-starchy, we found that:
  - 7 percent of total sodium comes from all vegetables, excluding starchy vegetables, and
  - 4 percent comes from starchy vegetables, including French fries and other fried potatoes, mashed potatoes, all other potatoes, corn, and other starchy vegetables.

With regard to Question 11c:

- The DGAC could not directly determine the contribution of refined grains to the nutrients of interest with the currently available data. However, the food categories that make up more than 90 percent of all refined grain intake (i.e., burgers, sandwiches, and tacos; breads and tortillas; rice and pasta mixed dishes; desserts and sweet snacks; pizza; chips, crackers, and savory snacks; quick breads; rice and pasta; and meat, poultry, and seafood mixed dishes) account for:
  - 28 percent of all added sugars intake
  - 47 percent of all saturated fat intake
  - 50 percent of all sodium intake

  (see ***Appendix E-2.8: Percent of total food group intake, 2009-2010, for the U.S. population ages 2 years and older, from WWEIA Food Categories*** and ***Appendix E-2.9: Percent of total energy and nutrient intake, 2009-2010 for the U.S. population ages 2 years and older, from WWEIA Food Categories***)

With regard to Question 11d, the DGAC found that (Figure D1.37):

- Among children and adolescents, sugar-sweetened and diet beverages and coffee and tea contribute to overall caffeine intake at approximately equal levels.
- Among adults, the primary sources of caffeine from all foods and beverages are coffee and tea.

For additional details on this body of evidence, visit:

- What We Eat in America. Food Categories for the NHANES 2009-10 dietary survey. Available from: http://seprl.ars.usda.gov/Services/docs.htm?docid=23429.
- Appendix E-2.7: Major categories and subcategories used in DGAC analyses of WWEIA Food Categories
- Appendix E-2.8: Percent of total food group intake, 2009-2010, for the U.S. population ages 2 years and older, from WWEIA Food Categories
- Appendix E-2.9: Percent of total energy and nutrient intake, 2009-2010, for the U.S. population ages 2 years and older, from WWEIA Food Categories

Question 12: What is the contribution of beverage types to energy intake by the U.S. population?

Source of evidence*:* Data analysis

Conclusion

Beverages contribute 19 percent of total energy intake. Of this 19 percent of energy, major sources are sugar-sweetened beverages (35 percent), milk and milk drinks (26 percent), and 100% fruit juices (10 percent).

Implications

The beverages that contribute the most to energy intake, particularly sugar-sweetened beverages, are those that are not nutrient dense and could be targeted for reduction. Others, like milk, fortified low- and non-fat milk, and milk beverage are good sources of key nutrients. Modifying the types of beverages consumed can reduce calories (e.g., switching from sugar-sweetened beverages to water) or improve nutrient intakes (e.g., switching from sugar-sweetened beverages to low-fat or fat-free milk). This may be an important strategy for individuals who need to reduce their energy intake and/or control their weight. Public health strategies (e.g., programs, regulations, and policies) are needed to reduce consumption of sugar-sweetened beverages.

Strategies are needed to encourage the U.S. population to drink water when they are thirsty. Water provides a healthy, low-cost, zero-calorie beverage option. Free, clean water should be available in public settings, as well as child care facilities, schools, worksites, publically funded athletic stadiums and arenas, transportation hubs (e.g., airports) and other community places and should be promoted in all settings where beverages are offered.

Review of the Evidence

These conclusions were reached by examining data from the WWEIA Food Categories data from the NHANES 2009-2010 dietary survey,[65] as described in relation to question 9 (current consumption patterns by food categories in the U.S. population). For this question, a new grouping of all beverages, including fluid milk and 100% fruit juice, was created. The conclusions and details below are based on this category of all beverages (see ***Appendix E-2.7: Major categories and subcategories used in DGAC analyses of WWEIA Food Categories***).

All beverages account for about one-fifth (19 percent) of total energy intake. Within that amount, about one-third (35 percent) is from sugar-sweetened beverages, mostly soft drinks and sweetened fruit drinks (see ***Appendix E-2.9: Percent of total energy and nutrient intake, 2009-2010, for the U.S. population ages 2 years and older, from WWEIA Food Categories***). About 20 percent of the calories from beverages come from alcoholic beverages (21 percent), and milk and milk drinks made with whole and 2 percent fat (18 percent). About 10 percent of the calories from beverages come from 100% fruit and vegetable juice (10 percent), fat-free and low-fat milk and milk drinks (8 percent), and coffee and tea (8 percent) (Figure D1.38).

For additional details on this body of evidence, visit:

- What We Eat in America. Food Categories for the NHANES 2009-10 dietary survey. Available from: http://seprl.ars.usda.gov/Services/docs.htm?docid=23429.
- Appendix E-2.7: Major categories and subcategories used in DGAC analyses of WWEIA Food Categories
- Appendix E-2.9: Percent of total energy and nutrient intake, 2009-2010, for the U.S. population ages 2 years and older, from WWEIA food categories

EATING BEHAVIORS—CURRENT STATUS AND TRENDS

Diet quality and energy balance directly affect health and weight status. Eating behaviors, such as when people eat (e.g., patterns of meals and snacks, meal and snack frequency), meal skipping, and the locations where food is obtained and consumed (e.g., retail and restaurants) influence dietary intake and quality. Assessing and understanding eating behaviors of the U.S. population can shed light on ways to improve food choices, weight status, and health outcomes of Americans.

Question 13: What are the current status and trends in the number of daily eating occasions and frequency of meal skipping? How do diet quality and energy content vary based on eating occasion?

Source of evidence: Data analysis

Conclusion

The majority of the U.S. population consumes three meals a day plus at least one snack. Children ages 2 to 5 years are most likely to consume three meals a day and adolescent females, young adult males, non-Hispanic Blacks, Hispanics, and individuals with lower incomes are least likely to consume three meals a day. Trend data from 2005-2006 to 2009-2010 show little change in meal and snack intake patterns.

Breakfast tends to have a higher overall dietary quality because of its higher nutrient density compared to other meals and snacks. Adolescents and young adults are the least likely to eat breakfast. Snacks contribute about one-fourth of daily energy intake for the U.S. population and are lower in nutrients of concern relative to energy intake than are meals. For young children ages 2 to 5 years, 29 percent of daily energy is from snacks.

Implications

Understanding eating behaviors is important for designing and implementing strategies to reduce obesity and other diet-related chronic diseases and for improving overall health. Breakfast eating is associated with more favorable nutrient intakes compared to nutrient intakes from other meals or snacks. Adolescents and young adults are the least likely to eat breakfast, and targeted promotion efforts are needed to reach these groups. For children and adolescents, the school breakfast program is an important venue for promoting breakfast consumption and efforts are needed to increase student participation rates.

Americans are frequent snackers and snacks contribute substantially to daily energy intake and tend to be lower than meals in shortfall nutrients of public health concern relative to energy intake. Because snack foods and beverages are readily available and accessible in multiple settings throughout the day, both population-level environmental changes and individual behavioral interventions and communications are needed to ensure that healthy choices are available in these settings and to minimize their contribution to excess energy intake.

Individuals with lower incomes are less likely to eat three meals a day compared to higher income individuals and low-income households are more likely to be food insecure. The federal nutrition programs play a key role in reducing food insecurity and improving nutritional health.

Review of the Evidence

These conclusions were reached by examining existing WWEIA NHANES data tables,[5] from NHANES 2009-2010 for current intakes, and WWEIA, NHANES 2003-2004, 2005-2006 and 2007-2008 data for trends. Respondents self-identified the specific meal or snack occasion for each food and beverage consumed.

Eating Occasions: Meals. Three meals a day is the current norm for most of the U.S. population ages 2 years and older, with almost two-thirds (63 percent) eating breakfast, lunch, and dinner (Figure D1.39). However, there are differences by age, sex, racial/ethnicity group, and income level. By age group, consuming three meals a day follows a modest U-shaped curve where it is most likely for children ages 2 to 5 years (84 percent). It then declines, and reaches its lowest point during adolescence and young adulthood, and then increases with age through the adult years. Adolescent females (12 to 19 years) and young adult males (20 to 29 years) are the most likely to not eat three meals a day (49 percent). For all other age/sex groups, eating three meals a day is reported by 59 to 73 percent of respondents. Eating only one meal a day is most likely for young adult males (12 percent) and adolescent females (10 percent). However, all but 1 percent of these respondents, consumed at least two or more snacks a day (Table D1.13).

Among the U.S. population ages 2 years and older, 15 percent do not eat breakfast, 20 percent do not eat lunch, and 7 percent do not eat dinner. Breakfast is most likely to be skipped by young adults ages 20 to 29 years (28 percent of males, 22 percent of females) and adolescents (25 percent of females, 26 percent of males). Breakfast skipping declines sharply with advancing age. Lunch is not eaten by 25 percent of adolescent females and from 17 to 28 percent of all adult age groups (Table D1.14).

Non-Hispanic whites are most likely to report consuming three meals a day, across all age/sex/racial/ethnic groups, with 68 percent reporting breakfast, lunch, and dinner consumption. For non-Hispanic Blacks, slightly less than half (48 percent) consumed all three meals, and for all Hispanics, slightly more than half (52 percent). Non-Hispanic Blacks ages 12 to 19 years and 20 years and older, and Hispanics ages 12 to 19 years, were least likely to consume three meals a day (42 percent, 45 percent, and 45 percent, respectively) and most likely to consume only one meal a day (18 percent, 11 percent, and 10 percent).[66]

The percent of individuals consuming three meals a day increases with higher income levels. For those below 131 percent and from 131 to 185 percent of the poverty threshold, 53 percent and 56 percent report three meals a day, while for those above 185 percent of the threshold, 70 percent report three meals a day. For lower income individuals, the lower number of meals consumed per day is much more evident for older children and adults. Among children ages 2 to 5 years in the three income groupings, 81 percent, 82 percent, and 88 percent, respectively, report consuming three meals a day, while for adults ages 20 years and older, the corresponding percentages are 48 percent, 54 percent, and 70 percent, respectively.[67]

Eating Occasions: Snacks. Nearly all of the U.S. population ages 2 years and older consume at least one snack a day (96 percent). The most common snacking pattern for most age, sex, racial/ethnic and income groups is two to three snacks per day. Females and males ages 70 years and older are most likely to report eating one or fewer snacks per day (26 percent), and children ages 2 to 5 years are the

least likely (10 percent). Children ages 2 to 5 years are most likely of any age group to report four or more snacks per day, across all racial/ethnic groups.[68]

The number of individuals reporting one or fewer snacks per day is highest (25 percent) for those below 131 percent of the poverty threshold, and lowest (17 percent) for those above 185 percent of the threshold. Consumption of four or more snacks per day is lowest (25 percent) for those below 131 percent of the poverty threshold and highest (35 percent) for those above 185 percent of the threshold. However, for all income groups, 2 to 3 snacks per day is the modal number and similar across income groups (51 percent, 48 percent, 48 percent).[67]

Trends. Trend data from NHANES from 2005-2006 to 2009-2010 show little change in number of daily eating occasions or frequency of meal skipping (Table D1.15).

Diet Quality and Energy content by Eating Occasion. For this analysis, diet quality is defined as a comparison of nutrient or food group content to energy content of a specified set of foods or beverages. In this question, diet quality compares the proportion of total nutrient intake at a given eating occasion to the proportion of energy intake at that eating occasion.

This analysis is summarized in Figure D1.40 and described below. In looking at this Figure, it should be noted that percent of total intake of nutrients of concern are shown in comparison to percent of total energy. If a nutrient is above the energy line, the meal/snack is a relatively higher source of that nutrient. If it is below the energy line, it is a relatively lower source.

Breakfast has a higher overall diet quality compared to lunch, dinner or snacks. Breakfast consists of 15 to 20 percent of the day's total energy intake (Table D1.16) but has a higher percent of nutrients. For all the shortfall nutrients of public health concern (fiber, folate, vitamin D, calcium, iron, and potassium), a higher percent of the day's total intake was consumed compared to the percent of energy consumed (Figure D1.40)

Among the U.S. population ages 2 years and older, about one fourth (24 percent) of daily energy intake is consumed at lunch and about one-third (35 percent) is consumed at dinner (Table D1.16). In terms of dietary quality, lunch is neutral, with similar percents of total nutrients and energy intakes for most nutrients. Dinner, which provides the greatest amount of daily total energy intake, has a higher percent of fiber, and potassium in comparison to percent energy, but calcium and several other nutrients are lower in comparison to percent energy. Sodium and saturated fat are higher as a percent of their total intakes than is energy intake. Further, the percent of total daily intake of sodium and saturated fat consumed at dinner is higher compared to other meals and snacks (Figure D1.40).

About one-fourth (24 percent) of daily energy intake comes from snacks. For young children ages 2 to 5 years, 29 percent of daily energy is from snacks (Table D1.17). Snacks provide the lowest percent of

key nutrients (protein, iron, vitamin D, fiber, and potassium) relative to the percent of energy provided. Snacks provide 42 percent of the daily intake of added sugars. A lower percent of total sodium than of energy is provided by snacks. Snacks provide roughly the same percent of total intake of calcium as they do energy. This is also true of saturated fat for females (Table D1.17).

For additional details on this body of evidence, visit:

- Percent of the U.S. population consuming or skipping meals and snacks, 2001-2002, 2005-2006, 2007-2008, and 2009-2010 by age/sex groups, race/ethnicity, and percent of the poverty threshold. Available from: http://seprl.ars.usda.gov/Services/docs.htm?docid=18349.
- Percent of total energy and nutrient intake by meal/snack, 2001-2002, 2005-2006, 2007-2008 and 2009-2010 by age/sex groups, race/ethnicity, and percent of the poverty threshold. Available from: http://seprl.ars.usda.gov/Services/docs.htm?docid=18349.

Question 14: What are the current status and trends in the location of meal and snack consumption and sources of food and beverages consumed at home and away from home? How do diet quality and energy content vary based on the food and beverage source?

Source of evidence: Data analysis

Conclusion

About two-thirds of the calories consumed by the U.S. population are purchased at a store (69 percent), such as a grocery store or supermarket, and consumed in the home. The percent of calories eaten away from home (32 percent) has remained about the same since 2003-2004.

Food group and nutrient quality as measured by the Healthy Eating Index (HEI) vary by where food is obtained. Despite this, no matter where the food is obtained, diet quality of the U.S. populations does not meet recommendations for fruit, vegetables, dairy, whole grains, and exceeds recommendations for sodium, saturated fats, refined grains, solid fats, and added sugars.

Implications

The overall diet quality of the U.S. population's dietary patterns, regardless of where the food is purchased and eaten, is of major public health concern. Given that fruit, vegetables, dairy, and whole grains are consumed in less than recommended amounts and that sodium, saturated fats, refined grains, solid fats, and added sugars exceed recommended levels, urgent action is needed at individual and population levels to alter food purchasing and consumption habits.

Efforts are needed by the food industry and food retail (food stores and restaurants) sectors to market and promote healthy foods. The general public needs to be encouraged to purchase these healthier

options. Making healthy options the default choice in restaurants (e.g., fat-free/low-fat milk instead of sugar-sweetened beverages, and fruit and non-fried vegetables in Children's Meals, whole wheat buns instead of refined grain buns for sandwich meals) would facilitate the consumption of more nutrient dense diets. Food manufacturers and restaurants should reformulate foods to make them lower in overconsumed nutrients (sodium, added sugars and saturated fat) and calories and higher in whole grains, fruits and vegetables.

In addition, Federal regulations for food labeling need to be updated. Food labels are an important tool to enable the public to follow the Dietary Guidelines and to make healthy food choices. They provide consumers with quick, easy to use information about the food they are purchasing. They also lead food companies to reformulate their food products to meet consumer demand. As recently proposed by the FDA, updates are needed in the Nutrition Facts label on packaged foods to emphasize calories, serving sizes, and nutrients of concern (including overconsumed nutrients such as sodium). Consumers also may benefit from a standardized Front of Pack label that gives clear guidance such as proposed by the IOM panel on FOP labeling.[69]

In addition to regulatory, policy, environmental and organizational changes, individual behavioral strategies are also needed to help Americans improve dietary behaviors. Comprehensive lifestyle interventions in a variety of settings and nutrition counseling by professionals in health care settings can modify dietary behaviors and improve health outcomes.

Review of the Evidence

This conclusion was reached by examining a new analysis of WWEIA, NHANES food intake data, from WWEIA NHANES 2009-2010 for current status, and WWEIA NHANES 2003-2004, 2005-2006 and 2007-2008 for trends (see ***Appendix E-2.13: Percent of energy intake from major points of purchase and location of eating, 2003-2004, 2005-2006, 2007-2008, 2009-2010, for the U.S. population ages 2 years and older*** and ***Appendix E-2.14: Food group and nutrient content of foods per 1000 calories obtained from major points of purchase, 2003-2004, 2005-2006, 2007-2008, 2009-2010, for the U.S. population ages 2 years and older***). This analysis was requested by the DGAC to answer the question. In addition, the DGAC reviewed the ERS publication *Nutritional Quality of Food Prepared at Home and Away from Home, 1977-2008*[70] to ascertain longer-term trends.

Respondents self-identified the food source (point of purchase) for each food or beverage they reported. For this analysis, food sources were grouped into the following categories: stores (grocery, supermarket, convenience/corner stores), full-service restaurants (defined as table service restaurants), quick-serve restaurants (includes fast food, counter service, and vending machines), school (includes child care). The location of eating, either at home or away from home, also was examined (Figure D1.41).

Americans increased their away-from-home share of caloric intake from 18 percent in 1977-1978 to 32 percent in 2005-2008, mainly from full service and fast food restaurants.[70] The percent of calories eaten away from home has remained roughly the same since 2003-2004. In 2009-2010, 69 percent of calories consumed by Americans were purchased from a store and 58 percent were eaten at home. This is about the same percent from 2003-2008 (Figure D1.41).

Diet quality was assessed using a density approach expressed as the amount of food group or nutrient per 1000 calories consumed, for each source from which food is obtained. The point of purchase (e.g., food store) is used as a proxy for where the food is consumed (e.g., home) because most food from stores are consumed at home, and most foods from other points of purchase are consumed away from home. Diet quality for a food group or nutrient for each food source obtained/consumed was then compared to the standard for a optimal HEI score per 1000 calories.[71] For saturated fat intake, the amount from each source was compared to the 2010 Dietary Guidelines limit for saturated fat intake.

Fruit. Fruit group density (cups per 1000 calories) is well below the HEI standard regardless of where the food is obtained or consumed. Amounts of fruit obtained and consumed differ by source, with full service and fast-food restaurants providing much less fruit per 1000 calories compared to other sources. This changed little from 2003-2004 to 2009-2010. Amount of fruit per 1000 calories is highest from schools/day care, and increased from 2003-2004 to 2009-2010, especially from 2007-2008 on (Figure D1.42).

Vegetables. Density for vegetables (cups per 1000 calories) falls below recommended intakes regardless of where food is obtained (Figure D1.43). Amounts of total vegetables and the starchy and other vegetable subgroups are shown in Figures D1.43 and D1.44. (Other vegetables are those not in the dark green, red orange, or starchy subgroups, such as green beans, iceberg lettuce, onions, cabbage, cucumbers.) Amounts of total vegetables and other vegetables per 1000 calorie are highest for restaurants, especially full service restaurants, with a slight downward trend from 2007-2008 to 2009-2010 (Figures D1.43 and D1.44). Amounts of total vegetables and starchy vegetables per 1000 calories from schools/daycare show a suggestive decrease in 2009-2010 compared to earlier years. Density for all vegetable subgroups by source for 2003-2004 through 2009-2010 are listed in Table D1.18.

Dairy. Amounts of total dairy products (fluid milk, cheese, and yogurt) are highest from schools/day care sources and are above the HEI standard, with an increase from 2007-2008. Amounts from other sources are far below recommendations (Figure D1.45).

Whole and refined grains. Whole grain density per 1000 calories is far below the HEI standard and is low for all food sources with little change since 2003-2004. On the other hand, refined grains exceed the HEI limit for all food sources, with the highest amount coming from quick serve restaurants (Figure D1.46).

Protein foods. Amounts of total protein foods per 1000 calories are above the HEI standard for full service restaurants and fast food restaurants (Figure D1.47).

Sodium. Amounts of sodium per 1000 calories are well above the HEI limit and do not differ greatly across sources. However, the density from full service and fast food restaurants are somewhat higher than from stores. There has been little change from 2003-2004 to 2009-2010 (Figure D1.48).

Saturated fats. Amounts of saturated fat per 1000 calories is well above the Dietary Guidelines limit and do not differ greatly across sources. However, the density from fast food restaurants is somewhat higher than from stores. There has been little change from 2003-2004 to 2009-2010 (Figure D1.49).

Empty calories. (defined as the total calories from solid fats and added sugars). Empty calories are well above the HEI limit (190 calories per 1000 calories) for all food sources, with the highest amount from fast food restaurants, but no large differences among sources. Empty calories have trended downward since 2003-2004 (Figure D1.50). The HEI does not have a separate HEI standard for added sugars and solid fats. Both added sugars and solid fats have decreased since 2003-2004. (Figures D1.51, D1.52) The highest amounts of added sugars are obtained from stores and the highest amounts of solid fats are obtained from fast food restaurants.

Food group density by age group. For children ages 2 to 5 years, fruit group density per 1000 calories from schools and stores reaches the HEI standard. School foods provide the highest fruit density among all food sources for 6-11 year olds, with an increase since 2007-2008. All other age groups do not reach the HEI standard for fruit from any source, although the store location is consistently the top source for adults. Vegetable density from full service restaurants reaches the HEI standard for ages 51-70 and 71 years and older. All sources of vegetables are below the standard for children, adolescents and adults under age 50. Dairy product density from child care and stores meet the HEI standard for children ages 2-5 and from schools for children ages 6-19. School foods provide the highest dairy product density among all food sources in children's diets. For school age children and adolescents, school foods are the only food source that meets the recommended amount of dairy products. Among adults, dairy product density is low for all sources. For children ages 6-11, there is a difference in the added sugars density by source, with schools having less added sugars per 1000 calories than other sources. This difference is not as clear for younger children or adolescents. For adults the highest amount of added sugars per 1000 calories is from stores. For most age groups, there is a slight downward trend, especially in the density of added sugars from stores (see ***Appendix E-2.15: Amount of key nutrients and food groups by age group per 1000 calories from each point of purchase, 2003-2004, 2005-2006, 2007-2008, and 2009-2010***).

For additional details on this body of evidence, visit:

- Appendix E-2.13: Percent of energy intake from major points of purchase and location of eating, 2003-2004, 2005-2006, 2007-2008, and 2009-2010, for the U.S. population ages 2 years and older

- Appendix E-2.14: Food group and nutrient content of foods per 1000 calories obtained from major points of purchase, 2003-2004, 2005-2006, 2007-2008, and 2009-2010, for the U.S. population ages2 years and older
- Appendix E-2.15: Amount of key nutrients and food groups by age group per 1000 calories from each major point of purchase, 2003-2004, 2005-2006, 2007-2008, and 2009-2010
- ERS report, Nutritional Quality of Food Prepared at Home and Away from Home, 1977-2008. Available from: http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib105.aspx.

PREVALENCE OF HEALTH CONDITIONS AND TRENDS

Preventable, diet- and lifestyle-related chronic diseases, including high blood pressure, CVD, type 2 diabetes, and certain cancers, contribute to the high and rising costs of U.S. health care. Adults with overweight or obesity frequently have co-morbid conditions and higher chronic disease risk profiles that contribute substantially to higher health care costs. These health problems are persistent in the population and pose major public health concerns. Increasing rates of overweight and obesity among American youth have resulted in rising rates of CVD risk factors, including borderline high blood pressure and diabetes, in this population. Health disparities in risk profiles and disease rates are evident across racial, ethnic, and income strata. In a new health care and public health vision, prevention of chronic diseases and other lifestyle-related health problems would become a major focus. Examining the status and trends in these health conditions provides a framework for discussing their relationship to dietary intake and lifestyle factors and can help in identifying evidence-based strategies for prevention.

Question15: What is the current prevalence of overweight/obesity and distribution of body weight, BMI, and abdominal obesity in the U.S. population and in specific age, sex, racial/ethnic, and income groups? What are the trends in prevalence?

Source of evidence: Data analysis

Conclusion

The current rates of overweight and obesity are extremely high among children, adolescents, and adults. These high rates have persisted for more than 25 years.

Overall, 65 percent of adult females and 70 percent of adult males are overweight or obese, and rates are highest in adults ages 40 years and older. Rates of overweight and obesity in adults vary by age and race/ethnicity.

- Overweight (excluding obesity) is most prevalent in those ages 40 years and older, and in Hispanic American adults.
- Obesity is most prevalent in those 40 years of age or older and in African American adults. Obesity is least prevalent in adults with highest incomes (400+ percent the poverty threshold).

Abdominal obesity is present in U.S. adults of all ages, increases with age, and varies by sex and race/ethnicity.

- Abdominal obesity rates are highest in individuals ages 60 years and older, and are higher in women than men at all ages.

- In men, abdominal obesity rates are slightly higher among non-Hispanic whites than Mexican Americans or African Americans. In women, abdominal obesity rates are lower in non-Hispanic whites than in Mexican Americans or African Americans.

Nearly one in three youth (31 percent), ages 2 to 19 years, is now overweight (85^{th}-94^{th} percentile) or obese ($\geq 95^{th}$ percentile) and these rates vary by age and ethnicity.

- In youth ages 2 to 19 years, obesity prevalence increases with age, and the age category with the highest prevalence is 12-19 year olds.
- In youth ages 2 to 19 years, the race categories with the highest prevalence of obesity are African Americans and Hispanics.

Implications

The persistent high levels of overweight and obesity require urgent population- and individual-level strategies across multiple settings, including health care, communities, schools, worksites, and families.

Comprehensive lifestyle interventions and evidence-based dietary interventions for weight management in individuals and small groups should be developed and implemented by trained interventionists and professional nutrition service providers in healthcare settings as well as in community locations, including public health facilities and worksites.

Quality of care standards in health care settings should include the provision and impact of preventive nutrition services provided by multidisciplinary teams of trained interventionists, as appropriate, and nutrition professionals. Incentives should be offered to providers and systems to develop preventive services.

The public should be encouraged to monitor their body weight and engage with their health care providers at least annually to assess their body weight and BMI. As appropriate, providers should use evidence-based approaches aimed at achieving and maintaining healthy body weight. Health care providers should encourage achieving and maintaining a healthy weight through healthy eating and physical activity behaviors.

The persistent high rates of obesity across the lifespan show the limited impact of our efforts to date. Accelerating progress in reversing obesity trends will require a more targeted, comprehensive, and coordinated strategy and a renewed commitment and action for sustained, large-scale, integrated multi-sectoral and cross-sectoral collaborations. Government at local, state, and national levels, the health care system, schools, worksites, community organizations, businesses, and the food industry all have critical roles in developing creative and effective solutions.

Behavioral change at the individual level is important. However, policy interventions that make healthy dietary and activity choices easier, more routine, and affordable and that reduce unhealthy options are likely to achieve population-wide benefits.

Age-appropriate nutrition and food preparation education should be a mandatory part of primary and secondary school curricula.

Review of the Evidence

To reach these conclusions, the DGAC examined evidence from NHANES 2009-2012, and additional survey years including 1988-1994 to 2011-2012 for trends data. These data are available in summary NHANES data table format on the CDC website, in published peer-reviewed articles by CDC,[72-74] and in analyses requested by the DGAC and provided by CDC/NCHS (see ***Appendix E-2.16: Body mass index, adults ages 20 years and older, NHANES 2009-2012*** and ***Appendix E-2.17: Body mass index, children and adolescents ages 2-19 years, NHANES 2009-2012***).

The prevalence rates of overweight and obesity among U.S. adults have been extremely high for the past 25 years and appear to be at record high levels in women and to have plateaued at near record high levels in men (Figure D1.53). In 2009-2012, combined rates of overweight and obesity in adult men, ages 20 years and older, were 72.6 percent (38.1 percent for overweight and 34.5 percent for obesity) and 64.8 percent (28.8 percent for overweight and 36 percent for obesity) in women (Table D1.19). Rates of overweight and obesity in adults vary by age and ethnicity and are most pronounced in adults ages 40 years and older and in Hispanic and African American adults (Table D1.19).

Overweight affects 29.5 percent of adults ages 20 to 39 years, 35.9 percent of adults ages 40 to 59 years, and 35.7 percent of adults ages 60 years and older, while obesity affects 31.5 percent of adults ages 20 to 39 years, 38 percent of those ages 40 to 59 years, and 37.5 percent of those ages 60 years and older (Table D1.19).

Overweight affects 31.7 percent of adult African American men and 24.5 percent of adult African American women, while obesity affects 37.9 percent of adult African American men and 57.5 percent of adult African American women. Among adult Hispanic men, overweight affects 41.5 percent and obesity affects 38.5 percent, and among adult Hispanic women, overweight affects 33.5 percent and obesity affects 43 percent (Table D1.19).

Obesity is least prevalent (about 31 percent) in adults ages 20 years and older with highest incomes (400 + percent the poverty threshold) in 2007-2010 (Table D1.20), while affecting 37.2 percent of those with incomes below 100 percent of the poverty threshold, 37.3 percent of those with incomes from 100 percent to 199 percent of the poverty threshold, and 36.8 percent of those with incomes from

200 percent to 399 percent of the poverty threshold (Table D1.20). Across all income strata, combined rates of overweight and obesity and particularly obesity rates have risen over the past 25 years.

Abdominal obesity, as measured by waist circumference (WC), and defined as WC more than 102 cm in men and more than 88 cm in women, is a risk factor for CVD and diabetes .[6] Abdominal obesity is prevalent in U.S. adults of all ages and varies by age and sex. In 2011-2012, overall rates of abdominal obesity were about 54 percent in adults ages 20 years and older, with a prevalence of about 44 percent in adult men and 65 percent in adult women (Table D1.21). Data from the NHANES 2007-2008 survey shows that men ages 20 to 39 years have the lowest rates of abdominal obesity (28.5 percent) compared to men ages 40 to 59 years (49.4 percent) and those ages 60 years and older (60.4 percent) (Table D1.21). Women ages 60 years and older have the highest rates of abdominal obesity (73.8 percent) compared to women ages 40 to 59 and 20 to 39 years (65.5 percent and 51.3 percent, respectively). Data from the 2011-2012 survey show that the highest prevalence of abdominal obesity among men is in non-Hispanic white men (44.5 percent), followed by Mexican American men (43.2 percent) and African American men (41.5 percent), while the highest prevalence among women is in African American women (75.9 percent), followed by Mexican American (71.6 percent) and non-Hispanic white women (63.3 percent) (Table D1.21). For 2007-2010, the prevalence of abdominal obesity is very high in obese adults ages 18 years and older (97 percent), and overweight adults (57 percent), compared to normal/underweight adults (8 percent).[75] Since 1999 rates of abdominal obesity have risen in all age and racial strata of both adult males and females (Table D1.21).

After increasing from the 1980s until about 2004, rates of overweight and obesity in children and adolescents ages 2 to 19 years have since remained at very high levels (Figure D1.54). A significant decrease in obesity among children ages 2 to 5 years old was observed in an analysis comparing the survey data from 2003-2004 (13.9 percent) to 2011-2012 (8.4 percent).[74] However, it is not clear whether this comparison of only two time periods reflects an actual downward trend. Currently, 14.9 percent of boys ages 2 to 19 years are overweight (85^{th} to 94^{th} percentile) and 17.6 percent are obese (95^{th} percentile and greater); rates in girls ages 2 to 19 years are 14.9 percent and 16.1 percent, respectively. Furthermore, rates of obesity in youth increase with age and vary by ethnicity, with obesity found in 22.1 percent of African American and 21.8 percent of Hispanic Americans ages 2 to 19 years (Table D1.22).

For additional details on this body of evidence, visit:

- Appendix E-2.16: Body mass index, adults ages 20 years and older, NHANES 2009-2012
- Appendix E-2.17: Body mass index, children and adolescents ages 2-19 years, NHANES 2009-2012

Question 16: What is the relative prevalence of metabolic and cardiovascular risk factors (i.e., blood pressure, blood lipids, and diabetes) by BMI/body weight/waist circumference (abdominal obesity) in the U.S. population and specific population groups?

Source of evidence: Data analysis

Conclusion

Approximately 50 percent of adults who are normal weight have at least one cardiometabolic risk factor. Approximately 70 percent of adults who are overweight and 75 percent of those who are obese have one or more cardiometabolic risk factors.

Rates of elevated blood pressure, adverse blood lipid profiles (i.e., low high density lipoprotein cholesterol [HDL-C], high low density lipoprotein choldesterol [LDL-C], and high triglycerides), and diabetes are highest in adults with elevated abdominal obesity (waist circumference greater than 102 cm in men, greater than 88 cm in women).

Ninety-three percent of the children with type 2 diabetes are ages 12 to 19 years and 90 percent of these children with type 2 diabetes are overweight or obese. In children with type 2 diabetes, the prevalence of obesity is higher in African Americans, followed by American Indians and Hispanics, compared to non-Hispanic whites or Asian Pacific Islander youth.

Dyslipidemia and rates of borderline high blood pressure vary by weight status in boys and girls; rates are particularly high in obese boys.

Nearly three-fourths of the overweight or obese populations have at least one cardiometabolic risk factor.

Implications

The rates of cardiometabolic risk factors in adult Americans are extremely high and reflect the high rates of population overweight and obesity. Many adults have personal health profiles in which multiple metabolic risk factors co-exist and substantially increase risks for coronary heart disease, hypertension and stroke, diabetes, and other obesity-related co-morbidities. These are the most costly health problems in the Nation today and they can be prevented or better managed with intensive, comprehensive, and evidence-based lifestyle interventions carried out by multidisciplinary teams of trained professionals or through medical nutrition therapy provided by registered dietitians or nutritionists (AHA/ACC/TOS).[2] Program plans and interventions needed to confront the nation's obesity epidemic and its devastating metabolic consequences. A shift in the healthcare paradigm toward prevention is critical. Nutrition and lifestyle services for obesity prevention and weight management should be expanded and integrated. As part of this approach, quality of care guidelines need to be revised to incentivize the provision of personalized lifestyle and nutrition interventions to

combat obesity and obesity-related chronic diseases and their metabolic risk factors and co-morbidities. As emphasized in ***Part D. Chapter 3: Individual Diet and Physical Activity Behavior Change*** and ***Part D. Chapter 4: Food Environment and Settings***, the most effective approach to preventing and treating overweight and obesity in our nation across the lifespan requires both individual and population-based, environmental strategies. Initiatives in health care and public health and other government sectors should be complemented with collaborative approaches in retail, educational, and social service and agricultural settings to make the long-term adoption of healthy nutrition and lifestyle behavior not only feasible but normative.

The high rates of overweight and obesity in youth and their concomitant cardiometabolic risk factors require early preventive interventions at individual and population levels. Evidence-based strategies in health and public health settings also should be implemented and complemented by environmental approaches across wide-ranging sectors to reverse these priority health problems.

Review of the Evidence

To reach these conclusions, the DGAC examined evidence from NHANES 2007-2010 and 2009-2012 data and SEARCH for Diabetes in Youth Study (SEARCH). These data were available in published peer-reviewed articles by CDC,[76] or SEARCH[77] authors and in analyses requested by the DGAC and provided by CDC/NCHS (see ***Appendix E-2.18: Total cholesterol and high density lipoprotein cholesterol (HDL), adults ages 20 years and older, NHANES 2009-2012***, ***Appendix E-2.19: Low density lipoprotein cholesterol (LDL-C) and triglycerides, adults ages 20 years and older, NHANES 2009-2012***, ***Appendix E-2.20: Prevalence of high blood pressure, adults ages 18 years and older, NHANES 2009-2012***, ***Appendix E-2.21: Total diabetes, adults ages 20 years and older, NHANES 2009-2012***, ***Appendix E-2.22: Total cholesterol, high density lipoprotein cholesterol (HDL), and non-HDL-cholesterol, children and adolescents ages 6–19 years, NHANES 2009-2012***, ***Appendix E-2.23: Low density lipoprotein cholesterol (LDL-C) and triglycerides, adolescents ages 12-19 years, NHANES 2009-2012***, ***Appendix E-2.24: Prevalence of high and borderline high blood pressure (BP), children and adolescents ages 8-17 years, NHANES 2009-2012***).

In U.S. adults ages 18 years and older, weight status is related to prevalent CVD risk. About two-thirds (66.6 percent) of U.S. adults, including more than half (56.1 percent) of normal weight adults (BMI 18.5-<25 kg/m^2), have one or more CVD risk factors (including type I and type II diabetes, hypertension, or dyslipidemia, or self-reported smoking) (Figure D1.55). About 70 percent (69.6 percent) of adults who are overweight (BMI 25-<30 kg/m^2) have at least one or more CVD risk factors, making them candidates for preventive weight management interventions, according to expert guidelines established by the American College of Cardiology, American Heart Association, and The Obesity Society for preventative weight management (see ***Part D. Chapter 2: Dietary Patterns, Foods and Nutrients, and Health Outcomes***). Furthermore, more than one-quarter (27.8 percent) have two or more CVD risk factors (Figure D1.55). About three-quarters (74.6 percent) of adults who are obese (BMI ≥30 kg/m^2) have one or more CVD risk factors and about 39 percent have two or more CVD risk

factors (Figure D1.55). Cardio-metabolic risk factors also are substantially more prevalent in adult men and women who have abdominal obesity (Table D1.23).

In terms of plasma lipids, the prevalence of low HDL-C (<40 mg/dl), high LDL-C (≥160 mg/dl), and high triglycerides (≥ 200 mg/dl) is highest in obese adults (ages 20 years and older) compared to normal weight adults (Table D1.23). Similar patterns are observed in those who are overweight compared to normal weight adults (Table D1.23). These lipid profiles also are highest in men with abdominal obesity (> 102 cm) or women (>88 cm). (Table D1.23). High total cholesterol (≥ 200 mg/dl), low HDL-C (<40 mg/dl), and high triglycerides (≥ 130 mg/dl) also are most prevalent in obese compared to overweight or normal weight children and adolescents (Table D1.24). There does not appear to be a difference in the prevalence of high LDL-C (≥ 130 mg/dl) by weight status in children and adolescents (Table D1.24).

In adults ages18 years and older, rates of elevated blood pressure (defined as having measured systolic pressure of at least 140 mm Hg or diastolic pressure of at least 90 mm Hg and/or taking antihypertensive medication) are highest with obesity (39.2 percent) compared to normal weight (20 percent) or overweight (26.4 percent). It is also highest in those with elevated waist circumferences (men > 102cm (37.2 percent vs 23.3 percent; and > 88 cm in women (32.9 percent vs 17.8 percent) (Table D1.23). Similar to adults, the rate of borderline high blood pressure (defined as a systolic or diastolic blood pressure ≥ 90th percentile but < 95th percentile or blood pressure levels ≥ 120/80 mm Hg) in youth ages 8 to 17 years was highest in with obesity (16.2 percent) compared to those who are normal weight (5.4 percent) or overweight (10.9 percent) (Table D1.25). Diabetes in adults ages 20 years and above also increases with body mass index from 5.5 percent in those who are of normal weight, to 9 percent in overweight and 20.3 percent in obese adults and is more prevalent in those with abdominal obesity (men > 102cm (19.6 percent vs 8.3 percent); and > 88 cm in women (13.9 percent vs 2.6 percent) (Table D1.23).

Data from 2001 to 2004 in children (ages 3 to 19 years) participating in the SEARCH for Diabetes in Youth Study (SEARCH) show that 93 percent of youth with type 2 diabetes are ages 12 to 19 years. The prevalence of obesity among youth with type 2 diabetes is 79.4 percent and an additional 10.4 percent are overweight (Table D1.26). The percentage of overweight among youth with type 2 diabetes is not significantly different than rates in U.S. youth who do not have type 2 diabetes.[77] However, the prevalence of obesity among youth with type 2 diabetes (79.4 percent) is much higher than in U.S. youth without type 2 diabetes (16.9 percent) (Table D1.26). The prevalence of obesity in those with type 2 diabetes was higher in African Americans (91.1 percent), followed by American Indians (88 percent), and Hispanics (75 percent) in comparison to non-Hispanic white or Asian Pacific Islander youths (about 68 percent for each) (Table D1.26).

For additional details on this body of evidence, visit:

- Appendix E-2.18: Total cholesterol and high density lipoprotein cholesterol (HDL), adult ages 20 years and older, NHANES 2009 -2012
- Appendix E-2.19: Low density lipoprotein cholesterol (LDL-C) and triglycerides, adults ages 20 years and older, NHANES 2009-2012
- Appendix E-2.20: Prevalence of high blood pressure, adults ages 18 years and older, NHANES 2009-2012
- Appendix E-2.21: Total diabetes, adults ages 20 years and older, NHANES 2009-2012
- Appendix E-2.22: Total cholesterol, high density lipoprotein cholesterol (HDL), and non-HDL-cholesterol, children and adolescents ages 6-19 years, NHANES 2009-2012
- Appendix E-2.23: Low density lipoprotein cholesterol (LDL-C) and triglycerides, adolescents ages 12-19 years, NHANES 2009-2012
- Appendix E-2.24: Prevalence of high and borderline high blood pressure (BP), children and adolescents ages 8-17 years, NHANES 2009-2012

Question 17: What are the current rates of nutrition-related health outcomes (i.e., incidence of and mortality from cancer [breast, lung, colorectal, prostate] and prevalence of CVD, high blood pressure, diabetes, bone health, congenital anomalies, neurological and psychological illness) in the overall U.S. population?

Source of evidence*:* Data analysis

Conclusion

Adults have high rates of nutrition-related chronic diseases, including high blood pressure, CVD, diabetes, and various forms of cancer. Children and adolescents also have nutrition-related chronic diseases, including borderline high blood pressure and type 2 diabetes. At all ages, rates of chronic disease risk are linked to overweight and obesity. The rates of these chronic diseases vary by race/ethnicity and income status. Prevalence of osteoporosis and of low bone mass increases with age, particularly in post-menopausal women. Among the less common health outcomes:

- Nutrition-related neurological and psychological conditions are a growing concern.
- Congenital anomalies are a relatively rare, but important pregnancy outcome.

Implications

Given the high rates of nutrition-related chronic diseases in the adult population and rising rates in youth, it is imperative to develop prevention policies and programs that target all age groups and

address nutrition and lifestyle issues with evidence-based interventions that are appropriate for delivery in multiple settings.

Qualified professionals should deliver multidisciplinary interventions and medical nutrition therapies, as appropriate, that are effective in reducing nutrition-related chronic diseases.

More studies are needed to understand the complex etiology of congenital anomalies and neurological and psychological conditions, and factors that influence bone health as well as healthy outcomes of pregnancy so as to inform potential dietary choices by the U.S. population.

Review of the Evidence

To reach these conclusions, the DGAC examined evidence from NHANES 2007-2010 and 2009-2012 (see ***Appendix E-2.18: Total cholesterol and high density lipoprotein cholesterol (HDL), adults ages 20 years and older, NHANES 2009-2012, Appendix E-2.19: Low density lipoprotein cholesterol (LDL-C) and triglycerides, adults ages 20 years and older, NHANES 2009-2012, Appendix E-2.20: Prevalence of high blood pressure, adults ages 18 years and older, NHANES 2009-2012, Appendix E-2.21: Total diabetes, adults ages 20 years and older, NHANES 2009-2012, Appendix E-2.22: Total cholesterol, high density lipoprotein cholesterol (HDL), and non-HDL-cholesterol, children and adolescents ages 6-19 years, NHANES 2009-2012, Appendix E-2.23: Low density lipoprotein cholesterol (LDL-C) and triglycerides, adolescents ages 12-19 years, NHANES 2009-2012, Appendix E-2.24: Prevalence of high and borderline high blood pressure (BP), children and adolescents ages 8-17 years, NHANES 2009-2012***), the National Health Interview Survey (NHIS) 2012,[78] SEARCH for Diabetes in Youth Study,[79] American Heart Association, 2014 report,[6] and the Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute.[80] The DGAC also examined evidence from CDC's population-based birth defects surveillance system,[81] Alzheimer's Association 2014 Facts and Figures,[82] and published data by CDC authors.[83]

Cardiovascular Diseases

Cardiovascular diseases, including coronary heart disease, hypertension, and stroke, affect an estimated 83.6 million (35.3 percent) men and women ages 20 years and older in the United States.[6] CVD increases with age, meaning that about half of those with CVD, 42.2 million adults, are ages 60 years and older.[6] Rates of coronary heart disease also vary by race/ethnicity and income. Coronary heart disease is most prevalent in Hispanics (7.8 percent of those reporting the disease) and Native Americans (including Alaskan natives 12.5 percent) adults.[78] Stroke is most prevalent in Native Americans (4.3 percent of those reporting the disease) and African Americans (3.9 percent).[78] Coronary heart disease rates are inversely related to income. Rates are about 9.8 percent and 7.7 percent in those with lower income (less than 100 percent of the poverty threshold and 100 to 199 percent, respectively) compared to those with higher income (200 percent and greater of the poverty threshold; 1.9 percent). Stroke also is more prevalent in those with incomes less than 100 percent of

the poverty threshold (4.8 percent) and 100 to 199 percent of the poverty threshold (3.7 percent) compared to those with higher incomes (1.9 percent).[78]

The prevalence of elevated blood pressure (measured systolic pressure of at least 140 mm Hg or diastolic pressure of at least 90 mm Hg and/or taking antihypertensive medication), in adults ages 18 years and older (29 percent) is similar in adult men (29.8 percent) and women (28.3 percent) and varies by age and race/ethnicity (Table D1.27). Rates of elevated blood pressure are highest in adults ages 60 years and older (66.3 percent), and African Americans (41.5 percent), relative to non-Hispanic whites (27.9 percent) or Hispanics (26.1 percent) (Table D1.27). A similar pattern is seen in youth ages 8 to 17 years, with borderline high blood pressure in 8.3 percent overall (Table D1.25). Boys (12 percent) are much more likely to have borderline high blood pressure than are girls (4.6 percent), as are those ages 13 to 17 years (12.4 percent) compared to those ages 8 to 12 years (3.8 percent), and African Americans (12.1 percent) compared to non-Hispanic whites (7.2 percent) and Hispanics (8.5 percent) (Table D1.25).

Diabetes

Total diabetes (type I plus type II) is the sum of self-reported diabetes and undiagnosed diabetes. Diagnosed diabetes was obtained by self-report and excludes women who reported having diabetes only during pregnancy. Undiagnosed diabetes was defined as fasting plasma glucose of at least 126 mg/dL or a hemoglobin A1C value of at least 6.5% and was not reported as a physician diagnosis. The prevalence of diabetes in U.S. adults, is 14 percent for men and 10.8 percent for women 20+ years of age (Table D1.27). Rates increase with age, to 26 percent for adults ages 60 years and older, and are higher in African Americans (18.4 percent) and Hispanics (19.3 percent) compared to non-Hispanic whites (9.8 percent) (Table D1.27). Between 2001 and 2009, rates of type 2 diabetes in children and adolescents ages 10 to 19 years increased 30.5 percent[79] and the disease now affects about 1 in 2,000 youth (0.46 per 1000) (Table D1.28). In 2009, type 2 diabetes appeared to be more common in girls than boys (0.58, vs. 0.35 /1000 youth), in older adolescents (ages15 to 19 years; 0.68) compared to those ages 10 to 14 years (0.23), and in American Indian (1.2), African American (1.06), and Hispanic (0.79) youth compared to non-Hispanic Whites (0.17) (Table D1.28).

Nutrition-related Major Cancers

Breast cancer: Breast cancer represents approximately 14 percent of all new cancer cases and 6.8 percent of all cancer deaths in the United States. In 2011, an estimated 2,899,726 (2.9 million) women in the United States had a history of breast cancer. About 232,670 new cases of breast cancer and 40,000 deaths from this disease are estimated for 2014. Breast cancer is the third leading cause of cancer death in the U.S.[80, 84] New cases of breast cancer are highest in the middle age and older women (about 22, 25.5, and 21.3 percent of new cases occur in women ages 45 to 54, 55 to 64 and 65 to 74 years, respectively) (Table D1.29) and in non-Hispanic white women (128/100,000 women per year), followed by African American (122.8/100,000 women). The death rate from this disease is also highest among women ages 55 to 84 years old (ranges 20.6 percent to 21.7 percent of deaths) and African

Americans (30.6 of death/100,000), followed by non-Hispanic white women (21.7/100,000) (Table D1.29).

Prostate cancer: Prostate cancer represents approximately 14 and 5 percent of all new cancer cases and all cancer death, respectively in U.S. men. In 2011, an estimated 2,707,821 (2.7 million) men had a history of prostate cancer. About 233,000 new cases of prostate cancer and 29,480 deaths from this disease are estimated for 2014. Prostate cancer is the fifth leading cause of cancer death in the United States.[84, 85] New cases of prostate cancer are most prevalent in older men (about 32.7, 36.3 and 16.8 percent of new cases in men ages 55 to 64, 65 to 74, and 75 to 84 years, respectively) (Table D1.29) and African American (223.9 of new cases/100,000 men). The death rate from this disease is highest among men ages 75 to 84 years old (36.8 percent of deaths) and African Americans (48.9/100,000) (Table D1.29).

Colorectal cancer: Colorectal cancer represents approximately 8.2 and 8.6 percent of all new cancer cases and all cancer death, respectively in the United States. In 2011, an estimated 1,162,426 (1.2M) adult men and women had a history of colorectal cancer. About 136,830 new cases of colorectal cancer and 50,310 deaths from this disease are estimated for 2014, respectively. Colorectal cancer is the second leading cause of cancer death in the United States.[84, 86] The incidence (new cases) of this cancer is more common in men than women and is more common in those older than age 55 years (highest frequency observed among those ages 65 to 74 years (23.9 percent) (Table D1.29) and in African Americans (62.3 and 47.5 new cases/100,000 persons in African American men and women, respectively). The death rate from this disease also is highest in people older than age 55 years old (highest frequency observed among those ages 75 to 84 years old (27.3 percent of deaths) and in African American (27.7, and 18.5 deaths/100,000 persons in men and women, respectively) (Table D1.29).

Lung and Bronchus cancer: Lung and bronchus cancer represents approximately 13.5 and 27.2 percent of all new cancer cases and all cancer deaths, respectively in the United States. In 2011, an estimated 402,326 people had a history of lung and bronchus cancer. About 224,210 new cases of lung and bronchus cancer and 159,260 deaths from this disease are estimated in 2014, respectively. This cancer is the first leading cause of cancer death in the United States.[84, 87] The incidence of lung and bronchus cancer is more common in men than women and is more common in those older than age 55 years (highest frequency observed among those ages 65 to 74 years (31.7 percent) in African American men (93 new cases/100,000 persons), and in white women (53.8/100,000 persons) (Table D1.29). The death rate from this disease also is higher in older people (highest frequency observed among those ages 65 to 84 years (about 30 percent of deaths) and in African American men (75.7 deaths/100,000 persons), and non-Hispanic white women (39.8/100,000 persons) (Table D1.29).

Bone Health

Approximately 10 million (10.3 percent) American adults ages 50 years and older were reported to have osteoporosis (defined as T-score ≤ -2.5 at either the femoral neck or the lumbar spine) and 43 million (44 percent) to have low bone mass (defined as T-scores between -1.0 and -2.5 at either skeletal site) in NHANES 2005-2010 (Table D1.30). A higher percent of women are affected by osteoporosis (15 percent) and low bone mass (51 percent) than men (about 4 percent and 35 percent, respectively). Osteoporosis increases with advancing age, occurring in about 35 percent in women ages 80 years and older compared to 26 percent in those ages 70 to 79 years old. The prevalence of low bone mass is similar in women ages 50 to 59 year and 80 years and older (ranges from 49 to 53 percent). Osteoporosis and low bone mass are more prevalent in Mexican American (20 percent, 48 percent) and non-Hispanic white (16 percent, 53 percent) relative to African American (8 percent, 36 percent) women (Table D1.30).

Congenital Anomalies

Each year, about 3 percent (one in every 33 babies) is born with spina bifida (without anencephaly); cleft lip (with and without cleft palate), or cleft palate (without cleft lip).[88] The estimated national prevalence of spina bifida was 3.17 per 10,000 live births in 1999-2007.[81] During this same time period, the prevalence of having a baby with spina bifida was reported to be more common in Native Americans/Alaska Natives (4.02/10,000 live birth), followed by Hispanics (3.8/10,000), non-Hispanic whites (3.09/10,000), African-Americans (2.73/10,000), and Asian/Pacific Islanders (1.2/10,000).[81] The estimated national prevalence of cleft palate and cleft lip is 5.67 and 9.3 per 10,000 live birth, respectively.[81] The prevalence of both of these congenital anomalies was highest in non-Hispanic Native Americans/Alaskan Natives (20/10,000 [cleft lip] and 6.5/10,000 [cleft palate]), and was lowest in African-Americans (6/10,000 [cleft lip] and 4.2/10,000 [cleft palate]).[81]

Congenital heart defects affect about 40,000 births (about 1 percent of births) per year in the United States.[89] The number of babies with congenital heart defects, especially those forms that are less severe (ventricular septal defects and atrial septal defects), is increasing compared to the total number of births, while the prevalence of other types has remained stable.[89]

Neurological and Psychological Conditions

There are numerous types of neurological and psychological conditions, and the DGAC focused only on depression and Alzheimer's disease. The prevalence of depression was estimated at 8 percent for the U.S. population ages 12 years and older in the NHANES 2007-2010 survey.[90] Depression is higher in females (10 percent) than in males (6 percent), and highest in those ages 40 to 59 years (12 percent women, 7 percent men).[90] Depression also is reported to be higher in African Americans (8 percent), followed by Mexican-Americans (6.3 percent) and non-Hispanic whites (4.8 percent) (NHANES 2005 -2006).[91]

In 2014, about 3.2 million women and 1.8 million men in the United States, ages 65 years and older are reported to be living with Alzheimer's disease.[82] This disease is most prevalent in those ages 75 to 84 years (44 percent of those with Alzheimer's) and those ages 85 years and older (38 percent).[82] About 63, 59, and 30 percent of those ages 85 years and older with Alzheimer's disease are reported to be Hispanics (primarily Caribbean-American), African Americans, and non-Hispanic white adults, respectively.[82] It has been projected that the number of people with Alzheimer's disease will increase by about threefold from 4.8 million in 2010 to 13.7 million in 2050.[92]

For additional details on this body of evidence, visit:

- Appendix E-2.18: Total cholesterol and high density lipoprotein cholesterol (HDL), adult ages 20 years and older, NHANES 2009-2012
- Appendix E-2.19: Low density lipoprotein cholesterol (LDL-C) and triglycerides, adults ages 20 years and older, NHANES 2009-2012
- Appendix E-2.20: Prevalence of high blood pressure, adults ages 18 years and older, NHANES 2009-2012
- Appendix E-2.21: Total diabetes, adults ages 20 years and older, NHANES 2009-2012
- Appendix E-2.22: Total cholesterol, high density lipoprotein cholesterol (HDL), and non-HDL-cholesterol, children and adolescents ages 6-19 years, NHANES 2009 -2012
- Appendix E-2.23: Low density lipoprotein cholesterol (LDL-C) and triglycerides, adolescents ages 12-19 years, NHANES 2009-2012
- Appendix E-2.24: Prevalence of high and borderline high blood pressure (BP), children and adolescents ages 8-17 years, NHANES 2009-2012
- SEER Cancer Statistics Review, 1975-2011. Available from: http://seer.cancer.gov/csr/1975_2011/.
- SEER Stat Fact Sheets: Breast Cancer. Available from: http://seer.cancer.gov/statfacts/html/breast.html.
- SEER Stat Fact Sheets: Colon and Rectum Cancer. Available from: http://seer.cancer.gov/statfacts/html/colorect.html.
- SEER Stat Fact Sheets: Lung and Bronchus Cancer. Available from: http://seer.cancer.gov/statfacts/html/lungb.html.
- SEER Stat Fact Sheets: Prostate Cancer. Available from: http://seer.cancer.gov/statfacts/html/prost.html.
- Summary health statistics for U.S. adults: National Health Interview Survey, 2012. Available from: http://www.cdc.gov/nchs/data/series/sr_10/sr10_260.pdf.

- Respondent-reported prevalence of heart disease, cancer, and stroke among adults aged 18 and over, by selected characteristics: United States, average annual, selected years 1997-1998 through 2011-2012. Available from: http://www.cdc.gov/nchs/data/hus/2012/044.pdf.
- 2014 Alzheimer's disease facts and figures: includes a special report on women and Alzheimer's disease. Alzheimers Dement. 2014;10(2):131-68. PMID: 22404854. Available from: http://www.alz.org/downloads/facts_figures_2014.pdf.
- Facts about Birth Defects [updated October 20, 2014]. Available from: http://www.cdc.gov/ncbddd/birthdefects/facts.html.
- Depression in the United States household population, 2005-2006. NCHS Data Brief. 2008(7):1-8. PMID: 19389321. Available from: http://www.cdc.gov/nchs/data/databriefs/db07.pdf.
- Congenital Heart Defects. Data and Statistics. Atlanta, GA [updated July 9, 2014; cited 2014 September 2]. Available from: http://www.cdc.gov/ncbddd/heartdefects/data.html.
- Prevalence of Current Depression Among Persons Aged >= 12 Years, by Age Group and Sex United States, National Health and Nutrition Examination Survey, 2007-2010. Morbidity and Mortality Weekly Report (MMWR). 2014;60(51):1747. Available from: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6051a7.htm?s_cid=mm6051a7_w.

DIETARY PATTERNS COMPOSITION

Dietary patterns with positive health benefits are described as high in vegetables, fruit, whole grains, seafood, legumes, and nuts; moderate in low- and non-fat dairy products; lower in red and processed meat; and low in sugar-sweetened foods and beverages and refined grains. The primary dietary patterns examined and described in Part D. Chapter 2: Dietary Patterns, Foods and Nutrients, and Health Outcomes included both a priori, investigator-derived scoring systems such as DASH/OMNI, Mediterranean diet scores, and the Healthy Eating Index, as well as data-driven approaches using factor/cluster analysis or reduced rank regression. The findings presented come from controlled intervention trials, cohort studies, and nested case-control studies. The DGAC examined these patterns in an attempt to quantify, for the first time, the approximate amounts of each food group in these patterns. The DGAC also examined the range of and commonalities across food group intakes in healthy dietary patterns and compared these ranges to the range of usual adult consumption in the United States and to the range recommended by the USDA Food Patterns.

Question 18: What is the composition of dietary patterns with evidence of positive health outcomes (e.g., Mediterranean-style patterns, Dietary Approaches to Stop Hypertension-style patterns, patterns that closely align with the Healthy Eating Index, and vegetarian patterns), and of patterns commonly consumed in the United States? What are the similarities (and differences) within and among the dietary patterns with evidence of positive health outcomes and the commonly consumed dietary patterns?

Source of evidence: Data analysis

Conclusions

Dietary patterns with varying food group composition, but certain common elements were observed across intervention and cohort studies to have health benefits. A healthful diet can be achieved by following any of these dietary patterns.

In general, the ranges of intake in dietary patterns with positive health benefits are very close to those recommended by the USDA Food Patterns, but amounts of some specific food groups vary across the various diet pattern types.

- DASH-style diets, Mediterranean-style diets, and the USDA Food Patterns are similar with respect to amounts of fruits and vegetables, and the OMNI diets are slightly higher than the USDA Food Patterns.
- Dairy intake is comparable between DASH-style diets and the USDA Food Patterns, but dairy is lower for Mediterranean-style diets than for the USDA Food Patterns.
- Red and processed meats are higher in the Mediterranean-style diets but lower in the DASH-style diet than is recommended by the USDA Food Patterns.
- Seafood intake is similar in DASH-style and higher in Mediterranean-style diets than in the USDA Food Patterns.

The data from the intervention trials and the cohort studies examined provide empirical data that the USDA Food Patterns provide an evidence-based guide to healthy patterns of food consumption.

Implications

The quality of the diets currently consumed by the U.S. population is suboptimal overall and has major adverse health consequences. Several options exist for dietary patterns that can be followed to improve the population's diet quality. The approaches that can be taken are varied and can be adapted to personal and cultural preferences. The ability to offer the U.S. population alternative dietary pattern options and to tailor them to personal preferences may increase the likelihood of long term success of maintaining a healthy diet pattern, ultimately leading to improved health in the U.S. population.

Review of the Evidence

The DGAC analyzed data on food group composition reported in research articles on dietary patterns and health outcomes. These articles were drawn from those included in the questions on dietary patterns and health examined by the Committee (see ***Part D. Chapter 2: Dietary Patterns, Food and Nutrients, and Health Outcomes).*** The studies reported in that chapter D2 were reviewed to identify those that reported semi-quantitative data on food group intakes among the sample or population group with positive health outcomes (Table D1.31).[93-112] These sample or population groups included the intervention group in intervention studies, the highest category (usually the top quintile) in cohorts and nested case-control studies measuring diet with an a priori index, or a specific cluster or factor analysis group. Approximate quantified food group intakes for these subsets of the population or samples with a beneficial health outcome were identified. These intakes were converted to grams per day if not reported this way in the original manuscripts. Then, all data were converted to grams per 1000 calories to allow for comparisons across studies.

For comparison to usual intake levels of each food group in the United States., data from NHANES 2007-2010 for usual intake by adult age/sex groups[41] in cup or ounce equivalents were converted into grams using average weights based on Food Patterns Equivalents Database (FPED) data.[48, 49] The gram weights were divided by the usual calorie intake for that group, and multiplied times 1000 for an estimate of the food group intake per 1000 calories for each adult age/sex group. The range of these intakes was used as a comparator. For comparison to the food group amounts recommended in the USDA Food Patterns (also called the Healthy U.S.-style Patterns; see Question 20) the recommended amount for adult age/sex groups in the patterns at 1600 to 2400 calories were converted to grams per 1000 calories by the same procedure used for the usual intakes (see Figures D1.56 to D1.60).

Vegetable intake in the OMNI diets was higher than both the USDA Food Patterns and current consumption estimates, but DASH-style, PREDIMED, most of the Mediterranean scores, and data driven approaches were very similar to vegetable amounts recommended by the USDA Food Patterns. Fruit intake was higher in the OMNI diets and PREDIMED relative to the USDA Food Patterns and current consumption, but DASH, the Mediterranean score diets, and many of the data driven scores are all within the range of the USDA Food Pattern recommendations. Dairy intakes in OMNI, DASH, and some of the Mediterranean and data driven scores were all within the ranges recommended by the USDA Food Patterns, while PREDIMED and some other scores had lower intakes of dairy. Consumption of red and processed meats was higher in PREDIMED and in some studies using Mediterranean diet scores relative to the USDA Food Patterns, whereas several cohorts using data-driven approaches to assessing diet patterns reported ranges of red and processed meat intake that aligned very well with the USDA Food Pattern recommendations. Intakes of red and processed meat were lower in the OMNI and DASH dietary interventions than in either the USDA Food Patterns or the range of usual intake in the United States. Seafood intakes for the OMNI diets and some of the data-driven dietary pattern studies aligned very well with the USDA Food Patterns. Seafood intake ranges

for all the other studies were much higher than both the USDA Food Patterns and the ranges of usual intake in the United States.

For additional details on this body of evidence, visit:

- Usual Dietary Intakes: Food Intakes, U.S. Population, 2007-10: Applied Research Program. National Cancer Institute; [updated May 22, 2014]. Available from: http://appliedresearch.cancer.gov/diet/usualintakes/pop/2007-10/.
- Appendix E-3.1: Adequacy of the USDA Food Patterns

Question 19: To what extent does the U.S. population consume a dietary pattern that is similar to those observed to have positive health benefits [e.g., Mediterranean-style pattern, Dietary Approaches to Stop Hypertension (DASH)-style patterns, patterns that closely align with the Healthy Eating Index, and vegetarian patterns] overall and by age/sex and race/ethnic groups?

Source of evidence: Data analysis

Conclusion

Data from WWEIA show that the average HEI score in the U.S. population is 57 points out of a total of 100 points. The best scores (average scores) were observed for the following components: total protein foods (average score of 100 percent of possible points), seafood and plant protein (84 percent of possible points), and dairy (69 percent of possible points), while the poorest scores were observed for whole grains (25 percent of possible points), sodium (37 percent of possible points), fatty acid ratio (41 percent of possible points), greens and beans (46 percent of possible points), and empty calories (60 percent of possible points).

Young children ages 2 to 3 years and middle aged and older adults (ages 51 years and older) have the best HEI scores (total scores of 63 percent and 66 percent, respectively), while preadolescents and adolescents have the poorest HEI scores (total scores of 49 percent and 48 percent, respectively).

Implications

To improve diet quality, the U.S. population should replace most refined grains with whole grains, decrease sodium, decrease saturated fat, consume fewer calories from added sugars, and replace these calories with more varied vegetable choices, seafood, plant proteins, and low-fat dairy.

Young children and middle-aged and older adults have the highest HEI scores. These positive healthy eating habits should continue to be encouraged. Because preadolescents and adolescents have the lowest HEI scores, significant intervention is needed at the level of the individual, family, school, day care, and community settings to help this age group adopt and maintain healthful dietary patterns.

Review of the Evidence

The DGAC examined mean HEI scores and component scores for the entire U.S. population ages 2 years and older (see ***Appendix E-2.25: Average Healthy Eating Index-2010 scores for Americans ages 2 years and older***). These data were examined for the entire population, for males and females and by age subgroups. In general, the best scores for the HEI components were for protein and seafood and plant proteins, while the poorest score was for whole grains. For nearly all of the component scores as well as the total HEI score, females tended to have better scores than males, indicating slightly healthier dietary patterns in females compared to males. Analyses by age showed that the youngest and oldest segments of the population had the best component and total HEI scores (Figure D1.61). For these groups, the component scores were very good to excellent for total fruit and whole fruit. Young children also had excellent scores for dairy, and middle-aged and older adults had excellent scores for total protein and seafood and plant protein. All age groups have poor scores for whole grains.

Data were not available to examine how closely the U.S. population's dietary patterns align with a Mediterranean-style or DASH-style dietary pattern.

For additional details on this body of evidence, visit:

- Healthy Eating Index, Center for Nutrition Policy and Promotion. Available from: http://www.cnpp.usda.gov/HealthyEatingIndex.
- Appendix E-2.25: Average Healthy Eating Index-2010 scores for Americans ages 2 years and older (National Health and Nutrition Examination Survey 2009-2010)

Question 20: Using the Food Pattern Modeling process, can healthy eating patterns for vegetarians and for those who want to follow a Mediterranean-style dietary pattern be developed? How do these patterns differ from the USDA Food Patterns previously updated for potential inclusion in the 2015 DGAs?

Source of evidence: Food Pattern Modeling

Conclusion

Food Pattern Modeling demonstrates that healthy eating patterns can be achieved for a variety of eating styles, including the "Healthy U.S.-style Pattern," the "Healthy Mediterranean-style Pattern," and the "Healthy Vegetarian-style Pattern". Although some differences exist across the three eating patterns, comparable amounts of nutrients can be obtained using nutrient dense foods while maintaining energy balance.

Implications

The U.S. population has a variety of options to help achieve healthful eating patterns that adhere to the Dietary Guidelines. These include the Healthy U.S.-style Pattern, Mediterranean-style Pattern, or Vegetarian Patterns. (Detailed information on these patterns can be found in Table D1.32 and ***Appendix E-3.7: Developing Vegetarian and Mediterranean-style Food Patterns***.) These diets meet nutritional goals without excess calories and use a variety of foods. Importantly, these diets reflect the range of foods that can be used to achieve a healthful eating pattern, and they support the inclusion of diverse foods that are consistent with personal, cultural and religious preferences. These diets can be used in a variety of settings, including homes, schools, worksites, health care facilities, and places of worship.

Review of the Evidence

These conclusions were reached based on the results of the Food Pattern Modeling analysis for vegetarian and Mediterranean-style food patterns. Data from WWEIA from self-reported vegetarians were used to inform the vegetarian eating pattern (Figure D1.62) and data from the Dietary Patterns composition project reviewed above were used to select foods for the Mediterranean-style pattern.[113]

From three dietary patterns ("Healthy U.S.-style," "Healthy Mediterranean-style Patter," and "Healthy Vegetarian Pattern"), selected food group intakes across calorie levels were compared (Table D1.32). Notably, fruit and seafood were higher in the Mediterranean-style diet, while dairy was lower, based on the data presented above (Figures D1.56 to D1.60). For the Vegetarian Pattern, meat and seafood are absent, but eggs and dairy are included because self-reported vegetarians in WWEIA reported consumption of these foods. Legumes, nuts/seeds, and processed soy are all higher in the Vegetarian Pattern compared to the Healthy U.S.-style and the Healthy Mediterranean-style Patterns.

When comparing nutrient intake across these three dietary patterns, as a percent of the RDA using a woman age 19 to 30 years as an example, modest difference emerged (Table D1.33). The Vegetarian pattern is lower in sodium and all three patterns are low in vitamin D.

For additional details on this body of evidence, visit:

- Usual Dietary Intakes: Food Intakes, US Population, 2007-10: Applied Research Program. National Cancer Institute; [updated May 22, 2014]. Available from: http://appliedresearch.cancer.gov/diet/usualintakes/pop/2007-10/.
- Appendix E-3.7: Developing Vegetarian and Mediterranean-style Food Patterns

CHAPTER SUMMARY

The DGAC conducted data analyses to address a series of questions related to the current status and trends in the Nation's dietary intake. The questions focused on: intake of specific nutrients and food groups; food categories (i.e., foods as consumed) that contribute to intake; eating behaviors; and the composition of various dietary patterns shown to have health benefits, including Mediterranean-style diets, the Healthy US-style and DASH-style diets. These topics were addressed using data from the WWEIA dietary survey, which is the dietary intake component of the ongoing NHANES. Food pattern modeling using the USDA Food Pattern food groups also was used to address some of the questions of interest. In addition, the DGAC examined the prevalence and trends of health conditions that may have a nutritional origin, or where the course of disease may be influenced by diet.

The DGAC found that several nutrients are underconsumed and the Committee characterized them as shortfall nutrients: vitamin A, vitamin D, vitamin E, vitamin C, folate, calcium, magnesium, fiber, and potassium. For adolescent and premenopausal females, iron also is a shortfall nutrient. Important to note, on the basis of nutrient biomarkers or health outcomes, calcium, vitamin D, fiber, and potassium also are classified as nutrients of public health concern because their underconsumption has been linked in the scientific literature to adverse health outcomes. Iron is included as a shortfall nutrient of public health concern for adolescent females and adult females who are premenopausal due to the increased risk of iron-deficiency in these groups. The DGAC also found that two nutrients—sodium and saturated fat—are overconsumed by the U.S. population and that the overconsumption poses health risks.

The majority of the U.S. population has low intakes of key food groups that are important sources of the shortfall nutrients including vegetables, fruits, whole grains, and dairy. Furthermore, population intake is too high for refined grains and added sugars. The data suggest cautious optimism about dietary intake of the youngest members of the U.S. population because many young children ages 2 to 5 years consume recommended amounts of fruit and dairy. However, a better understanding is needed on how to maintain and encourage the good habits that are started early in life. Analysis of data on food categories, such as burgers, sandwiches, mixed dishes, desserts, and beverages, because they represent such a large proportion of the calories consumed, are prime targets for reformulation to increase population intake of vegetables, whole grains, and other underconsumed food groups and to lower population intake of the nutrients sodium and saturated fat, and the food component refined grains. Dramatically reducing the intake of sugar-sweetened beverages and limiting sweets and desserts would help lower intakes the food component added sugars.

The U.S. population purchases its food in a variety of locations, including supermarkets, convenience stores, schools, and the workplace, and consumes prepared food outside the home. The DGAC found that while diet quality varies somewhat by the setting where food is obtained, overall, independent of where the food is prepared or obtained, the diet quality of the U.S. population does not meet recommendations for fruit, vegetables, dairy, or whole grains, and exceeds recommendations, leading

to overconsumption, for the nutrients sodium and saturated fat, and the food components refined grains, solid fats, and added sugars.

Obesity and chronic diseases with a nutritional origin are very common. The Nation must accelerate progress toward reducing the incidence and prevalence of overweight and obesity and chronic disease risk across the U.S. population throughout the lifespan and reduce the disparities in obesity and chronic disease rates that exist in the United States for certain ethnic and racial groups and for those with lower incomes.

The DGAC identified key aspects of several different dietary patterns that are associated with lower risk of many nutrition-related outcomes such as cardiovascular disease, diabetes, some cancers, psychological health and bone health. These patterns and their associated health benefits are described in greater detail in the next chapter.

The DGAC had enough descriptive information from existing research and data to model three dietary patterns and to examine their nutritional adequacy. These patterns are the Healthy U.S.-style Pattern, the Healthy Mediterranean-style Pattern, and the Healthy Vegetarian Pattern. These patterns include the components of a dietary pattern associated with health benefits.

The findings from this chapter and the remainder of the 2015 DGAC report can be used by individuals, families, communities, schools, local, state and federal agencies and the food industry to address the high prevalence of obesity and other nutrition-related health conditions in the United States and help all sectors of the population consume a diet that is healthful, accessible, and affordable.

NEEDS FOR FUTURE RESEARCH

1. Expand WWEIA participation to include more respondents from race/ethnic minorities and non-U.S. born residents.

   Rationale: Very little is known about the dietary habits of many of the cultural subgroups in the United States. This knowledge is essential to moving forward any nutrition programs for first and second generation immigrants. More data on the impact of acculturation also are needed on food and health behaviors. The number of participants in WWEIA using the derived acculturation variable was too small for any analysis. Finally, “Hispanic” is a very broad term and a better understanding is needed of the nutritional profiles (including shortfalls and excesses) across various Spanish-speaking people in the United States, who come from different cultural backgrounds with distinct eating patterns.

2. Include higher proportion of older Americans as respondents in WWEIA.

Rationale: More data are needed on dietary intake of older adults; the sample sizes in WWEIA were too small for any meaningful analyses for those older than the age of 71 years. In addition to nutrient intake, additional information is needed on whether older adults are able to shop and cook, whether polypharmacy plays a role in nutritional adequacy, and whether co-morbidities, such as poor dentition, musculo-skeletal difficulties, arthralgias and other age-related symptoms, affect their ability to establish and maintain proper nutritional status.

3. Increase the number of pregnant women as respondents in WWEIA.

Rationale: The number of pregnant women in WWEIA is currently too small to properly evaluate the status and trends in food and nutrient intake in pregnant women. Since good nutrition in pregnancy is critical to proper growth development of the infant it is critical to properly evaluate food and nutrient intake, which will inform recommendations and public policies for pregnant women.

4. Conduct research on nutrition transitions from childhood to shed light on how and why dietary intake changes so rapidly from early childhood through pre-adolescence and adolescence, and to identify the driving forces behind dietary intake change in these age groups and what programs are most effective at maintaining positive nutrition habits established in very young children.

Rationale: Young children have better dietary intake than older children and adolescents. It is important to maintain the positive gains made in early childhood and identify factors responsible for the declines in intakes of fruit, dairy, and other food groups and increases in added sugars and refined grains as children become enter the elementary school age years, as poor eating patterns in elementary school seem to persist into adolescence and beyond.

5. Evaluate the effects of common variations in dietary patterns in small children on nutrient intakes.

Rationale: Children from 2 to 4 years of age have a highly variable diet and often do not fit readily into the USDA Food Pattern food groups diet pattern analyses. Further information is needed to understand the broad range of diets and supplement use in small children and how this relates to nutrient intake and growth. Research is needed to better characterize their diets so that appropriate guidance can be offered.

6. Increase the quantity and quality of food composition databases available for research.

Rationale: Accurate assessment of nutrient intake and trends over time in the U.S. population is dependent upon the quality of food composition data. Tens of thousands of foods are available for purchase and consumption in the United States, but accurate nutrient content data are available only for less than 10,000 foods and are almost non-existent for many ready-to-eat and restaurant-type foods. Analytic values from foods are needed on specific nutrients and components, such as vitamin D, fiber, added sugars, and sodium. Improved food composition data also is critical for

needed research to better define, identify, and quantify total grain, whole grain consumption, and refined grain consumption in dietary studies.

7. Investigate the validity, reliability, and reproducibility of new biomarkers of nutrient intake and biomarkers of nutritional status.

   Rationale: Limited biomarkers are available and some that are available are difficult to interpret due to other contributing factors to the biomarker measure (e.g., vitamin D is obtained in the diet and is also endogenously synthesized).

8. Evaluate effects of fortification strategies and supplement use on consumer behavior related to the intake of foods and supplements containing key nutrients, including calcium, vitamin D, potassium, iron, and fiber

   Rationale: The intake of key nutrients of concern is considerably affected by the rapidly evolving marketplace of food fortification and supplementation. Understanding consumer behavior related to fortification and supplementation would be important in predicting the effects of interventions and marketplace changes in content of these nutrients. Special interest exists regarding fortification strategies of foods, including whole grains and yogurts, in allowing individuals to reach the RDA for vitamin D without using supplements. Data are needed on how supplements may help meet nutrients shortfalls and/or how use of supplements may place individuals at risk of overconsumption. Research on effective consumer guidance is needed.

9. Understand the rationale for and consequences of the use of supplements above the UL for vitamins and minerals. Identify biochemical markers that would indicate the effects of high-dose supplement use.

   Rationale: Consumer use of high-dose supplements has increased. Understanding the influences guiding this use would be helpful in considering how to educate consumers about safe upper intake limits.

10. Develop a standardized research definition for meals and snacks.

    Rationale: Multiple different criteria are used in studies to define a snack or meal occasion, such as time of day, the types or amounts of food consumed, or subjective assessment by the study respondent. Researchers should work toward a consensus on the use of standard definitions.

11. Understand better the concept of dietary patterns and design approaches to quantify the diet in large population-based studies.
    Rationale: More methodological work on dietary patterns is needed. For example, food frequency questionnaires, which are used in most diet assessment studies, do not capture data on meal timing, meal frequency, or the types of foods consumed together. Studies using diet recalls and records are better at capturing specific foods and their quantities consumed (portion sizes) and the types of

foods eaten together, but often these detailed assessment methods are not feasible for large population-based studies. Quantification of food group intake is needed. In addition, dietary patterns research encompasses a broader scope of issues than can e addressed by diet scores and data drive approaches.

12. Consistently report the nutrients, foods, and food groups that are used to evaluate dietary patterns in published studies.

    Rationale: The current scientific literature evaluating dietary patterns and health is inconsistent in its provision of dietary patterns composition information. This makes it difficult to compare, across studies, the components of healthful patterns that are associated with health benefits.

13. Conduct population surveillance on the prevalence and trends of nutrition-related chronic diseases including type 2 diabetes, cardiovascular disease, some cancers osteoporosis and neurocognitive disorders.

    Rationale: Current data on diabetes in adults cannot be stratified by disease type (type I or type II), making it very difficult to monitor incidence and prevalence of type 2 diabetes. Continued population surveillance is needed to effectively link nutritional factors with risk of these diseases.

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Part D. Chapter 1: *Food and Nutrient Intakes, and Health: Current Status and Trends*—Tables

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Table D1.1 Mean intake of shortfall* and overconsumed nutrients by age and race/ethnicity, for all ages 2+ WWEIA NHANES 2009-10.**

Race/ethnicity and age	n	Vit A* (RAE) µg	Vit D* µg	Vit E* µg	Vit C* mg	Folate* (DFE) µg	Calcium* mg	Magne-sium* mg	Iron* mg	Potas-sium* mg	Dietary fiber* g	Saturated fat** g	Sodium** mg
Ages 2 to 5													
Non-Hispanic White	305	606	6.9	4.8	77.3	405	1081	214	11.2	2070	11.7	21.0	2295
Non-Hispanic Black	150	537	5.8	5.5	86.5	447	879	196	12.6	1956	11.2	19.8	2492
Mexican-American	237	644	7.3	4.3	84.8	450	1057	210	11.8	2141	12.1	19.4	2157
All Hispanic	332	606	7.2	4.4	92.2	439	1031	209	11.5	2144	11.7	18.7	2189
Ages 6 to 11													
Non-Hispanic White	371	618	6.3	5.9	64.9	519	1083	231	13.4	2151	13.6	23.2	2920
Non-Hispanic Black	229	582	5.3	6.2	96.1	526	981	227	14.4	2216	14	23.7	3032
Mexican-American	337	545	6	5.5	78.9	501	970	230	13.9	2175	15.3	22.6	2824
All Hispanic	474	550	5.9	5.5	78.4	518	985	231	13.9	2180	14.7	23.1	2913
Ages 12 to 19													
Non-Hispanic White	425	611	5.9	7.2	67.5	578	1142	262	15.2	2364	14.3	27.7	3584
Non-Hispanic Black	275	502	4.1	7.2	106.7	498	974	234	14.1	2204	13	27.2	3348
Mexican-American	340	518	5	6.7	103.7	538	1074	267	15.4	2431	16.1	25.4	3454
All Hispanic	482	540	5.3	6.9	97.9	565	1081	265	15.7	2411	15.9	25.3	3434
Ages 20 and older													
Non-Hispanic White	2786	682	5.4	8.4	86	559	1070	315	15.6	2868	17.3	26.9	3627
Non-Hispanic Black	1025	555	4.1	6.8	92.4	464	828	261	14.0	2364	13.6	25.2	3358
Mexican-American	1062	537	4.9	6.8	97.8	525	975	320	15.1	2758	20.0	23.7	3368
All Hispanic	1647	525	4.8	6.7	100.9	530	969	307	14.8	2711	18.4	23.6	3417
Ages 2 and older													
Non-Hispanic White	3887	667	5.6	8.0	82.2	551	1079	299	15.2	2728	16.4	26.5	3511
Non-Hispanic Black	1679	549	4.3	6.7	94.3	473	865	251	14.0	2304	13.4	25.0	3273
Mexican-American	1976	545	5.3	6.4	95.2	518	997	291	14.7	2583	18.1	23.4	3206
All Hispanic	2935	537	5.2	6.4	97.1	526	992	284	14.5	2556	17.0	23.3	3252

Source: Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, USDA. WWEIA Data Tables, NHANES 2009-2010. For standard errors, more nutrients and documentation, see: http://seprl.ars.usda.gov/Services/docs.htm?docid=18349

Table D1.2 Usual Intakes from Food and Beverages compared to Dietary Reference Intakes -- females 19-50 years old by pregnancy status. Mean intake and % below EAR, AI, or above UL from food and beverages, WWEIA NHANES 2007-10.

Nutrient	Pregnancy status**	n	Mean	EAR	% Below EAR	UL	% Above UL
Energy (calorie/day)	Non-pregnant	2957	1848				
	Pregnant	133	2131				
Protein (g/day)	Non-pregnant	2957	69.4				
	Pregnant	133	78.6				
Dietary Fiber (g/day)	Non-pregnant	2957	14.4	25	5		
	Pregnant	133	17.3	28	8*		
Vitamin A (µg RAE/day)	Non-pregnant	2957	549	500	48	3000	<3
	Pregnant	133	728	550	26*	3000	<3
Folate (µg DFE/day)	Non-pregnant	2957	470	320	15	1000	<3
	Pregnant	133	622	520	29*	1000	<3
Vitamin C (mg/day)	Non-pregnant	2957	76.6	60	45	2000	<3
	Pregnant	133	121.0	70	30	2000	<3
Vitamin D (µg/day)	Non-pregnant	2957	3.9	10	>97	100	<3
	Pregnant	133	5.6	10	90*	100	<3
Vitamin E -ATE (mg/day)	Non-pregnant	2957	6.9	12	95		
	Pregnant	133	7.4	12	94*		
Calcium (mg/day)	Non-pregnant	2957	885	800	43	2500	<3
	Pregnant	133	1123	800	24	2500	<3
Iron (mg/day)	Non-pregnant	2957	13.2	8.1	16	45	<3
	Pregnant	133	16.9	22	96*	45	<3
				AI		**UL**	
Potassium (mg/day)	Non-pregnant	2957	2277	4700	<3		
	Pregnant	133	2660	4700	<3		
Sodium (mg/day)	Non-pregnant	2957	3111	1500	>97	2300	84
(overconsumed nutrient)	Pregnant	133	3523	1500	>97	2300	>97

*The values flagged with an asterisk (*) may be less reliable; interpret with caution **Non-pregnant includes non-lactating.

Source: Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, USDA. For more detailed tables and standard errors, see usual intake tables for pregnant women in ***Appendix E-2.4.***

Table D1.3. Mean intake of nutrients of public health concern by income as a percentage of the poverty threshold, for all ages 2+ WWEIA NHANES 2009-10

Income as % of poverty level and age	n	Dietary fiber g	Vitamin D µg	Calcium mg	Potassium mg
Less than 131% poverty:					
Ages 2-5	431	10.9	6.9	992	2036
Ages 6-11	496	13.9	6.3	1073	2254
Ages 12-19	503	14.1	5.4	1060	2319
Ages 20+	1755	15.5	4.7	942	2564
Ages 2+	3185	14.8	5.2	977	2451
131-185% poverty:					
Ages 2-5	93	12.3	6.8	1090	2160
Ages 6-11	145	12.9	5.8	955	2062
Ages 12-19	162	13.4	3.8	939	2096
Ages 20+	743	15.6	4.7	971	2638
Ages 2+	1143	14.9	4.8	973	2499
Over 185% poverty:					
Ages 2-5	266	12.3	6.8	1057	2070
Ages 6-11	422	14.2	5.9	1052	2134
Ages 12-19	482	14.6	5.8	1126	2417
Ages 20+	2730	17.7	5.3	1053	2866
Ages 2+	3900	16.9	5.5	1061	2735

Source: Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, USDA. WWEIA Data Tables, NHANES 2009-2010. For standard errors, more nutrients and documentation, see: http://seprl.ars.usda.gov/Services/docs.htm?docid=18349

Table D1.4 Prevalence (%) of serum 25-hydroxyvitamin D (25(OH)D) concentration levels for the U.S. population aged 1 year and older, NHANES 2003 -2006

	Serum 25(OH)D < 30 nmol/L* %(95% conf interval)	Serum 25(OH)D < 40 nmol/L* %(95% conf interval)	Serum 25(OH)D 30 -< 50 nmol/L* %(95% conf interval)	Serum 25(OH)D > 125 nmol/L* %(95% conf interval)
Total, 1 year and older	8.1 (6.7 – 9.8)	17.2 (14.7 – 20.0)	23.6 (21.6 – 25.8)	0.9 (0.6 – 1.2)
Sex				
Male	6.3 (5.0 – 7.9)	14.6 (12.3 – 17.4)	23.1 (20.8 – 25.6)	0.4 (0.3 – 0.7)
Female	9.9 (8.1 – 11.9)	19.6 (16.9 – 22.7)	24.1 (22.1 – 26.3)	1.3 (0.9 – 1.9)
Age category (years)				
1 to 5	0.7 (0.4 – 1.3)	2.7 (1.8 – 4.0)	8.9 (7.1 – 11.0)	§
6 to 11	1.8 (1.3 – 2.6)	5.7 (4.2 – 7.7)	14.1 (11.5 – 17.2)	§
12 to 19	8.5 (6.5 – 11.2)	17.1 (13.8 – 21.0)	24.2 (21.3 – 27.3)	1.4 (0.9 – 2.1)
20 -39	9.5 (7.6 – 11.8)	19.7 (16.4 – 23.4)	26.2 (23.6 – 29.0)	1.5 (0.9 – 2.4)
40 -59	9.3 (7.4 – 11.7)	20.0 (16.6 – 23.9)	25.0 (22.2 – 28.0)	0.6‡ (0.3 – 1.2)
60 +	8.8 (7.3 – 10.5)	17.8 (15.5 – 20.4)	25.5 (23.7 – 27.4)	0.3‡ (0.1 – 0.6)
Race/Ethnicity				
Non-Hispanic Whites	3.6 (3.0 – 4.4)	9.4 (7.9 – 11.2)	18.1 (16.2 – 20.2)	1.2 (0.8 – 1.7)
Non-Hispanic Blacks	31.1 (27.4 – 35.1)	51.6 (46.7 – 56.5)	39.5 (37.3 – 41.7)	§
Mexican Americans	11.3 (8.7 – 14.6)	24.4 (20.1 – 29.3)	32.9 (29.6 – 36.4)	§

1 ng/ml = 2.5 nmol/L

* Serum 25(OH)D < 30 nmol/L = risk for deficiency
  Serum 25(OH)D < 40 nmol/L = level set by IOM equal to EAR
  Serum 25(OH)D between 30 -50 nmol/L = at risk of inadequacy
  Serum 25(OH)D > 125 nmol/L = maybe reason for concern about excess

‡ Estimate flagged: 30% ≤ RSE < 40% for the prevalence estimate

§ Estimate suppressed: RSE ≥ 40% for the prevalence estimate

Source: Centers for Disease Control and Prevention. Second National Report on Biochemical Indicators of Diet and Nutrition in the U.S. Population. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Department of Health and Human Services; 2012. Available from: http://www.cdc.gov/nutritionreport/pdf/Nutrition_Book_complete508_final.pdf.

Table D1.5 Vitamin D: Food sources ranked by amounts of vitamin D and energy per standard food portions and per 100 grams of foods

Food	Standard Portion Size	Calories in Standard Portion[1]	Vitamin D in Standard Portion (µg)[1]	Calories per 100 grams[1]	Vitamin D per 100 grams (µg)[1]
Salmon, sockeye, canned	3 ounces	142	17.9	167	21.0
Trout, rainbow, farmed, cooked	3 ounces	143	16.2	168	19.0
Salmon, chinook, smoked	3 ounces	99	14.5	117	17.1
Swordfish, cooked	3 ounces	146	14.1	172	16.6
Sturgeon, mixed species, smoked	3 ounces	147	13.7	173	16.1
Salmon, pink, canned	3 ounces	117	12.3	138	14.5
Fish oil, cod liver	1 tsp	41	11.3	902	250
Cisco, smoked	3 ounces	150	11.3	177	13.3
Salmon, sockeye, cooked	3 ounces	144	11.1	169	13.1
Salmon, pink, cooked	3 ounces	130	11.1	153	13.0
Sturgeon, mixed species, cooked	3 ounces	115	11.0	135	12.9
Whitefish, mixed species, smoked	3 ounces	92	10.9	108	12.8
Mackerel, Pacific and jack, cooked	3 ounces	171	9.7	201	11.4
Salmon, coho, wild, cooked	3 ounces	118	9.6	139	11.3
Mushrooms, portabella, exposed to UV light, grilled	½ cup	18	7.9	29	13.1
Tuna, light, canned in oil, drained	3 ounces	168	5.7	198	6.7
Halibut, Atlantic and Pacific, cooked	3 ounces	94	4.9	111	5.8
Herring, Atlantic, cooked	3 ounces	173	4.6	203	5.4
Sardine, canned in oil, drained	3 ounces	177	4.1	208	4.8
Rockfish, Pacific, mixed species, cooked	3 ounces	93	3.9	109	4.6
Whole milk[2]	1 cup	149	3.2	61	1.3
Whole chocolate milk[2]	1 cup	208	3.2	83	1.3
Tilapia, cooked	3 ounces	109	3.1	128	3.7
Flatfish (flounder and sole), cooked	3 ounces	73	3.0	86	3.5
Reduced fat chocolate milk (2%)[2]	1 cup	190	3.0	76	1.2
Yogurt (various types and flavors)[2]	8 ounces	98-254	2.0-3.0	43-112	0.9-1.3
Milk (non-fat, 1% and 2%)[2]	1 cup	83-122	2.9	34-50	1.2
Soymilk[2]	1 cup	109	2.9	45	1.2
Low-fat chocolate milk (1%)[2]	1 cup	178	2.8	71	1.1
Fortified ready-to-eat cereals (various)[2]	1/3 -1 ¼ cup	74-247	0.2-2.5	248-443	0.8-8.6
Orange juice, fortified[2]	1 cup	117	2.5	47	1.0
Almond milk (all flavors)[2]	1 cup	91-120	2.4	38-50	1.0
Rice drink[2]	1 cup	113	2.4	47	1.0
Pork, cooked (various cuts)	3 ounces	122-390	0.2-2.2	143-459	0.2-2.6
Mushrooms, morel, raw	½ cup	10	1.7	31	5.1
Margarine (various)[2]	1 Tbsp	75-100	1.5	533-717	10.7
Mushrooms, Chanterelle, raw	½ cup	10	1.4	38	5.3
Egg, hard-boiled	1 large	78	1.1	155	2.2

[1]Source: U.S Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. 2014. USDA National Nutrient Database for Standard Reference, Release 27. Available at: http://www.ars.usda.gov/nutrientdata .
[2]Vitamin D fortified

Table D1.6. Calcium: Food sources ranked by amounts of calcium and energy per standard food portions and per 100 grams of foods

Food	Standard Portion Size	Calories in Standard Portion[1]	Calcium in Standard Portion (mg)[1]	Calories per 100 grams[1]	Calcium per 100 grams (mg)[1]
Fortified ready-to-eat cereals (various)[2]	¾ -1 ¼ cup	70-197	137-1000	234-394	455-3333
Pasteurized process American cheese	2 ounces	210	593	371	1045
Parmesan cheese, hard	1.5 ounces	167	503	392	1184
Plain yogurt, nonfat	8 ounces	127	452	56	199
Romano cheese	1.5 ounces	165	452	387	1064
Almond milk (all flavors)[2]	1 cup	91-120	451	38-50	188
Pasteurized process Swiss cheese	2 ounces	189	438	334	772
Tofu, raw, regular, prepared with calcium sulfate	½ cup	94	434	76	350
Gruyere cheese	1.5 ounces	176	430	413	1011
Vanilla yogurt, low-fat	8 ounces	193	388	85	171
Plain yogurt, low-fat	8 ounces	143	415	63	183
Pasteurized process American cheese food	2 ounces	187	387	330	682
Fruit yogurt, low-fat	8 ounces	238	383	105	169
Orange juice, calcium fortified[2]	1 cup	117	349	47	140
Soymilk (all flavors) [2]	1 cup	109	340	45	140
Ricotta cheese, part skim	½ cup	171	337	138	272
Swiss cheese	1.5 ounces	162	336	380	791
Evaporated milk	½ cup	170	329	135	261
Sardines, canned in oil, drained	3 ounces	177	325	208	382
Provolone cheese	1.5 ounces	149	321	351	756
Monterey cheese	1.5 ounces	159	317	373	746
Mustard spinach (tendergreen), raw	1 cup	33	315	22	210
Muenster cheese	1.5 ounces	156	305	368	717
Low-fat milk (1%)	1 cup	102	305	42	125
Mozzarella cheese, part-skim	1.5 ounces	128	304	301	716
Skim milk (nonfat)	1 cup	83	299	34	122
Reduced fat milk (2%)	1 cup	122	293	50	120
Colby cheese	1.5 ounces	167	291	394	685
Low-fat chocolate milk (1%)	1 cup	178	290	71	116
Cheddar cheese	1.5 ounces	173	287	406	675
Rice drink[2]	1 cup	113	283	47	118
Whole buttermilk	1 cup	152	282	62	115
Whole chocolate milk	1 cup	208	280	83	112
Whole milk	1 cup	149	276	61	113
Reduced fat chocolate milk (2%)	1 cup	190	273	76	109
Ricotta cheese, whole milk	½ cup	216	257	174	207

[1]Source: U.S Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. 2014. USDA National Nutrient Database for Standard Reference, Release 27. Available at: http://www.ars.usda.gov/nutrientdata .
[2]Calcium fortified

Table D1.7. Potassium: Food sources ranked by amounts of potassium and energy per standard food portions and per 100 grams of foods

Food	Standard Portion Size	Calories in Standard Portion[1]	Potassium in Standard Portion (mg)[1]	Calories per 100 grams[1]	Potassium per 100 grams (mg)[1]
Potato, baked, flesh and skin	1 medium	163	941	94	544
Prune juice, canned	1 cup	182	707	71	276
Carrot juice, canned	1 cup	94	689	40	292
Passion-fruit juice, yellow or purple	1 cup	126-148	687	51-60	278
Tomato paste, canned	¼ cup	54	669	82	1014
Beet greens, cooked from fresh	½ cup	19	654	27	909
Adzuki beans, cooked	½ cup	147	612	128	532
White beans, canned	½ cup	149	595	114	454
Plain yogurt, nonfat	1 cup	127	579	56	255
Tomato puree	½ cup	48	549	38	439
Sweet potato, baked in skin	1 medium	103	542	90	475
Salmon, Atlantic, wild, cooked	3 ounces	155	534	182	628
Clams, canned	3 ounces	121	534	142	628
Pomegranate juice	1 cup	134	533	54	214
Plain yogurt, low-fat	8 ounces	143	531	63	234
Tomato juice, canned	1 cup	41	527	17	217
Orange juice, fresh	1 cup	112	496	45	200
Soybeans, green, cooked	½ cup	127	485	141	539
Chard, swiss, cooked	½ cup	18	481	20	549
Lima beans, cooked	½ cup	108	478	115	508
Mackerel, various types, cooked	3 ounces	114-171	443-474	134-201	521-558
Vegetable juice, canned	1 cup	48	468	19	185
Chili with beans, canned	½ cup	144	467	112	365
Great northern beans, canned	½ cup	150	460	114	351
Yam, cooked	½ cup	79	456	116	670
Halibut, cooked	3 ounces	94	449	111	528
Tuna, yellowfin, cooked	3 ounces	111	448	130	527
Acorn squash, cooked	½ cup	58	448	56	437
Snapper, cooked	3 ounces	109	444	128	522
Soybeans, mature, cooked	½ cup	149	443	173	515
Tangerine juice, fresh	1 cup	106	440	43	178
Pink beans, cooked	½ cup	126	430	149	508
Chocolate milk (1%, 2% and whole)	1 cup	178-208	418-425	71-83	167-170
Amaranth leaves, cooked	½ cup	14	423	21	641
Banana	1 medium	105	422	89	358
Spinach cooked from fresh or canned	½ cup	21-25	370-419	23	346-466
Black turtle beans, cooked	½ cup	121	401	130	433
Peaches, dried, uncooked	¼ cup	96	399	239	996
Prunes, stewed	½ cup	133	398	107	321
Rockfish, Pacific, cooked	3 ounces	93	397	109	467
Rainbow trout, wild or farmed, cooked	3 ounces	128-143	381-383	150-168	448-450
Skim milk (nonfat)	1 cup	83	382	34	156
Refried beans, canned, traditional	½ cup	106	380	89	319

Table D1.7. Potassium, continued

Food	Standard Portion Size	Calories in Standard Portion[1]	Potassium in Standard Portion (mg)[1]	Calories per 100 grams[1]	Potassium per 100 grams (mg)[1]
Apricots, dried, uncooked	¼ cup	78	378	241	1162
Pinto beans, cooked	½ cup	123	373	143	436
Lentils, cooked	½ cup	115	365	116	369
Avocado	½ cup	120	364	160	485
Tomato sauce, canned	½ cup	30	364	24	297
Plantains, slices, cooked	½ cup	89	358	116	465
Kidney beans, cooked	½ cup	113	357	127	403
Navy beans, cooked	½ cup	128	354	140	389

[1]Source: U.S Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. 2014. USDA National Nutrient Database for Standard Reference, Release 27. Available at: http://www.ars.usda.gov/nutrientdata .

Table D1.8. Dietary fiber: Food sources ranked by amounts of dietary fiber and energy per standard food portions and per 100 grams of foods

Food	Standard Portion Size	Calories in Standard Portion[1]	Dietary fiber in Standard Portion (g)[1]	Calories per 100 grams[1]	Dietary fiber per 100 grams (g)[1]
High fiber bran ready-to eat-cereal	1/3 – ¾ cup	60-81	9.1-14.3	200-260	29.3-47.5
Navy beans, cooked	½ cup	127	9.6	140	10.5
Small white beans, cooked	½ cup	127	9.3	142	10.4
Yellow beans, cooked	½ cup	127	9.2	144	10.4
Shredded wheat ready-to-eat cereal (various)	1-1 ¼ cup	155-220	5.0-9.0	321-373	9.6-15.0
Cranberry (roman) beans, cooked	½ cup	120	8.9	136	10.0
Adzuki beans, cooked	½ cup	147	8.4	128	7.3
French beans, cooked	½ cup	114	8.3	129	9.4
Split peas, cooked	½ cup	114	8.1	116	8.3
Chickpeas, canned	½ cup	176	8.1	139	6.4
Lentils, cooked	½ cup	115	7.8	116	7.9
Pinto beans, cooked	½ cup	122	7.7	143	9.0
Black turtle beans, cooked	½ cup	120	7.7	130	8.3
Mung beans, cooked	½ cup	106	7.7	105	7.6
Black beans, cooked	½ cup	114	7.5	132	8.7
Artichoke, globe or French, cooked	½ cup	45	7.2	53	8.6
Lima beans, cooked	½ cup	108	6.6	115	7.0
Great northern beans, canned	½ cup	149	6.4	114	4.9
White beans, canned	½ cup	149	6.3	114	4.8
Kidney beans, all types, cooked	½ cup	112	5.7	127	6.4
Pigeon peas, cooked	½ cup	102	5.6	121	6.7
Cowpeas, cooked	½ cup	99	5.6	116	6.5
Wheat bran flakes ready-to-eat cereal (various)	¾ cup	90-98	4.9-5.5	310-328	16.9-18.3
Pear	1 medium	101	5.5	57	3.1
Pumpkin seeds, whole, roasted	1 ounce	126	5.2	446	18.4
Baked beans, canned, plain	½ cup	119	5.2	94	4.1
Soybeans, cooked	½ cup	149	5.2	173	6.0
Plain rye wafer crackers	2 wafers	73	5.0	334	22.9
Avocado	½ cup	120	5.0	160	6.7
Broadbeans (fava beans), cooked	½ cup	94	4.6	110	5.4
Pink beans, cooked	½ cup	126	4.5	149	5.3
Apple, with skin	1 medium	95	4.4	52	2.4
Green peas, cooked (frsh, frzn, cnd)	½ cup	59-67	3.5-4.4	69-84	4.1-5.5
Refried beans, canned	½ cup	107	4.4	90	3.7
Chia seeds, dried	1 Tbsp	58	4.1	486	34.4
Bulgur, cooked	½ cup	76	4.1	83	4.5
Mixed vegetables, cooked from frozen	½ cup	59	4.0	65	4.4
Raspberries	½ cup	32	4.0	52	6.5
Blackberries	½ cup	31	3.8	43	5.3
Collards, cooked	½ cup	32	3.8	33	4.0

Table D1.8. Dietary fiber, continued

Food	Standard Portion Size	Calories in Standard Portion[1]	Dietary fiber in Standard Portion (g)[1]	Calories per 100 grams[1]	Dietary fiber per 100 grams (g)[1]
Soybeans, green, cooked	½ cup	127	3.8	141	4.2
Prunes, stewed	½ cup	133	3.8	107	3.1
Sweet potato, baked in skin	1 medium	103	3.8	90	3.3
Figs, dried	¼ cup	93	3.7	249	9.8
Pumpkin, canned	½ cup	42	3.6	34	2.9
Potato, baked, with skin	1 medium	163	3.6	94	2.1
Popcorn, air-popped	3 cups	93	3.5	387	14.5
Almonds	1 ounce	164	3.5	579	12.5
Pears, dried	¼ cup	118	3.4	262	7.5
Whole wheat spaghetti, cooked	½ cup	87	3.2	124	4.5
Parsnips, cooked	½ cup	55	3.1	71	4.0
Sunflower seed kernels, dry roasted	1 ounce	165	3.1	582	11.1
Orange	1 medium	69	3.1	49	2.2
Banana	1 medium	105	3.1	89	2.6
Guava	1 fruit	37	3.0	68	5.4
Oat bran muffin	1 small	178	3.0	270	4.6
Pearled barley, cooked	½ cup	97	3.0	123	3.8
Winter squash, cooked	½ cup	38	2.9	37	2.8
Dates	¼ cup	104	2.9	282	8.0
Pistachios, dry roasted	1 ounce	161	2.8	567	9.9
Pecans, oil roasted	1 ounce	203	2.7	715	9.5
Hazelnuts or filberts	1 ounce	178	2.7	628	9.7
Peanuts, oil roasted	1 ounce	170	2.7	599	9.4
Whole wheat paratha bread	1 ounce	92	2.7	326	9.6
Quinoa, cooked	½ cup	111	2.6	120	2.8

[1]Source: U.S Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. 2014. USDA National Nutrient Database for Standard Reference, Release 27. Available at: http://www.ars.usda.gov/nutrientdata .

Table D1.9. Iron: Food sources ranked by amounts of iron and energy per standard food portions and per 100 grams of foods

Food	Standard Portion Size	Calories in Standard Portion[1]	Iron in Standard Portion (mg)[1]	Calories per 100 grams[1]	Iron per 100 grams (mg)[1]
Organ meats (spleen, liver, giblets, heart, kidney or lung) various, cooked	3 ounces	84-235	4.5-33.5	99-277	5.3-39.4
Fortified ready-to-eat cereals (various)	½ -1 ½ cup	89-230	5.1-19.6	310-443	19.4-67.7
Fortified instant cereals (various), prepared	1 cup	174-241	5.1-14.7	62-96	2.1-6.7
Clams, cooked, breaded and fried	3 ounces	172	11.8	202	13.9
Octopus, cooked, moist heat	3 ounces	139	8.1	164	9.5
Coconut milk, canned	1 cup	445	7.5	197	3.3
Tofu, raw, regular, prep. w/ Ca sulfate	½ cup	94	6.6	76	5.4
Oysters, eastern, wild/farmed, cooked, dry heat	3 ounces	67	6.1-6.6	79	7.2-7.8
Oysters, cooked, breaded and fried	3 ounces	169	5.9	199	7.0
Mussels, blue, cooked, moist heat	3 ounces	146	5.7	172	6.7
Liverwurst spread	¼ cup	168	4.9	305	8.9
Soybeans, mature, cooked	½ cup	149	4.4	173	5.1
Chili with beans, canned	½ cup	128	4.4	112	3.4
Beef, plate steak, boneless, outside skirt, all grades, grilled[2]	3 ounces	240-248	4.3-4.4	282-292	5.1-5.2
Mushrooms, morel, raw	½ cup	10	4.0	31	12.2
White beans, canned or cooked	½ cup	125-149	3.3-3.9	114-139	3.0-3.7
Lentils, cooked	½ cup	115	3.3	116	3.3
Spinach, cooked from fresh, frzn or cnd	½ cup	21-32	1.9-3.2	23-34	2.0-3.6
Beef, shoulder pot roast, boneless, 0" fat, all grades, braised[2]	3 ounces	167-173	3.1	196-204	3.5-3.6
Beef, loin, tenderloin steak, boneless, 0" fat, all grades, grilled[2]	3 ounces	168-179	2.7-3.0	198-211	3.2-3.6
Ground beef (95% lean/5% fat), cooked	3 ounces	164	2.8	193	3.2
Black turtle beans, cooked	½ cup	121	2.7	130	2.9
Kidney beans, cooked	½ cup	113	2.6	127	2.9
Sardines, canned in oil, drained	3 ounces	177	2.5	208	2.9
Bagel, enriched	1 sm (3” dia)	182	2.5	264	3.6
Chickpeas, cooked	½ cup	134	2.4	164	2.9
Pumpkin/squash seed kernels, roasted	1 ounce	163	2.3	574	8.1
Adzuki beans, cooked	½ cup	147	2.3	128	2.0
Hearts of palm, canned	½ cup	21	2.3	28	3.1
Yardlong beans, cooked	½ cup	101	2.3	118	2.6
Lima beans, cooked	½ cup	108	2.3	115	2.4
Tomato puree, canned	½ cup	48	2.3	38	1.8
Navy beans, cooked	½ cup	127	2.2	140	2.4
Cowpeas, cooked	½ cup	100	2.2	116	2.5

[1]Source: U.S Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. 2014. USDA National Nutrient Database for Standard Reference, Release 27. Available at: http://www.ars.usda.gov/nutrientdata.

[2]Lean and fat or lean only

Table D1.10. USDA Food Intake Patterns (Healthy U.S.-Style Patterns) recommended daily intake amounts, weekly amounts for vegetable and protein foods subgroups.

Energy Level of Pattern*	1,000	1,200	1,400	1,600	1,800	2,000	2,200	2,400	2,600	2,800	3,000	3,200
Food Group												
Fruits	1 c	1 c	1½ c	1½ c	1½ c	2 c	2 c	2 c	2 c	2½ c	2½ c	2½ c
Vegetables	1 c	1½ c	1½ c	2 c	2½ c	2½ c	3 c	3 c	3½ c	3½ c	4 c	4 c
Dark green vegetables (c/wk)	½	1	1	1½	1½	1½	2	2	2½	2½	2½	2½
Red/Orange vegetables (c/wk)	2½	3	3	4	5½	5½	6	6	7	7	7½	7½
Dry beans and peas(c/wk)	½	½	½	1	1½	1½	2	2	2½	2½	3	3
Starchy vegetables (c/wk)	2	3½	3½	4	5	5	6	6	7	7	8	8
Other vegetables (c/wk)	1½	2½	2½	3½	4	4	5	5	5½	5½	7	7
Grains	3 oz eq	4 oz eq	5 oz eq	5 oz eq	6 oz eq	6 oz eq	7 oz eq	8 oz eq	9 oz eq	10 oz eq	10 oz eq	10 oz eq
Whole grains	1½ oz eq	2 oz eq	2½ oz eq	3 oz eq	3 oz eq	3 oz eq	3½ oz eq	4 oz eq	4½ oz eq	5 oz eq	5 oz eq	5 oz eq
Other grains	1½ oz eq	2 oz eq	2½ oz eq	2 oz eq	3 oz eq	3 oz eq	3½ oz eq	4 oz eq	4½ oz eq	5 oz eq	5 oz eq	5 oz eq
Protein Foods	2 oz eq	3 oz eq	4 oz eq	5 oz eq	5 oz eq	5½ oz eq	6 oz eq	6½ oz eq	6½ oz eq	7 oz eq	7 oz eq	7 oz eq
Meat, poultry, eggs (oz/wk)	10	14	19	23	23	26	28	31	31	33	33	33
Seafood (oz/wk)	3	4	6	8	8	8	9	10	10	10	10	10
Nuts seeds, soy (oz/wk)	2	2	3	4	4	5	5	5	5	6	6	6
Dairy	2 c	2.5 c	2.5 c	3 c	3 c	3 c	3 c	3 c	3 c	3 c	3 c	3 c
Oils	15 g	17 g	17 g	22 g	24 g	27 g	29 g	31 g	34 g	36 g	44 g	51g
Limits for:												
Solid fats	10g	7g	7g	8g	11g	18g	18g	23g	25g	26g	31g	40g
Added Sugars	17g	12g	13g	14g	19g	30g	32g	39g	43g	45g	53g	69g

*Food group amounts shown in cup (c) or ounce equivalents (oz eq). Oils, solid fats, and added sugars are shown in grams (g).

Notes continue on next page.

Table D1.10. USDA Food Intake Patterns (Healthy U.S.-Style Patterns), continued

Quantity equivalents for each food group are:

- Grains, 1 ounce equivalent is: ½ cup cooked rice, pasta, or cooked cereal; 1 ounce dry pasta or rice; 1 slice bread; 1 small muffin (1 oz); 1 cup RTE cereal flakes.
- Fruits and vegetables, 1 cup equivalent is: 1 cup raw or cooked fruit or vegetable, 1 cup fruit or vegetable juice, 2 cups leafy salad greens.
- Protein Foods **,** 1 ounce equivalent is: 1 ounce lean meat, poultry, or fish; 1 egg; ¼ cup cooked dry beans or tofu; 1 Tbsp peanut butter; ½ ounce nuts or seeds.
- Milk, 1 cup equivalent is: 1 cup milk or yogurt, 1½ ounces natural cheese such as Cheddar cheese or 2 ounces of processed cheese.

Source: Center for Nutrition Policy and Promotion, USDA. USDA Food Patterns. For more information see Appendix E-3.1: Adequacy of the USDA Food Patterns

Table D1.11. Energy levels used for assignment of individuals to USDA Food Intake Patterns

Males, age	Sedentary[1] Males	Moderately Active[2] Male	Active[3] Male	Females, age	Sedentary[1] Female	Moderately Active[2] Female	Active[3] Female
2	1000	1000	1000	2	1000	1000	1000
3	1000	1400	1400	3	1000	1200	1400
4	1200	1400	1600	4	1200	1400	1400
5	1200	1400	1600	5	1200	1400	1600
6	1400	1600	1800	6	1200	1400	1600
7	1400	1600	1800	7	1200	1600	1800
8	1400	1600	2000	8	1400	1600	1800
9	1600	1800	2000	9	1400	1600	1800
10	1600	1800	2200	10	1400	1800	2000
11	1800	2000	2200	11	1600	1800	2000
12	1800	2200	2400	12	1600	2000	2200
13	2000	2200	2600	13	1600	2000	2200
14	2000	2400	2800	14	1800	2000	2400
15	2200	2600	3000	15	1800	2000	2400
16	2400	2800	3200	16	1800	2000	2400
17	2400	2800	3200	17	1800	2000	2400
18	2400	2800	3200	18	1800	2000	2400
19-20	2600	2800	3000	19-20	2000	2200	2400
21-25	2400	2800	3000	21-25	2000	2200	2400
26-30	2400	2600	3000	26-30	1800	2000	2400
31-35	2400	2600	3000	31-35	1800	2000	2200
36-40	2400	2600	2800	36-40	1800	2000	2200
41-45	2200	2600	2800	41-45	1800	2000	2200
46-50	2200	2400	2800	46-50	1800	2000	2200
51-55	2200	2400	2800	51-55	1600	1800	2200
56-60	2200	2400	2600	56-60	1600	1800	2200
61-65	2000	2400	2600	61-65	1600	1800	2000
66-70	2000	2200	2600	66-70	1600	1800	2000
71-75	2000	2200	2600	71-75	1600	1800	2000
76 and up	2000	2200	2400	76 and up	1600	1800	2000

[1]Sedentary means a lifestyle that includes only the physical activity of independent living.

[2]Moderately Active means a lifestyle that includes physical activity equivalent to walking about 1.5 to 3 miles per day at 3 to 4 miles per hour, in addition to the activities of independent living.

[3]Active means a lifestyle that includes physical activity equivalent to walking more than 3 miles per day at 3 to 4 miles per hour, in addition to the activities of independent living.

Source: Center for Nutrition Policy and Promotion, USDA. USDA Food Patterns. Available at http://www.cnpp.usda.gov/sites/default/files/usda_food_patterns/EstimatedCalorieNeedsPerDayTable.pdf

Table D1.12. Percent of total energy intake from the 32 as-consumed food subcategories,* NHANES 2009-10.

Subcategory	% of total energy consumption	Cumulative %
BURGERS, SANDWICHES, and TACOS	13.8	13.8
DESSERTS and SWEET SNACKS	8.5	22.3
SUGAR-SWEETENED and DIET BEVERAGES	6.5	28.8
RICE, PASTA, GRAIN-BASED MIXED DISHES	5.5	34.3
CHIPS, CRACKERS, and SAVORY SNACKS	4.6	38.9
PIZZA	4.3	43.2
MEAT, POULTRY, SEAFOOD MIXED DISHES	3.9	47.1
VEGETABLES (Incl. Beans and Peas, not Starchy)	3.8	50.9
ALCOHOLIC BEVERAGES	3.8	54.8
STARCHY VEGETABLES	3.8	58.6
YEAST BREADS AND TORTILLAS	3.8	62.4
HIGHER FAT MILK/YOGURT	3.5	65.8
BREAKFAST CEREALS AND BARS	3.5	69.3
POULTRY (Not incl. Deli and Mixed Dishes)	3.3	72.6
CANDY AND SUGARS	3.1	75.6
FRUIT (non-juice)	2.7	78.4
MEATS (Not incl. Deli and Mixed Dishes)	2.1	80.5
LOWFAT MILK/YOGURT	1.9	82.4
QUICK BREADS (Biscuits, Muffins, Pancakes, Waffles)	1.9	84.4
100% FRUIT JUICE	1.8	86.2
NUTS, SEEDS, AND SOY	1.7	87.9
EGGS	1.5	89.4
RICE AND PASTA	1.5	90.8
COFFEE AND TEA	1.4	92.3
SPREADS	1.3	93.6
SOUPS	1.3	95.0
DELI/CURED PRODUCTS (Meat and Poultry)	1.3	96.3
CHEESE	1.3	97.6
SEAFOOD (Not incl. Mixed Dishes)	1.1	98.7
CONDIMENTS AND GRAVIES	0.7	99.4
SALAD DRESSINGS	0.3	99.7
WATERS	0.0	99.7

*Collapsed from the 150 WWEIA Food Categories.

Note: does not total to 100% because baby foods and formulas are not included.

Source: Analysis of What We Eat in America (WWEIA) Food categories for NHANES 2009-10, population ages 2+. (see ***Appendix E-2.9)***

Table D1.13. Percent of individuals consuming 1, 2, or 3 meals per day, and number of snacks consumed, by age/sex groups, NHANES 2009-2010

	3 meals total	3 meals + ≤1 snack	3 meals + 2-3 snacks	3 meals +≥4 snacks	2 meals total	2 meals + ≤1 snack	2 meals + 2-3 snacks	2 meals + ≥4 snacks	1 meal total	1 meal + ≤1 snack	1 meal + 2-3 snacks	1 meal + ≥4 snacks
	%	%	%	%	%	%	%	%	%	%	%	%
Males:												
Ages 2-5	84	9	42	32	16	1	8	7	1	0	0	1
Ages 6-11	73	17	37	19	22	4	10	8	5	1	2	1
Ages 12-19	57	14	27	15	36	8	17	11	8	2	3	2
Ages 20-29	49	10	28	11	39	9	16	14	12	1	6	4
Ages 30-39	59	10	27	22	34	7	17	10	7	2	4	1
Ages 40-49	60	10	32	18	33	4	18	11	6	1	1	4
Ages 50-59	64	11	31	21	31	5	14	13	5	1	3	1
Ages 60-69	72	13	38	21	24	5	13	6	4	0	0	1
Ages 70+	64	18	34	12	32	7	18	7	3	1	1	2
20+	60	12	31	18	33	6	16	11	7	0	1	2
Females:												
Ages 2-5	84	9	38	36	15	1	7	7	1	0	0	0
Ages 6-11	68	15	40	13	30	4	14	12	3	0	1	2
Ages 12-19	49	11	27	10	41	13	19	9	10	1	5	4
Ages 20-29	55	13	23	18	38	8	18	12	7	1	4	3
Ages 30-39	63	9	30	24	34	7	19	7	3	1	1	1
Ages 40-49	64	14	31	20	29	5	12	12	7	1	2	4
Ages 50-59	69	14	28	26	29	4	11	14	3	1	1	1
Ages 60-69	72	8	36	28	26	3	14	9	2	0	1	1
Ages 70+	70	19	32	18	29	7	14	8	1	0	1	0
20+	65	13	30	22	31	6	15	11	4	1	2	2
M/F 2+	63	12	31	20	31	6	15	10	5	1	2	2

Source: Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, USDA. WWEIA Data Tables, NHANES 2009-2010. For standard errors and documentation, see: http://seprl.ars.usda.gov/Services/docs.htm?docid=18349

Table D1.14. Percent of individuals skipping specific meals, by age/sex groups, NHANES 2009-2010

Age/sex	% skipping breakfast	% skipping lunch	% skipping dinner
Males:			
Ages 2-5	6	7	4
Ages 6-11	13	13	6
Ages 12-19	26	19	7
Ages 20-29	28	23	12
Ages 30-39	19	22	8
Ages 40-49	16	25	6
Ages 50-59	12	23	7
Ages 60-69	9	18	6
Ages 70+	5	28	7
Females:			
Ages 2-5	5	7	5
Ages 6-11	14	16	5
Ages 12-19	25	25	11
Ages 20-29	22	24	7
Ages 30-39	14	17	9
Ages 40-49	13	22	8
Ages 50-59	8	19	8
Ages 60-69	6	18	6
Ages 70+	4	21	6
Males and Females ages 2+	15	20	7

Source: Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, USDA. WWEIA Data Tables, NHANES 2009-2010. For standard errors and documentation, see: http://seprl.ars.usda.gov/Services/docs.htm?docid=18349

Table D1.15. Meal and snack intake over time—percent reporting consumption of each meal, by age/sex group, NHANES 2005-2006 to 2009-2010

	Breakfast 2005-2006	Breakfast 2007-2008	Breakfast 2009-2010	Lunch 2005-2006	Lunch 2007-2008	Lunch 2009-2010	Dinner 2005-2006	Dinner 2007-2008	Dinner 2009-2010	Snacks 2005-2006	Snacks 2007-2008	Snacks 2009-2010
	%	%	%	%	%	%	%	%	%	%	%	%
Males:												
Ages 2-5	96	94	94	92	91	93	96	96	96	99	98	97
Ages 6-11	91	87	87	88	90	87	97	94	94	98	95	96
Ages 12-19	71	74	74	78	81	81	92	88	93	93	95	92
Ages 20-29	69	72	72	73	82	77	88	91	88	98	94	96
Ages 30-39	82	81	81	85	77	78	90	89	92	95	95	96
Ages 40-49	83	84	84	79	79	75	94	94	94	99	97	97
Ages 50-59	88	88	88	79	80	77	92	91	93	95	98	97
Ages 60-69	91	91	91	74	74	82	95	91	94	94	95	94
Ages 70+	95	95	95	74	70	72	92	94	93	94	93	94
Ages 20+	83	84	84	78	78	77	92	92	92	96	95	96
Females:												
Ages 2-5	97	95	95	91	90	93	95	95	95	96	97	97
Ages 6-11	90	86	86	88	91	84	96	94	95	97	98	98
Ages 12-19	71	75	75	80	82	75	92	89	89	94	95	94
Ages 20-29	74	78	78	79	81	76	89	94	93	94	96	95
Ages 30-39	88	86	86	83	77	83	92	92	91	97	95	97
Ages 40-49	85	87	87	79	82	78	93	94	92	97	98	94
Ages 50-59	92	92	92	81	83	81	94	95	92	98	98	97
Ages 60-69	93	94	94	79	76	82	95	94	94	98	99	97
Ages 70+	96	96	96	79	78	79	93	93	94	93	94	94
Ages 20+	87	88	88	80	80	80	93	94	93	96	97	96
M/F Ages 2+	85	85	85	80	81	80	93	92	93	96	96	96

Source: Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, USDA. WWEIA Data Tables, NHANES 2005-06, 2007-08, 2009-2010. For standard errors and documentation, see: http://seprl.ars.usda.gov/Services/docs.htm?docid=18349

Table D1.16. Percent of energy from each meal and snack occasion over time, by age/sex group, NHANES 2005-2006 to 2009-2010

	Breakfast 2005-2006	Breakfast 2007-2008	Breakfast 2009-2010	Lunch 2005-2006	Lunch 2007-2008	Lunch 2009-2010	Dinner 2005-2006	Dinner 2007-2008	Dinner 2009-2010	Snacks 2005-2006	Snacks 2007-2008	Snacks 2009-2010
	%	%	%	%	%	%	%	%	%	%	%	%
Males:												
Ages 2-5	19	20	20	26	24	26	27	27	26	28	28	28
Ages 6-11	17	19	19	26	27	26	30	29	31	26	25	25
Ages 12-19	14	15	15	26	26	25	35	33	33	26	26	26
Ages 20-29	15	15	15	24	26	25	34	34	34	28	26	26
Ages 30-39	15	15	15	29	25	24	32	35	36	24	22	25
Ages 40-49	15	15	15	22	24	22	39	37	37	24	23	25
Ages 50-59	16	16	16	23	25	22	38	36	37	23	23	25
Ages 60-69	19	19	19	21	21	23	39	37	39	21	24	20
Ages 70+	22	22	22	21	19	20	38	38	39	18	20	19
Ages 20+	16	16	16	24	24	23	36	36	36	24	23	24
Females:												
Ages 2-5	20	19	19	24	23	24	26	26	27	30	29	29
Ages 6-11	19	19	19	26	27	24	31	30	33	24	26	24
Ages 12-19	14	16	16	25	27	25	35	30	33	26	28	26
Ages 20-29	15	16	16	26	25	23	33	36	35	26	25	25
Ages 30-39	17	18	18	26	23	25	34	35	33	23	25	24
Ages 40-49	16	17	17	24	24	23	37	36	35	23	25	24
Ages 50-59	18	18	18	25	24	23	37	37	36	21	23	23
Ages 60-69	19	18	18	22	22	22	39	36	37	20	23	23
Ages 70+	22	21	21	22	24	24	36	37	38	20	19	18
Ages 20+	17	18	18	24	24	23	35	36	35	23	24	23
M/F Ages 2+	17	17	17	25	25	24	35	35	35	24	24	24

Source: Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, USDA. WWEIA Data Tables, NHANES 2005-06, 2007-08, 2009-2010. For standard errors and documentation, see: http://seprl.ars.usda.gov/Services/docs.htm?docid=18349

Table D1.17. Percent of nutrient intake from snacks by age/sex group, NHANES 2009-2010

Age/sex	Food energy %	Protein %	Dietary fiber %	Folate %	Vitamin D %	Calcium %	Iron %	Potas-sium %	Sodium* %	Caffeine %	Saturated Fat* %
Males:											
Ages 2-5	28	19	25	18	24	27	18	26	18	36	26
Ages 6-11	25	15	22	17	21	23	18	22	16	41	24
Ages 12-19	26	14	23	17	17	23	18	21	16	60	23
Ages 20-29	26	14	22	21	22	28	20	24	15	48	18
Ages 30-39	25	12	19	17	17	24	17	21	13	45	17
Ages 40-49	25	14	21	19	20	25	17	22	14	48	21
Ages 50-59	25	14	21	18	17	24	17	21	13	43	23
Ages 60-69	20	11	16	13	14	22	13	18	11	37	17
Ages 70+	19	10	16	11	9	19	11	17	9	41	18
Females:											
Ages 2-5	29	21	28	17	29	32	19	29	18	44	30
Ages 6-11	24	14	25	17	14	19	19	20	16	39	23
Ages 12-19	26	16	26	20	19	26	21	24	19	47	24
Ages 20-29	25	14	21	16	18	25	17	22	15	39	23
Ages 30-39	24	13	22	14	16	24	15	22	14	42	20
Ages 40-49	24	14	19	18	17	28	18	22	14	40	24
Ages 50-59	23	13	20	17	15	23	17	20	13	42	22
Ages 60-69	23	14	19	14	16	26	15	21	13	42	24
Ages 70+	18	10	15	11	13	20	11	16	10	35	18

*Overconsumed nutrient

Source: Food Surveys Research Group, Beltsville Human Nutrition Research Center, Agricultural Research Service, USDA. WWEIA Data Tables, NHANES 2009-2010. For standard errors and documentation, see: http://seprl.ars.usda.gov/Services/docs.htm?docid=18349

Table D1.18. Vegetable density (cup equivalents per 1000 calorie) for all vegetable subgroups, by point of purchase, NHANES 2003-2004 to 2009-2010

Point of purchase	2003-2004	2005-2006	2007-2008	2009-2010
DARK GREEN VEGETABLES (cup eq/1000 calorie)				
Store	0.04	0.05	0.05	0.06
Restaurant	0.07	0.08	0.09	0.09
Quick serve restaurant	0.02	0.02	0.03	0.03
School/day care	0.01	0.02	0.01	0.02
Other	0.05	0.08	0.07	0.07
RED AND ORANGE VEGETABLES (cup eq/1000 calorie)				
Store	n/a	0.16	0.16	0.16
Restaurant	n/a	0.23	0.23	0.20
Quick serve restaurant	n/a	0.22	0.17	0.17
School/day care	n/a	0.19	0.17	0.14
Other	n/a	0.23	0.22	0.22
STARCHY VEGETABLES (cup eq/1000 calorie)				
Store	0.20	0.18	0.20	0.19
Restaurant	0.23	0.24	0.26	0.24
Quick serve restaurant	0.24	0.22	0.23	0.23
School/day care	0.16	0.17	0.21	0.12
Other	0.22	0.23	0.25	0.25
OTHER VEGETABLES (cup eq/1000 calorie)				
Store	0.20	0.20	0.20	0.22
Restaurant	0.44	0.42	0.42	0.38
Quick serve restaurant	0.26	0.28	0.23	0.25
School/day care	0.16	0.16	0.13	0.12
Other	0.32	0.33	0.27	0.35

Source: Analysis of food group content, expressed as Food Pattern Equivalents, by point of purchase for What We Eat in America, NHANES 2003-2004, 2005-2006, 2007-2008, 2009-2010, population ages 2+ (see ***Appendix E-2.15).***

Table D1.19. Body mass index (BMI)*, by sex, age, and race/ethnicity, adults ages 20 years and older, NHANES 2009-2012

	Normal weight % (SE)	Overweight % (SE)	Obese % (SE)
All adults ages 20 y and older	29.6 (0.9)	33.3 (0.8)	35.3 (0.8)
Men	26.5 (1.1)	38.1 (0.9)	34.5 (1.1)
Women	32.6 (1.0)	28.8 (1.1)	36.0 (1.0)
Age group (years)			
20-39	36.8 (1.8)	29.5 (1.2)	31.5 (1.3)
40-59	24.5 (1.0)	35.9 (1.2)	38.0 (1.0)
≥60	25.4 (1.1)	35.7 (1.1)	37.5 (1.3)
Race/ethnicity**			
Non-Hispanic White	31.2 (1.2)	33.5 (1.1)	33.4 (1.1)
Non-Hispanic Black	21.7 (0.9)	27.7 (1.1)	48.7 (1.4)
Hispanic	21.0 (1.0)	37.5 (1.2)	40.8 (1.2)
Race/ethnicity by sex			
Men			
Non-Hispanic White	26.7 (1.5)	38.4 (1.1)	34.3 (1.3)
Non-Hispanic Black	28.5 (1.1)	31.7 (1.5)	37.9 (1.5)
Hispanic	19.4 (1.4)	41.5 (1.5)	38.5 (1.5)
Women			
Non-Hispanic White	35.7 (1.4)	28.8 (1.7)	32.5 (1.5)
Non-Hispanic Black	16.2 (1.2)	24.5 (1.4)	57.5 (1.7)
Hispanic	22.7 (1.1)	33.5 (1.4)	43.0 (1.5)

* Normal weight = 18.5 ≤ BMI <25 kg/m^2; Overweight = 25≤ BMI <30 kg/m^2; Obese= BMI = ≥30 kg/m^2

Estimates are age-adjusted to the year 2000 standard population using three age groups: 20–39 years, 40–59 years, and 60 years and over; estimates are weighted; all pregnant women excluded from analysis. SE = standard error.

**Participants with a race-Hispanic origin categorized as "other" are included in overall estimates but are not separately reported.

Source: Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination survey (NHANES). Body Mass Index, Adults 20 y and over, NHANES 2009 -2012.

Table D1.20. Percent of overweight and obesity* by income in relation to poverty level, adults ages 20 years and older

Income as % of poverty level	% Overweight 1988-1994	% Obese 1988-1994	% Overweight 1999-2002	% Obese 1999-2002	% Overweight 2003-2006	% Obese 2003-2006	% Overweight 2007-2010	% Obese 2007-2010
Below 100%	31.5	28.1	30	34.7	30.7	35	32.5	37.2
100%-199%	31.9	26.1	33.2	34.1	30.6	35.9	33.2	37.3
200%-399%	33.3	22.7	36.5	32.1	33.3	35.7	31.8	36.8
400% or more	33.7	18.7	36.7	25.5	35.8	28.9	35.6	31.3

*Overweight = 25≤ BMI <30 kg/m^2; Obese= BMI = ≥30 kg/m^2 .

Source: Centers for Disease Control and Prevention. National Center for Health Statistics. U.S. Department of Health and Human Services. Table 74. Healthy weight, overweight, and obesity among persons 20 years of age and over, by selected characteristics: United States, selected years 1960–1962 through 2007–2010. Health, United States, 2011. 2011. Available from: http://www.cdc.gov/nchs/data/hus/2011/074.pdf.

Table D1.21. Trends in prevalence of abdominal obesity[@] among adults, by age, sex, and race/ethnicity, NHANES*

		1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012
	Overall	46.4	43.4	52.1	51.6	52.7	52.8	54.2
	Men	37.1	39.1	42.5	44.8	43.4	43	43.5
	Women	55.4	57.1	61.3	58.2	61.6	62.3	64.7
Age group (years)**	**Men**							
	20 - 39	25.3	26.5	28.7	29.9	28.5	NA	NA
	40 - 59	41.8	43.9	49.8	52.7	49.4	NA	NA
	60 +	52.8	55	57.2	60.9	60.4	NA	NA
	Women							
	20 - 39	43.8	45.6	48.5	46.2	51.3	NA	NA
	40 - 59	60.3	59.9	66.7	63.5	65.5	NA	NA
	60 +	69.1	73.5	76.3	72.4	73.8	NA	NA
Race/ethnicity Overall	Non-Hispanic White	45.8	48.4	51.8	51.2	53.3	52.3	53.8
	Non-Hispanic Black	52.4	52.3	57.5	57.1	57.4	60.2	60.9
	Mexican American	48.1	49.9	55	51.4	55.5	58.4	57.4
	Men							
	Non-Hispanic White	38.6	42.4	45.1	46.2	46.6	45.3	44.5
	Non-Hispanic Black	31.5	30.6	35.1	40	38.9	39.5	41.5
	Mexican American	35.8	34.5	38	34.8	41.6	43.4	43.2
	Women							
	Non-Hispanic White	52.9	54.1	57.9	56.3	59.7	59.3	63.3
	Non-Hispanic Black	69.7	70.1	75.7	71	72.3	77.7	75.9
	Mexican American	60.2	66.9	73.8	70.5	71	75.5	71.6

[@]Abdominal obesity, as measured by waist circumference (WC) is defined as WC >102 cm in men and >88 cm in women

*All data from 1999 -2012, except age group –source: Ford ES, Maynard LM, Li C. Trends in mean waist circumference and abdominal obesity among US adults, 1999-2012. JAMA. 2014;312(11):1151-3. PMID: 25226482. http://www.ncbi.nlm.nih.gov/pubmed/25226482.

**Age group data only available from 1999 -2008 – source: Ford ES, Li C, Zhao G, Tsai J. Trends in obesity and abdominal obesity among adults in the United States from 1999-2008. Int J Obes (Lond). 2011;35(5):736-43. PMID: 20820173. http://www.ncbi.nlm.nih.gov/pubmed/20820173.

Age adjustment was performed using the direct method using the projected year 2000 US population aged 20 years or older.

NA = data not available.

Table D1.22. Body mass index (BMI) * among children and adolescents ages 2 to 19 years, NHANES 2009-2012

	Normal weight % (SE)	Overweight % (SE)	Obese % (SE)
Total	64.8 (0.8)	14.9 (0.6)	16.9 (0.6)
Sex			
Boys	63.7 (1.0)	14.9 (0.8)	17.6 (0.9)
Girls	65.9 (1.3)	14.9 (0.8)	16.1 (0.7)
Age group (years)			
2- 5	72.1 (1.5)	14.5 (1.3)	10.2 (0.9)
6-11	62.7 (1.1)	15.5 (0.8)	17.9 (0.9)
12-19	62.7 (1.2)	14.6 (0.8)	19.4 (1.1)
Race/ethnicity**			
Non-Hispanic White	68.2 (1.2)	14.1 (1.0)	14.0 (1.0)
Non-Hispanic Black	60.0 (1.4)	14.9 (0.7)	22.1 (1.2)
Hispanic	58.4 (0.9)	17.2 (0.7)	21.8 (0.6)
Boys			
Non-Hispanic White	66.8 (1.6)	14.5 (1.5)	14.4 (1.5)
Non-Hispanic Black	61.2 (1.8)	13.6 (1.1)	21.9 (1.4)
Hispanic	57.1 (1.3)	16.4 (0.9)	23.7 (1.0)
Girls			
Non-Hispanic White	69.8 (1.9)	13.7 (1.4)	13.6 (1.2)
Non-Hispanic Black	58.7 (2.0)	16.3 (1.3)	22.3 (2.0)
Hispanic	59.7 (1.2)	18.0 (0.9)	19.8 (1.1)

*5th - 84th percentile = normal weight; 85th - 94th percentile = overweight; ≥95th percentile = obese.

**Race-Hispanic origin classified as "other" not separately reported by included in overall estimates. Analyses based on age at the time of exam and exclude pregnant women.

SE = standard error.

Source: Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination survey (NHANES). Body Mass Index Among Children and Adolescents Ages 2 – 19 years, NHANES 2009 -2012.

Table D1.23. Hypertension, lipid profile, and diabetes by body mass index (BMI) and waist circumference, adults ages 20 years and older, NHANES 2009-2012

	Total cholesterol[£] % (SE) ≥ 240 mg/dl	HDL-C[£] % (SE) < 40 mg/dl	LDL-C[∫] % (SE) ≥ 160 mg/dl	Triglycerides[∫] %(SE) ≥ 200 mg/dl	Hypertension*[@∂] % (SE)	Diabetes**[Ω] % (SE)
BMI[€]						
Normal weight	12.1 (0.8)	8.5 (0.7)	8 (0.8)	4.8 (0.7)	20.0 (1.1)	5.5 (0.8)
Over weight	15.2 (1)	18.8 (1)	12 (1.2)	12 (0.8)	26.4 (0.8)	9.0 (0.9)
Obese	11.7 (0.6)	30.2 (1.3)	11.2 (0.8)	17.2 (1.6)	39.2 (0.8)	20.3 (1.2)
Waist Circumference (cm)[&]						
Men ≤102, Women ≤ 88	12.1 (0.8)	13.7 (0.8)	8 (0.9)	7.6 (0.8)	21.2 (0.9)	6.0 (0.9)
Men >102, Women >88	13.4 (0.6)	24.9 (1.1)	12.1 (0.9)	14.8 (1.3)	34.6 (0.6)	16.2 (0.9)
BMI, waist circumference (cm) by sex						
Men						
Normal weight	9.7 (1.1)	14.2 (1)	8.3 (1.3)	7 (1.4)	20.1 (1.2)	8.8 (1.6)
Over weight	13.7 (1)	26.8 (1.7)	11 (1.5)	15.6 (1.4)	28.1 (1.3)	10.0 (1.3)
Obese	10.9 (0.9)	42.2 (1.7)	10.2 (1.1)	20.2 (1.9)	39.1 (1.2)	21.6 (1.6)
≤102 cm	12 (1)	20.4 (1.1)	9.3 (0.9)	10.8 (1.2)	23.3 (1)	8.3 (1.2)
>102 cm	11.3 (1)	40.3 (1.6)	11 (1.3)	20.4 (2)	37.2 (1)	19.6 (1.3)
Women						
Normal weight	13.6 (1.1)	4.3 (0.7)	7.7 (0.9)	3.2 (0.7)	19.9 (1.3)	3.2 (0.7)
Over weight	16.7 (1.4)	8.6 (0.9)	12.8 (1.5)	7 (1.1)	24.3 (1)	7.8 (0.8)
Obese	12.3 (0.8)	18.9 (1.4)	11.9 (1.2)	14.2 (1.9)	39.2 (1)	19.2 (1.1)
≤ 88 cm	12.1 (1.1)	3.6 (0.5)	5.9 (1.2)	2.4 (0.6)	17.8 (1.3)	2.6 (0.6)
> 88 cm	14.9 (0.7)	14.9 (1)	12.8 (0.9)	11.2 (1.2)	32.9 (0.7)	13.9 (0.9)

* Adults ages 18 years and older.

[@] Hypertension is defined as having measured systolic pressure of at least 140 mm Hg or diastolic pressure of at least 90 mm Hg and/or taking antihypertensive medication. Estimates are based on the average of up to 3 measurements.

**Total diabetes is the sum of self-reported diabetes and undiagnosed diabetes. Diagnosed diabetes was obtained by self-report and excludes women who reported having diabetes only during pregnancy. Undiagnosed diabetes is defined as fasting plasma glucose (FPG) of at least 126 mg/dL or a hemoglobin A1c of at least 6.5% and no reported physician diagnosis. Respondents had fasted for at least 8 hours and less than 24 hours. The definition of undiagnosed diabetes was based on recommendations from the American Diabetes Association. For more information, see Standards of medical care in diabetes – 2010. Diabetes Care 2010: 33 (suppl 1): S11-S61.

Notes continue on next page

Table D1.23, continued

[€]BMI= 18.5-24.9 kg/m^2 = normal weight; BMI =25-29.9 kg/m^2= overweight; BMI = ≥30 kg/m^2= obese.

[&]Abdominal obesity, as measured by waist circumference (WC) is defined as WC >102 cm in men and >88 cm in women

SE = standard error.

Source –

[£]Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination survey (NHANES). Total cholesterol and high density lipoprotein cholesterol (HDL), adult 20 years and over, NHANES 2009 -2012.

[∫]Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination survey (NHANES). Low density lipoprotein cholesterol (LDL-C) and triglycerides, adults 20 years and over, NHANES 2009-2012.

[∂]Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination survey (NHANES). Prevalence of high blood pressure, adults 18 years and over, NHANES 2009-2012.

[Ω]Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination survey (NHANES). Total diabetes, in adults 20 years and over, NHANES 2009 -2012.

Table D1.24. Lipid profile by weight status, among children and adolescents, NHANES 2009-2012

	Total cholesterol*[$£] ***≥ 200 mg/dL*** ***% (SE)***	**HDL-C*[£]** ***< 40 mg/dL*** ***% (SE)***	**LDL-C**[# Ω]** ***≥ 130 mg/dL*** ***% (SE)***	**Triglycerides**[$ Ω]** ***≥ 130 mg/dL*** ***% (SE)***
Body mass index (BMI)				
Normal weight	6.9 (0.7)	7.7 (0.6)	6.7 (1.4)	6.5 (1.2)
Overweight	7.1 (1.2)	16.4 (2.3)	8.0 (2.1)	11.4 (2.7)
Obese	11.3 (1.5)	30.5 (2.5)	6.8 (1.8)	24.1 (3.4)
Weight Status by Sex				
Boys				
Normal weight	5.1 (0.7)	8.8 (1.1)	6.1 (2.0)[@]	5.8 (1.4)
Overweight	5.3 (1.4)	16.9 (3.2)	7.5 (2.7)[@]	11.6 (2.9)
Obese	13.2 (2.4)	35.1 (2.6)	8.8 (3.0)[@]	38.6 (5.0)
Girls				
Normal weight	8.7 (1.1)	6.5 (0.9)	7.3 (1.8)	7.2 (2.5)[@]
Overweight	9.1 (2.1)	15.8 (2.6)	+	11.2 (4.4)[@]
Obese	9.1 (1.9)	25.5 (3.7)	4.6 (1.8)[@]	7.9 (2.4)

Analyses based on age at exam and exclude pregnant adolescents. Estimates are weighted.

[$]Cut-point criteria based on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents .

[*]Data for children and adolescents ages 6 to 19 years old.

[**]Data for children and adolescents ages 12 – 19 years old.

[#]LDL-C calculated using the Friedewald equation (which is valid when triglyceride <400 mg/dL).

Normal weight = 5th-84th percentile; overweight = 85th-94th percentile; obese = ≥95th percentile.

[@]Relative standard error (RSE)≥30 but < 40; + = RSE≥40.

SE = standard error.

Sources:

[£]Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination survey (NHANES). Total cholesterol, high density lipoprotein cholesterol (HDL), and non-HDL-cholesterol among children and adolescents ages 6 –19 years, NHANES 2009 -2012.

[Ω]Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination survey (NHANES). Low density lipoprotein cholesterol (LDL-C) and triglycerides among adolescents ages 12-19 years, NHANES 2009-2012.

Table D1.25. Prevalence of high and borderline high blood pressure (BP) in children, 2009-2012

	High BP* % (SE)	Borderline high BP* % (SE)
Total	1.7 (0.2)	8.3 (0.7)
Boys	1.7 (0.4)	12.0 (1.3)
Girls	1.6 (0.2)	4.6 (0.8)
Age group (years)		
8 - 12	1.8 (0.4)	3.8 (0.7)
13 -17	1.5 (0.4)	12.4 (1.1)
Race/Ethnicity**		
Non-Hispanic White	1.4 (0.3)	7.2 (0.9)
Non-Hispanic Black	2.3 (0.5)	12.1 (1.3)
Hispanic	1.8 (0.6)@	8.5 (1.4)
Body Mass Index (BMI)		
Normal weight	1.4 (0.3)	5.4 (0.8)
Overweight	+	10.9 (1.6)
Obese	1.8 (0.6) @	16.2 (1.8)
Race/Ethnicity by Sex		
Boys		
Non-Hispanic White	**	10.8 (1.8)
Non-Hispanic Black	2.5 (0.7)	16.6 (2.0)
Hispanic	+	12.7 (2.3)
Girls		
Non-Hispanic White	1.8 (0.4)	3.8 (1.1)
Non-Hispanic Black	+	7.5 (1.6)
Hispanic	1.5 (0.6) @	4.3(1.0)
BMI by Sex		
Boys		
Normal weight	1.8 (0.5)	8.6 (1.5)
Overweight	+	16.3 (2.8)
Obese	1.8 (0.6) @	20.1 (3.0)
Girls		
Normal weight	1.0 (0.3)	2.4 (0.8) @
Overweight	+	5.3 (1.2)
Obese	+	12.0 (2.7)

Analyses based on age at exam and exclude pregnant adolescents. Estimates are weighted. SE = standard error.
*Borderline high BP was defined as a systolic or diastolic BP ≥90th percentile but <95th percentile or BP levels ≥120/80 mm Hg and high BP was defined as a systolic or diastolic BP ≥95th percentile. Definitions are based on the Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescent. Estimates are based on the average of up to 3 measurements.
**Race-Hispanic origin classified as "other" not separately reported but included in overall estimates
Normal weight = 5th - 84th percentile; overweight = 85th - 94th percentile; obese = ≥95th percentile
@ Relative standard error (RSE)≥30 but < 40; + = RSE≥40.
Source: Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination survey (NHANES). Prevalence of high and borderline high blood pressure (BP), children and adolescents, Ages 8-17 years, NHANES 2009-2012.

Table D1.26. Prevalence of overweight and obesity among youth ages 3 to 19* years with type 2 diabetes by race and ethnicity , compared to youth without type 2 diabetes, SEARCH population, 2001-2004

Children ages 3 to 19 years with type 2 diabetes who are:	N	% (95% CI)	Children ages 3 to 19 without diabetes** who are:	% (95% CI)
Overweight [€]			**Overweight** [€]	
All	50	10.4 (6.7,15.9)	All	16.1 (15.0,17.3)
Non-Hispanic White	10	13.9 (6.3,28)	Non-Hispanic White	15.9 (14.3,17.6)
Non-Hispanic Black	15	8 (3.2,18.4)	Non-Hispanic Black	14.8 (13.4,16.3)
Hispanic	11	10.5 (4.2,23.8)	Hispanic	18.8 (16.6,21.1)
Asian Pacific Islander	7	14.9 (4.4,39.9)	Asian Pacific Islander	--
American Indian	7	3.3(0.4,20.7)	American Indian	--
Obese [&]			**Obese** [&]	
All	331	79.4 (72.8, 84.8)	All	16.9 (15.8,18.0)
Non-Hispanic White	64	68.8 (53.2,81)	Non-Hispanic White	15.8 (14.3,17.5)
Non-Hispanic Black	111	91.1 (81,96.1)	Non-Hispanic Black	20.2 (18.6,21.9)
Hispanic	63	75 (59.8,85.7)	Hispanic	18.3 (16.2,20.5)
Asian Pacific Islander	34	68.2 (43.4,85.7)	Asian Pacific Islander	--
American Indian	59	88 (67.9, 96.2)	American Indian	--

* 93% of children with type 2 diabetes are 12 -19 years old.

** US population estimates based on non-diabetic youth (NHANES 2001–2004).

-- NHANES does not contain large enough samples of Asian Pacific Islander I and American Indian to provide comparable estimates.

[€] Overweight defined as BMI from the 85th to <95th percentile for age and sex

[&] Obesity defined as BMI ≥ 95th percentile.

Source: Liu LL, Lawrence JM, Davis C, Liese AD, Pettitt DJ, Pihoker C, et al. Prevalence of overweight and obesity in youth with diabetes in USA: the SEARCH for Diabetes in Youth study. Pediatr Diabetes. 2010;11(1):4-11. PMID: 19473302. http://www.ncbi.nlm.nih.gov/pubmed/19473302.

Table D1.27. Prevalence of hypertension and diabetes in US adults, NHANES 2009-2012

	Hypertension*[£] % (SE)	Total Diabetes**[, Ω] % (SE)
Overall	29.1 (0.6)	12.3 (0.8)
Men	29.8 (0.8)	14.0 (1.0)
Women	28.3 (0.6)	10.8 (0.8)
Age group (years)		
18-39[&]	7.1 (0.4)	3.2 (0.5)
40-59	31.7 (1.2)	13.5 (1.3)
≥60	66.3 (1.3)	26 (1.7)
Race/ethnicity[@]		
Non-Hispanic white	27.9 (0.7)	9.8 (0.8)
Non-Hispanic black	41.5 (0.9)	18.4 (1.3)
Hispanic	26.1 (0.9)	19.3 (1.5)
Race/ethnicity by sex		
Men		
Non-Hispanic White	28.9 (1.1)	11.7 (1.3)
Non-Hispanic Black	40.5 (1.1)	18.8 (1.8)
Hispanic	26.2 (1.4)	21 (1.7)
Women		
Non-Hispanic White	26.8 (0.8)	8.0 (0.9)
Non-Hispanic Black	42.1 (1.3)	18.1 (1.5)
Hispanic	25.8 (0.8)	17.6 (1.9)

Estimates are age-adjusted to the year 2000 standard population. Estimates are weighted. All pregnant women excluded from analysis.

SE = standard error.

*Hypertension is reported for adults ages 18 yrs and older and is defined as having measured systolic pressure of at least 140 mm Hg or diastolic pressure of at least 90 mm Hg and/or taking antihypertensive medication. Estimates are based on the average of up to 3 measurements.

**Total diabetes is reported for adults ages 20 years and older and is the sum of self-reported diabetes and undiagnosed diabetes. Diagnosed diabetes was obtained by self-report and excludes women who reported having diabetes only during pregnancy. Undiagnosed diabetes is defined as fasting plasma glucose (FPG) of at least 126 mg/dLor a hemoglobin A1c of at least 6.5% and no reported physician diagnosis. Respondents had fasted for at least 8 hours and less than 24 hours.

[&] Data for diabetes is reported for adults ages 20 to 39 years old.

[@]Participants with a race-Hispanic origin categorized as "other" are included in overall estimates but are not separately reported.

Sources:

[£]Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination survey (NHANES). Prevalence of high blood pressure, adults 18 years and over, NHANES 2009-2012.

[Ω]Centers for Disease Control and Prevention. National Center for Health Statistics. National Health and Nutrition Examination survey (NHANES). Total diabetes, in adults 20 years and over, NHANES 2009 -2012

Table D1.28. Prevalence of type 2 diabetes by sex, age, and race/ethnicity in children and adolescents*

	Cases with type 2 diabetes	Prevalence /1000 youth (95% CI)
Overall (< 20 years old)	819	0.46 (0.43 - 0.49)
Sex		
Boys	314	0.35 (0.31 - 0.39)
Girls	505	0.58 (0.53 - 0.63)
Age group (years)		
10 to 14	198	0.23 (0.2 - 0.26)
15 to 19	621	0.68 (0.63 - 0.74)
Race/ethnicity		
Non-Hispanic White	172	0.17 (0.15 -0.2)
Non-Hispanic Black	209	1.06 (0.93 - 1.22)
Hispanic	317	0.79 (0.7 - 0.88)
Asian Pacific Islander	46	0.34 (0.26 - 0.46)
American Indian	75	1.2 (0.96 - 1.51)

*2009 SEARCH population

Source: Dabelea D, Mayer-Davis EJ, Saydah S, Imperatore G, Linder B, Divers J, et al. Prevalence of type 1 and type 2 diabetes among children and adolescents from 2001 to 2009. JAMA. 2014;311(17):1778-86. PMID: 24794371. http://www.ncbi.nlm.nih.gov/pubmed/24794371.

Table D1.29. Cancer incidence and death rates per 100,000 persons by age category, sex and race and ethnicity, United States, 2007 -2011*

Rates per 100,000 persons	Incidence Breast	Death Breast	Incidence Prostate	Death Prostate	Incidence Colorectal	Death Colorectal	Incidence Lung & Bronchus	Death Lung & Bronchus
Age (years), men and women								
<20	0	0	0	0	0.1	0	0	0
20-34	1.8	0.9	0	0	1.2	0.6	0.3	0.1
35-44	9.3	5.2	0.6	0.1	4.1	2.5	1.3	1
45-54	22	14.5	9.7	1.6	14.2	9.1	8.6	7.7
55-64	25.5	21.7	32.7	8.5	21.2	17.6	21.4	19.7
65-74	21.3	20.6	36.3	20.1	23.9	21.9	31.7	30.6
75-84	14.4	21	16.8	36.8	23.2	27.3	27.9	29.8
>84	5.7	16.2	3.8	33	12.1	20.9	8.9	11.2
Men								
all race/ethnicities	–	–	147.8	22.3	50.6	19.1	72.2	61.6
Non-Hispanic White	–	–	139.9	20.6	49.6	18.5	72.4	61.4
Non-Hispanic Black	–	–	223.9	48.9	62.3	27.7	93	75.7
Hispanic	–	–	121.8	18.5	44.3	15.8	39.6	30.5
Asian/Pacific Islander	–	–	79.3	10	43.1	13.1	49.4	34.7
American Indian/Alaska Native	–	–	71.5	21.2	45.5	19.2	49.5	50
Women								
all race/ethnicities	124.6	22.2	–	–	38.2	13.5	51.1	38.5
Non-Hispanic White	128	21.7	–	–	37.3	13	53.8	39.8
Non-Hispanic Black	122.8	30.6	–	–	47.5	18.5	51.2	36.5
Hispanic	91.3	14.5	–	–	30.6	9.9	25.5	14
Asian/Pacific Isldander	93.6	11.3	–	–	32	9.5	28.1	18.4
American Indian/Alaska Native	79.3	15.2	–	–	35.5	15.6	34.7	32.4

*SEER 18, 2007 -2011; rates (numbers) of new cases and deaths are per 100,000 persons and are age-adjusted to the 2000 U.S. standard population.
Data are from selected statewide and metropolitan area cancer registries that meet the data quality criteria for all invasive cancer sites combined.
Rates cover approximately 95% of the U.S. population.
Source: Data are from NCI factsheets, and can be found in the SEER Cancer Statistics Review (http://seer.cancer.gov/csr/1975_2011/)
Breast cancer - http://seer.cancer.gov/statfacts/html/breast.html , Prostate Cancer - http://seer.cancer.gov/statfacts/html/prost.html ,
Colon and Rectum Cancer - http://seer.cancer.gov/statfacts/html/colorect.html ,Lung and Bronchus Cancer - http://seer.cancer.gov/statfacts/html/lungb.html

Table D1.30. Estimates of the prevalence and number of US adults ages 50 years and older with osteoporosis (OP) and low bone mass (LBM) at either the femoral neck or lumber spine (NHANES 2005-2010)

	OP Prevalence * % (SE)	OP N (95% CI)**	BM Prevalence * % (SE)	LBM, N (95% CI)**
Both Sexes				
Overall (ages 50 above)	10.3 (0.37)	10.2 (9.4,10.9)	43.9 (0.72)	43.4 (42.0,44.8)
Men				
Overall	4.3 (0.40)	2.0 (1.6,2.3)	35.2 (0.93)	16.1 (15.3,17.0)
Age group (years)				
50-59	3.4 (0.68)	0.7 (0.4,1.0)	30.7 (1.78)	6.3 (5.6,7.0)
60-69	3.3 (0.73)	0.5 (0.3,0.7)	32.9 (1.82)	4.6 (4.1,5.1)
70-79	5.0 (0.78)	0.4 (0.3,0.5)	41.8 (2.51)	3.1 (2.7,3.5)
80+	10.9 (1.7)	0.4 (0.3,0.6)	53.1 (2.82)	2.2 (1.9,2.4)
Race/ethnicity [@]				
Non-Hispanic White	3.9 (0.39)	1.4 (1.1,1.6)	36.0 (1.13)	12.7 (11.9,13.4)
Non-Hispanic Black	1.3* (0.40)	0.1 (0.02,0.1)	21.3 (1.75)	0.9 (0.8,1.1)
Mexican American	5.9 (1.08)	0.1 (0.1,0.2)	38.3 (2.55)	0.9 (0.7,1.0)
Women				
Overall	15.4 (0.63)	8.2 (7.5,8.9)	51.4 (0.93)	27.3 (26.3,28.3)
Age group (years)				
50-59	6.8 (0.83)	1.5 (1.1,1.8)	49.3 (1.69)	10.6 (9.9,11.3)
60-69	12.3 (1.44)	1.9 (1.5,2.3)	53.4 (1.54)	8.2 (7.7,8.6)
70-79	25.7 (1.56)	2.4 (2.1,2.6)	51.8 (1.70)	4.7 (4.4,5.1)
80+	34.9 (2.44)	2.5 (2.2,2.8)	52.7 (3.07)	3.8 (3.3,4.2)
Race/ethnicity [c]				
Non-Hispanic White	15.8 (0.81)	6.3 (5.7,7.0)	52.6 (1.17)	21.1 (20.2,22.0)
Non-Hispanic Black	7.7 (1.10)	0.4 (0.3,0.5)	36.2 (2.03)	2.0 (1.8,2.2)
Mexican American	20.4 (1.70)	0.5 (0.4,0.6)	47.8 (2.33)	1.1 (1.0,1.2)

* Prevalence from NHANES 2005-2010 has been adjusted to the age, sex, and race/ethnic distribution of the US population at the time of the 2010 Census using the direct method.

**Count expressed in millions; 95% CI=95% confidence limits

[@] Other races not shown separately

OP = osteoporosis; LBM= low bone mass; NH= non-Hispanic. SE = standard error.

Osteoporosis and low bone mass were defined using the WHO criteria. Specifically, osteoporosis was defined as a T-score ≤ -2.5 at either the femoral neck or the lumbar spine. Among those without osteoporosis, low bone mass was defined as those with T-scores between -1.0 and -2.5 at either skeletal site. The reference group for calculation of the scores at the femoral neck for both men and women, consisted of 20-29 non-Hispanic White females from NHANES III. As there is no internationally recommended reference group for the lumbar spine, the reference group for calculation of these scores at the lumbar spine consisted of 30-year old White females from the DXA manufacturer reference database. These reference groups were used to calculate T-scores for all race/ethnic groups and for both sexes.

Source: Wright NC, Looker AC, Saag KG, Curtis JR, Delzell ES, Randall S, et al. The Recent Prevalence of Osteoporosis and Low Bone Mass in the United States Based on Bone Mineral Density at the Femoral Neck or Lumbar Spine. J Bone Miner Res. 2014. PMID: 24771492. http://www.ncbi.nlm.nih.gov/pubmed/24771492.

Table D1.31 Studies included in the analysis of Dietary Patterns Composition. Abbreviations listed below are used in Figures D1.56 to D1.60

Abbreviation Used in Figures	Study/Cohort	Citation
Interventions—feeding studies		
DASH	DASH – Dietary Approaches to Stop Hypertension Trial	Karanja et al. 1999[97]
OMNI CHO	OmniHeart trial – Carbohydrate-rich pattern	Swain et al. 2008[101]
OMNI PRO	OmniHeart trial – higher-protein pattern	
OMNI UNSAT	OmniHeart trial – higher unsaturated fat pattern	
Interventions—other		
EVOO	PREDIMED (Prevención con Dieta Mediterránea) trial. Extra Virgin Olive Oil group	Estruch et al. 2013[94]
NUTS	PREDIMED Mixed nuts group	
Cohorts--Med Diet score		
SUN F (CVD endpoint)	Seguimiento Universidad de Navarra (SUN) project. Female subjects	Martínez-González et al. 2010[98]
SUN M (CVD endpoint)	SUN project. Male subjects	
SUN (blood pressure endpoint)	Seguimiento Universidad de Navarra (SUN) project	Núñez-Córdoba et al.. 2009[99]
NHS (CVD endpoint)	Nurses' Health Study	Fung et al. 2009[95]
EPIC PAN F	European Prospective Investigation into Cancer and Nutrition – Physical Activity, Nutrition, Alcohol, Cessation of Smoking, Eating Out of Home and Obesity project (EPIC-PANACEA) Female subjects	Romaguera et al. 2009[100]
EPIC PAN M	EPIC-PANACEA Male subjects	
EPIC SPAIN	EPIC Spanish Cohort	Buckland et al. 2011[93]
WAICAP	Washington Heights-Inwood Columbia Aging Project (WHICAP)	Scarmeas et al. 2006[112]
NHS (cognitive decline endpoint)	Nurses' Health Study	Samieri et al. 2013[111]
Cohorts/Other scores		
WHI	Women's Health Initiative	George et al. 2014[96]
HPFS	Health Professionals Follow-up Study	McCullough et al. 2000[114]
EPIC POT F	EPIC Potsdam (Germany) study Female Subjects	von Ruesten et al. 2010[109]
EPIC POT M	EPIC Potsdam (Germany) study Male Subjects	

Table D1.31, continued

Abbreviation Used in Figures	Study/Cohort	Citation
Factor/Cluster Analyses		
NHS (type 2 diabetes endpoint)	Nurses' Health Study	Fung et al. 2004[103]
NHS (CHD endpoint)	Nurses' Health Study	Fung et al. 2001[104]
HPFS	Health Professionals Follow-up Study	Hu et al. 2000[105]
FOS	Framingham Offspring Study	McKeown et al. 2002[107]
WHITEHALL	Whitehall II study	Brunner et al. 2008[102]
SHANGHAI	Shanghai Women's Health Study	Villegas et al. 2010[108]
SINGAPORE	Singapore Chinese Health Study	Butler 2010[110]

Table D1.32. Composition of three USDA Food Patterns (Healthy U.S.-Style, Healthy Vegetarian, and Healthy Mediterranean-style) at the 2000 calorie level. Daily or weekly amounts from selected food groups, subgroups, and components.

Food group	Healthy US-style Pattern	Healthy Vegetarian Pattern	Healthy Med-style Pattern
Fruit	2 c per day	2 c per day	2 ½ c per day
Vegetables	2 ½ c per day	2 ½ c per day	2 ½ c per day
-Legumes	1 ½ c per wk	3 c per wk	1 ½ c per wk
Whole Grains	3 oz eq per day	3 oz eq per day	3 oz eq per day
Dairy	3 c per day	3 c per day	2 c per day
Protein Foods	5 ½ oz eq per day	3 ½ oz eq per day	6 ½ oz eq per day
--Meat	12 ½ oz eq/wk	--	12 ½ oz eq/wk
--Poultry	10 ½ oz eq/wk	--	10 ½ oz eq/wk
--Seafood	8 oz eq/wk	--	15 oz eq/wk
--Eggs	3 oz eq/wk	3 oz eq/wk	3 oz eq/wk
--Nuts/seeds	4 oz eq/wk	7 oz eq/wk	4 oz eq/wk
--Processed soy	½ oz eq/wk	8 oz eq/wk	½ oz eq/wk
Oils	27 g per day	27 g per day	27 g per day

Source: Food Pattern Modeling report: ***Appendix E-3.7 Developing Vegetarian and Mediterranean-style Food Patterns***

Table D1.33. Nutrients in the three USDA Food Patterns (Healthy US Style, Healthy Vegetarian, and Healthy Mediterranean-style) at the 2000 calorie level as a percent of the goal or limit for a 19 to 30 year old woman.

Nutrient	Healthy US-style Pattern % goal/limit	Healthy Vegetarian Pattern % goal/limit	Healthy Med-style Pattern % goal/limit
Protein -%RDA	198	155	194
Protein -%calorie	18	14	18
Fat-%calorie	33	34	32
Saturated fat* - %calorie	8	8	8
CHO-%RDA	197	211	199
CHO-%calorie	51	55	52
Fiber -% goal	`109	126	112
Calcium-%RDA	127	133	100
Iron-%RDA	93	96	95
Vitamin D-%RDA	46	37	42
Potassium-%AI	71	70	71
Sodium*-%UL	78	61	73

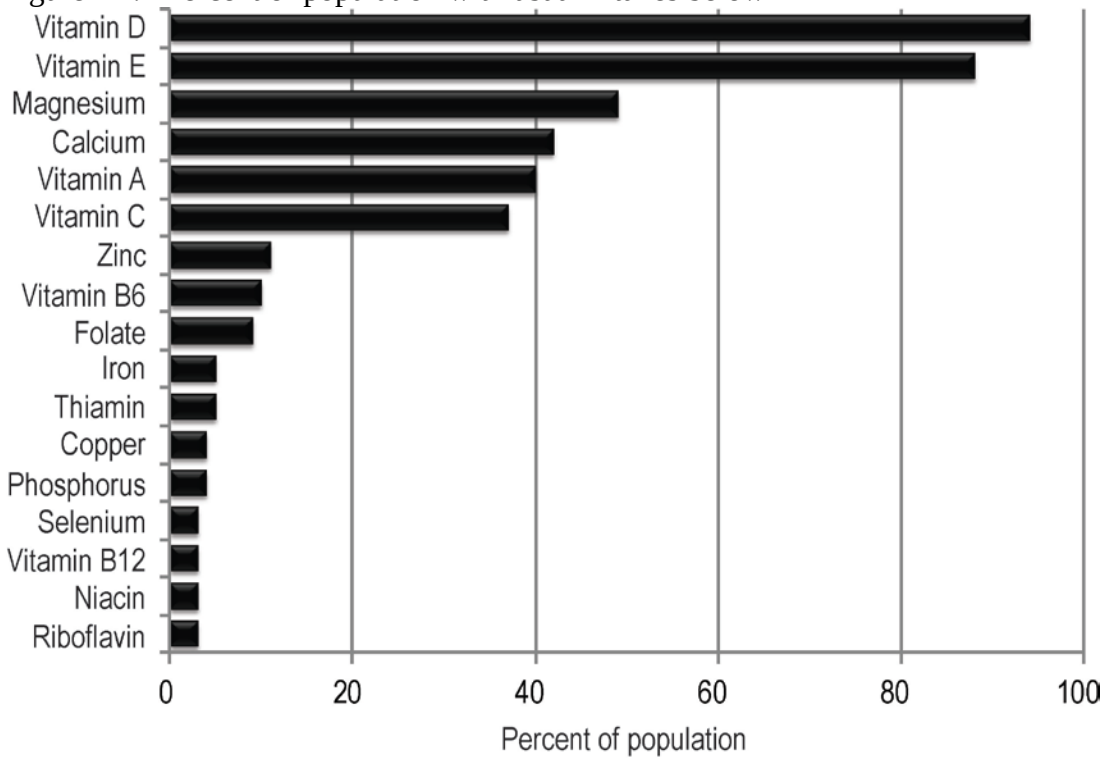
*overconsumed nutrient

Source: Food Pattern Modeling report: Developing Vegetarian and Mediterranean-style Food Patterns (see ***Appendix E-3.7)***

Part D Chapter 1. Figures

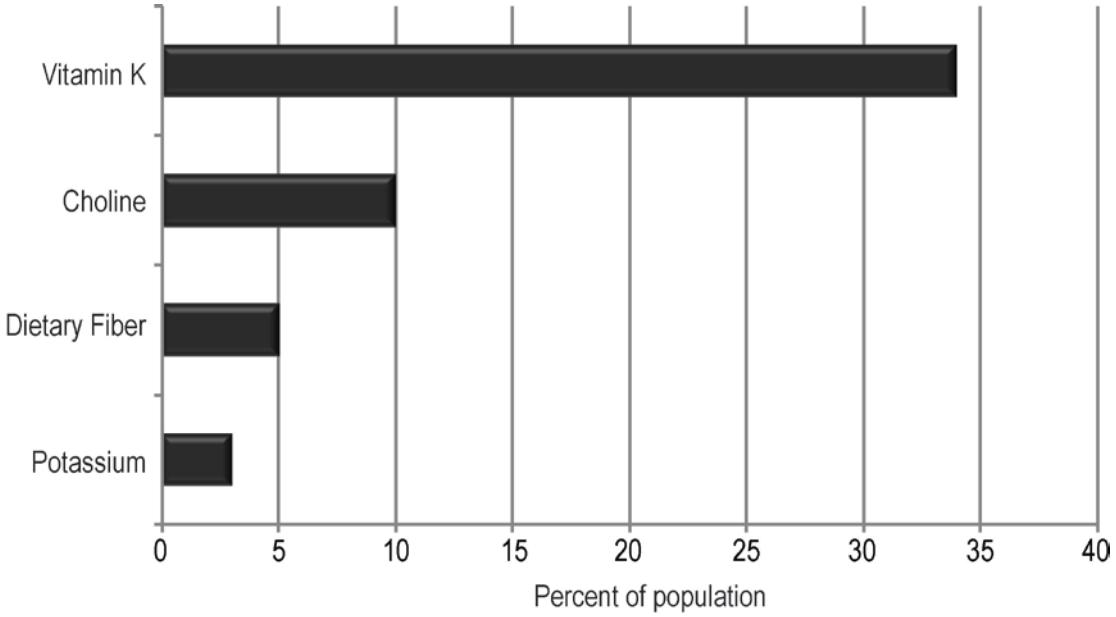
Figure D1.62	Intake from Protein Foods subgroups by self-identified vegetarians in comparison to non-vegetarian and amounts in USDA Food Pattern at 2000 calories.

Figure D1.1 Percent of population with usual intakes below EAR



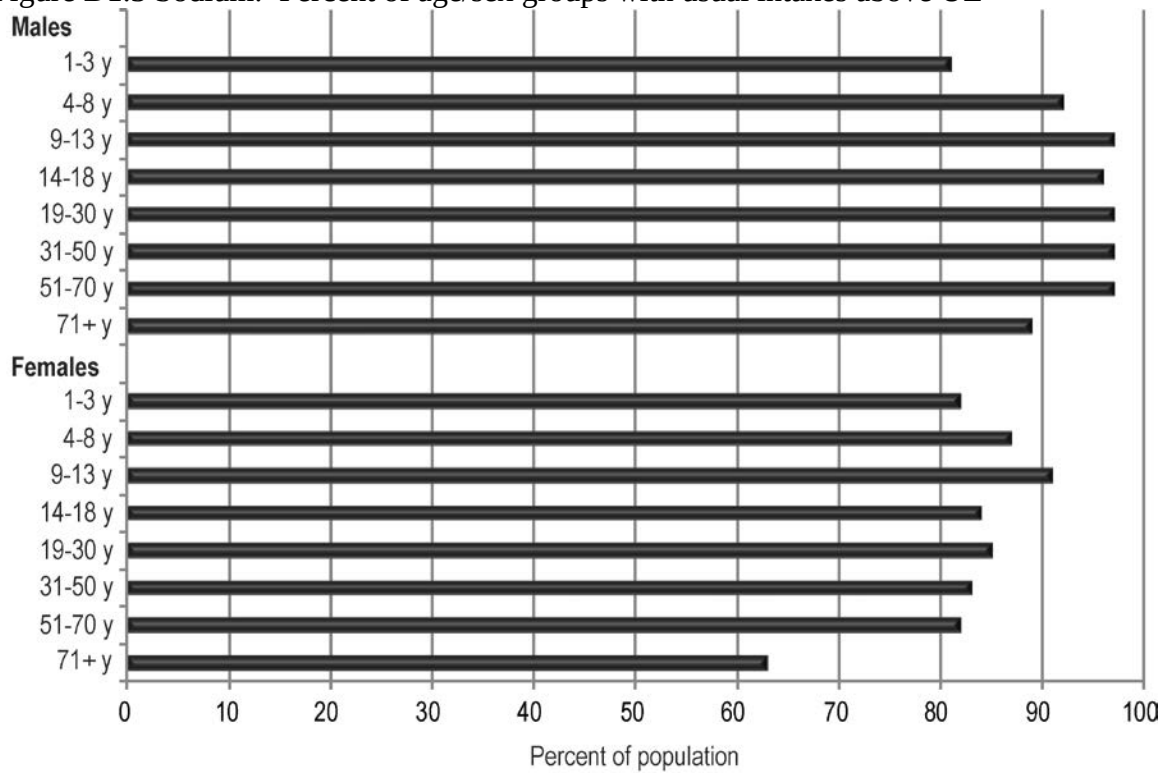
Source: What We Eat in America, NHANES 2007-2010

Figure D1.2 Percent of population with usual intakes above AI



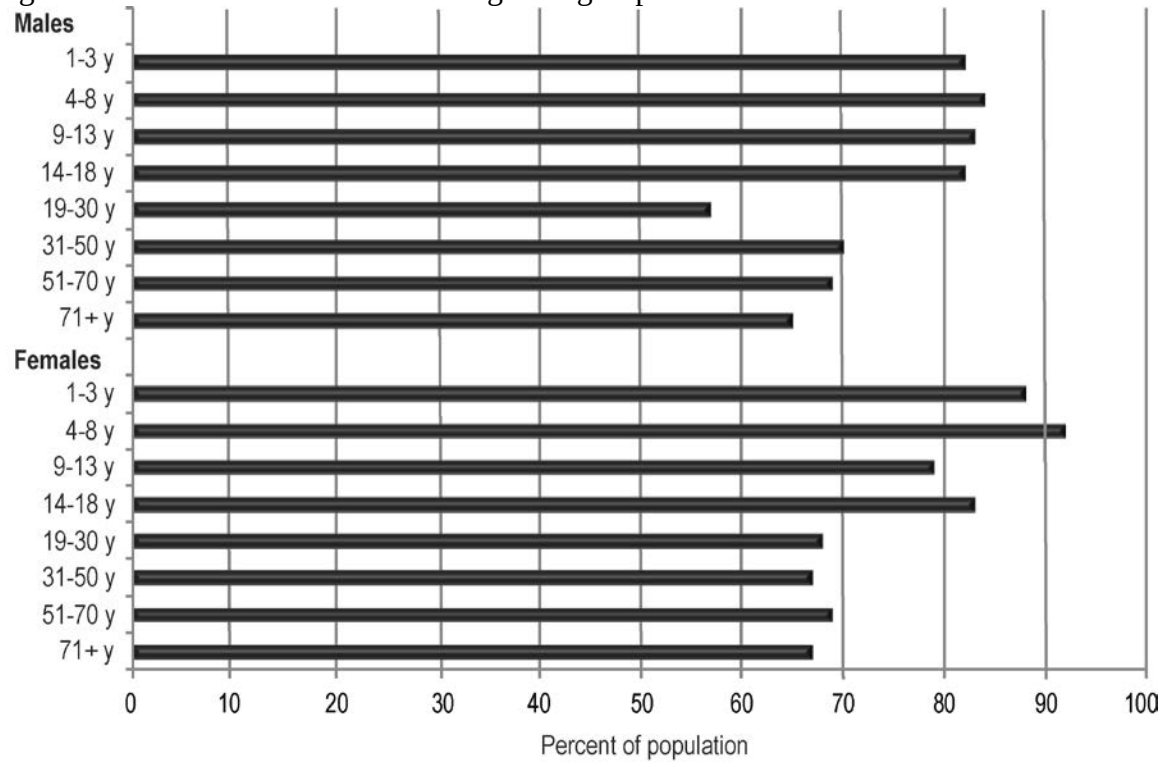
Source: What We Eat in America, NHANES 2007-2010

Figure D1.3 Sodium: Percent of age/sex groups with usual intakes above UL



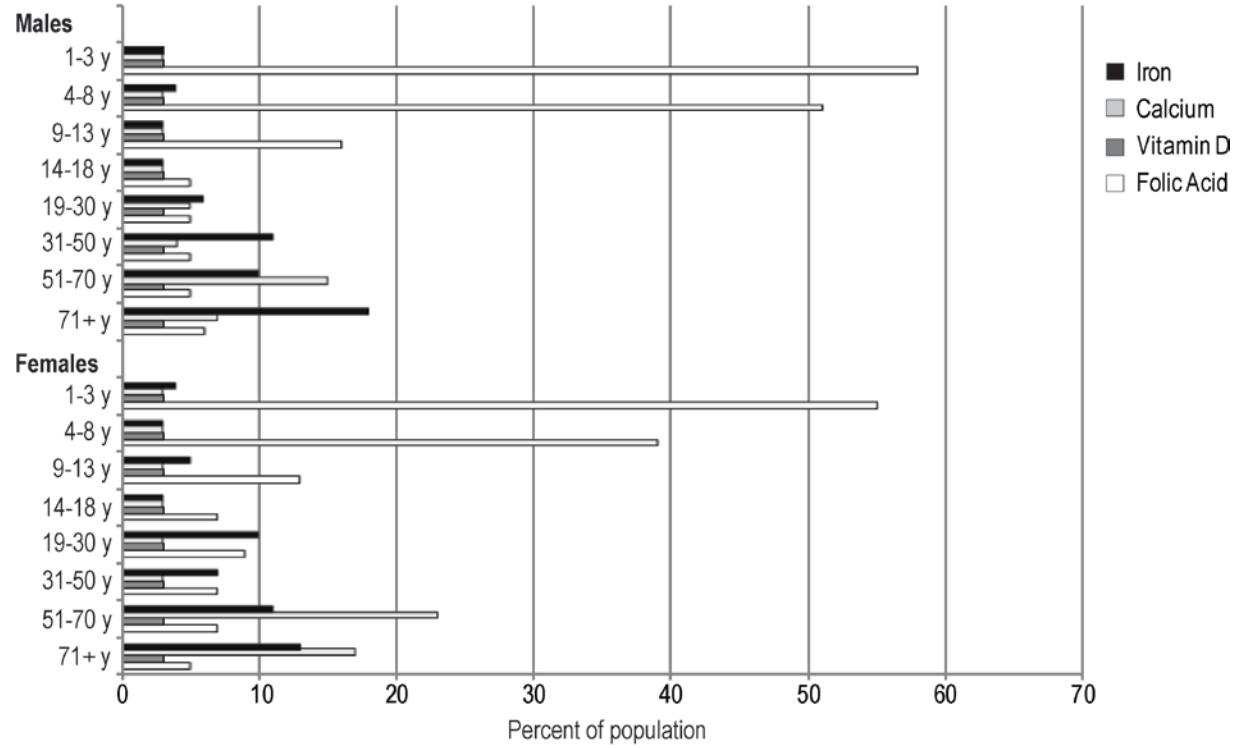
Source: What We Eat in America, NHANES 2007-2010

Figure D1.4 Saturated fat: Percent of age/sex groups with usual intake above 10% of calories



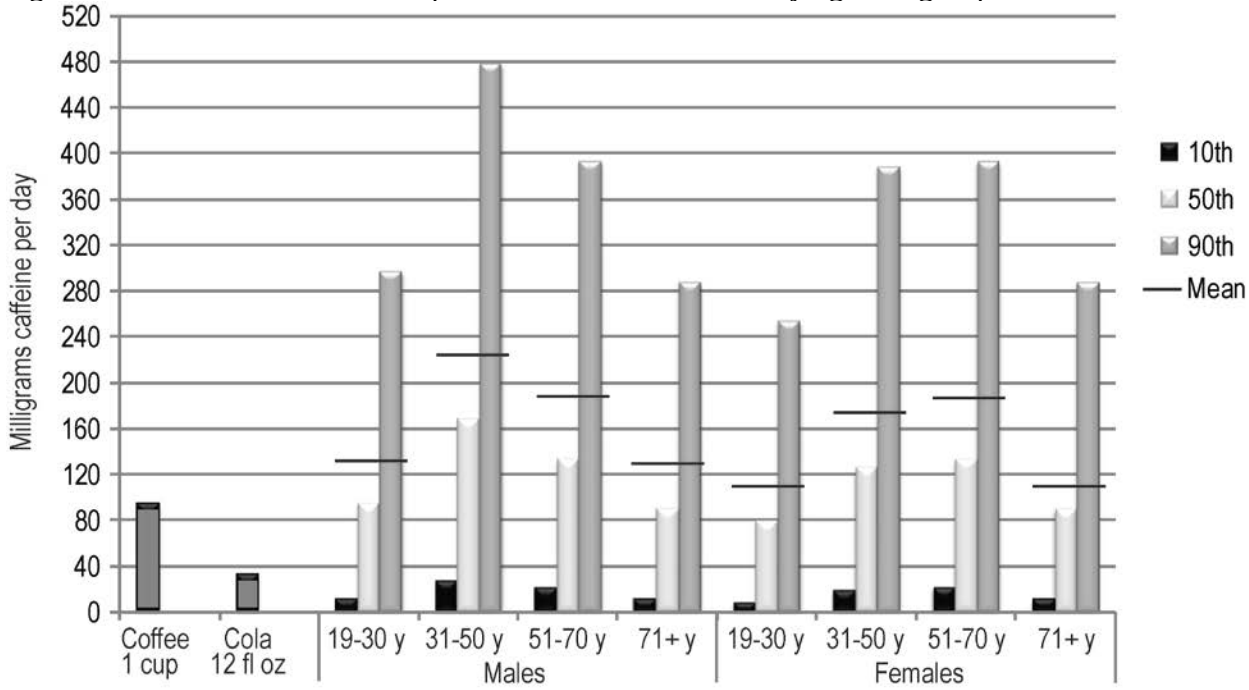
Source: What We Eat in America, NHANES 2007-2010

Figure D1.5 Supplement users: Percent with usual intakes from foods, beverages, and supplements greater than the UL



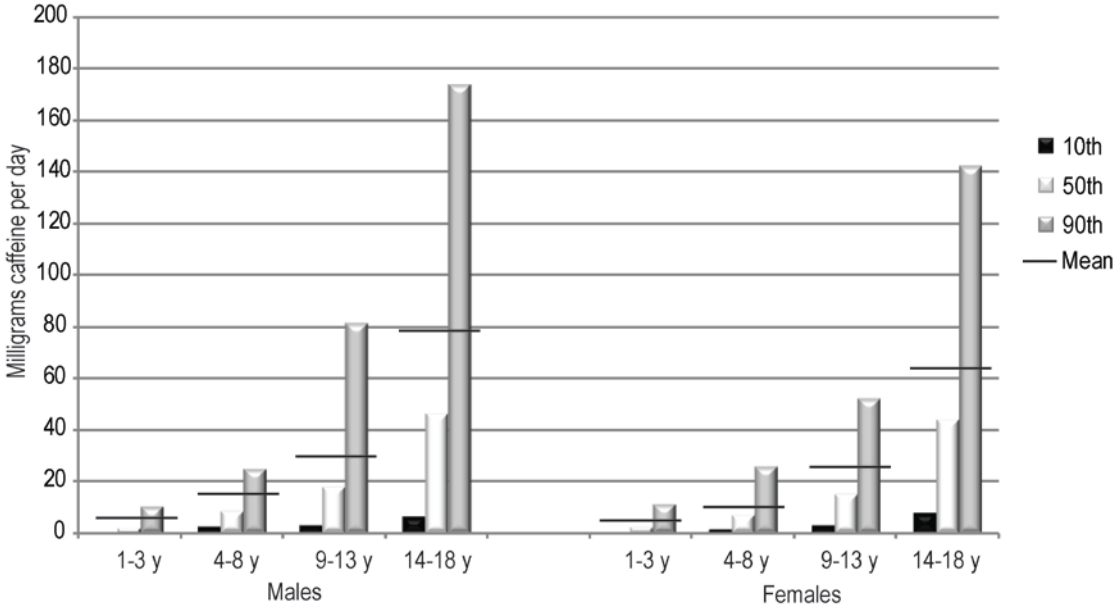
Source: What We Eat in America, NHANES 2007-2010

Figure D1.6 Caffeine: mean and percentiles of usual intake by age/sex groups-adults



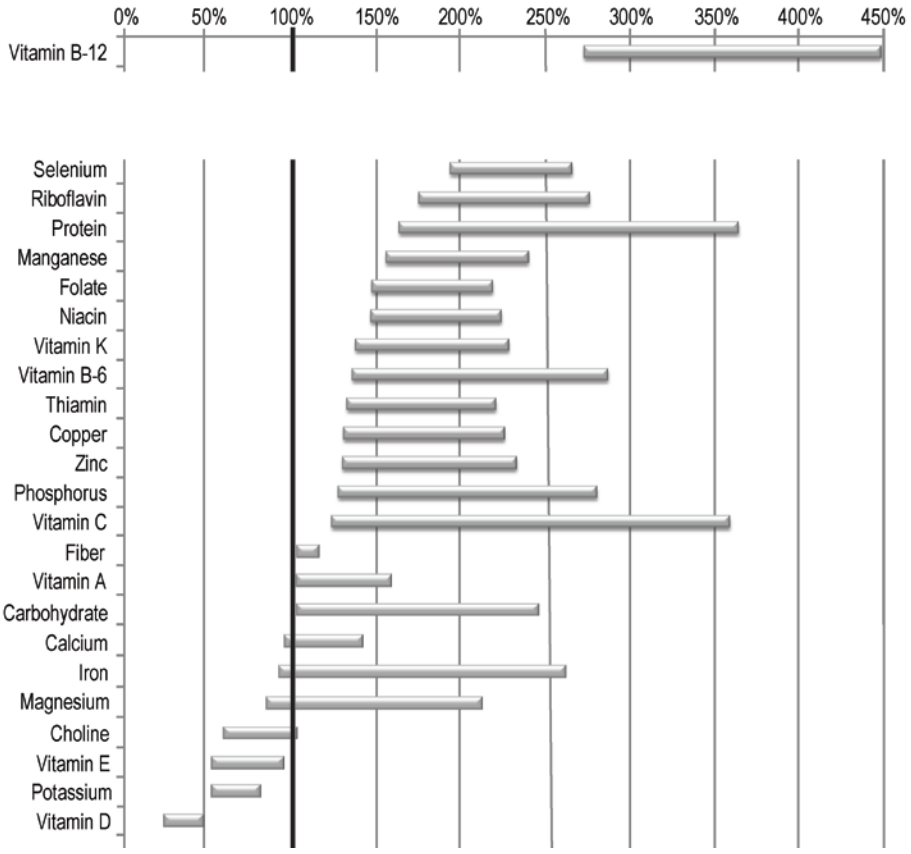
Source: What We Eat in America, NHANES 2007-2010

Figure D1.7 Caffeine: mean and percentiles of usual intake by age/sex groups-children and adolescents



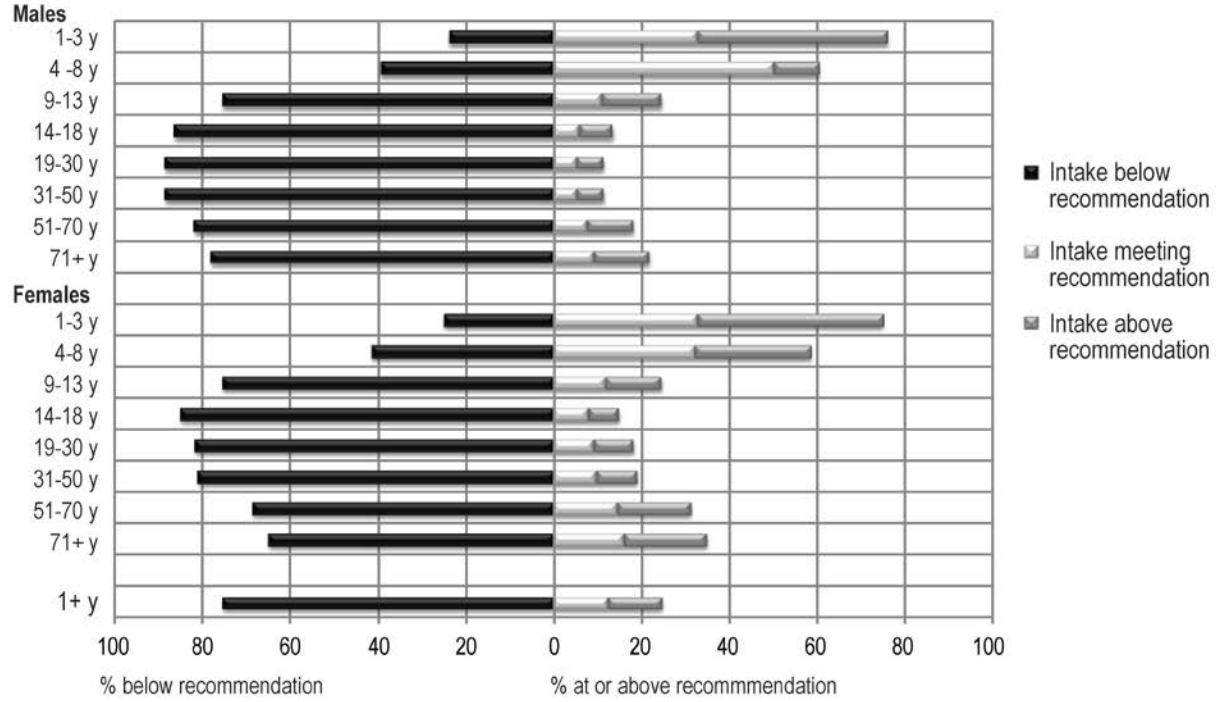
Source: What We Eat in America, NHANES 2007-2010

Figure D1.8 USDA Food Patterns: Range of nutrients in patterns as a percent of the target levels for all age/gender groups



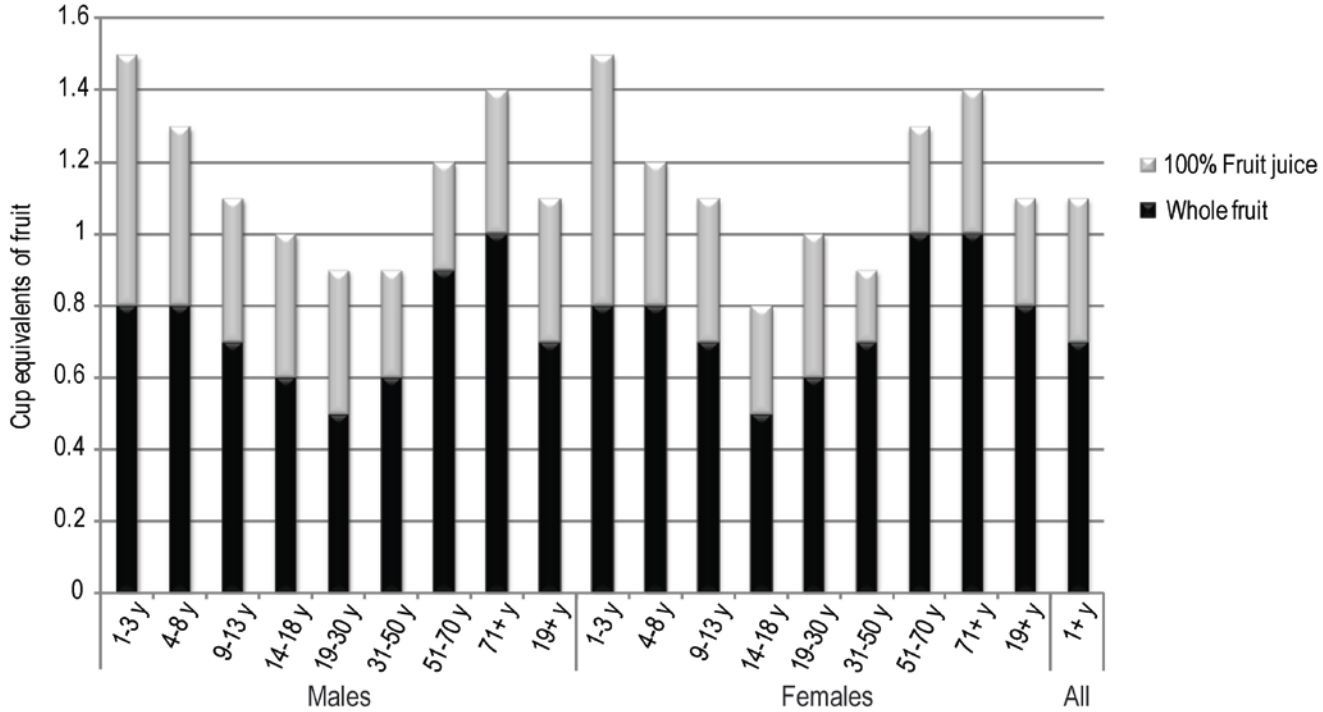
Source: What We Eat in America, NHANES 2007-2010

Figure D1.9 Total Fruit: Estimated percent of persons below, at, or above recommendation



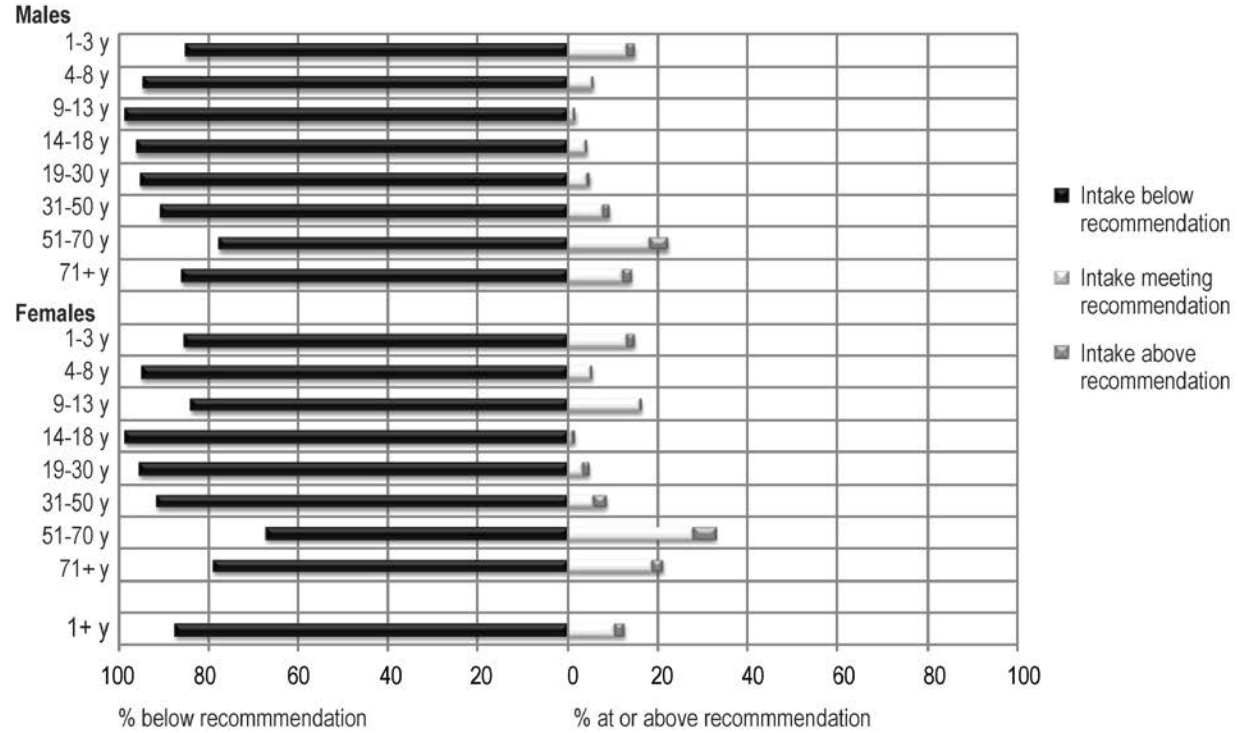
Source: What We Eat in America, NHANES 2007-2010

Figure D1.10 Whole fruit vs. fruit juice consumption by age/sex groups



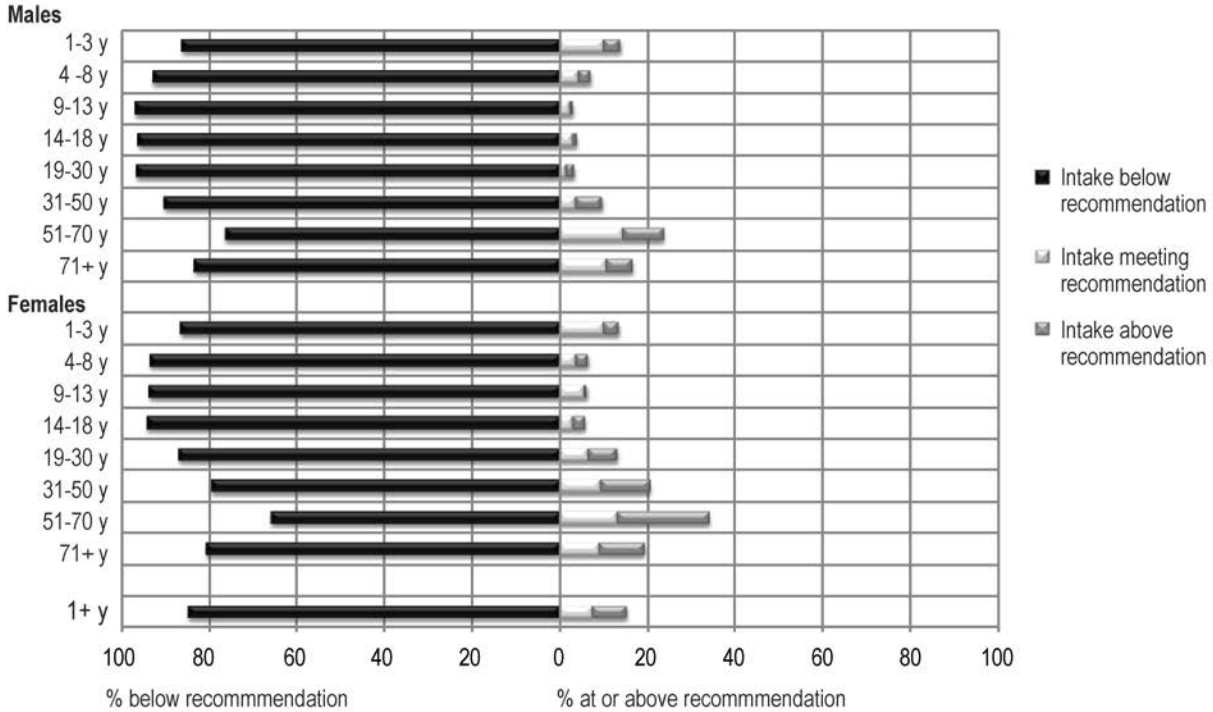
Source: What We Eat in America, NHANES 2007-2010

Figure D1.11 Total Vegetables: Estimated percent of persons below, at, or above recommendation



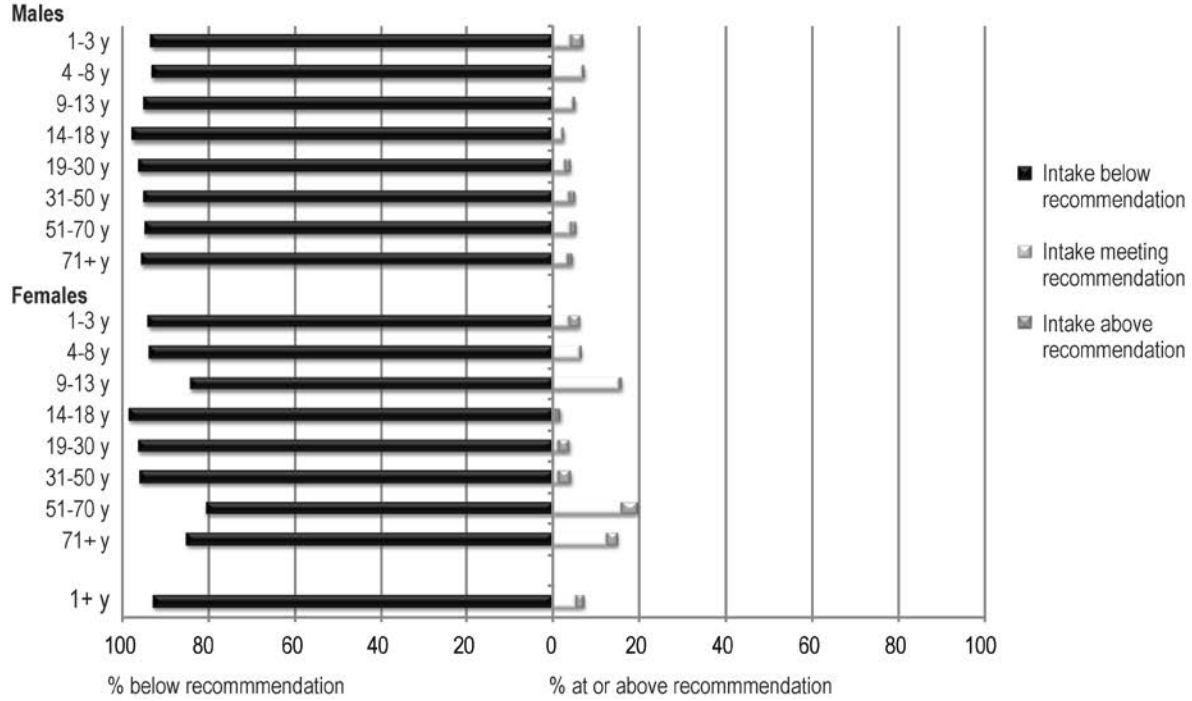
Source: What We Eat in America, NHANES 2007-2010

Figure D1.12 Dark Green vegetables: Estimated percent of persons below, at, or above recommendation



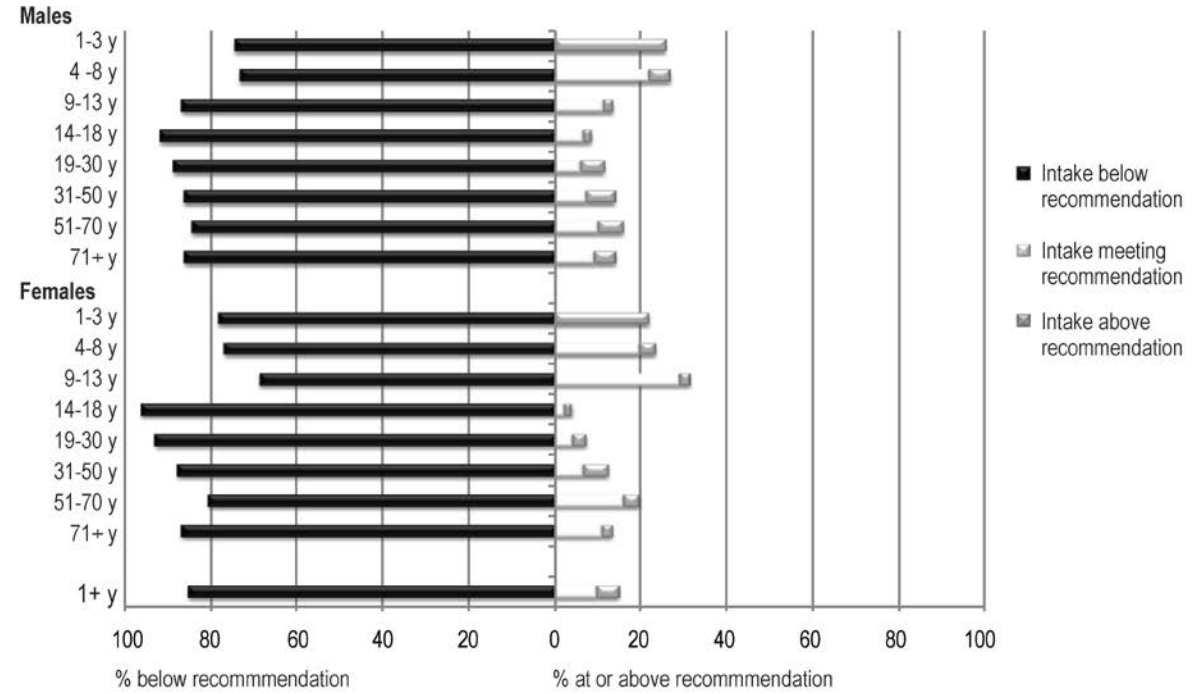
Source: What We Eat in America, NHANES 2007-2010

Figure D1.13 Red and Orange vegetables: Estimated percent of persons below, at, or above recommendation



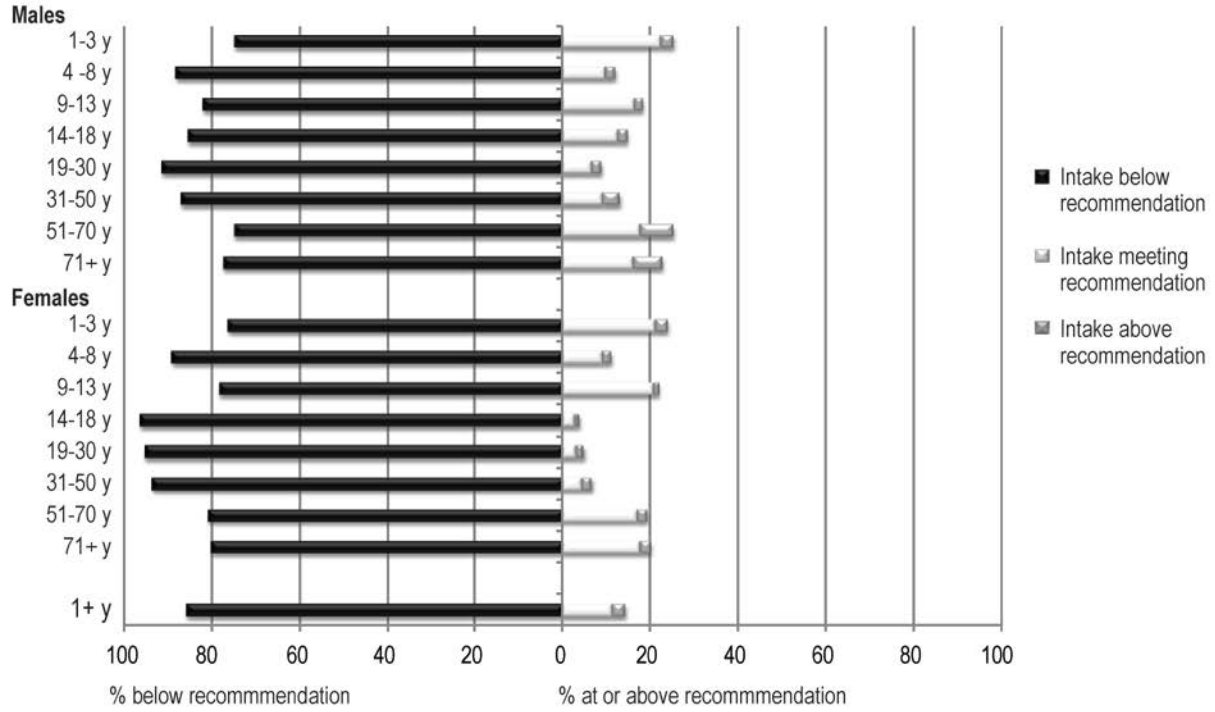
Source: What We Eat in America, NHANES 2007-2010

Figure D1.14 Beans and Peas: Estimated percent of persons below, at, or above recommendation



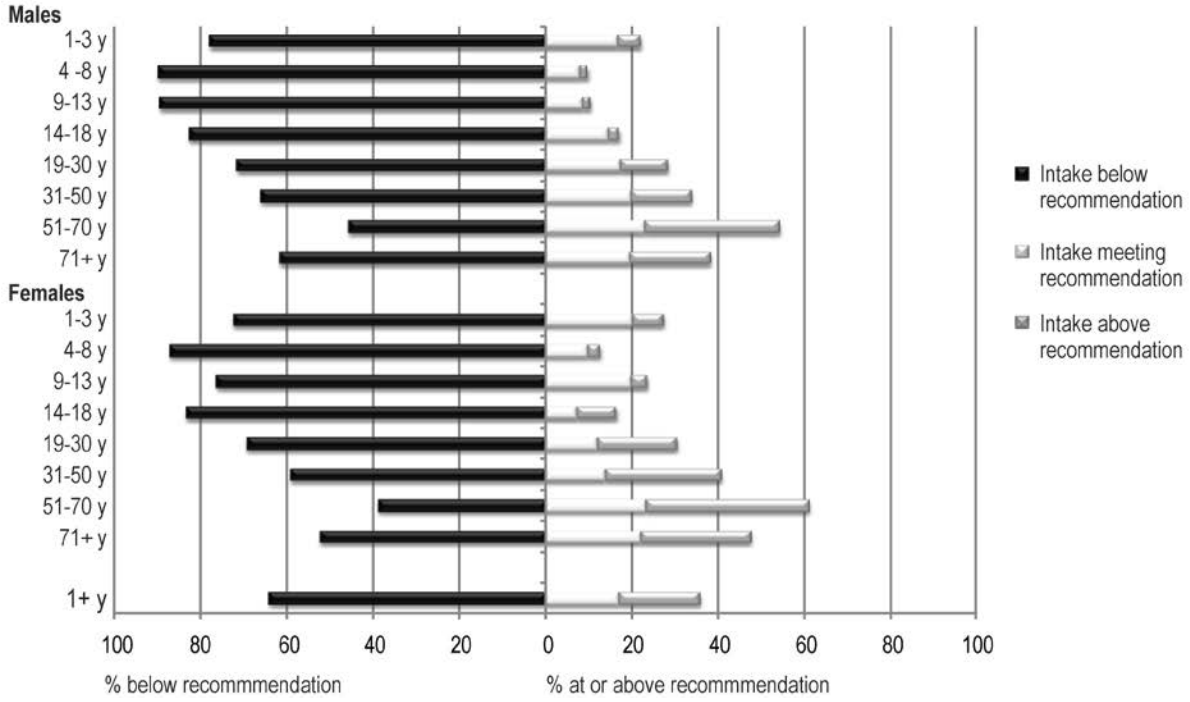
Source: What We Eat in America, NHANES 2007-2010

Figure D1.15 Starchy vegetables: Estimated percent of persons below, at, or above recommendation



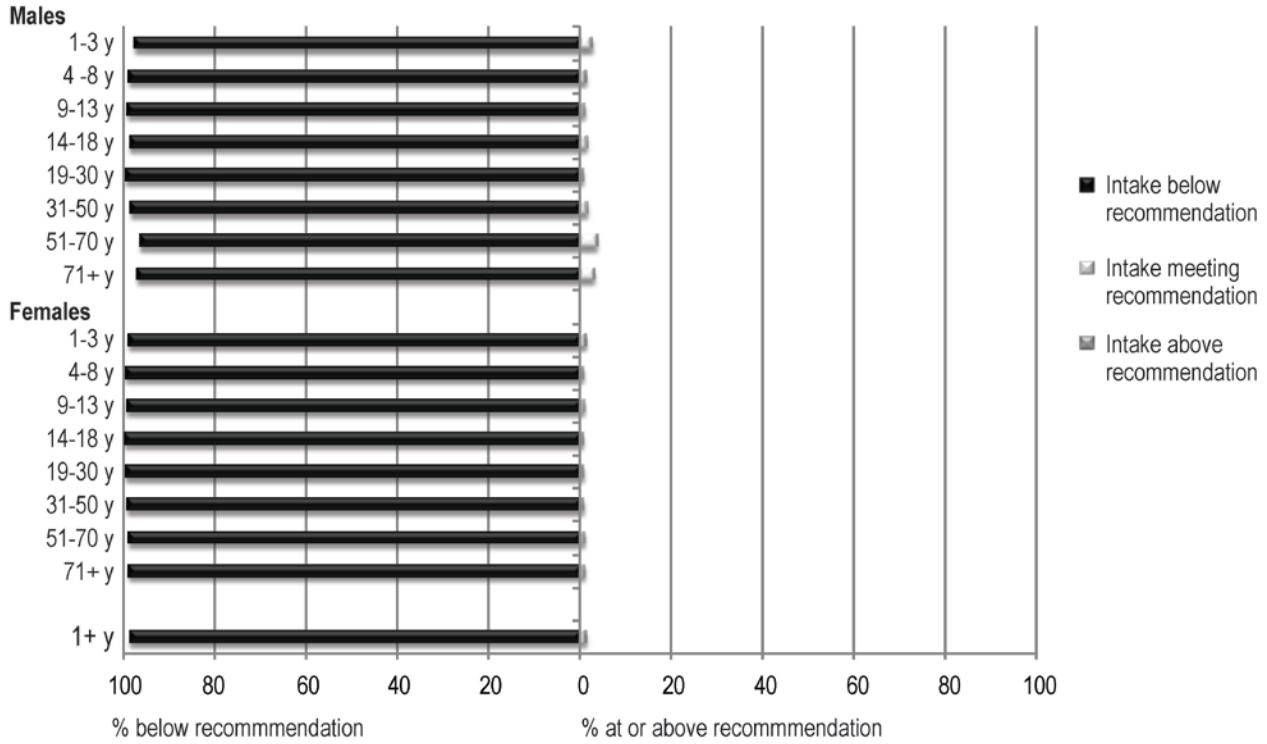
Source: What We Eat in America, NHANES 2007-2010

Figure D1.16 Other vegetables: Estimated percent of persons below, at, or above recommendation



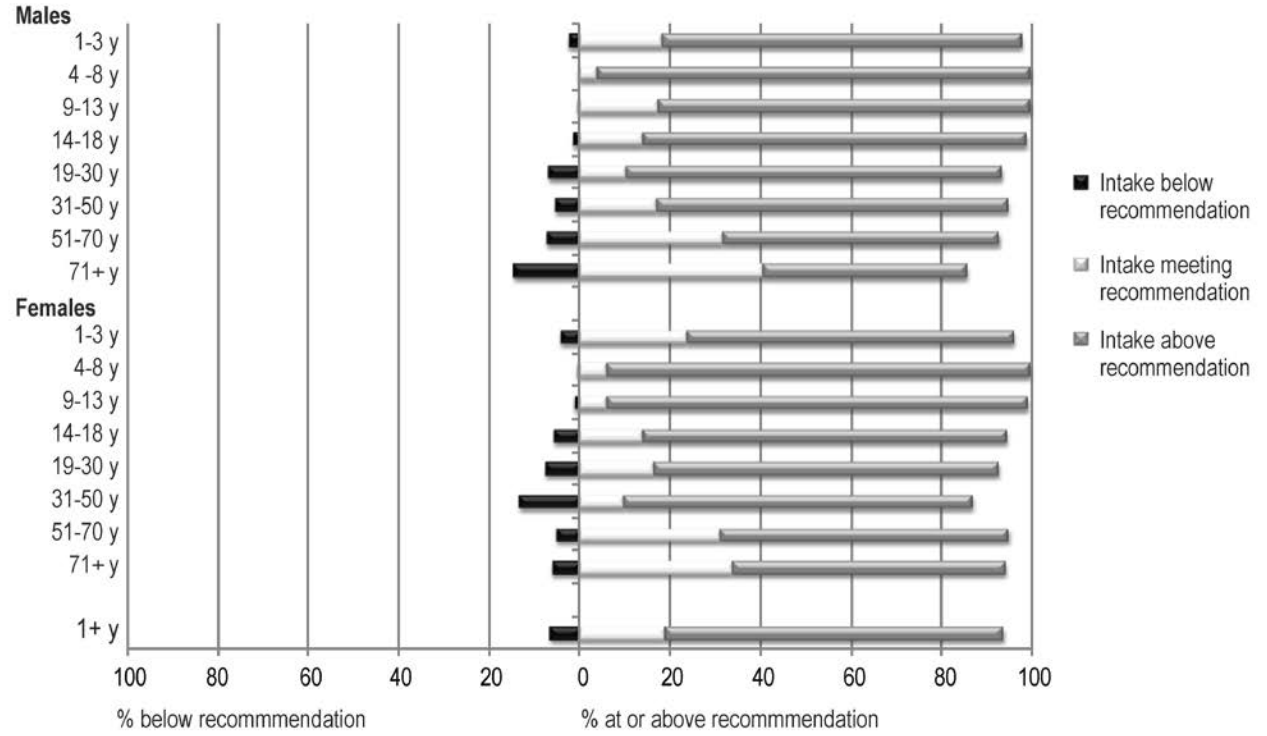
Source: What We Eat in America, NHANES 2007-2010

Figure D1.17 Whole grains: Estimated percent of persons below, at, or above recommendation



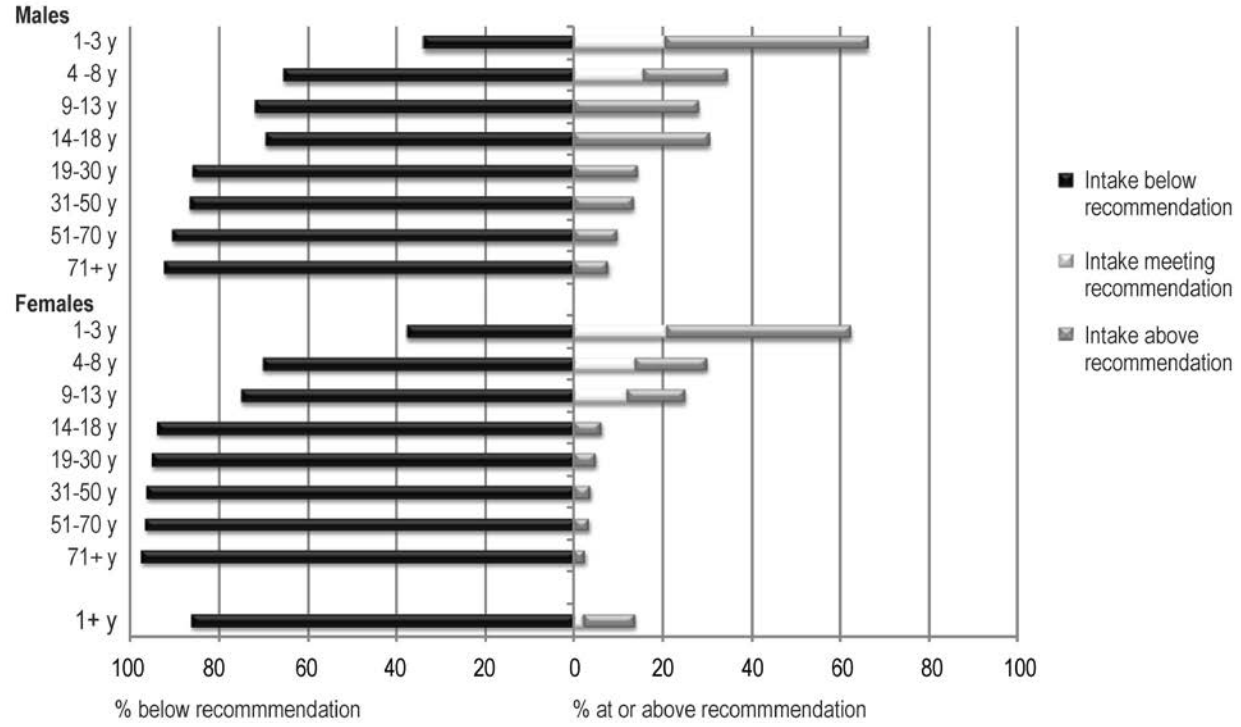
Source: What We Eat in America, NHANES 2007-2010

Figure D1.18 Refined grains: Estimated percent of persons below, at, or above limits



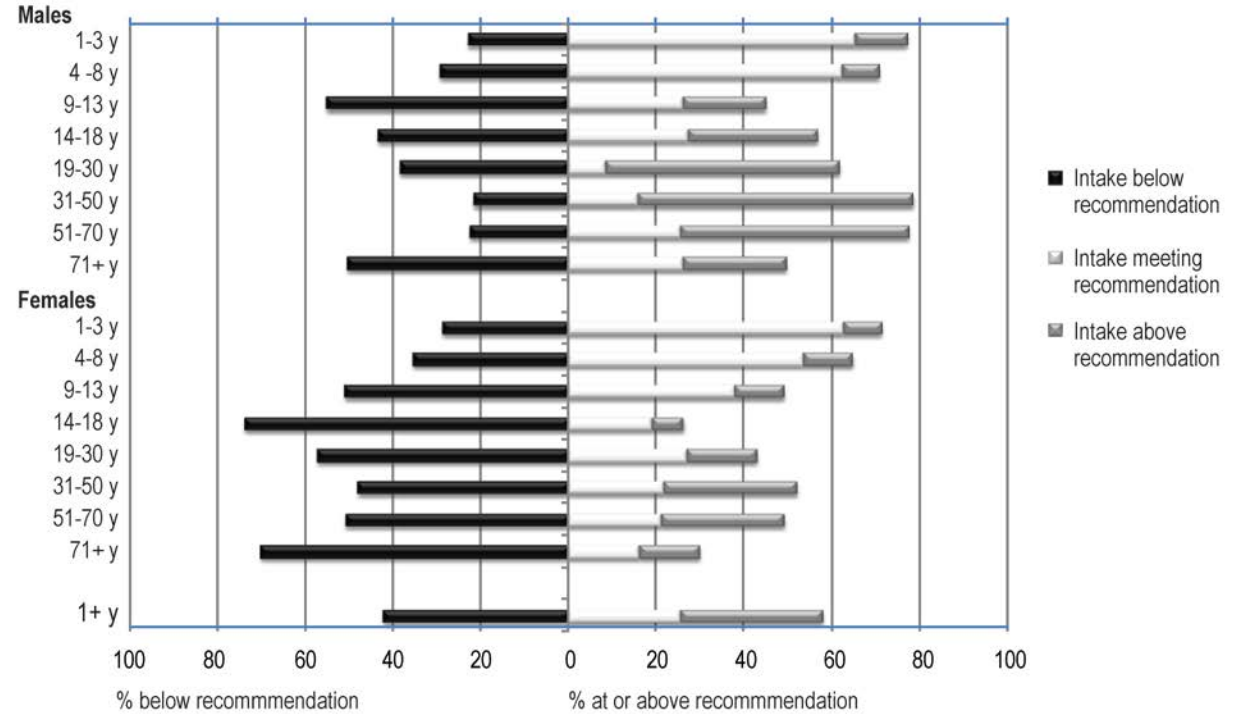
Source: What We Eat in America, NHANES 2007-2010

Figure D1.19 Dairy: Estimated percent of persons below, at, or above recommendation



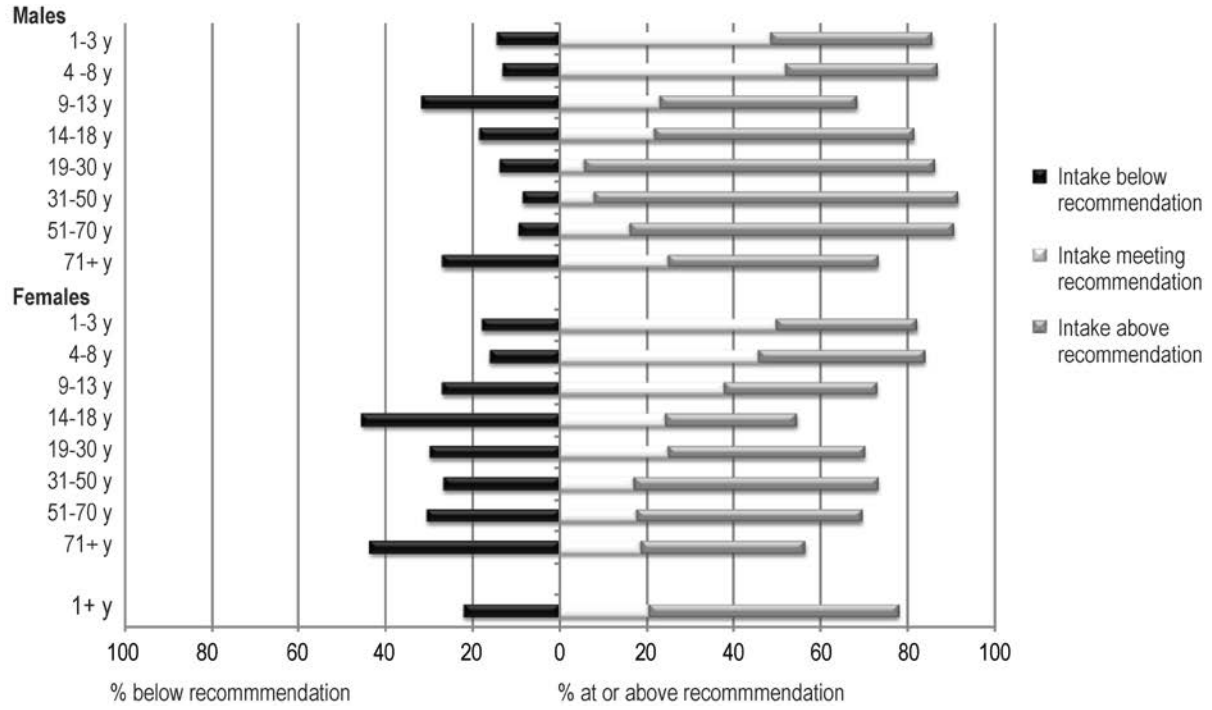
Source: What We Eat in America, NHANES 2007-2010

Figure D1.20 Total Protein foods: Estimated percent of persons below, at, or above recommendation



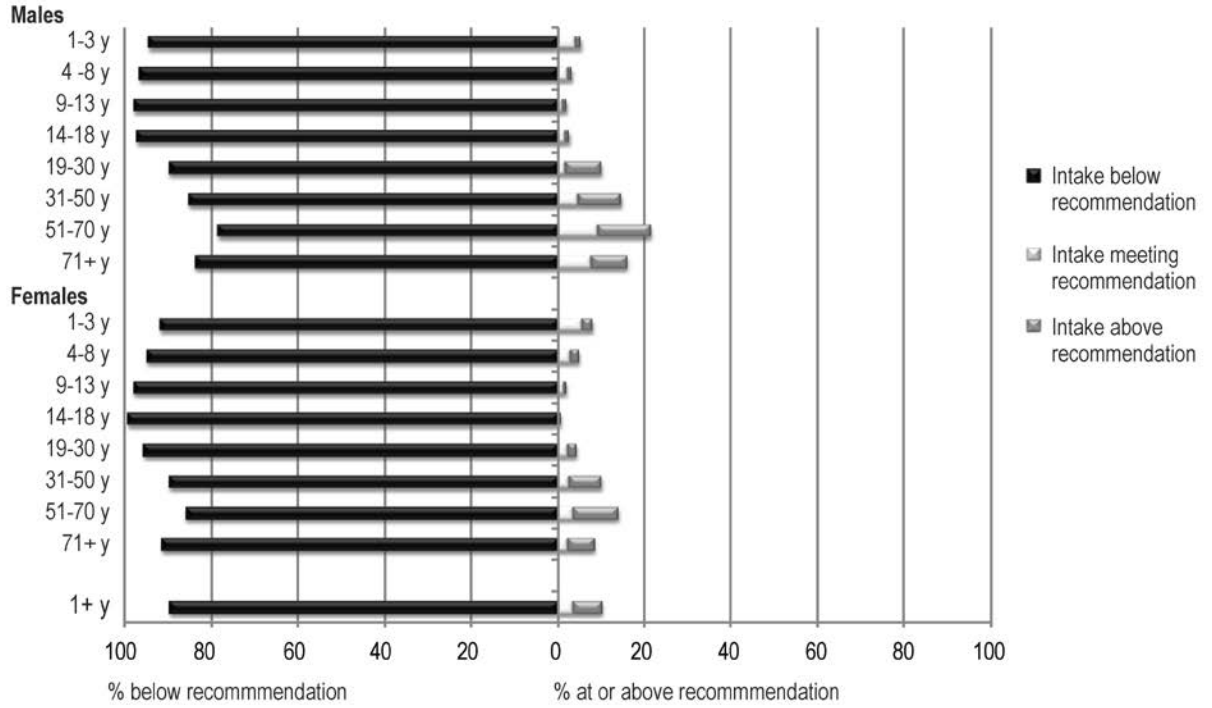
Source: What We Eat in America, NHANES 2007-2010

Figure D1.21 Meat, poultry, eggs: Estimated percent of persons below, at, or above recommendation



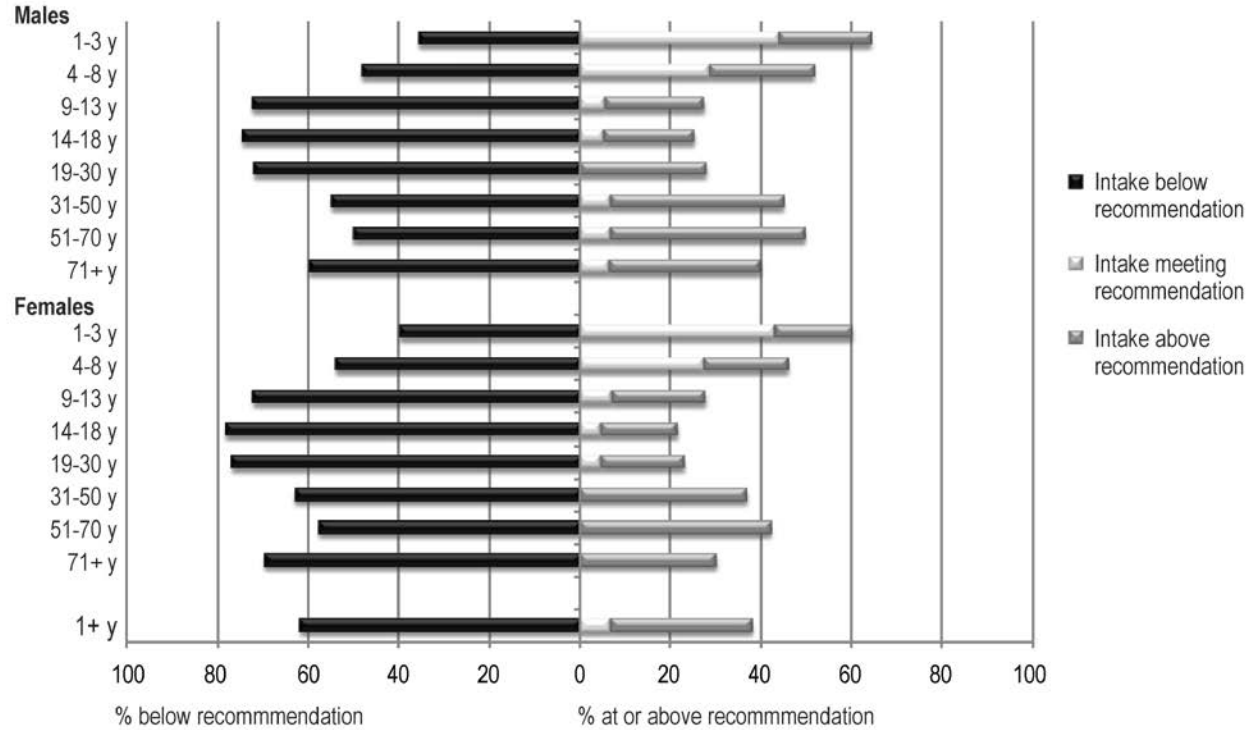
Source: What We Eat in America, NHANES 2007-2010

Figure D1.22 Seafood: Estimated percent of persons below, at, or above recommendation



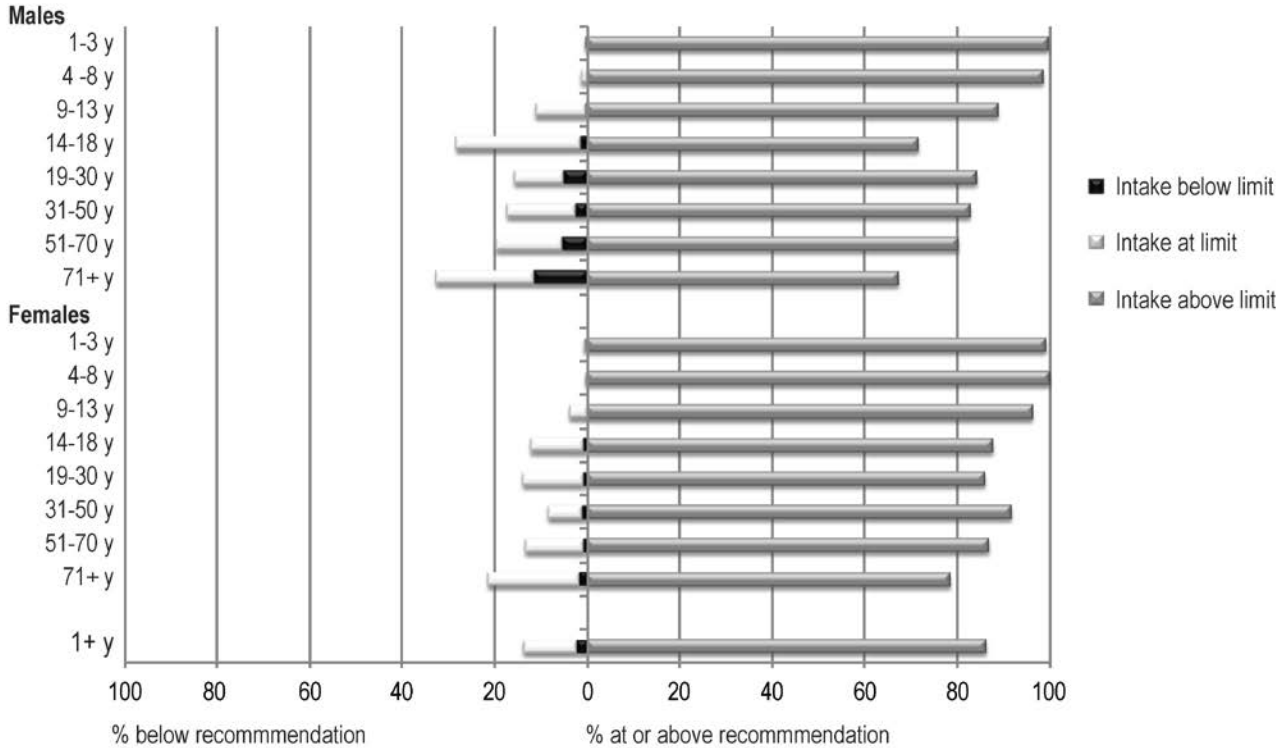
Source: What We Eat in America, NHANES 2007-2010

Figure D1.23 Nuts, seeds, soy: Estimated percent of persons below, at, or above recommendation



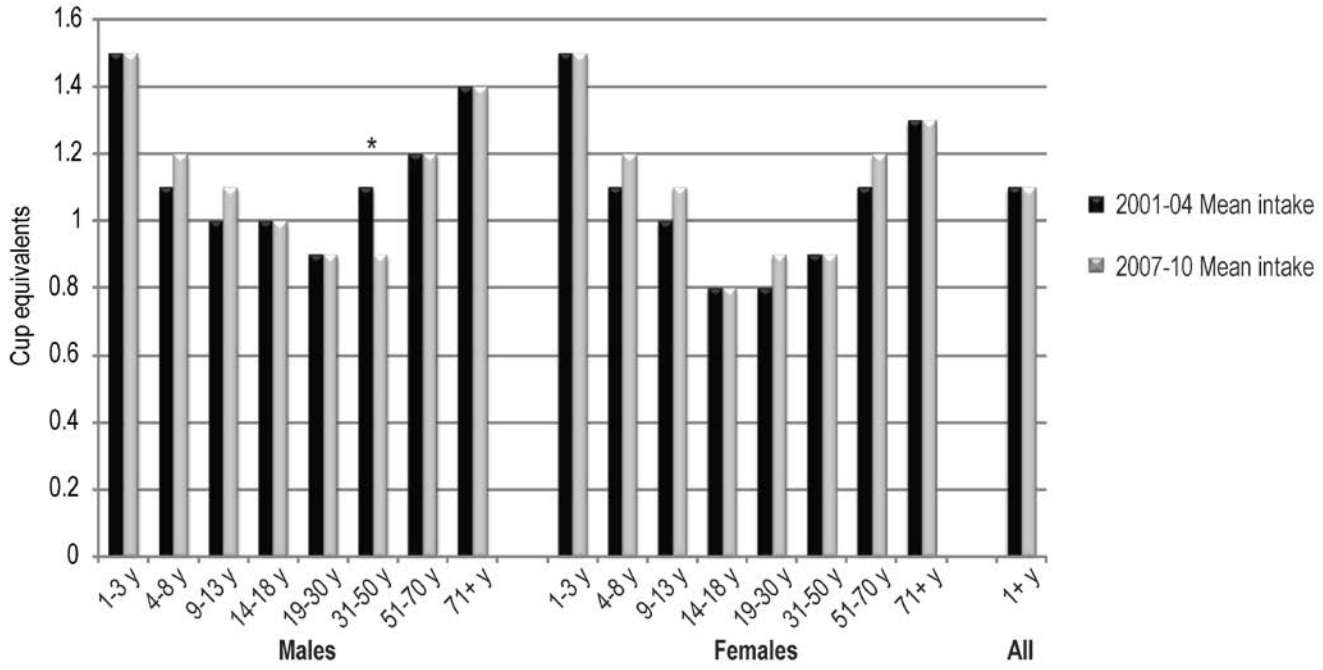
Source: What We Eat in America, NHANES 2007-2010

Figure D1.24 Empty calories: Estimated percent of persons below, at, or above limits



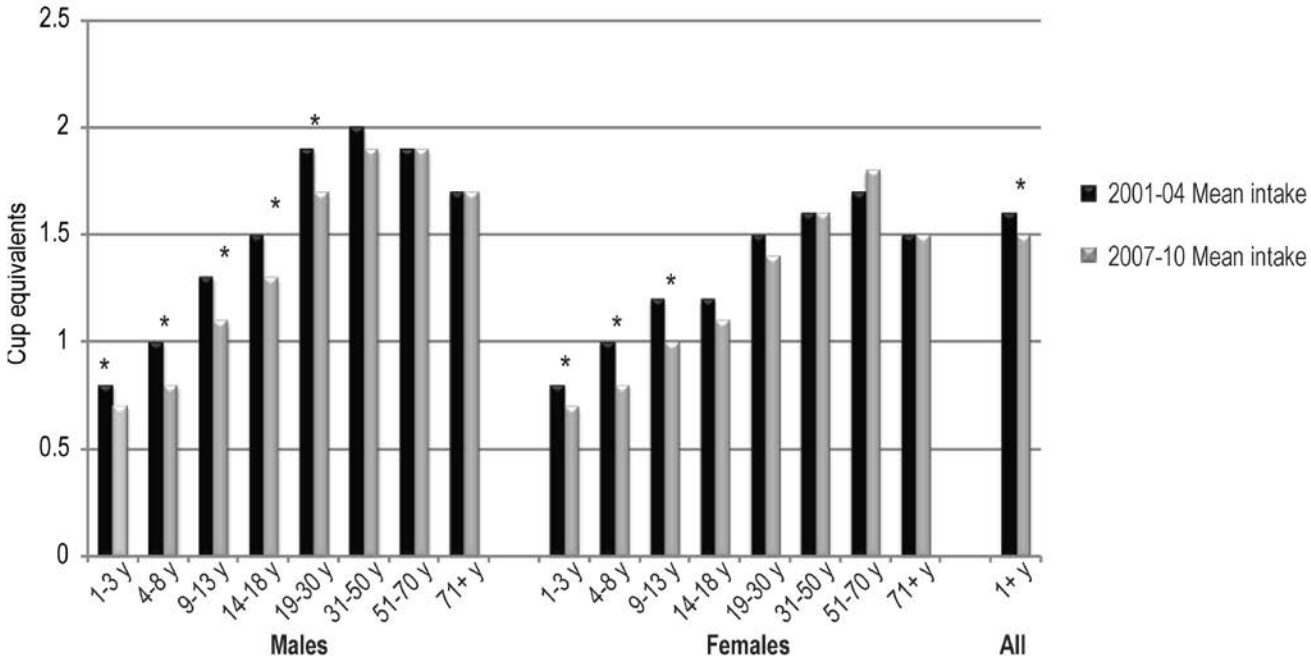
Source: What We Eat in America, NHANES 2007-2010

Figure D1.25 Fruit: Mean intakes over time (2001-04 vs. 2007-10) by age/sex group



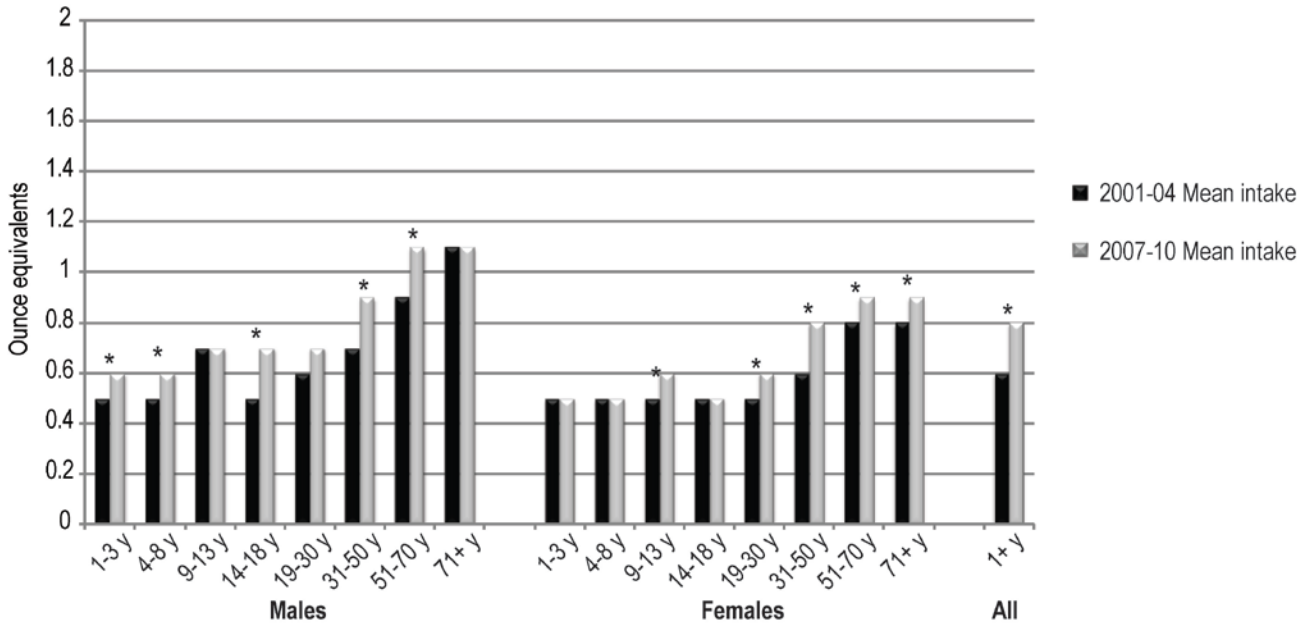
*p<.05
Source: What We Eat in America, NHANES 2001-2004 and 2007-2010

Figure D1.26 Vegetables: Mean intakes over time (2001-04 vs. 2007-10) by age/sex group



*p<.05
Source: What We Eat in America, NHANES 2001-2004 and 2007-2010

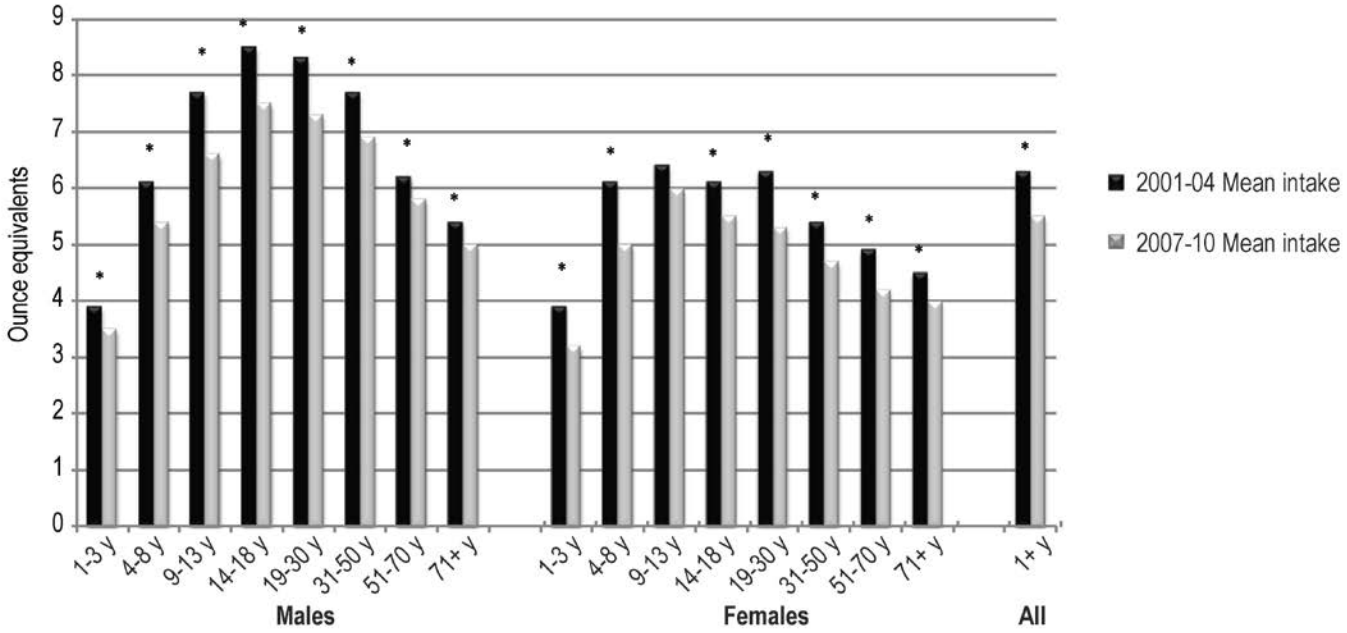
Figure D1.27 Whole grains: Mean intakes over time (2001-04 vs. 2007-10) by age/sex group



*p<.05

Source: What We Eat in America, NHANES 2001-2004 and 2007-2010

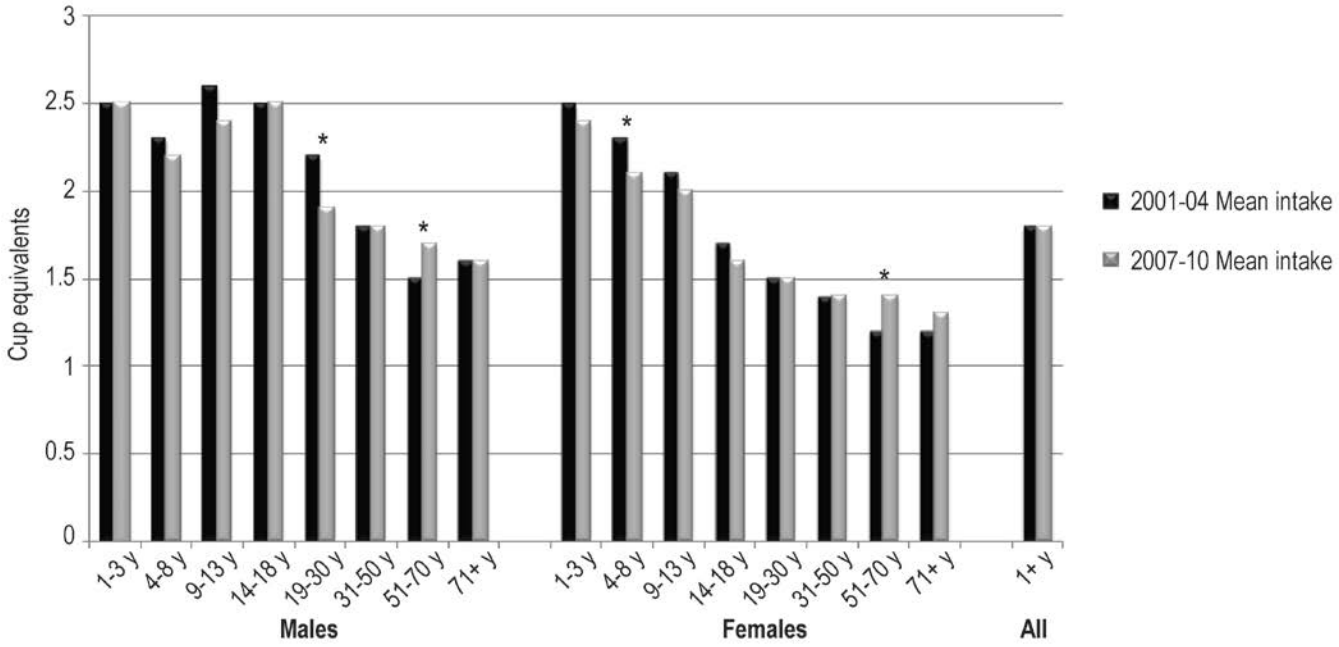
Figure D1.28 Refined grains: Mean intakes over time (2001-04 vs. 2007-10) by age/sex group



*p<.05

Source: What We Eat in America, NHANES 2001-2004 and 2007-2010

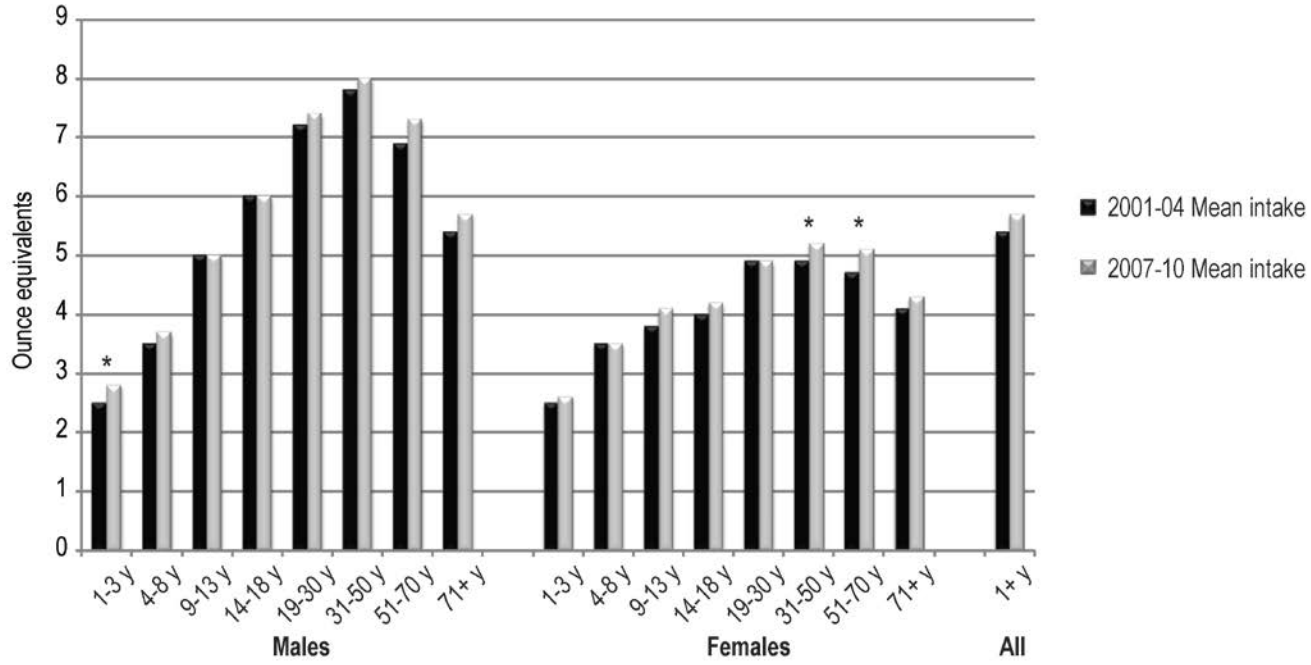
Figure D1.29 Dairy: Mean intakes over time (2001-04 vs. 2007-10) by age/sex group



*p<.05

Source: What We Eat in America, NHANES 2001-2004 and 2007-2010

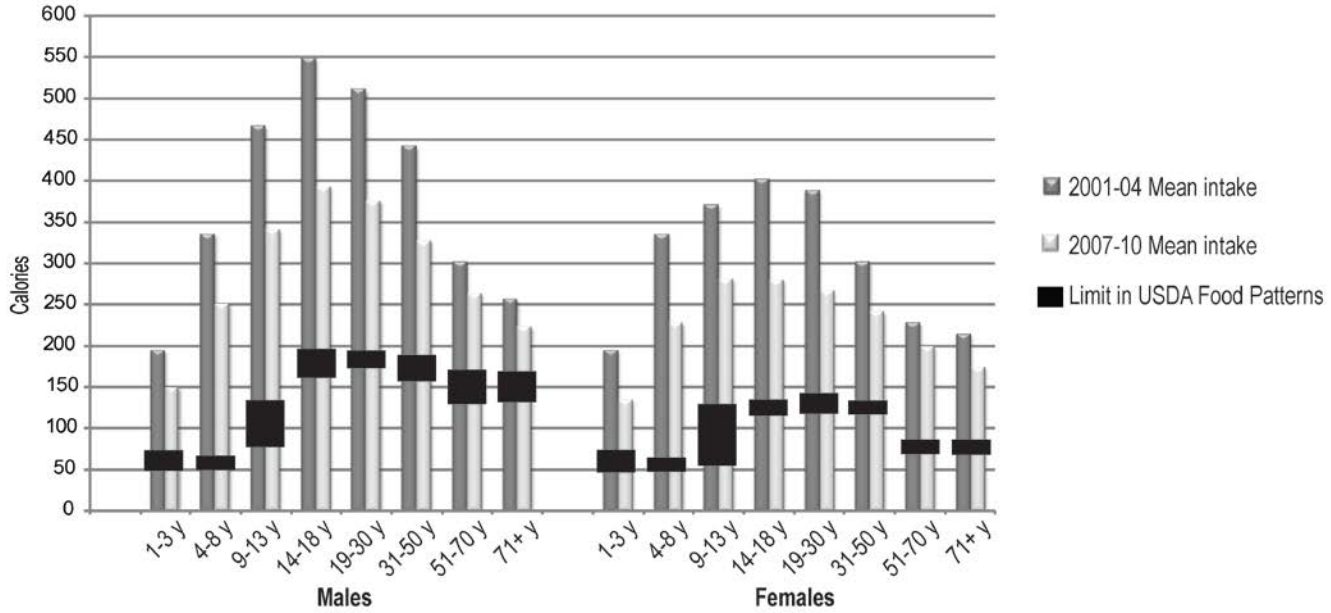
Figure D1.30 Protein Foods: Mean intakes over time (2001-04 vs. 2007-10) by age/sex group



*p<.05

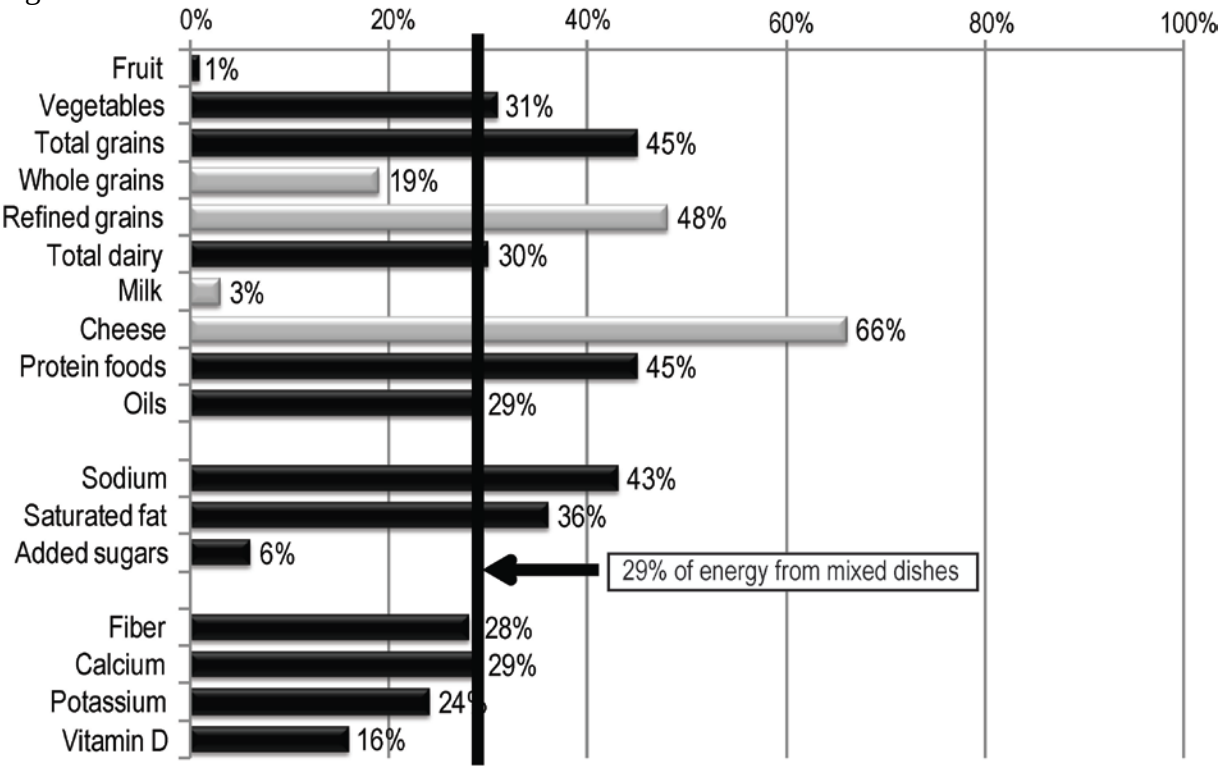
Source: What We Eat in America, NHANES 2001-2004 and 2007-2010

Figure D1.31 Added sugars intakes in 2001-04 and 2007-10 by age/sex groups in comparison to added sugars limits in the USDA Food Patterns



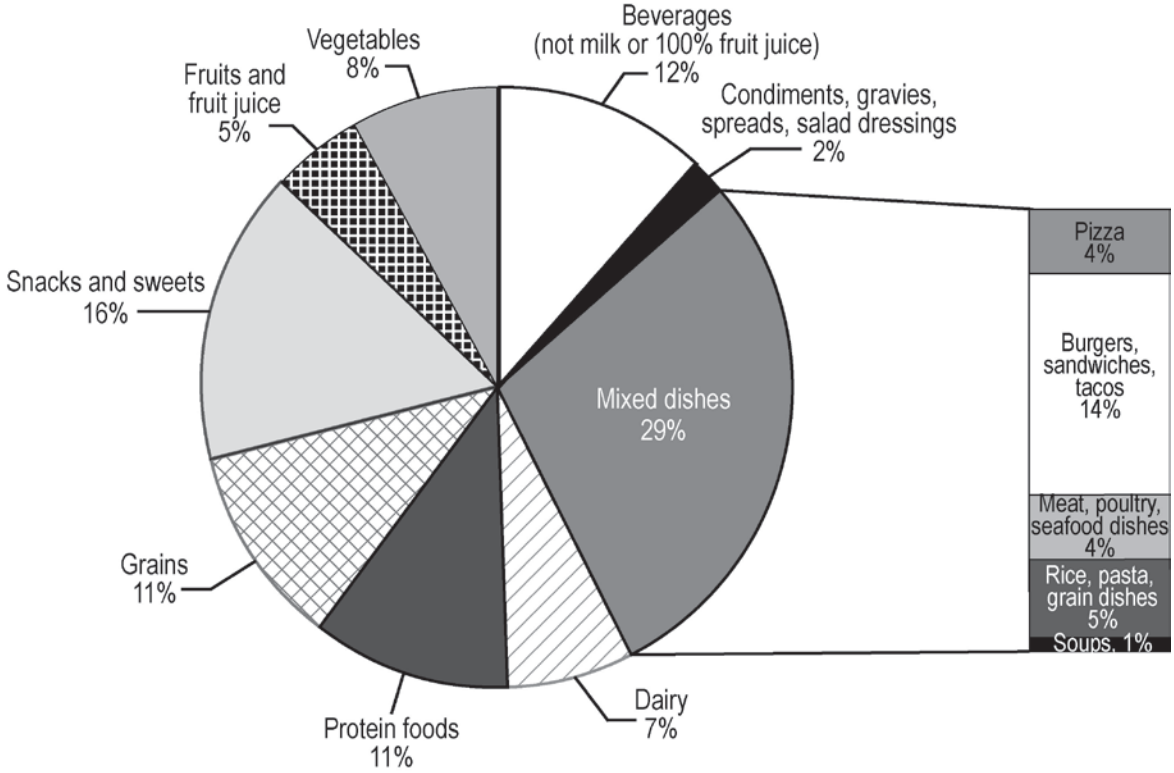
Source: What We Eat in America, NHANES 2001-2004 and 2007-2010

Figure D1.32 Percent of Total intake from mixed dishes



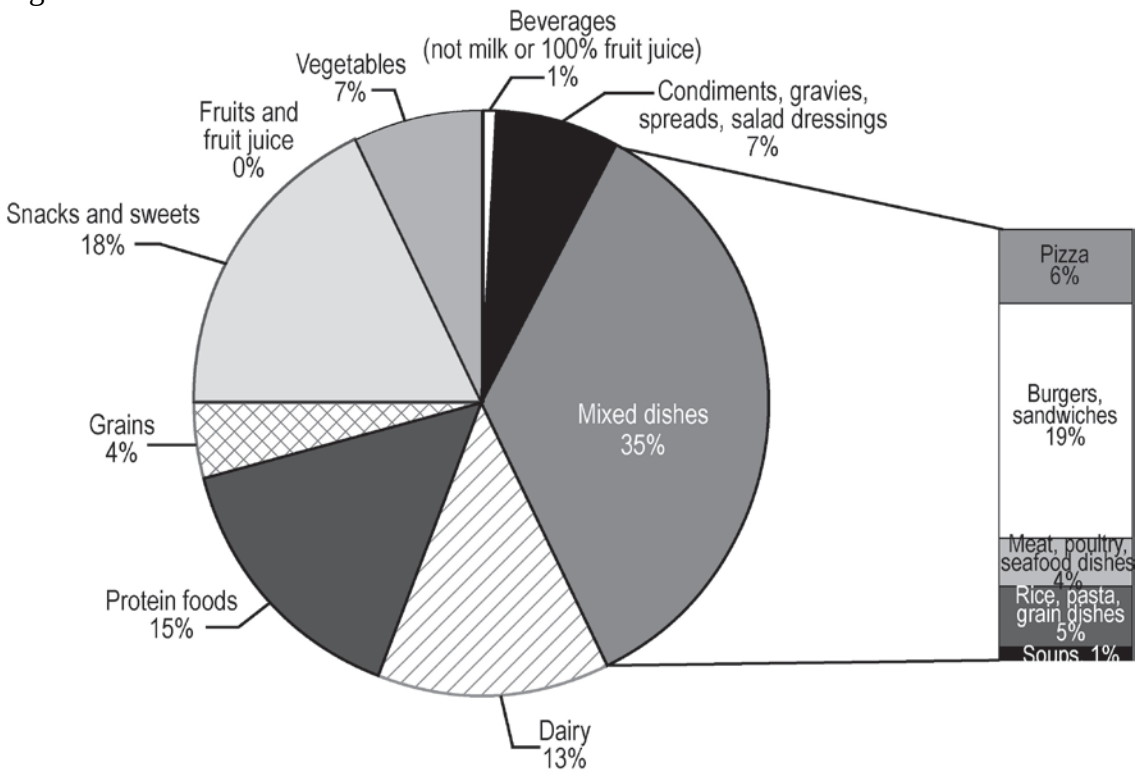
Note: Bars in lighter shades are for subgroups that "break out" the food group above them.
Source: What We Eat in America, NHANES 2009-2010

Figure D1.33 Percent of Energy Intake from Major food categories



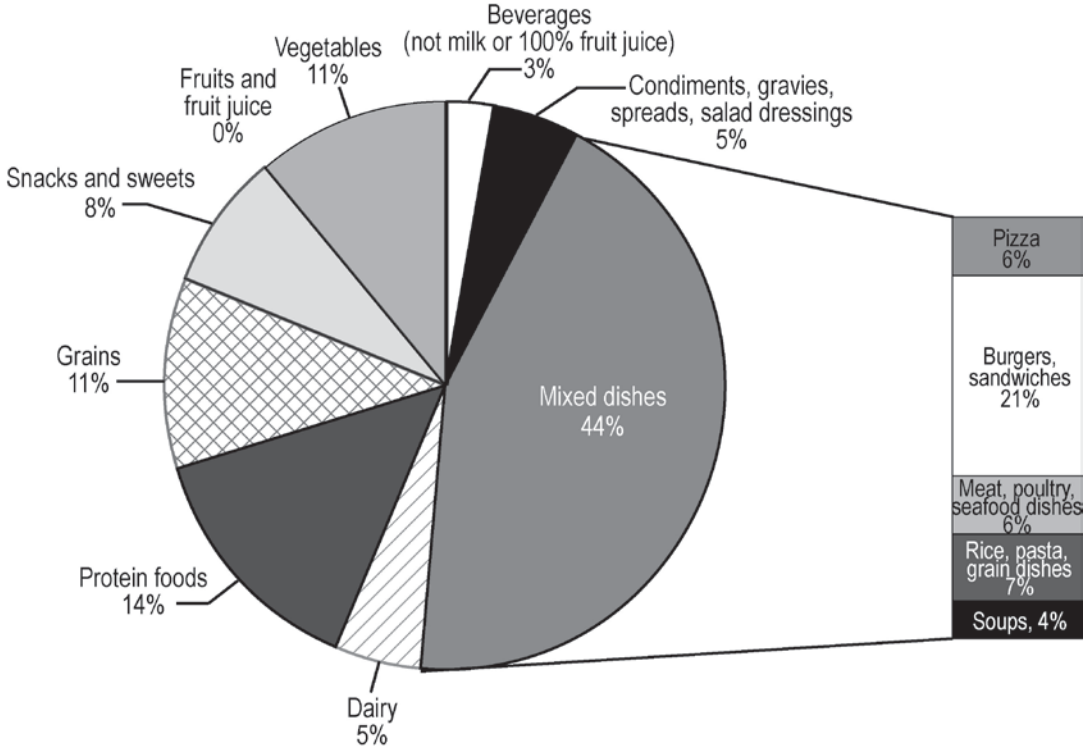
Source: What We Eat in America, NHANES 2009-2010

Figure D1.34 Food sources Saturated Fat



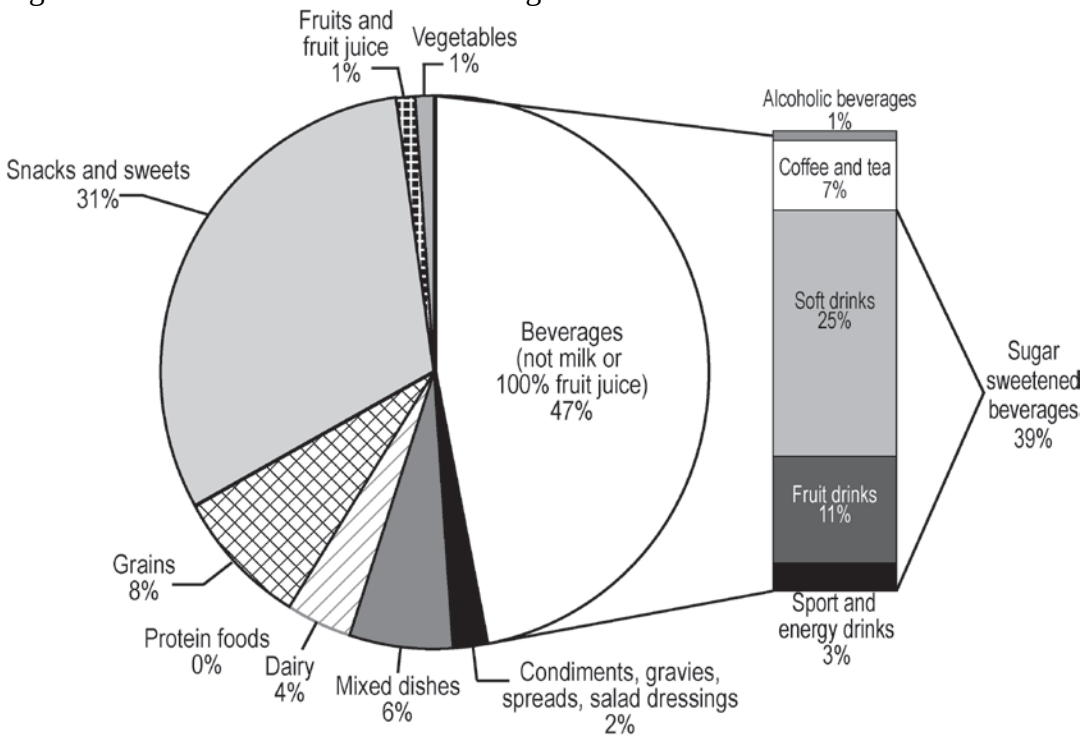
Source: What We Eat in America, NHANES 2009-2010

Figure D1.35 Food Sources of Sodium



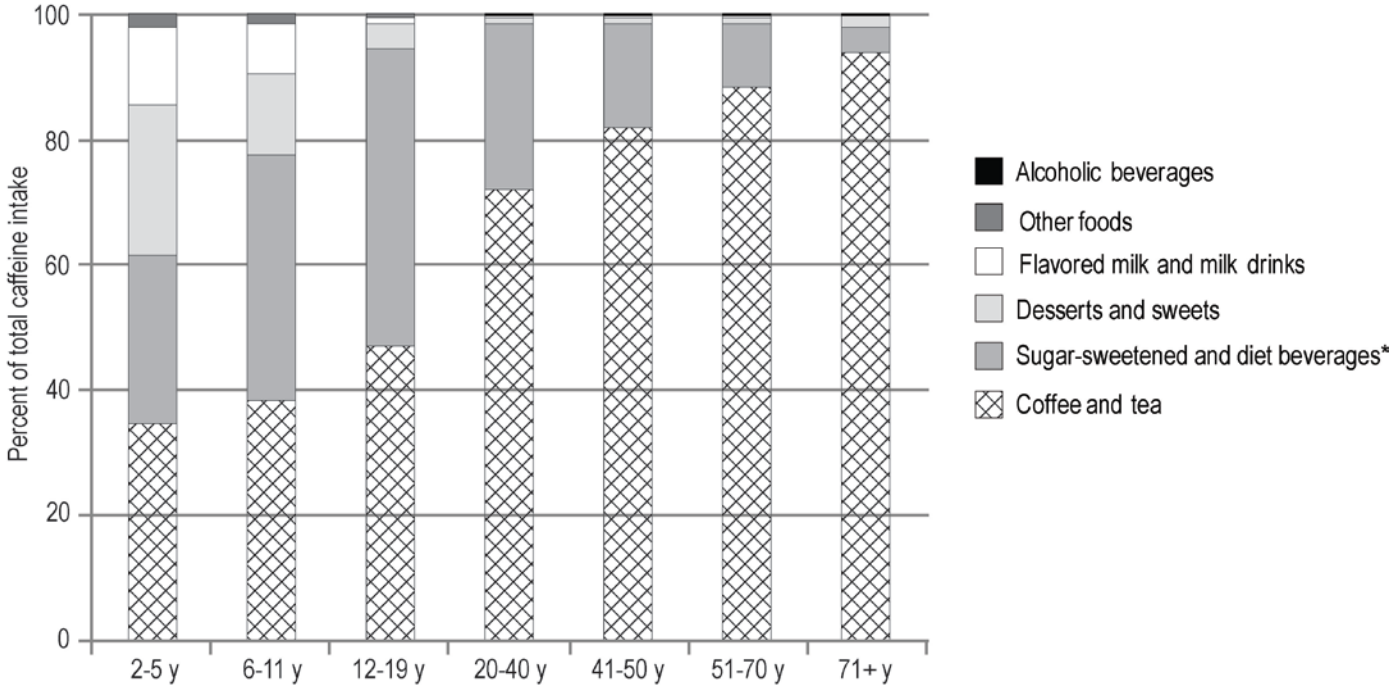
Source: What We Eat in America, NHANES 2009-2010

Figure D1.36 Food Sources of Added Sugars



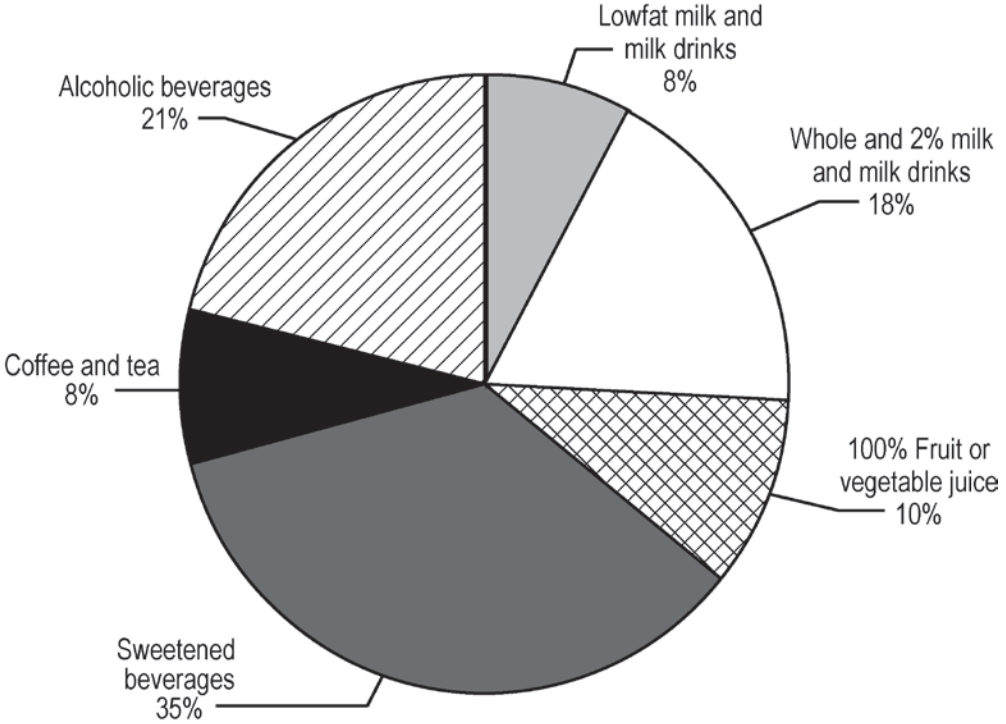
Source: What We Eat in America, NHANES 2009-2010

Figure D1.37 Caffeine sources by age group



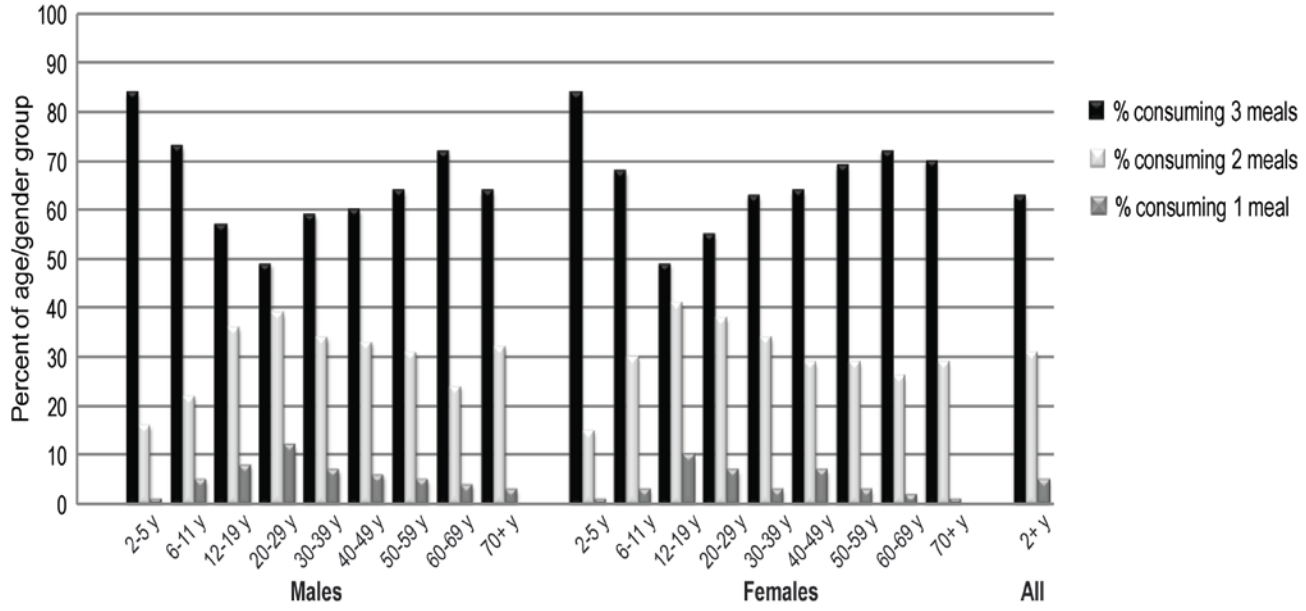
Source: What We Eat in America, NHANES 2009-2010

Figure D1.38 Percent of beverage energy from various beverages, all persons 2+



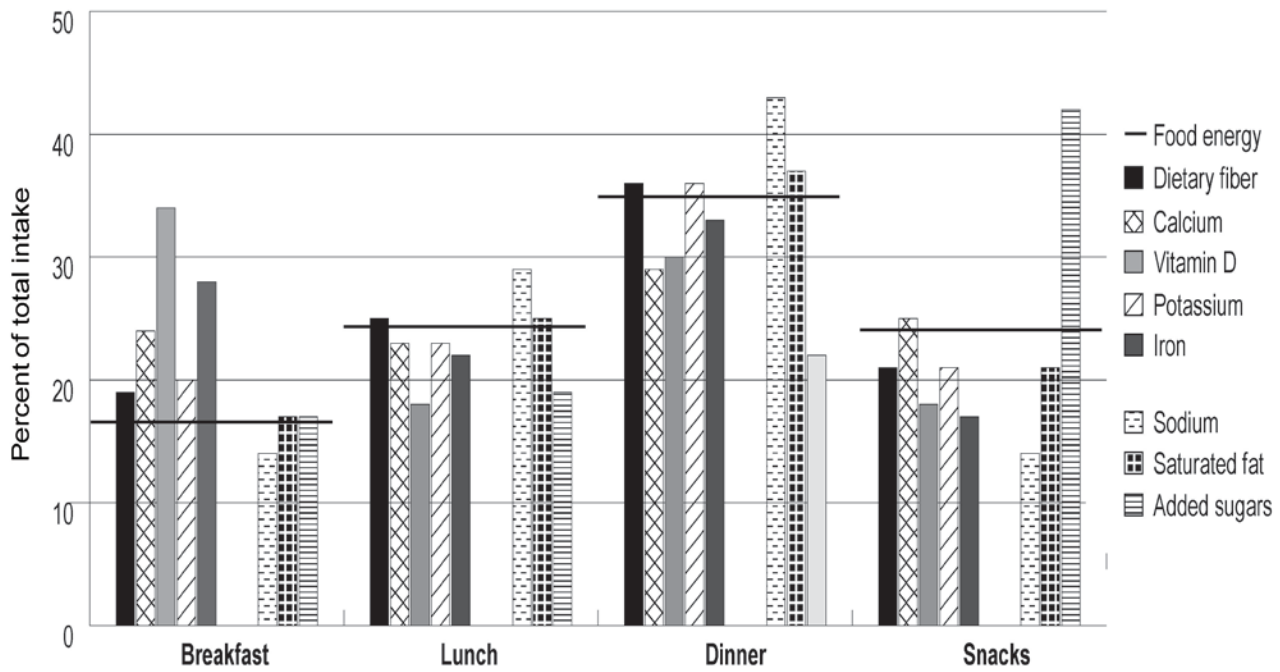
Source: What We Eat in America, NHANES 2009-2010

Figure D1.39 Number of meals reported per day by age/sex group



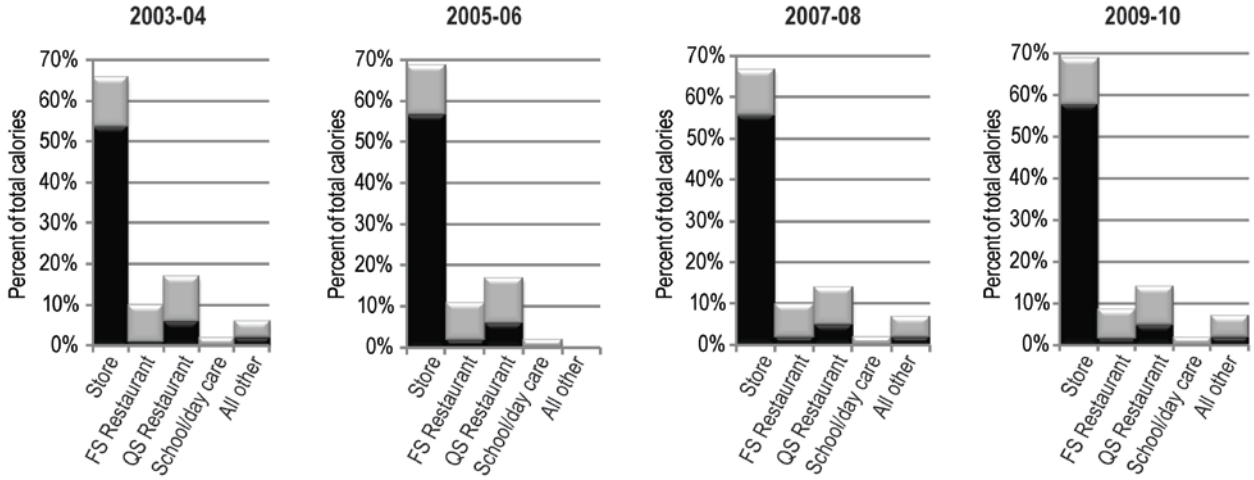
Source: What We Eat in America, NHANES 2009-2010

Figure D1.40 Percent of total daily intake of nutrients of concern from each eating occasion, for the population 2+



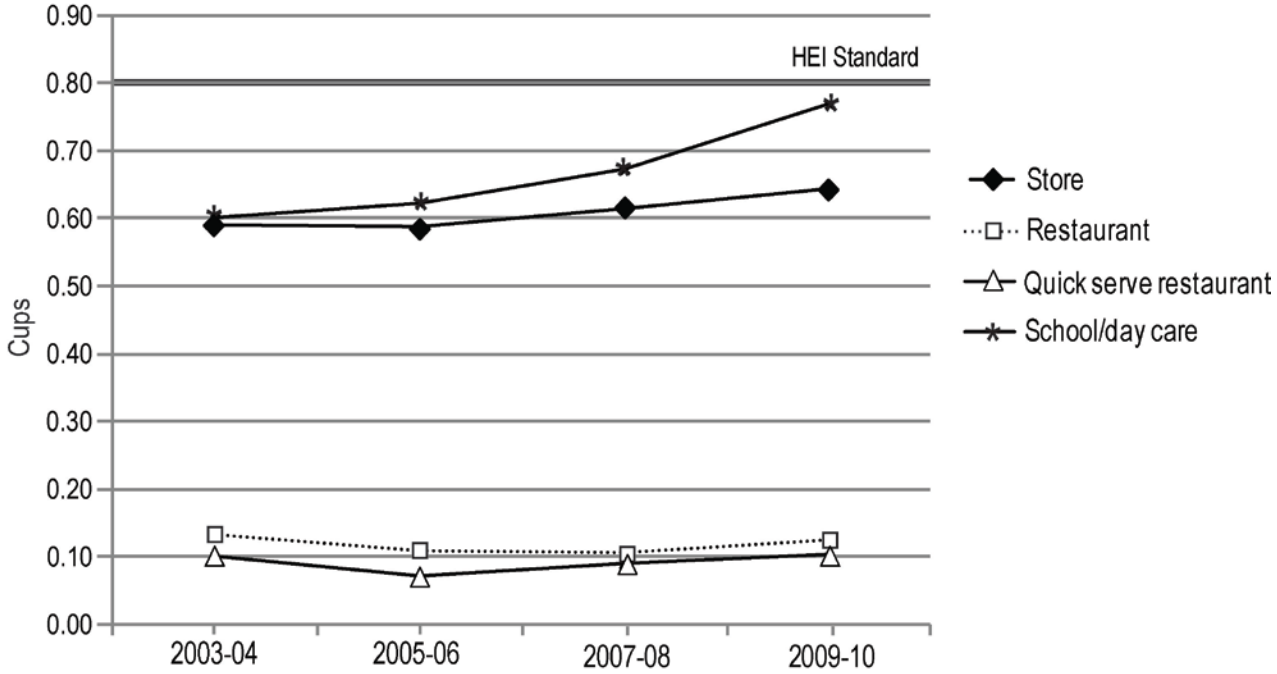
Source: What We Eat in America, NHANES 2009-2010

Figure D1.41 Percent of calories by where food was obtained and consumed



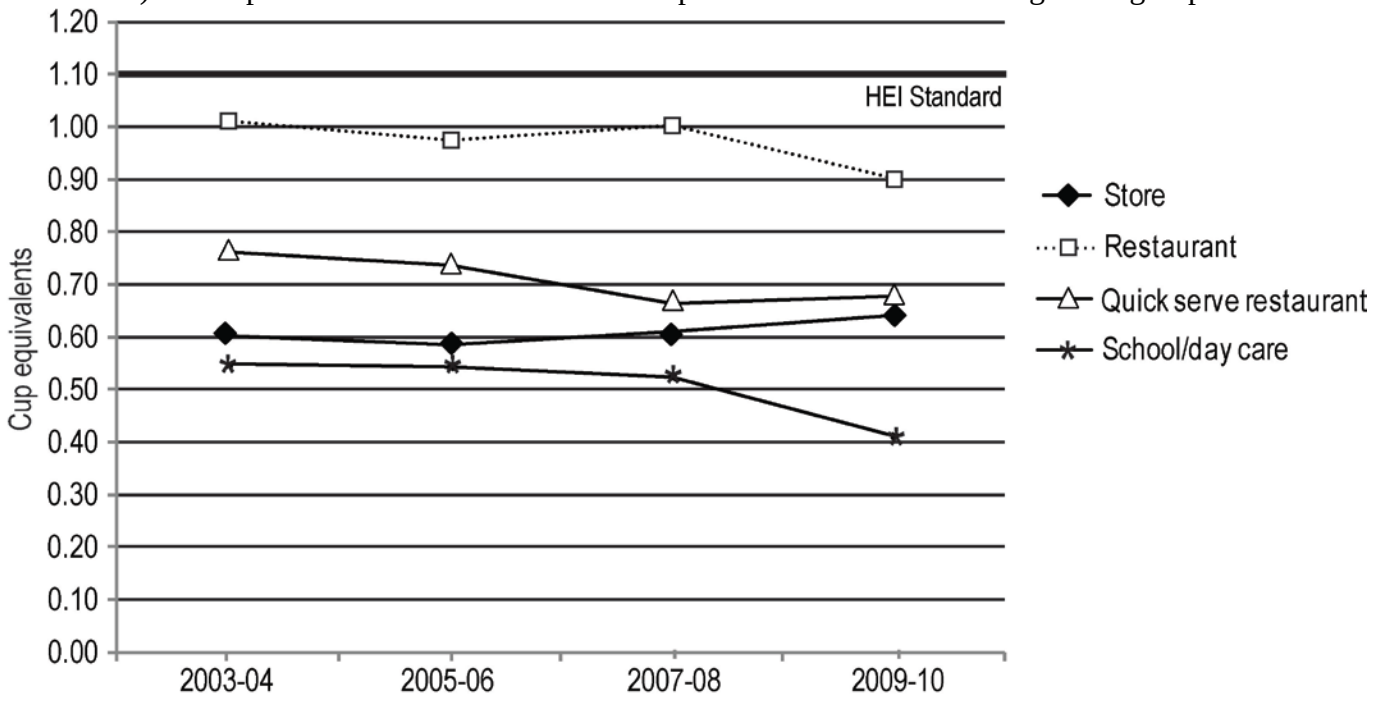
Darker shading indicates food eaten at home; lighter shading indicates food eaten away from home.
FS = Full Service (sit-down service); QS = Quick Service (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.42 Fruit group density: cups per 1000 calories by where obtained, over time (2003-04 to 2009-10) in comparison to the 2010 HEI standard per 1000 calories for the fruit group.



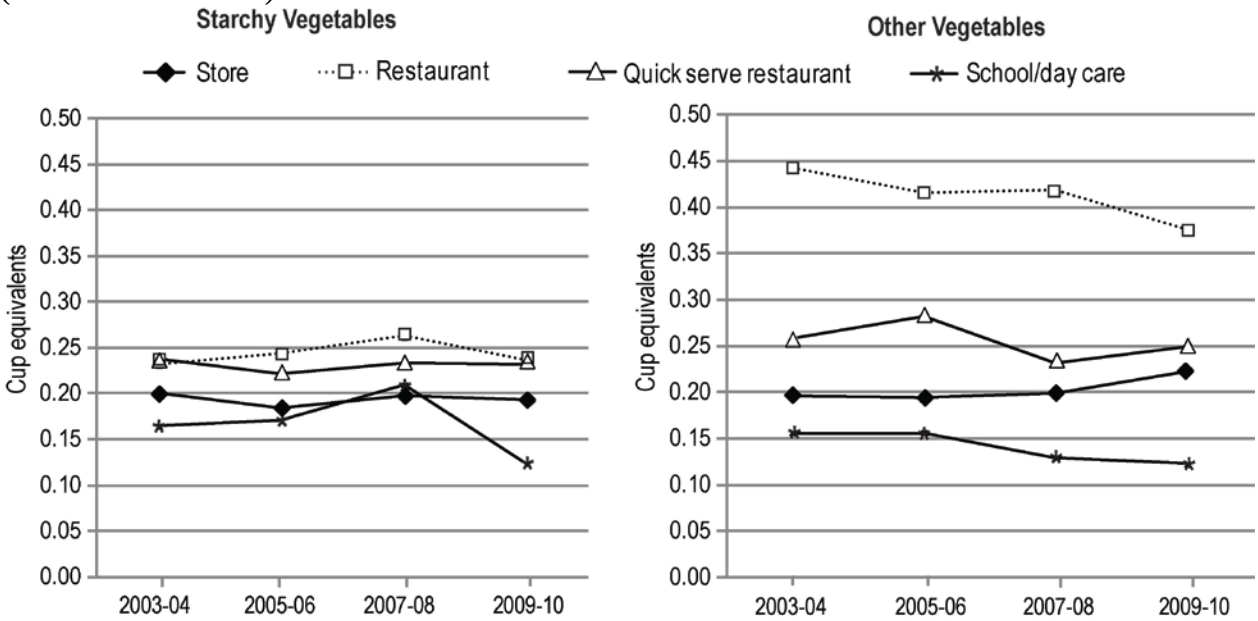
Restaurant = Full Service (sit-down service); Quick Serve = (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.43 Vegetable density: cups per 1000 calories by where obtained, over time (2003-04 to 2009-10) in comparison to the 2010 HEI standard per 1000 calories for the vegetable group



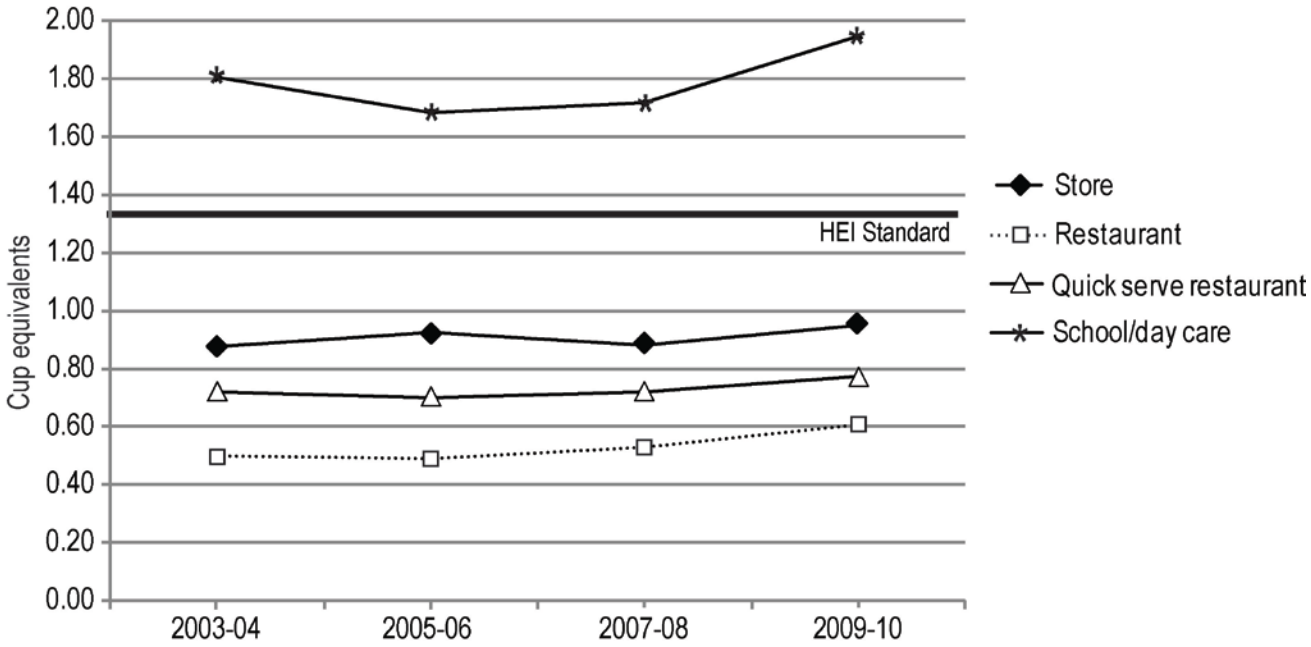
Restaurant = Full Service (sit-down service); Quick Serve = (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.44 Vegetable subgroup density: cups per 1000 calories by where obtained, over time (2003-04 to 2009-10)



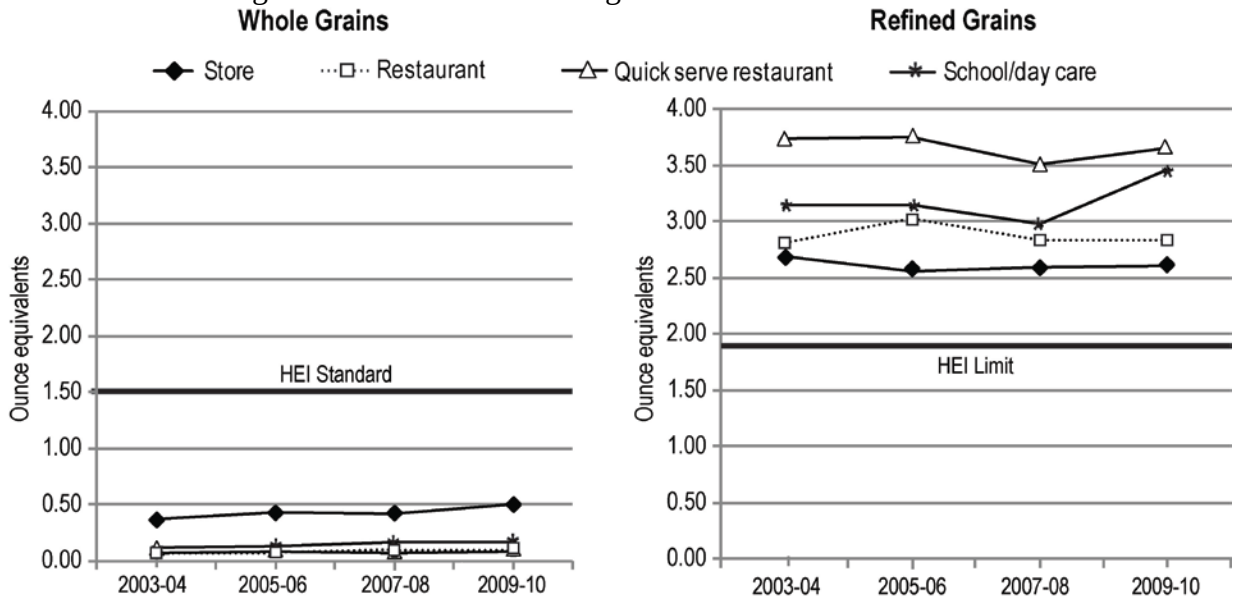
Restaurant = Full Service (sit-down service); Quick Serve = (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.45 Dairy group density: cups per 1000 calories by where obtained, over time (2003-04 to 2009-10) in comparison to the 2010 HEI standard per 1000 calories for the dairy group



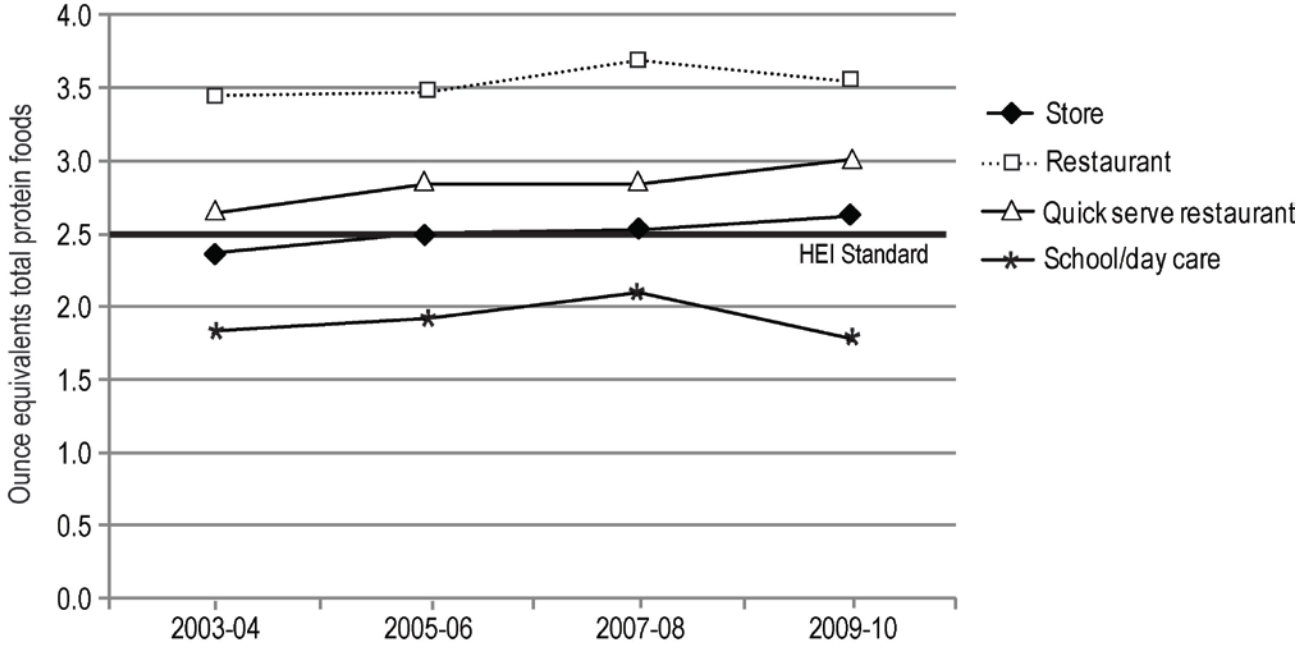
Restaurant = Full Service (sit-down service); Quick Serve = (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.46 Grain group density (whole and refined) : ounce eqs per 1000 calories by where obtained over time (2003-04 to 2009-10) in comparison to the 2010 HEI standard per 1000 calories for the whole grains and limit for refined grains.



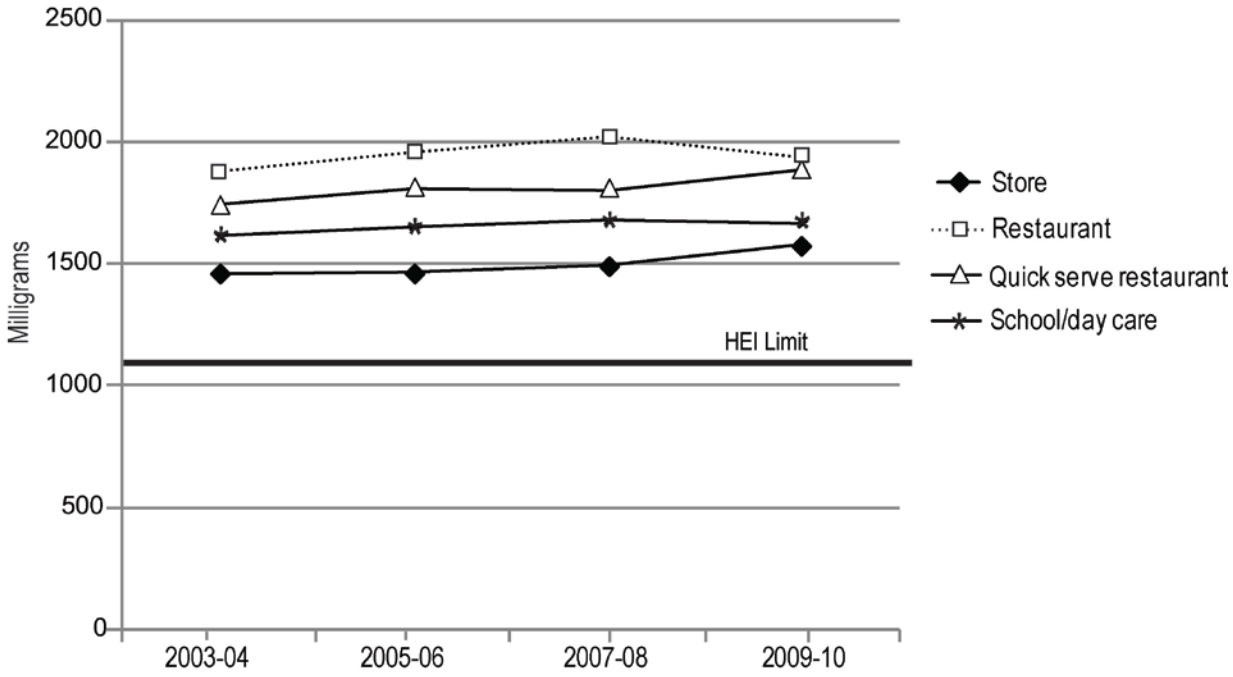
Restaurant = Full Service (sit-down service); Quick Serve = (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.47 Protein Foods Group density: ounce eqs per 1000 calories by where obtained, over time (2001-04 vs. 2007-10) in comparison to the 2010 HEI standard per 1000 calories for the protein foods group.



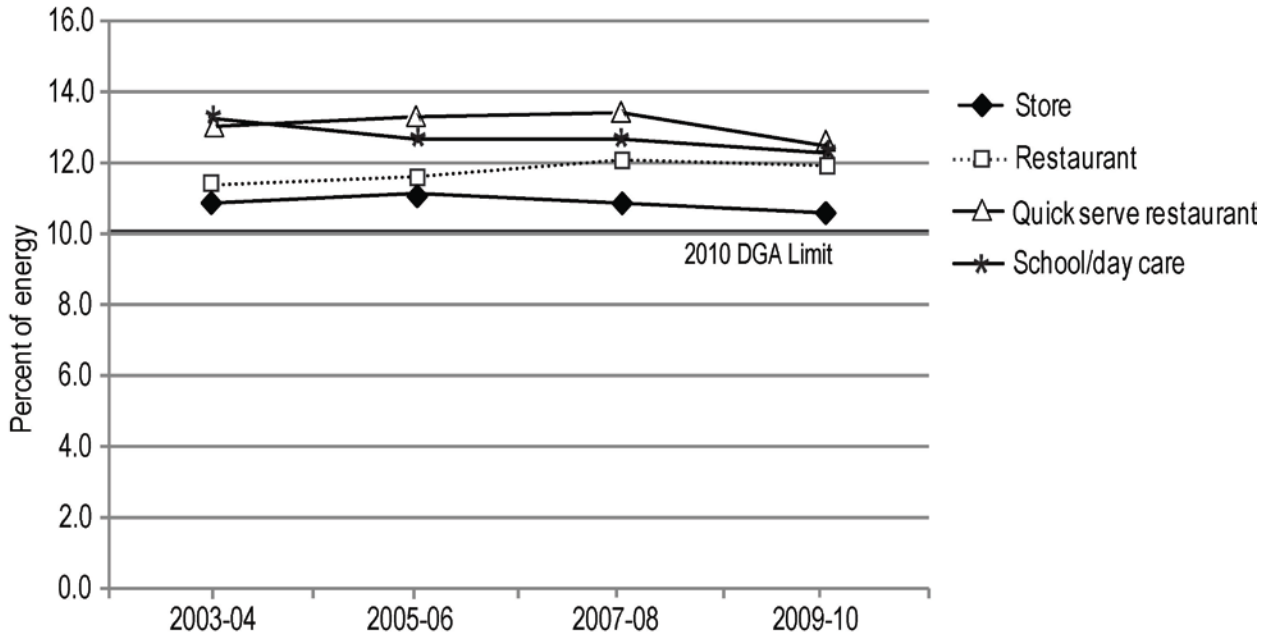
Restaurant = Full Service (sit-down service); Quick Serve = (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.48 Sodium density: milligrams per 1000 calories by where obtained, over time (2003-04 to 2009-10) in comparison to the 2010 HEI limit per 1000 calories for sodium.



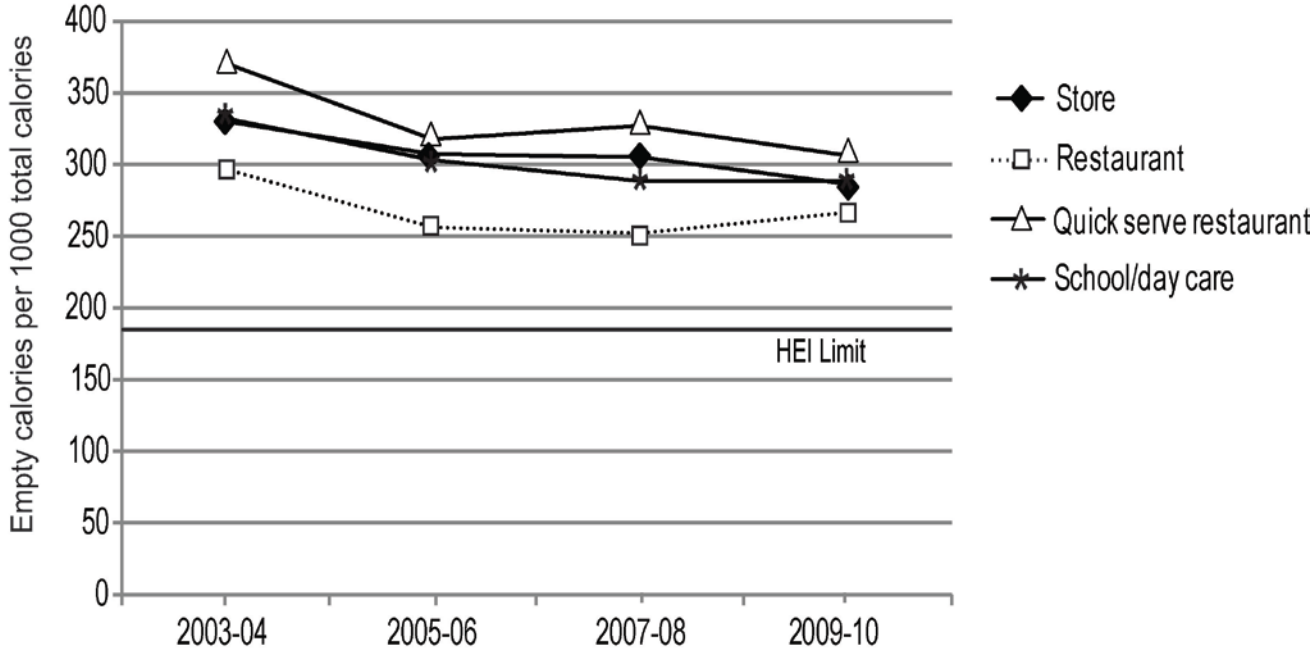
Restaurant = Full Service (sit-down service); Quick Serve = (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.49 Saturated fat density: percent of energy by where obtained, over time (2003-04 to 2009-10), in comparison to the 2010 DGA limit for saturated fat as a percent of energy.



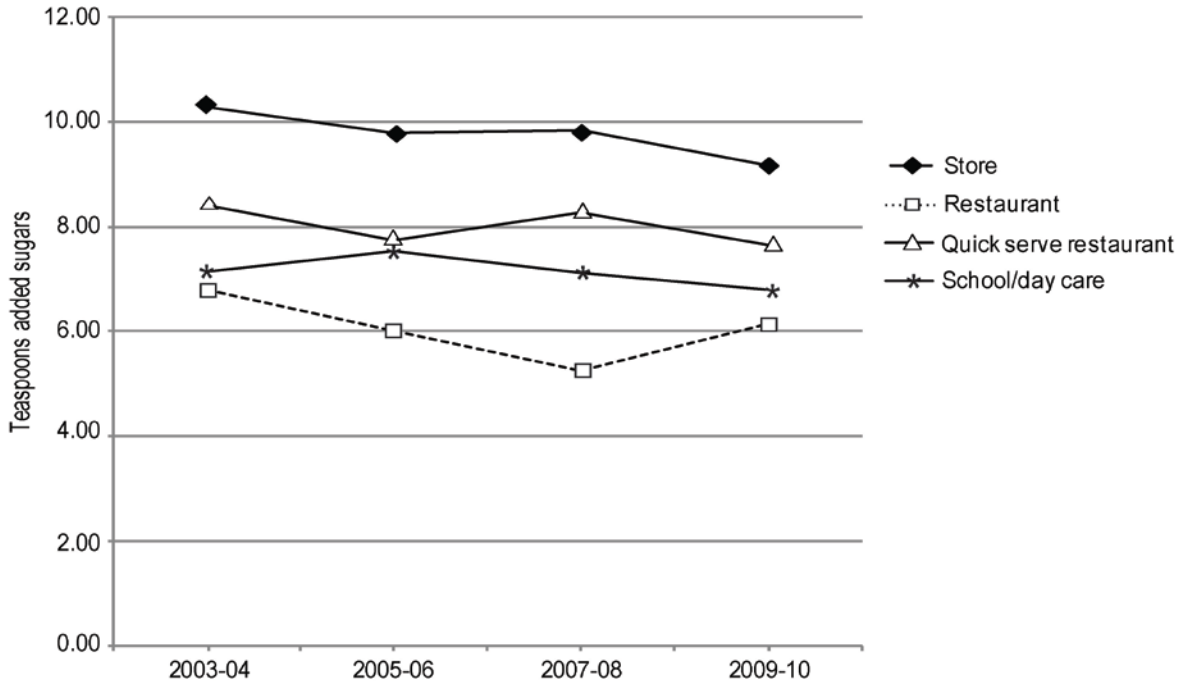
Restaurant = Full Service (sit-down service); Quick Serve = (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.50 Empty calorie density: calories per 1000 calories by where obtained, over time (2003-04 to 2009-10), in comparison to the HEI limit for empty calories per 1000 calories.



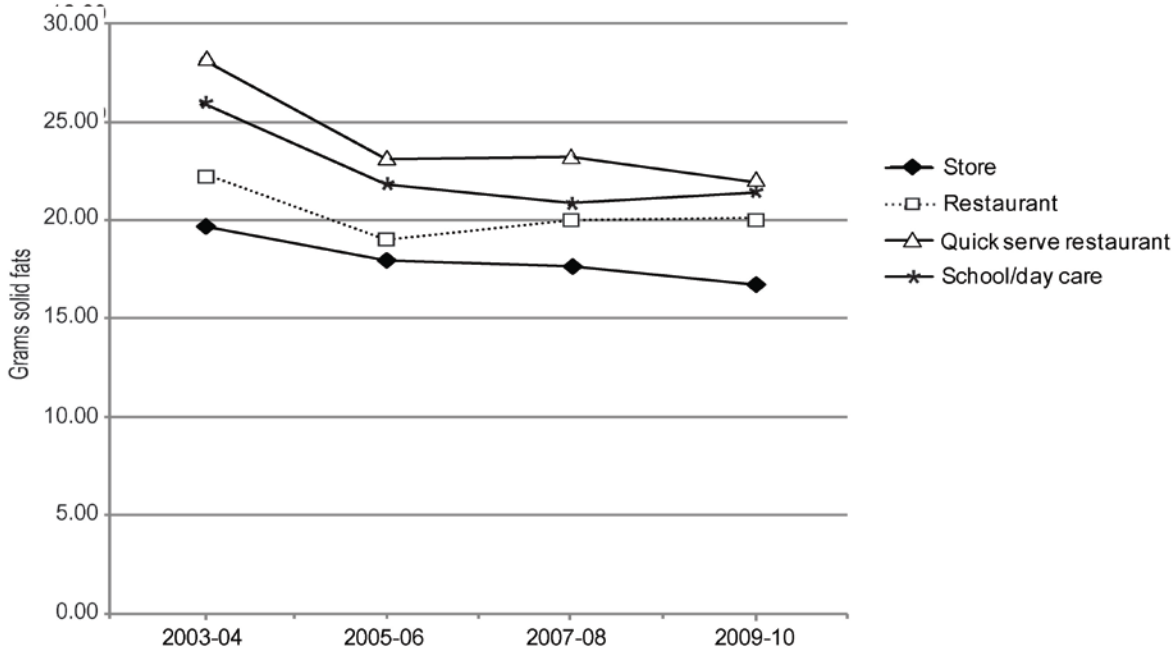
Restaurant = Full Service (sit-down service); Quick Serve = (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.51 Added sugars density: Added sugars per 1000 calories by where obtained, over time (2003-04 to 2009-10)



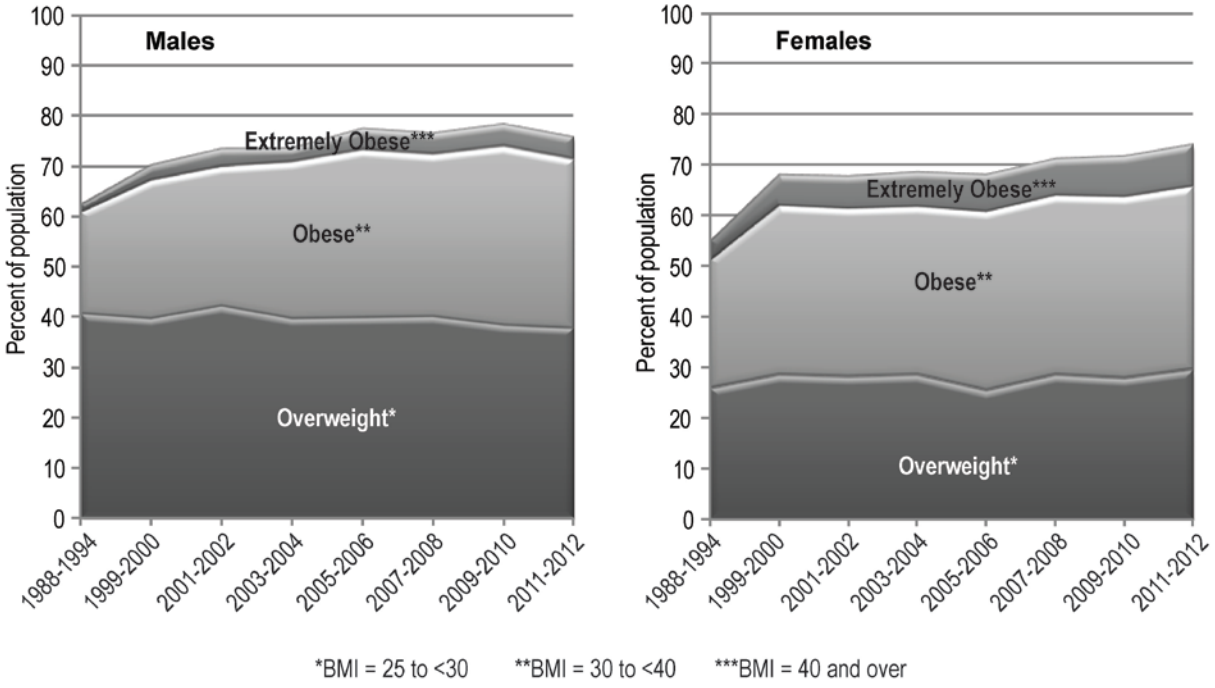
Restaurant = Full Service (sit-down service); Quick Serve = (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.52 Solid fats density: Solid fats per 1000 calories by where obtained, over time (2003-04 to 2009-10)



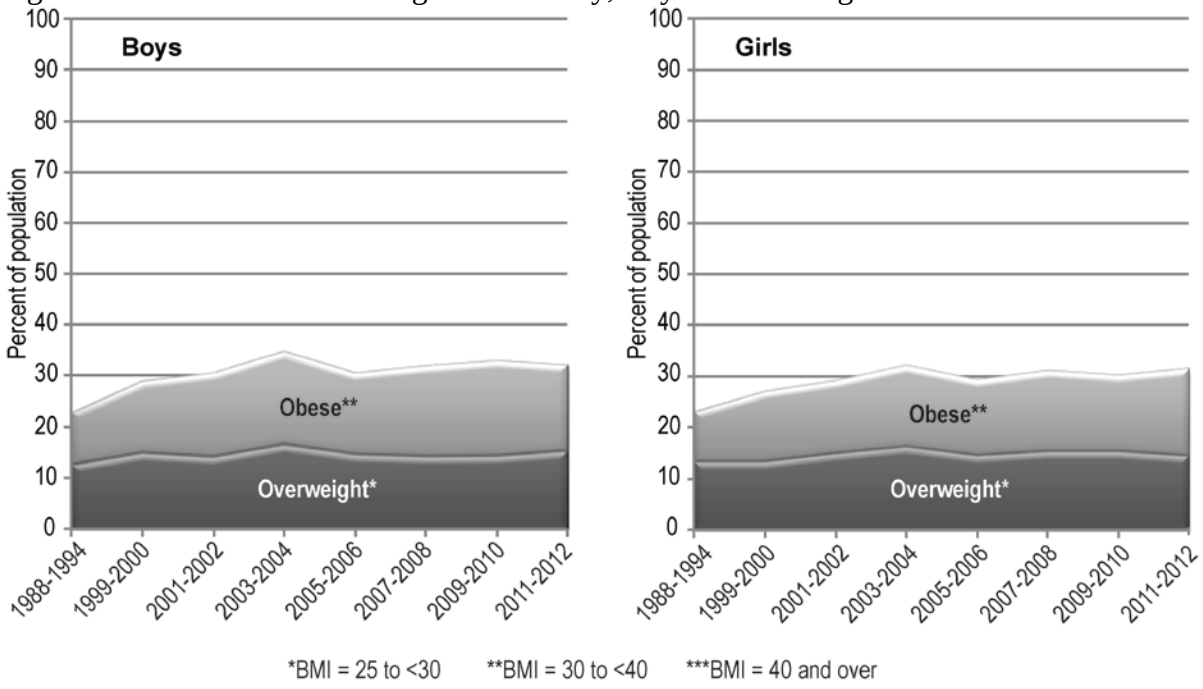
Restaurant = Full Service (sit-down service); Quick Serve = (fast food, food trucks, etc.)
Source: What We Eat in America, NHANES2003-2004, 2005-2006, 2007-2008, 2009-2010

Figure D1.53 Trends in overweight and obesity, Males and Females ages 20+.



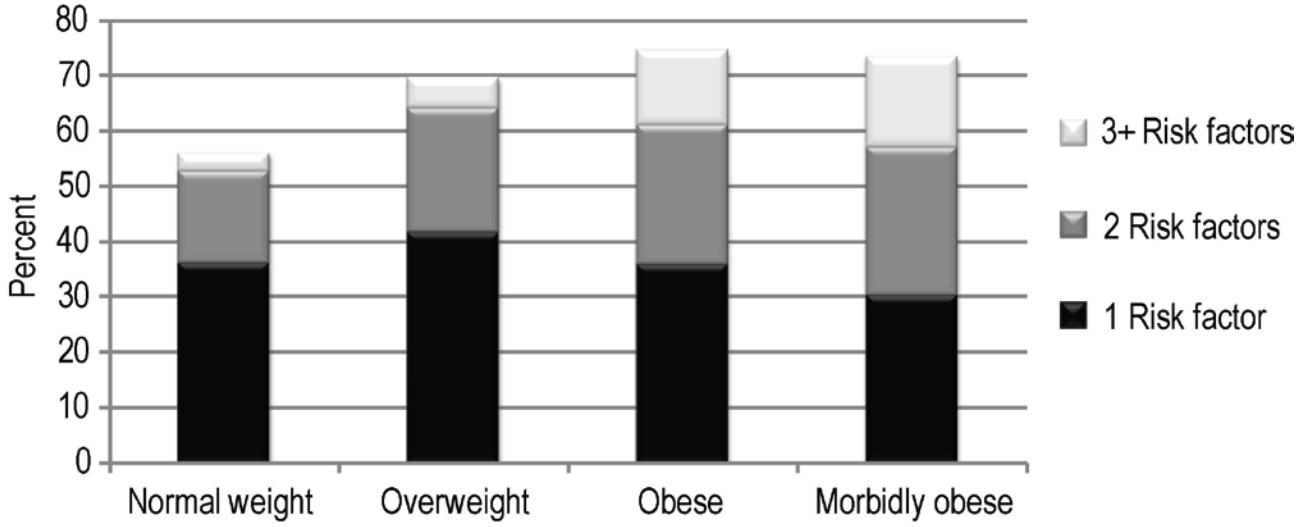
Source: Fryar, CD, Carroll, MD, Ogden, CL. Prevalence of Overweight and Obesity among Adults: United States, 1960–1962 Through 2011–2012. CDC/NCHS, the Health E-Stat, September 2014

Figure D1.54 Trends in overweight and obesity, Boys and Girls ages 2-19.



Source: Fryar, CD, Carroll, MD, Ogden, CL. Prevalence of Overweight and Obesity among Children and Adolescents: United States, 1963–1965 Through 2011–2012. CDC/NCHS, the Health E-Stat, September 2014

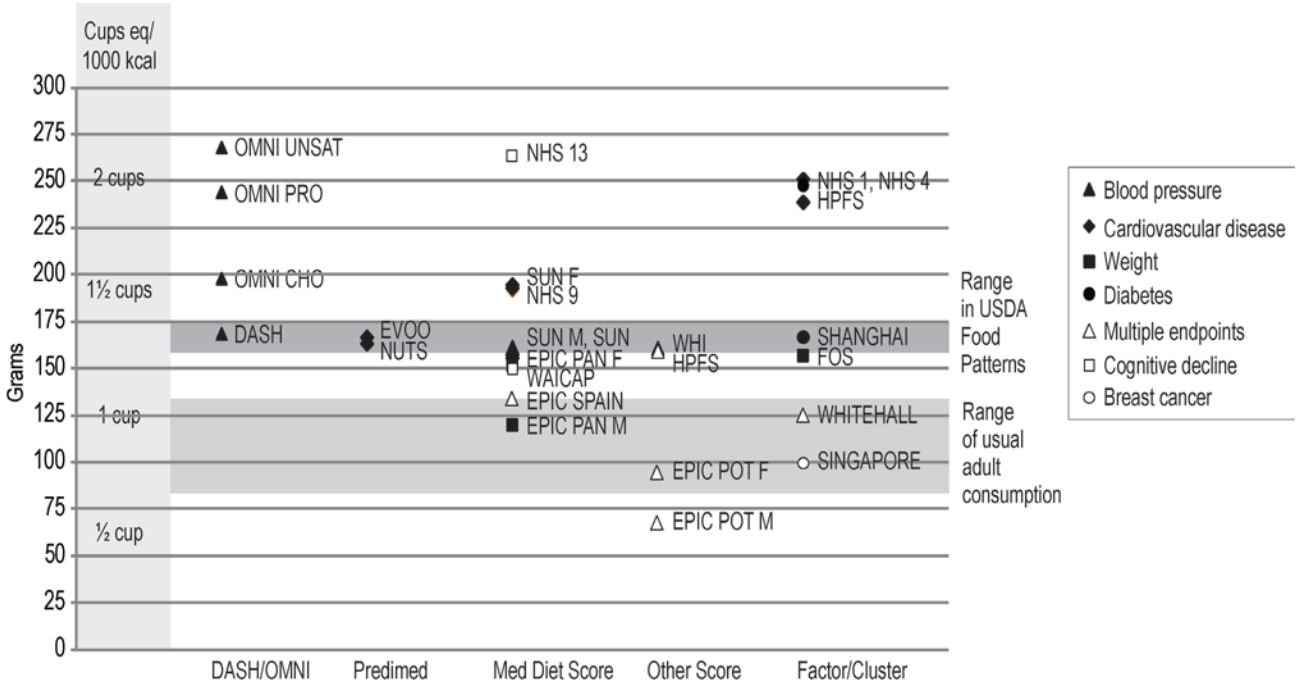
Figure D1.55 Prevalence and number of CVD risk factors by weight category, among adults 18 years and older, NHANES 2007-10.



Note: Risk factors included: total diabetes, total hypertension, total dislipidemia, and self reported smoking

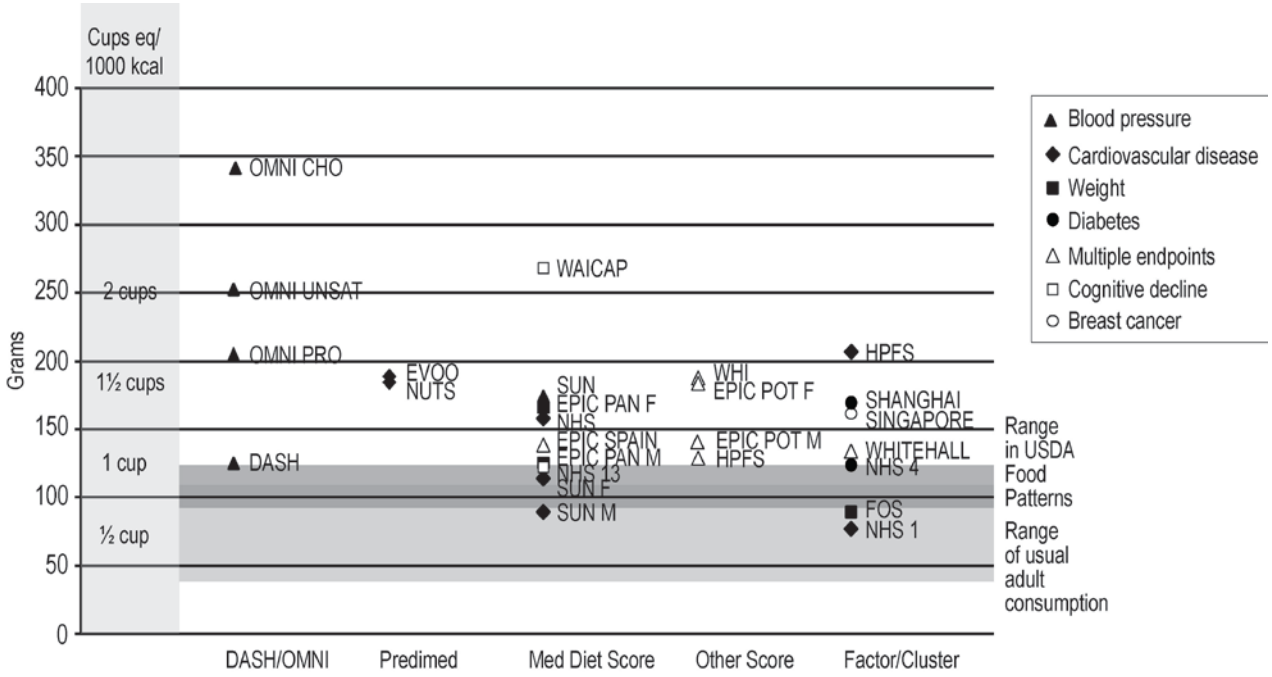
Source: Saydah S, Bullard KM, Cheng Y, Ali MK, Gregg EW, Geiss L, et al. Trends in cardiovascular disease risk factors by obesity level in adults in the United States, NHANES 1999-2010. Obesity (Silver Spring). 2014.

Figure D1.56 Vegetable intake (g/1000 calories) in dietary patterns identified as having health benefits, in comparison to usual vegetable intake by adults, NHANES 2007-2010, and to amounts in the USDA Food Patterns for adults.



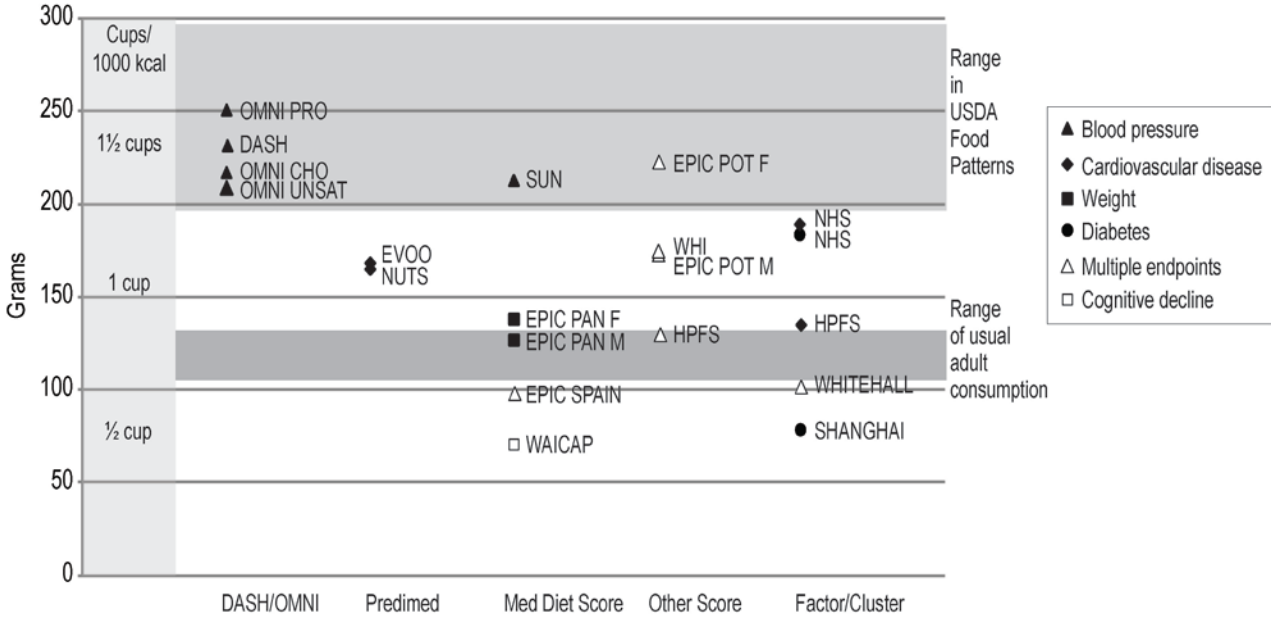
Source: USDA Food Patterns, What We Eat in America, NHANES 2007-2010, articles identified in table D1.31.

Figure D1.57 Fruit intake (g/1000 calories) in dietary patterns identified as having health benefits, in comparison to usual fruit intake by adults, NHANES 2007-2010, and to amounts in the USDA Food Patterns for adults.



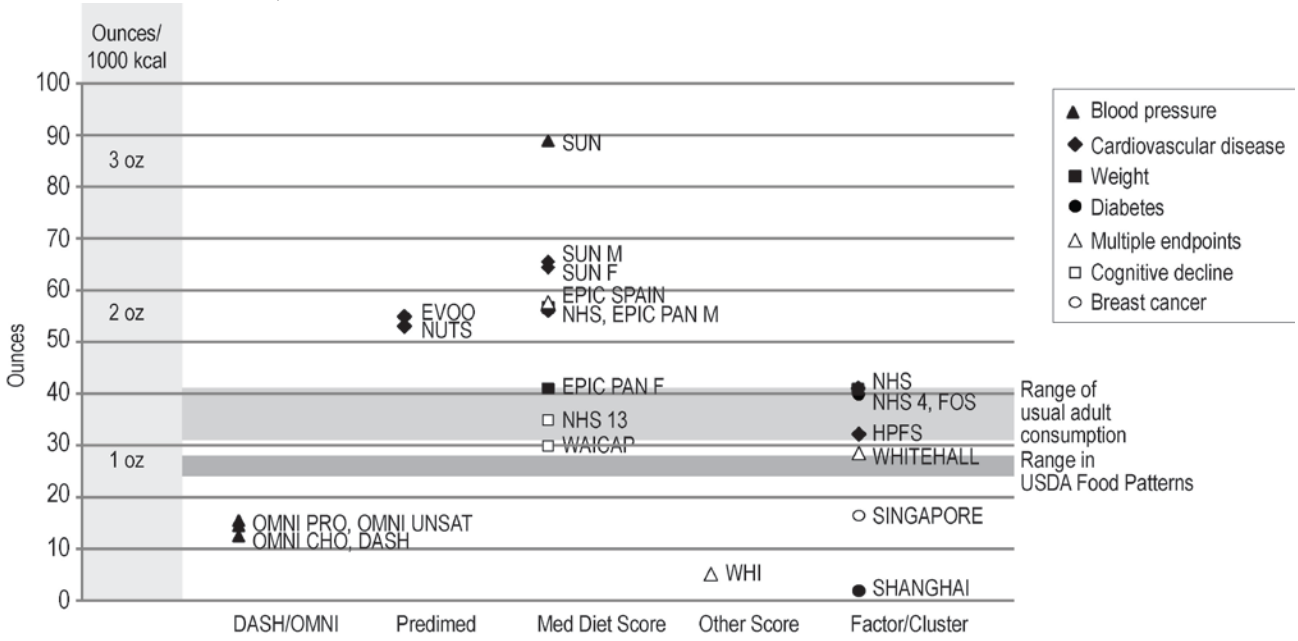
Source: USDA Food Patterns, What We Eat in America, NHANES 2007-2010, articles identified in table D1.31.

Figure D1.58 Dairy intake (g/1000 calories) in dietary patterns identified as having health benefits, in comparison to usual dairy intake by adults, NHANES 2007-2010, and to amounts in the USDA Food Patterns for adults.



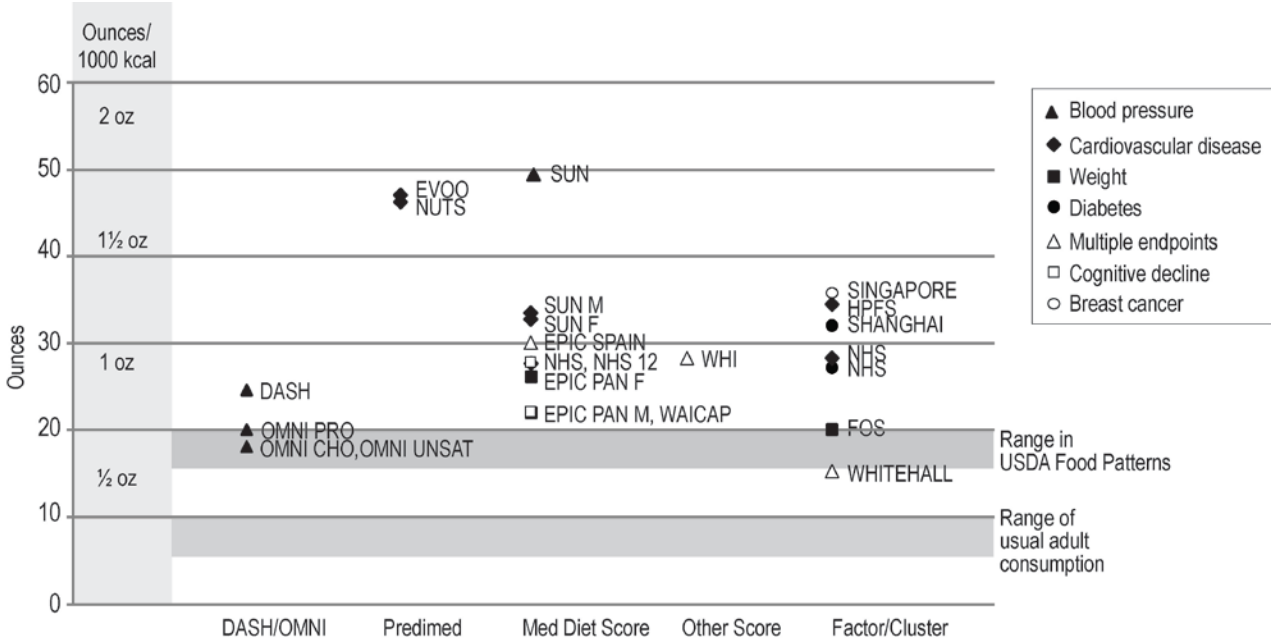
Source: USDA Food Patterns, What We Eat in America, NHANES 2007-2010, articles identified in table D1.31

Figure D1.59 Red and processed meat intake (g/1000 calories) in dietary patterns identified as having health benefits, in comparison to usual red and processed meat intake by adults, NHANES 2007-2010, and to amounts in the USDA Food Patterns for adults.



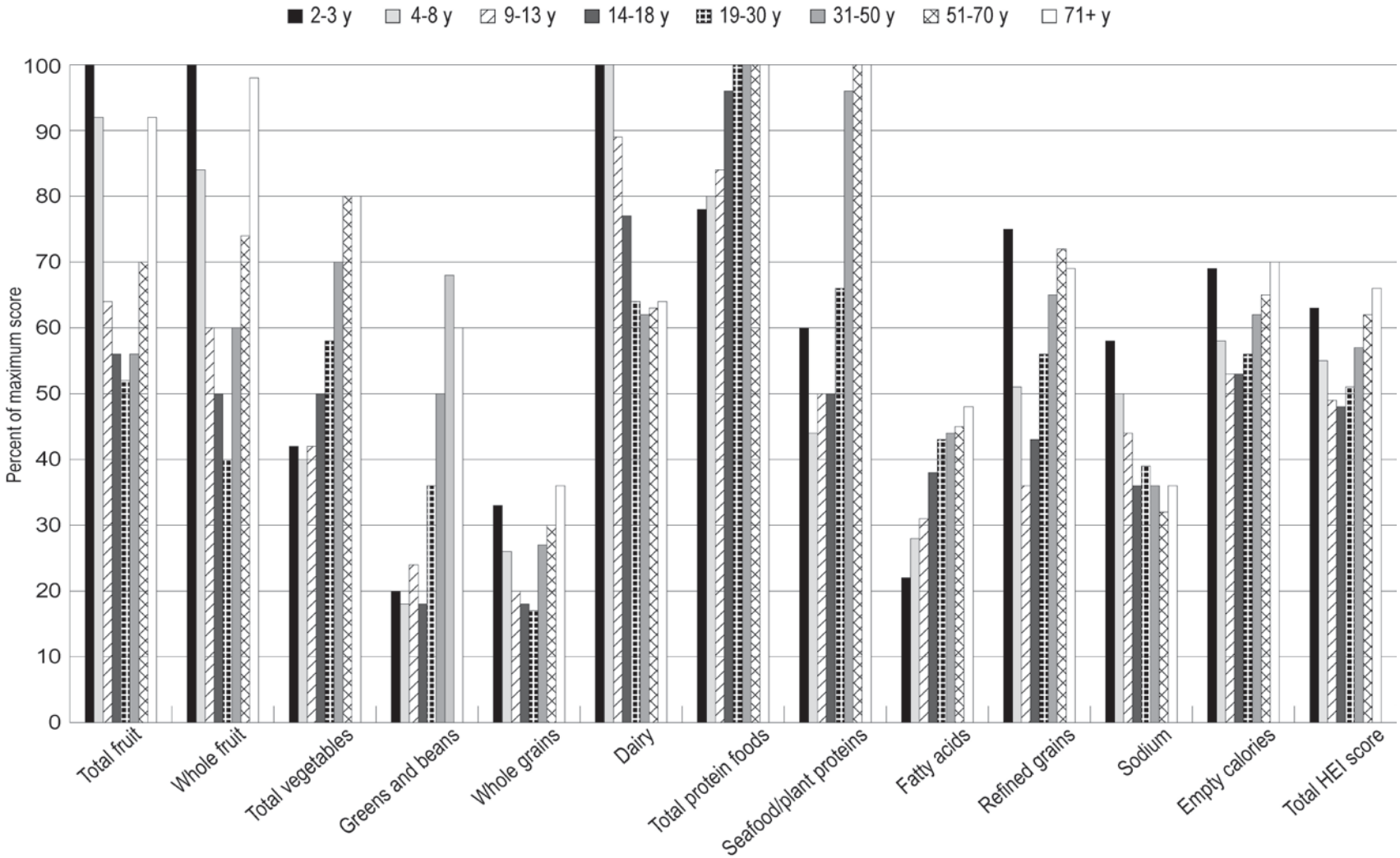
Source: USDA Food Patterns, What We Eat in America, NHANES 2007-2010, articles identified in table D1.31

Figure D1.60 Seafood intake (g/1000 calories) in dietary patterns identified as having health benefits, in comparison to usual seafood intake by adults, NHANES 2007-2010, and to amounts in the USDA Food Patterns for adults.



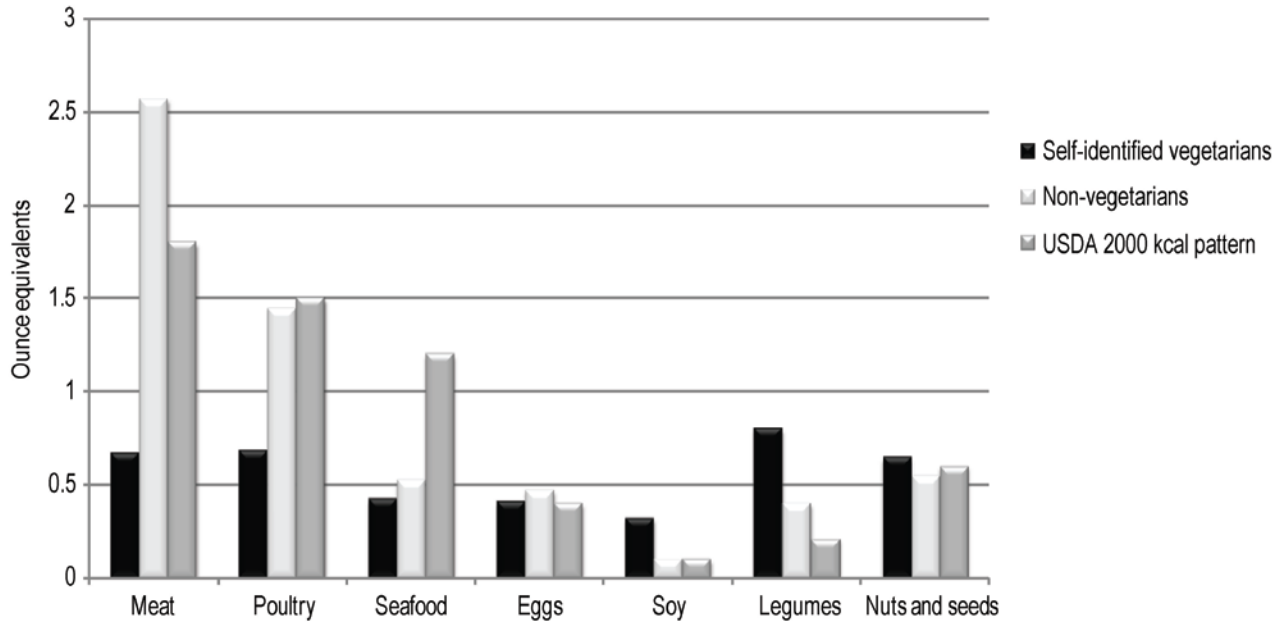
Source: USDA Food Patterns, What We Eat in America, NHANES 2007-2010, articles identified in table D1.31

Figure D1.61 Average HEI-2010 component scores for Americans by age group, 2009-10, as a percent of the total possible score for each component.



Source: HEI scores for Americans by age group, What We Eat in America, NHANES 2009-10 Appendix E2.x. Average Healthy Eating Index-2010 Scores for Americans ages 2 years and older

Figure D1.62 Intake from Protein Foods subgroups by self-identified vegetarians in comparison to non-vegetarian and to amounts in USDA Food Pattern at 2000 calories.



Source: Juan, WY, S. Yamini, P. Britten (2014) Food intake patterns of self-identified vegetarians among the U.S. population, 2007-2010. 38th Nutrient Data Bank Conference, May 2014 http://www.nutrientdataconf.org/PastConf/NDBC38/NNDC38_PosterAbstracts.pdf