Part B. Section 2: The Total Diet: Combining Nutrients, Consuming Food

Introduction

The 2010 Dietary Guidelines Advisory Committee (DGAC) supports a total diet approach to achieving dietary goals. The purpose of this chapter is to demonstrate how the scientific evidence presented in each of the topic-specific chapters in ***Part D: The Science Base***—Energy Balance and Weight Management; Nutrient Adequacy; Fatty Acids and Cholesterol; Protein; Carbohydrates; Sodium, Potassium, and Water; Alcohol; and Food Safety and Technology—can be incorporated into an overall eating pattern that optimizes health outcomes.

Until recently, data were insufficient to document the impact of whole diets and eating patterns on health outcomes. The state of the evidence and the methodologic rigor regarding such questions have improved tremendously and the data can now be incorporated into this Report.

This chapter synthesizes the evidence on dietary components that contribute to excess energy and inadequate nutrient intakes in the United States (US), and the foods that can provide these missing essential nutrients and other health benefits. It presents a brief, evidence-based comparison of worldwide eating patterns, including the Dietary Approaches to Stop Hypertension (DASH), Mediterranean, and other patterns, along with a description of the US Department of Agriculture (USDA) Food Patterns with vegetarian variations.

A nutrient-dense total diet has multiple health benefits and can be implemented in various ways. The US is comprised of individuals of all ages who come from many cultures and have a variety of food and taste preferences. All of these factors were considered in developing a recommended total diet that is flexible while meeting nutrient needs without exceeding energy requirements.

The Catalyst for the Total Diet Approach

Although there is no single "American" or "Western" diet, average American food patterns currently bear little resemblance to the diet recommended in the 2005 Dietary Guidelines for Americans. As documented by the latest data from the National Health and Nutrition Examination Survey (NHANES), Americans eat too many calories and too much solid fats, added sugars, refined grains, and sodium. Americans also eat too little dietary fiber, vitamin D, calcium, potassium, and unsaturated fatty acids (specifically omega-3s), and other important nutrients that are mostly found in vegetables, fruits, whole grains, low-fat milk and milk products, and seafood (see ***Part D. Section 2: Nutrient Adequacy***).

Overweight and obesity are highly prevalent in the US in both adults and children. This is of great public health concern because excess body fat is associated with a much higher risk of premature death and many serious disorders, as identified in ***Part D. Section 1: Energy Balance and Weight Management***. Preventing overweight is highly preferable to initiating weight loss treatment after weight gain occurs, because the failure rate in achieving and maintaining weight loss is very high. Furthermore, the behaviors required to prevent overweight are less daunting than the behaviors necessary to lose and sustain weight loss. Currently, the average American gains about a pound a year between the ages of 20 to 60 years. Some persons gain much more. Remaining conscious of one's body weight throughout life and adopting a lifestyle early on that will achieve and sustain weight control across the lifespan are paramount to maintaining good health and quality of life.

A Special Focus on Children and Adolescents

The single most significant adverse health trend among US children in the past 40 years has been the dramatic increase in overweight and obesity (see ***Part D. Section 1: Energy Balance and Weight Management***). Since the early 1970s, the prevalence of overweight and obesity has approximately doubled among children ages 2 to 11 years, and tripled among adolescents ages 12 to 19 years. Not only is obesity associated with adverse health effects during childhood, but evidence documents increased risk of future chronic disease in adult life.

Childhood obesity results from poorly regulated energy balance. Ideally, children and adolescents should consume foods that provide an adequate intake of all essential nutrients needed for normal growth and development, metabolism, immunity and cognitive function, without exceeding caloric requirements. Factors associated with preventing excess adiposity in children are incorporated into the total diet described here, and include:

- Energy intake balanced with expenditure
- Greatly reduced intake of sugar-sweetened beverages
- Increased intake of vegetables and fruits
- Smaller amounts of fruit juice, especially for overweight children
- Smaller portions of foods and beverages
- Infrequent consumption of meals from quick service (i.e., fast food) restaurants
- Habitual consumption of breakfast
- Fewer hours of screen time (e.g., television, computer)
- More hours of active play

Blending Science-Based Recommendations Into a Healthful Total Diet

The DGAC defines "total diet" as the combination of foods and beverages that provide energy and nutrients and constitute an individual's complete dietary intake, on average, over time. This encompasses various foods and food groups, their recommended amounts and frequency, and the resulting eating pattern. To achieve dietary goals and energy balance, Americans must become mindful, or "conscious," eaters, that is, attentively choosing what and how much they eat. Since the mid-1980s, the USDA has provided recommended food patterns that represent a total diet approach to dietary guidance (Britten, 2006). The most recent USDA Food Patterns have been visually conveyed as the MyPyramid Food Guidance System (Haven, 2006). This approach was intended to help people personalize dietary recommendations and offer flexibility based on individual preferences. The key core components of a nutrient-dense total diet for all Americans are presented below.

Moderate Energy Intake

The DGAC encourages Americans to achieve their recommended nutrient intakes by consuming foods within a total diet that meets but does not exceed energy needs. Overweight and obesity result from energy imbalance (intake exceeding expenditure) (see ***Part D. Section 1: Energy Balance and Weight Management***). The increased incidence and current high proportion of overweight and obesity in the US illustrates an energy imbalance across virtually all subgroups of the population. People consume too many calories (i.e., energy) relative to the calories they expend. As a start, all Americans are encouraged to know their energy needs in order to avoid inappropriate weight gain. Table B2.1 (see the end of this chapter) can help individuals identify their energy needs based on their age, sex, and level of activity. Self-monitoring of both calorie intake and time spent in physical activity is one of the most useful tools a person can use to engage in and maintain behaviors that sustain a healthy weight.

Because levels of leisure time physical activity in US adults have remained stable or increased only slightly between 1990 and 2004, it is clear that an increased calorie intake has been the primary cause of the obesity problem. Hence, even though one can achieve a calorie deficit by increasing physical activity, the primary focus should be on reducing excessive calorie intake.

Overall, the top food sources of energy, and mean energy intake from each, for the US population, as reported in the National Health and Nutrition Examination Survey (NHANES) 2005-2006, are (NCI, 2010a):

- Grain-based desserts (cakes, cookies, doughnuts, pies, crisps, cobblers, and granola bars; 139 calories per day)

- Yeast breads (129 calories per day)
- Chicken and chicken mixed dishes (121 calories per day)
- Soda/energy/sports drinks (114 calories per day)
- Pizza (98 calories per day)

While the top sources of energy intake vary by age group, many of these sources are foods and beverages that are not in nutrient-dense forms. For example, the top energy source for adults ages 19 years and older and for children ages 4 to 13 years is grain-based desserts. These desserts are also among the top five sources of energy for teens and younger children. For teens ages 14 to 18 years, the top energy source is soda/energy/sports drinks, and these beverages are also among the top five energy sources for adults ages 19 years and older and for children ages 9 to 13 years. For children ages 2 to 3 years only, the top energy source is whole milk (rather than low-fat milk). Other foods that are among the top five sources of energy for various age groups are yeast breads, chicken and chicken mixed dishes, pizza, and, for adults only, alcoholic beverages (NCI, 2010a; see Table B2.2 at the end of this chapter for the top five sources of energy for each age group, and Tables D1.1, D1.6, and D1.7 in ***Part D. Section 1: Energy Balance and Weight Management*** for more detailed lists of food sources of energy).

Total diets that are high in energy, but low in nutrients, can paradoxically leave a person overweight but undernourished and thus, at higher risk of cardiovascular disease (CVD), type 2 diabetes (T2D), and certain types of cancers. Of urgent concern is America's youth, most of whom currently fit this pattern. Many children consume nutrient-poor sources of energy at the highest end of their respective energy ranges (see Figure D1.1 in ***Part D. Section 1: Energy Balance and Weight Management***) and they are increasingly sedentary.

Beverages also contribute substantially to overall dietary and energy intake. Although they provide needed fluid, beverages often add calories to the diet without providing nutrients. Their consumption should be planned in the context of total calorie intake and how they can fit into the total diet of each individual. Currently, US adults ages 19 years and older consume an average of 394 calories per day as beverages. The major types of beverages consumed, and the mean caloric intake from each, are (NCI, 2010b):

- Soda (114 calories per day)
- Coffee and tea (26 calories per day)
- Fluid milk (80 calories per day)
- 100 percent fruit juice and fruit drinks (67 calories per day)

- Alcoholic beverages (108 calories per day)

Children, ages 2 to 18 years, consume an average of 400 calories per day as beverages. The major beverages for children and calories from each are somewhat different:

- Fluid milk (162 calories per day)
- Soda (121 calories per day)
- 100 percent fruit juices and fruit drinks (112 calories per day)

In children, the amount and source of calories from beverages differs by age. For example, 100 percent fruit juice is a prominent source of energy in children ages 2 to 3 years, while soda/sports/energy drinks are the most common source of energy among beverages (and energy overall) in children ages 14 to 18 years.

Portion control and the quantity of foods and beverages consumed within the total diet also are important considerations in moderating energy intake (see ***Part D. Section 1: Energy Balance and Weight Management***). Excessive portion sizes are very common in the US and are linked to higher energy intakes and weight gain over time. This is particularly true when large portions of foods high in solid fats and added sugars (SoFAS) and refined grains are consumed.

Reduce Solid Fats and Added Sugars (SoFAS)

Solid fats and added sugars contribute substantially (approximately 35% of calories) to total energy intakes of Americans, thereby leading to excessive saturated fat and cholesterol intakes and insufficient intake of dietary fiber and other nutrients (see ***Part D. Section 2: Nutrient Adequacy***; ***Part D. Section 3: Fatty Acids and Cholesterol***; and ***Part D. Section 5: Carbohydrates***).

The 2005 DGAC defined the term "discretionary calorie allowance" as "the difference between total energy requirements and the energy consumed to meet recommended nutrient intakes" (DGAC, 2004). Discretionary calories were intended to represent the calories available for consumption *only* after meeting nutrient recommendations and without exceeding total energy needs. Unfortunately, this concept has been difficult to translate into meaningful consumer education. To clarify translation, the 2010 DGAC focused specifically on reducing the intake of solid fats and added sugars (SoFAS), which provide most of the non-essential or extra calories that Americans consume. Major food sources of the two components of SoFAS are (Bachman, 2008):

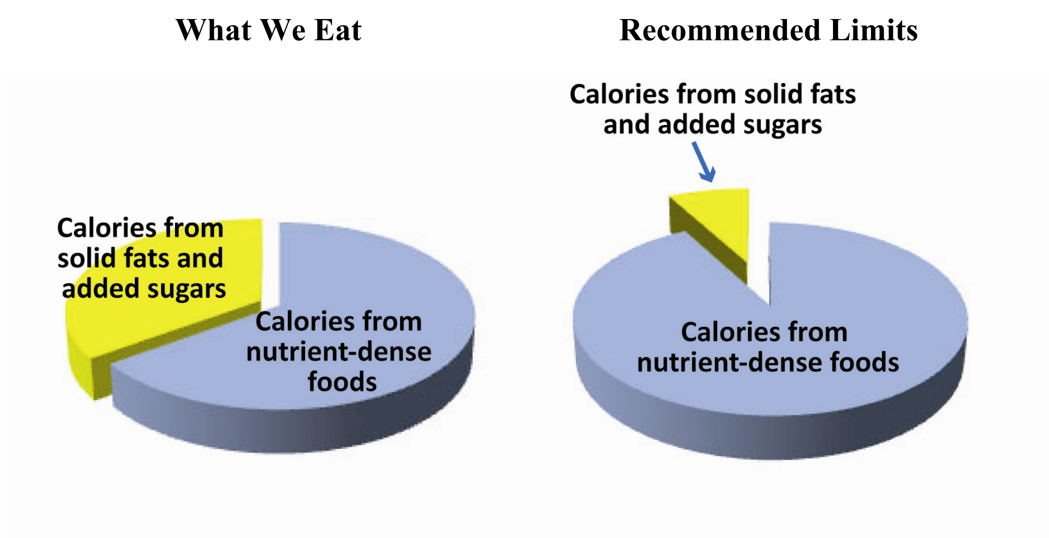
- Solid fats (percent of solid fat intake)
    - Grain-based desserts, including cakes, cookies, pies, doughnuts, and granola bars (10.9%)
    - Regular cheese (7.7%)
    - Sausage, franks, bacon, and ribs (7.1%)

- Pizza (5.9%)
- Fried white potatoes, including French fries and hash browns (5.5%)
- Dairy-based desserts, such as ice cream (5.1%)

- Added sugars (percent of added sugars intake)
  - Soda (36.6%)
  - Grain-based desserts (11.7%)
  - Fruit drinks (11.5%)
  - Dairy-based desserts (6.4%)
  - Candy (6.2%)

Maximum limits on SoFAS are meant to be estimates and not necessarily daily targets (see limits from USDA Food Patterns, Table B2.3, end of this chapter). These foods should constitute a very small proportion of total energy intake in the total diet. Figure B2.1 contrasts the current disproportionately high intake of SoFAS with what is more appropriate from a healthy eating pattern.

Figure B2.1. What we eat versus recommended limits: Calories from Solid Fats and Added Sugars (SoFAS)



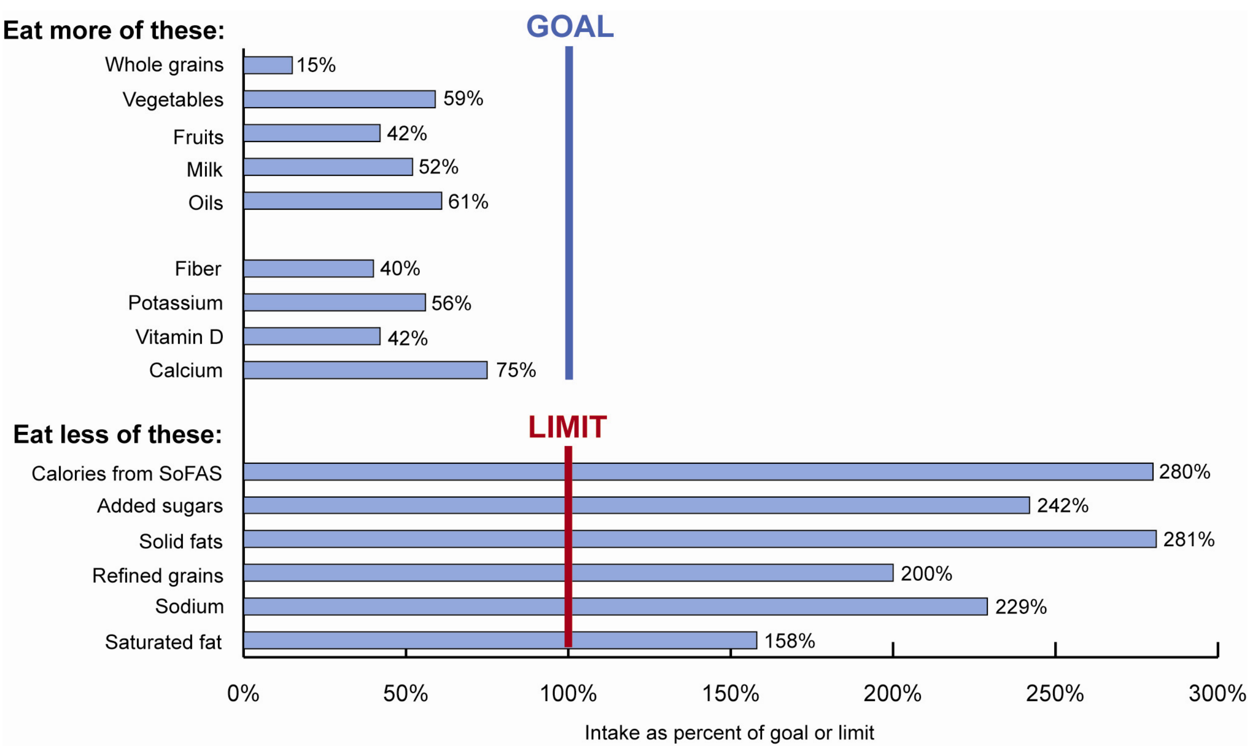
Note: The depiction of the proportionate amounts of total calories consumed and the recommended limits are illustrative only. The figure illustrates about 35 percent of total calories consumed as SoFAS, on average, in contrast to a recommended limit of no more than about 5 to 15 percent of total calories for most individuals.

Americans currently consume 35 percent of their total calories from SoFAS. This is too high. They should reduce intake of calories from SoFAS by 20 to 30 percent. This means that no more than 5 to 15 percent of total calories should be derived from SoFAS. For example, the USDA Food Patterns limit SoFAS to about 120 calories in the 1600-calorie pattern, 160 calories in the 1800-calorie pattern, and 260 calories in the 2000-calorie pattern (Table B2.3, at the end of the chapter, lists SoFAS limits for all calorie levels). Reduction of calories from SoFAS to these amounts allows for increased intakes of nutrient-dense foods such as vegetables (including cooked dry beans and peas), fruits, whole grains, and fat-free and low-fat fluid milk and milk products, without exceeding overall calorie needs.

Consume Nutrient-Dense Foods (But Not too Much of Them)

Currently, Americans consume less than 20 percent of the recommended intakes for whole grains, less than 60 percent for vegetables, less than 50 percent for fruits, and less than 60 percent for milk and milk products (Figure B2.2). Inadequate intakes of nutrient-dense foods from these basic food groups place individuals at risk for lower than recommended levels of specific nutrients, namely vitamin D, calcium, potassium, and dietary fiber.

Figure B2.2. Dietary intakes in comparison to recommended intake levels or limits



Note: Bars show average intakes for all individuals (ages 1 or 2 years or older) as a percent of the recommended intake level or limit. Recommended intakes for food groups and limits for refined grains, SoFAS, solid fats, and added sugars are based on the USDA 2000-calorie food patterns. Recommended intakes for fiber, potassium, vitamin D, and calcium are based on the highest AI for ages 14 to 70 years. Limits for sodium are based on the AI and for saturated fat on 7 percent of calories.

Data source: What We Eat in America, National Health and Nutrition Examination Survey (WWEIA, NHANES) 2001-2004 or 2005-2006.

Figure B2.2. Data points. All values in percents.

	Percent of recommended intake
Whole grains	15
Vegetables	59
Fruits	42
Milk	52
Oils	61
Fiber	40
Potassium	56
Vitamin D	42
Calcium	75
	Percent of recommended limit
Calories from SoFAS	280
Added sugars	242
Solid fats	281
Refined grains	200
Sodium	229
Saturated fat	158

Food from all food groups are composed of a combination of the macronutrients carbohydrates, fats, and protein in varying proportions. These are the major sources of energy in any food or diet. Understanding their role in the diet will help Americans make appropriate food choices.

Carbohydrates (4 kcal/g) are the primary source of energy intake, and higher intakes of carbohydrates, especially complex sources, are recommended for active people. Sedentary individuals, and thus most Americans, should lower their intakes of refined carbohydrates, greatly reducing intakes of sugar and sugar-sweetened beverages and refined grains that are high in calories, but relatively low in certain nutrients. Whole-grain versions of many grain products (such as plain white bread, rolls, bagels, muffins, pasta, breakfast cereals) should be substituted to meet the recommendation that half of grains consumed be whole grains, also assisting in meeting dietary fiber recommendations (see ***Part D. Section 5: Carbohydrates***).

Dietary fats (both solid fats and oils) are high in calories (9 kcal/g). Unsaturated fats, including omega-3 from seafood sources, should be increased and saturated fat and *trans* fatty acid intake should be minimized. Given typical patterns of consumption in the US, dietary saturated fat intake is highly correlated with total fat intake. Consuming the recommended intake of saturated fat (less than 10% of calories immediately as an interim step toward an eventual goal of less than 7% of calories) is more likely achievable when total fat intake is less than 30 percent of total calories. It is recommended that total fat should be in the range of 20 to 35 percent of total calories but derived mostly from oils within a nutrient-rich, energy-balanced dietary pattern. These oils should replace solid fats and not add calories to the total diet (see ***Part D. Section 3: Fatty Acids and Cholesterol***).

Dietary protein (4 kcal/g) provides essential amino acids and energy, and assists in building and preserving body proteins. Both plant-based sources of protein (i.e., cooked dry beans and peas, nuts, seeds, and soy products) and animal-based sources (i.e., meat, poultry, seafood, eggs, and low-fat and fat-free milk) can be incorporated into the total diet, with further emphasis on increasing seafood (rich in omega-3 fatty acids as well as protein) and cooked dry beans and peas (rich in dietary fiber as well as vegetable protein) (see ***Part D. Section 4: Protein***).

Consumption of alcoholic beverages also contributes to calories (7 kcal/g), from the alcohol itself as well as accompanying mixers (e.g., soda, juice or sweetened mixer). In many cases, the accompanying mixer (See Table D1.9 in ***Part D. Section 1: Energy Balance and Weight Management***) has more calories than the alcohol itself, so careful attention to portion size is important for alcoholic beverages. Based on individual preferences among adults, a moderate amount of alcohol may be included in the total diet if calorie allowances are not exceeded and essential nutrient needs are met. For adults who are attempting to reduce calorie intake, alcohol could be one of the energy sources that is reduced to lower total calorie intake. Pregnant women or individuals with certain medical conditions or on certain medications as well as individuals who will take part in activities that require attention or skill should not consume alcohol (see ***Part D. Section 7: Alcohol***).

Vegetables, fruits, high-fiber whole grains, seafood, eggs, and nuts prepared without added SoFAS are considered "nutrient-dense foods," as are low-fat forms of milk and lean meat and poultry prepared without added SoFAS. Nutrient-dense foods are found in a variety of forms but ideally are minimally processed and minimize or exclude added SoFAS, starches, and sodium. Combined into a total diet, these foods should provide a full range of essential nutrients, including those of special concern (e.g., vitamin D, calcium, potassium, and dietary fiber).

Finally, the nutrient-dense total diet should be prepared using best practices for food safety to ensure that foods consumed do not induce foodborne illnesses. (See ***Part D. Section 8: Food Safety and Technology***.) A balanced grouping of a variety of foods among all the food groups, consumed in moderation, that are culturally appealing will offer pleasurable eating experiences and promote health among Americans.

Reduce Sodium Intake

Even a nutrient-dense total diet that remains excessive in sodium can lead to health consequences such as elevated blood pressure. Excessive sodium intake raises blood pressure, a well-documented and extraordinarily common risk factor for heart disease, stroke, and kidney disease. Although most research has been conducted in adults, the adverse effects of sodium on blood pressure begin early in life, and reducing sodium intake has substantial health benefits. Given the fact that a higher potassium intake attenuates the adverse effects of sodium on blood pressure, ensuring increased intakes of dietary potassium also would have health benefits.

The current food supply is replete with excess sodium. In this setting, virtually all Americans exceed the recommended upper limit of sodium intake. Because approximately 75 percent of dietary sodium is added during food processing, food manufacturers and restaurant industries have a critically important role in reducing the sodium intake. In addition, individuals should choose and prepare foods with little or no sodium (see ***Part D. Section 6: Sodium, Potassium, and Water***).

A Flexible Approach to Applying Total Diet Recommendations

A healthful total diet is not a rigid prescription, but rather is a flexible approach that incorporates a wide range of individual tastes and preferences. Just as there is no one "American" or "Western" diet, there is no one recommendation for a healthful diet. As is evident in the following sections, data are accumulating that certain dietary patterns consumed around the world are associated with beneficial health outcomes. Likewise, the Food Patterns developed by the USDA illustrate that both nutrient and moderation goals can be met in a variety of ways.

Worldwide Dietary Patterns Provide Support for a Nutrient-dense Total Diet

Across the world and within the US, there are striking differences in diets and also in diet-related health outcomes. Although research on dietary patterns is complex, and many methodological issues remain in synthesizing data across studies, a consensus is emerging that consumption of certain dietary patterns is associated with a reduced risk of several major chronic diseases. The 2010 DGAC focused on the effects of dietary patterns on total mortality, CVD, and blood pressure (a major diet-related cardiovascular risk factor). The World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR, 2007) recently reviewed the available evidence of the relationship of cancer with specific dietary factors and overall dietary patterns. While several dietary factors were associated with specific types of cancer, it concluded that no firm judgment can be made on the relationship of dietary patterns with cancer.

The 2010 DGAC focused on the DASH-style dietary patterns and Mediterranean-style dietary patterns because considerable research exists on health outcomes as well as information on nutrient and food group composition. It also examined traditional Asian dietary patterns and vegetarian diets. Traditional Asian dietary patterns (e.g., Japanese and Okinawan dietary patterns) have been associated with a reduced risk of coronary heart disease, but documentation using contemporary research methods is scant. Most traditional dietary patterns provide for health at least moderately well, and their variety demonstrates that a person can eat healthfully in a number of ways. Vegetarian diets have been associated with a reduced risk of CVD, but information on nutrient content and food group composition is sparse.

Dietary patterns with health benefits are summarized below. An Appendix at the end of this chapter provides further detail on these dietary patterns as well as several summary tables.

DASH-style Dietary Patterns

DASH-style dietary patterns emphasize vegetables, fruits, and low-fat milk and milk products; include whole grains, poultry, seafood, and nuts; and are reduced in red meat, sweets, sodium, and sugar-containing beverages. As originally tested, the DASH diet is reduced in total fat (27% of kcal) with total protein intake of 18 percent of calories and carbohydrate intake of 55 percent of calories. However, other versions of the DASH diet are available, in which carbohydrate is partially replaced with protein (about half from plant sources) or unsaturated fat (predominantly monounsaturated fat). The latter version is noteworthy because nutrient adequacy and a reduced saturated fat intake (6% of kcal) were both achieved in the setting of high monounsaturated fat (21% of kcal) and total fat (37% of kcal) intake. In a free-living setting, care is needed to meet but not exceed energy needs in order to avoid weight gain.

Each of these DASH style diets lowers blood pressure, improves blood lipids, and reduces CVD risk. Blood pressure reduction is the greatest when the DASH diet is consumed with reduced sodium intake. At present, few adults, even those with hypertension, eat a diet that is consistent with the DASH dietary pattern.

Mediterranean-style Dietary Patterns

In view of the large number of cultures and agricultural patterns of countries that border the Mediterranean Sea, the “Mediterranean” diet is not a single dietary pattern. Although no well-accepted set of criteria exist, a traditional Mediterranean diet can be described as one that emphasizes breads and other cereal foods usually made from wheat, vegetables, fruits, nuts, unrefined cereals, and olive oil; includes fish and wine with meals (in non-Islamic countries); and is reduced in saturated fat, meat, and full-fat dairy products. Results from observational studies and clinical trials suggest that consumption of a traditional Mediterranean diet, similar to that of Crete in the 1960s, is associated with one of the lowest risks of coronary heart disease in the world. Over time, the diet of Crete has changed remarkably and is now characterized by higher intake of saturated fat and cholesterol, and reduced intake of monounsaturated fats. At the same time, total fat consumption has fallen. These trends have been accompanied by a steady rise in heart disease risk.

Vegetarian Dietary Patterns

In some observational studies, vegetarian diets and lifestyle have been associated with improved health outcomes. The types of vegetarian diets consumed in the US vary widely. Vegans do not consume any animal products, while lacto-ovo vegetarians, consume milk and eggs. Although not strict vegetarians, many individuals consume small or minimal amounts of animal products. On average, vegetarians consume fewer calories from fat than non-vegetarians, particularly saturated fat, and have a higher consumption of carbohydrates than non-vegetarians. In addition, vegetarians tend to consume fewer overall calories and have a lower body mass index than non-vegetarians. These characteristics, in addition to the dietary pattern per se, may contribute to the improved health outcomes of vegetarians (see the Appendix at the end of this chapter and ***Part D. Section 4: Protein*** for additional information on vegetarian diets).

Other Dietary Patterns

In view of the increasing diversity of the US population, interest in the health effects of non-Western diets is substantial. One group of diets with potential health benefits are those traditionally consumed in Asia, which has experienced some of the lowest rates of coronary heart disease in the world. Both traditional Japanese and Okinawan dietary patterns have been associated with a low risk of coronary heart disease. Nonetheless, compared to the evidence supporting DASH and Mediterranean diets, detailed information on diet composition as well as epidemiologic and clinical trial evidence on health benefits, similar to that available for the other types of diets, is sparse. Also, over time, dietary intakes in these countries have changed and may no longer reflect the healthiest choices.

USDA Food Patterns Provide Guidance for Meeting Dietary Guideline Recommendations

Applying results from carefully conducted studies of nutrition and health, the USDA has developed a number of different food guides over the past century. These guides have identified eating patterns that meet known nutrient needs and balance intake from various food groups. Based upon the Nation's dietary intake at the time, early USDA food guides focused on nutrient adequacy only. Due to the health risks associated with overconsumption of specific dietary components, including the increasing obesity problem, recent guides have encompassed moderation goals while meeting nutrient adequacy goals. The current USDA Food Patterns also are aimed at primary disease prevention. For example, Table B2.4 (see end of chapter) compares the 2000-calorie USDA food pattern with the DASH diet and with current consumption patterns. The types and amounts of foods recommended in the USDA patterns are very similar to the DASH diet, and both are very different from current intakes.

The USDA Food Patterns recommend the amounts of foods to eat each day from the five major food groups and subgroups, specifically in nutrient-dense forms. The Patterns allow for oils and limit the maximum number of calories that should be consumed from SoFAS. Table B2.3 (see end of chapter) shows recommended amounts and limits in the USDA food patterns at all 12 energy levels (***Part D. Section 2: Nutrient Adequacy***, Table D2.1 provides the specific nutritional goals for each pattern).

The USDA Food Patterns incorporate several important assumptions:

- A variety of foods are used to meet recommended intakes from each food group or subgroup, in amounts proportionate to current consumption by the population.
- Food choices selected for use in the analysis are in nutrient-dense forms, that is, with little or no SoFAS, and in most cases without added salt.
- For each age-sex group, the pattern developed to meet nutrient needs is at a caloric level that meets but does not exceed energy needs for sedentary individuals.

The online ***Appendix E3.1: Adequacy of the USDA Food Patterns***, available at www.dietaryguidelines.gov, provides details of the analysis conducted for the DGAC to determine whether the USDA Food Patterns meet nutritional goals for adequacy and moderation while staying within established calorie targets.

Recommended intake amounts in the USDA Food Patterns remain unchanged from 2005 with the exception of the vegetable subgroups. Several changes were made to decrease the wide discrepancy in number and amounts of vegetables consumed between the largest and the smallest subgroups. This resulted in moving tomatoes and red peppers from "other vegetables" to a new "red-orange vegetable" subgroup, which provided a greater focus on tomatoes without compromising the nutrient adequacy of the patterns (see the online ***Appendix E3.2: Realigning Vegetable Subgroups*** report at www.dietaryguidelines.gov, for details). The USDA Food Patterns meet almost all of their nutritional goals for adequacy and moderation, when evaluated using current food composition and consumption data.

USDA also developed and evaluated several variations on the base patterns, applying the same principles but modifying food choices to accommodate those wanting to eat a plant-based or vegetarian diet. An additional analysis investigated a possible modification of the patterns for those tracking carbohydrate intake, such as people with diabetes. The results of these analyses are presented below (see ***Part C: Methodology*** for a description of the methods used and a list of all food pattern modeling analyses).

Vegetarian Patterns Based on USDA Food Patterns

The USDA Food Patterns include two animal-based food groups: the "meat, poultry, seafood, eggs, soy products, nuts, and seeds" group and the "milk, yogurt, and cheese" group. Although the groups contain some plant foods, the majority of consumption from them is from animal products. As is true in American diets, these two food groups in the Food Patterns are the major sources of protein, calcium, vitamin D, vitamin B_{12}, riboflavin, choline, selenium, zinc, and the omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaeonic acid (DHA).

The USDA food patterns were modified to replace some or all animal products with plant products (see the online ***Appendix E3.3: Vegetarian Food Patterns*** report at www.dietaryguidelines.gov for details). The plant-based (at least 50% of all protein from plant sources), lacto-ovo vegetarian (no meat, poultry, or seafood), and vegan (no meat, poultry, seafood, eggs, fluid milk or milk products) food patterns, collectively referred to as the "vegetarian patterns," meet almost all goals for nutrient adequacy. Amounts of protein, including all essential amino acids, were adequate in all vegetarian patterns. Amounts of calcium and vitamins D and B_{12} were adequate because fortified sources of these nutrients were selected to replace milk and meat products. The estimated bioavailable iron in the vegan patterns was less than the RDA for some children and women. While no dietary standards exist for omega-3 fatty acids, levels of EPA and DHA are substantially lower than the base Food Patterns, especially in the vegan patterns. All moderation goals are met in the vegetarian patterns. If only plant foods are consumed, choices should include foods fortified with vitamin B_{12}, vitamin D, and calcium. Other nutrients of potential concern include iron, choline, EPA, and DHA.

Considering an Alternative Placement for Starchy Vegetables

To offer flexibility in selecting a food pattern that meets nutrient needs and accommodates food preferences, USDA evaluated a nutritionally adequate option that considers starchy vegetables as a grain alternative (See the online ***Appendix E3.4: Starchy Vegetables*** report at www.dietaryguidelines.gov for details). This pattern may be useful for individuals who wish to track the amount of carbohydrates they consume, who prefer a dietary pattern that groups all major sources of starch together, or who wish to integrate the USDA recommendations with other diet plans. In this pattern, individuals can substitute starchy vegetables for a portion of the recommended grains, as long as they eat additional vegetables from other subgroups to replace the starchy vegetables. As with all of the modeling analyses, the vegetables and grains selected should be nutrient-dense forms, not forms with added fats, sugars, or salt. Although starchy vegetables remain part of the vegetable group in the USDA Food Patterns, this analysis identified an option for flexibility to help some individuals integrate the USDA recommendations with other dietary plans.

The Importance of Nutrient-dense Choices

The USDA Food Patterns assume that foods in each food group will be consumed in the same relative proportions as they appear in the average American diet, but that most will be in nutrient-dense forms. Nutrient-dense choices are available to consumers, but they are not the forms most typically consumed. Consuming recommended amounts of foods, but in forms that represent typical food choices rather than the "ideal" nutrient-dense choices, has a major impact on energy and nutrient intake. Excess intake of energy, sodium, saturated fat, and cholesterol result from using typical food choices in the recommended amounts for the patterns. For example, assuming typical food choices, the calorie intake in the 2000-calorie pattern is almost 400 calories more per day than the target (see the online ***Appendix E3.5: "Typical Choices" Food Patterns*** report at www.dietaryguidelines.gov for details of an analysis of the effect of typical versus ideal choices). If consumers act on the message about quantities to eat from each food group or subgroup, but fail to implement the moderation messages about choosing most foods in low-fat, no-added-sugars, and low-sodium forms, they will not meet the important moderation goals.

Chapter Summary

Good health and vitality across the life span are what Americans desire. The 2010 DGAC report concludes that this is achievable but requires a lifestyle approach that includes a total diet that is:

- Energy balanced, limited in total calories, and portion controlled
- Nutrient-dense and includes:
    - Vegetables, fruits, high-fiber whole grains
    - Fat-free or low-fat fluid milk and milk products
    - Seafood, lean meat and poultry, eggs, soy products, nuts, seeds, and oils
- Very low in solid fats and added sugars (SoFAS)

- Reduced in sodium

Physical activity will assist in the helping to achieve a balance between calorie intake and expenditure, leading to body weight maintenance. Children and adolescents are of particular concern because the dietary habits that they form during their youth will set the foundation for their choices and behaviors as adults.

Several distinct dietary patterns are associated with health benefits, including lower blood pressure and a reduced risk of CVD and total mortality. A common feature of these diets is an emphasis on plant foods. Accordingly, fiber intake is high and saturated fat is typically low. When total fat intake is high, that is, more than 30 percent of calories, the predominant fats are monounsaturated and polyunsaturated fats. Carbohydrate intake is typically in the range of 50 to 60 percent of calories, but these often include whole grain products with minimal processing, as well as cooked dry beans and peas. The totality of evidence documenting a beneficial impact of plant-based dietary patterns on CVD risk is remarkable and worthy of recommendation.

Americans have considerable flexibility in selecting a diet that includes foods they enjoy, meets nutrient requirements, reduces risk of preventable disease, and controls weight. No one specific dietary pattern provides the only way to incorporate the principles listed above into a total diet. The daunting public health challenge is to accomplish population-wide adoption of healthful dietary patterns within the setting of powerful influences that currently promote unhealthy lifestyles. The 2010 DGAC is united in advocating that policy makers, stakeholders and health-care providers embrace and support these important, evidence-based guidelines for the benefit of all Americans.

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Table B2.1. Estimated energy needs[1] in calories per day, for reference-sized individuals by age, sex, and activity level

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

[1]Based on Estimated Energy Requirements (EER) equations, using reference heights (average) and reference weights (healthy) for each age/sex group, rounded to the nearest 200 calories. EER equations are from the Institute of Medicine. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids.* Washington DC: National Academies Press, 2002.
Source: Britten et al., 2006.

Table B2.2. Top five sources of energy among US children, adolescents, and adults by age, NHANES 2005-06[1]

	Overall, ages 2+ years	Ages 2-18 years	Ages 2-3 years	Ages 4-8 years	Ages 9-13 years	Ages 14-18 years	Ages 19+ years
Mean energy intake (kcal)	2157	2027	1471	1802	2035	2427	2199
Rank							
1	Grain-based desserts[1] (138 kcal)	Grain-based desserts (138 kcal)	Whole milk (104 kcal)	Grain-based desserts (136 kcal)	Grain-based desserts (145 kcal)	Soda/energy /sports drinks[2] (226 kcal)	Grain-based desserts (138 kcal)
2	Yeast breads (129 kcal)	Pizza (136 kcal)	100% fruit juice (not orange or grapefruit) (93 kcal)	Yeast breads (98 kcal)	Pizza (128 kcal)	Pizza (213 kcal)	Yeast breads (134 kcal)
3	Chicken and chicken mixed dishes (121 kcal)	Soda/energy/ sports drinks (118 kcal)	Reduced fat milk (91 kcal)	Pasta and pasta dishes (97 kcal)	Chicken and chicken mixed dishes (122 kcal)	Grain-based desserts (157 kcal)	Chicken and chicken mixed dishes (123 kcal)
4	Soda/energy/ sports drinks (114 kcal)	Yeast breads (114 kcal)	Pasta and pasta dishes (86 kcal)	Pizza (95 kcal)	Yeast breads (109 kcal)	Yeast breads (151 kcal)	Soda/energy /sports drinks[2] (112 kcal)
5	Pizza (98 kcal)	Chicken and chicken mixed dishes (113 kcal)	Grain-based desserts (68 kcal)	Reduced fat milk (95 kcal)	Soda/energy/ sports drinks (105 kcal)	Chicken and chicken mixed dishes (143 kcal)	Alcoholic beverages (106 kcal)

[1]Foods ranked by mean contribution to overall energy intake. Table shows each food category and its mean caloric contribution for each age group.
[2]Includes cakes, cookies, doughnuts, pies, crisps, cobblers, granola bars.
[3]Includes sodas, energy drinks, sports drinks, and sweetened bottled water including vitamin water.
Note: For a more detailed listing of food sources of energy, see ***Part D. Section 1. Energy Balance***, Tables D1.1, D1.6, and D1.7.
Source: National Cancer Institute (NCI). Food Sources of Energy Among US Population, 2005-06. Risk Factor Monitoring and Methods Branch Website. Applied Research Program. National Cancer Institute, 2010a. http://riskfactor.cancer.gov/diet/foodsources/. Updated May 21, 2010. Accessed May 21, 2010.

Table B2.3. USDA Food Patterns—recommended daily intake amounts[1] from each food group or subgroup at all calorie levels. Recommended intakes from vegetable subgroups are per week

Energy level of pattern[2]	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
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	½ c/wk	1 c/wk	1 c/wk	1 ½ c/wk	1 ½ c/wk	1 ½ c/wk	2 c/wk	2 c/wk	2 ½ c/wk	2 ½ c/wk	2 ½ c/wk	2 ½ c/wk
Red/Orange vegetables	2½ c/wk	3 c/wk	3 c/wk	4 c/wk	5 ½ c/wk	5 ½ c/wk	6 c/wk	6 c/wk	7 c/wk	7 c/wk	7½ c/wk	7½ c/wk
Cooked dry beans and peas	½ c/wk	½ c/wk	½ c/wk	1 c/wk	1 ½ c/wk	1 ½ c/wk	2 c/wk	2 c/wk	2 ½ c/wk	2 ½ c/wk	3 c/wk	3 c/wk
Starchy vegetables	2 c/wk	3½ c/wk	3½ c/wk	4 c/wk	5 c/wk	5 c/wk	6 c/wk	6 c/wk	7 c/wk	7 c/wk	8 c/wk	8 c/wk
Other vegetables	1½ c/wk	2½ c/wk	2½ c/wk	3½ c/wk	4 c/wk	4 c/wk	5 c/wk	5 c/wk	5½ c/wk	5½ c/wk	7 c/wk	7 c/wk
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
Meat and beans	2 oz eq	3 oz eq	4 oz eq	5 oz eq	5 oz eq	5½ oz eq	6 oz eq	6 ½ oz eq	6 ½ oz eq	7 oz eq	7 oz eq	7 oz eq
Milk	2 c	2 c	2 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
Maximum SoFAS[3] limit, calories (%total calories)	137 (14%)	137 (11%)	137 (10%)	121(8%)	161(9%)	258 (13%)	266 (12%)	330 (14%)	362 (14%)	395 (14%)	459 (15%)	596 (19%)

[1]Food group amounts shown in cup (c) or ounce equivalents (oz eq). Oils are shown in grams (g). 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 oz ready-to-eat cereal.
- 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.
- Meat and beans**,** 1 ounce equivalent is: 1 ounce lean meat, poultry, fish; 1 egg; ¼ cup cooked dry beans; 1 Tbsp peanut butter; ½ ounce nuts/ 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.

[2]Food intake patterns at 1000, 1200, and 1400 calories meet the nutritional needs of children ages 2 to 8 years. Patterns from 1600 to 3200 calories meet the nutritional needs of children 9 years of age and older and adults. If a child ages 2 to 8 years needs more calories and, therefore, is following a pattern at 1600 calories or more, the recommended amount from the milk group can be 2 cups per day. Children ages 9 years and older and adults should not use the 1000, 1200, or 1400 calorie patterns.

[3]SoFAS are calories from solid fats and added sugars.

Table B2.4. Dietary pattern comparison: Current US Intake, DASH-sodium diet, and USDA food patterns. Description, nutrient composition, and food group amounts (adjusted to 2000 calories)

Dietary Pattern	Usual US Intake Adults	DASH with Reduced Sodium	USDA Base Pattern[1]	USDA Plant-based	USDA Lacto-ovo Vegetarian	USDA Vegan
Citation	NHANES 2001-04; 2005-06; Ages 19+	Karanja et al., 1999 and Lin et al., 2003	Britten et al., 2006; Online Appendix E-3.1	Online Appendix E-3.3	Online Appendix E-3.3	Online Appendix E-3.3
Qualitative Description						
Emphasizes		Potassium-rich vegetables, fruits, and low-fat milk products	Vegetables, fruits, and whole grains, low-fat milk products	Plant foods - vegetables, fruits, whole grains, legumes, low-fat milk products	Plant foods - vegetables, fruits, whole grains, legumes, nuts, seeds, soy foods, milk products	Plant foods - vegetables, fruits, whole grains, legumes, nuts, seeds, soy foods
Includes		Whole grains, poultry, fish, and nuts	Enriched grains, lean meat, fish, and oils	Lean meat, eggs, fish, and oils	Eggs, oils	Non-dairy milk alternatives
Limits (small amount)		Red meats, sweets, and sugar-containing beverages	Solid fats Added sugars	Solid fats Added sugars	No meat, poultry, fish Added sugars	No animal products Added sugars
Nutrients						
Calories (kcal)	2000	2000	2000	2000	2000	2000
Carbohydrates (% total kcal)	48.4%	58%	56.7%	55.8%	56.7%	56.8%
Protein (% total kcal)	15.2%	18%	15.2%	16.3%	15.2%	13.3%
Total Fat (% total kcal)	33.5%	27%	32%	31%	31%	33%
Saturated Fat (% total kcal)	10.9%	6%	8.4%	7.8%	7.8%	6.8%
Monounsaturated (% total kcal)	12.5%	10%	12.0%	11.4%	11.8%	12.4%
Polyunsaturated (% total kcal)	6.8%	8%	9.0%	9.3%	9.4%	12.0%
Cholesterol (mg)	269	143	229	170	160	17
Fiber (g)	15	29	30	37	39	43
Potassium (mg)	2909	4371	3478	3611	3610	3645
Sodium (mg)	2846	1095	1722	1582	1595	1224
Food Groups						
Vegetables: total (c)	1.6	2.1	2.5	2.5	2.5	2.5
- Dark Green (c)	0.1	nd	0.2	0.2	0.2	0.2
- Legumes[2](c)	0.1	nd	0.2	0.2	0.2	0.2
- Red Orange (c)	0.4	nd	0.8	0.8	0.8	0.8
- Other Veg (c)	0.5	nd	0.6	0.6	0.6	0.6
- Starchy Veg (c)	0.5	nd	0.7	0.7	0.7	0.7

Table B2.4 (continued). Dietary pattern comparison: Current US Intake, DASH-sodium diet, and USDA food patterns. Description, nutrient composition, and food group amounts (adjusted to 2000 calories)

Dietary Pattern	Usual US Intake Adults 19 year+	DASH with Reduced Sodium	USDA Base Pattern[1]	USDA Plant-based	USDA Lacto-ovo Vegetarian	USDA Vegan
Calories (kcal)	2000	2000	2000	2000	2000	2000
Food Groups						
Fruit & juices (c)	1.0	2.5	2	2	2	2
Grains: total (oz)	6.4	7.3	6	6	6	6
- Whole grains (oz)	0.6	3.9	3	3	3	3
Milk & milk products incl whole fat (c)	1.5	0.7 (whole)	-	-	-	-
- Low-fat milk (c)	Nd	1.9	3	3	3	3 (non-dairy)[3]
Animal Proteins:						
- Meat (oz)	2.5	1.4	2.5	0.6	-	-
- Poultry (oz)	1.2	1.7	1.5	0.4	-	-
- Eggs (oz)	0.4	nd	0.4	0.4	0.6	-
- Fish (total) (oz)	0.5	1.4	0.5	0.7	-	-
-- Hi N3 (oz)	0.1	nd	0.1	nd	-	-
-- Low N3 (oz)	0.4	nd	0.4	nd	-	-
Plant Proteins:						
- Legumes (oz)	nd	0.4	See vegetables.	1.4	1.4	1.9
- Nuts & seeds (oz)	0.5	0.9	0.6	1.1	1.9	2.1
- Soy products (oz)	0.0	nd	0.05	0.9	1.7	1.4
Oils (g)	17.7	24.8	27	23	19	18
Solid Fats (g)	43.2	nd	16	16	16	16
Added Sugar (g)	79.0	12 (snacks/sweets)	32	32	32	32
Alcohol (g)	9.9	-	-	-	-	-

[1] The USDA Base Food Pattern Is slightly adapted from the 2000-calorie pattern presented in the 2005 Dietary Guidelines for Americans (DGA). Vegetable subgroups were realigned to include a Red/Orange subgroup. The base pattern and the vegetarian variations are subject to change as the 2010 DGA are developed.. The measures are cup and ounce equivalents (Britten, 2006; Marcoe,2006). Nutrient distribution updated with 2010 composites.

[2] On USDA patterns, total recommended legume amount is the sum of amounts recommended in the Vegetable and the Meat & Beans groups. An ounce equivalent of legumes in the Meat & Beans group is ¼ cup. For example, in the 2000-calorie pattern, total weekly legume recommendation is (13 oz eq /4) + 1.5 cups = 5 cups.

[3] Non-dairy options in Vegan pattern are calcium-fortified soymilk, rice milk, and tofu. All USDA patterns contain a small amount of soy milk.

nd = Not described.

(-) = No recommendation.

Sources: Usual US Intakes – WWEIA, NHANES 2001-2004 and WWEIA, NHANES 2005-2006, one-day mean intakes consumed per individual. Male and female intakes adjusted to 2000 calories, averaged, and rounded to one decimal point.

Part B. Section 2. Appendix: Dietary Patterns and Health Outcomes

Introduction

Across the world and within the United States, there are striking differences in diet. Concomitantly, there are substantial differences in health outcomes, many of which are related to diet. This section discusses several dietary patterns that are associated with desirable health outcomes. It focuses on total mortality, cardiovascular disease (CVD), and blood pressure, a major diet-related cardiovascular risk factor. The World Cancer Research Fund/American Institute for Cancer Research, recently reviewed the available evidence of the relationship of cancer with specific dietary factors and overall dietary patterns (WCRF/AICR, 2007). Although several dietary factors were associated with specific types of cancer, it concluded that no firm judgment can be made on the relationship of dietary patterns with cancer, in large part, because variability in definitions precluded a formal synthesis of evidence.

The study of dietary patterns is complex. First, there is substantial heterogeneity even among diets that fall under a common rubric (e.g., Mediterranean diets). Second, dietary patterns are not static. Traditional diets known for their health benefits (e.g., Mediterranean and Okinawan diets) are being supplanted by versions that often reflect Western culture and that lead to worse not better health outcomes. For this reason, we focused on pre-transition dietary patterns. Third, with few exceptions, standardized assessment of diet is unavailable, making it difficult to compare diets. Fourth, health outcomes are often unavailable and, when available, are not directly comparable across studies. Fifth, dietary patterns, even with proven health benefits, may not be ideal and could be improved. For example, traditional Japanese diets are associated with a low risk of coronary heart disease but a high risk of stroke, likely because of excessive sodium intake. Sixth, describing dietary patterns and evaluating their health outcomes often requires scoring systems based on adherence to specific aspects of the diets. This approach commonly relies on researchers who exercise best judgment in selecting biologically relevant aspects of the diet and in developing a formula, which typically weights each dimension as of equivalent importance. Seventh, in the interpretation of observational data, particularly ecologic data, it is difficult to separate the effects of diet from other factors, such as smoking and physical inactivity, that likely account for part of the observed differences in health outcomes.

Despite these caveats, the 2010 Dietary Guidelines Advisory Committee (DGAC) was able to identify dietary patterns that are associated with substantial beneficial health benefits (Table B2.5). Specifically, the Committee focused on the following dietary patterns for which there was research on health outcomes as well as information on nutrient and food group composition: 1) Dietary

Approaches to Stop Hypertension (DASH)-style dietary patterns, 2) Mediterranean-style dietary patterns, and 3) Vegetarian dietary patterns. The DASH dietary pattern is a Western-style dietary pattern for which a large and burgeoning literature documents its health benefits. The Committee also included Mediterranean and Japanese dietary patterns, which were associated with the lowest risk of coronary heart disease in the Seven Countries study (Keys, 1980). Subsequently, a substantial literature has documented the health benefits of Mediterranean-style diets. In contrast, while traditional Asian dietary patterns (e.g., Japanese and Okinawan dietary patterns) have also been associated with a reduced risk of coronary heart disease (Wilcox, 2007), documentation using contemporary research methods is scant. Finally, the Committee studied vegetarian diets, which have been associated with a reduced risk of coronary heart disease (Key, 1999).

DASH-style Dietary Patterns

DASH-style dietary patterns emphasize fruits, vegetables, and low-fat dairy products; include whole grains, poultry, fish and nuts; and are reduced in red meat, sweets, and sugar-containing beverages (Karanja, 1999; Craddick, 2003). The diets are rich in potassium, magnesium, calcium and fiber, and reduced in saturated fat and cholesterol. As originally tested, the DASH diet is reduced in total fat (27% kcal) with total protein intake of 18 percent of calories and carbohydrate intake of 55 percent of calories. However, other versions of the DASH diet are available, in which carbohydrate is partially replaced with protein (about half from plant sources) or unsaturated fat (predominantly monounsaturated fat) (Appel, 2005; Swain, 2008). The latter version is noteworthy because nutrient adequacy and a reduced saturated fat intake (6% kcal) were both achieved in the setting of high monounsaturated fat intake (21% kcal). Each of these DASH-style diets lowers blood pressure, improves blood lipids, and reduces CVD risk. Blood pressure reduction is the greatest when the DASH diet is consumed with reduced sodium intake (Sacks, 2001).

As originally developed, the DASH diet was designed to provide a nutrient profile that might lower blood pressure. As such, it is a derived dietary pattern. Nonetheless, it is based on foods that are routinely available in US and was studied using foods purchased at local stores. At present, few adults, even those with hypertension, eat a diet that is consistent with the DASH dietary pattern (Mellen, 2008).

Mediterranean-style Dietary Patterns

In view of the large number of cultures and agricultural patterns of countries that border the Mediterranean Sea, the "Mediterranean" diet is not a single dietary pattern. Countries included those of southern-most Europe, the Middle East, and northern-most Africa. Interest in traditional Mediterranean-style diets is substantial because such diets have been associated with considerable health benefits. Because of the multiplicity of dietary patterns termed "Mediterranean," it has been challenging to characterize these diets. Although a traditional Mediterranean diet has no well-accepted set of criteria, it can be described as one that emphasizes breads and other cereal foods usually made from wheat, vegetables, fruits, nuts, unrefined cereals, and olive oil; includes fish and wine with meals (in non-Islamic countries); and is reduced in saturated fat, meat, and full-fat dairy products (Kris-Etherton, 2001; Trichopoulou, 2003; WCRF/AICR, 2007). Table B2.5. displays the nutrient profile and food group composition of Mediterranean-style diets, as reported in three cohort studies (one from Greece, one from Spain, and one from the US) (Fung, 2009; Karanja, 1999; Lin, 2003; Nunez-Cordoba, 2008; Trichopoulou, 2003; Wilcox, 2007).

Results from observational studies and clinical trials suggest that consumption of a traditional Mediterranean diet, similar to that of Crete in the 1960s, is associated with one of the lowest risks of coronary heart disease in the world. Over time, the diet of Crete has changed remarkably and is now characterized by higher intake of saturated fat and cholesterol, and reduced intake of monounsaturated fats. At the same time, total fat consumption has fallen. These trends have been accompanied by a steady rise in coronary heart disease risk (Menotti, 1999).

Vegetarian Dietary Patterns

In many observational studies, vegetarian diets and lifestyle have been associated with improved health outcomes. The types of vegetarian diets consumed in the US vary considerably. Strict vegetarians (i.e., vegans), do not consume any animal products, while other types of vegetarians, such as lacto-ovo vegetarians, consume milk and eggs. Although not strict vegetarians, many individuals consume small or minimal amounts of animal products. On average, vegetarians consume fewer calories from fat than non-vegetarians, particularly saturated fat, and have a higher consumption of carbohydrates than non-vegetarians. In addition, vegetarians tend to consume fewer overall calories and have a lower body mass index than non-vegetarians. These characteristics, in addition to the dietary pattern per se, may contribute to the improved health outcomes of vegetarians.

Although no or minimal consumption of animal products is a hallmark of vegetarian diets, these diets have a clear potential for confounding, particularly from other dietary and non-dietary factors. Hence, the improved health experience of vegetarians may not only result from reduced consumption of saturated fats but also from greater consumption of vegetables, fruit, nuts, and grains or from other health attributes, such as not smoking cigarettes).

Other Dietary Patterns

In view of the increasing diversity of the US population, interest in the health effects of non-Western diets is substantial. One group of diets with potential health benefits are those consumed in Asia. It is well-documented that in Southeast Asia, coronary heart disease rates have been among the lowest in the world. Lifestyle factors, especially diet, appear to be a major reason. However, contemporary evidence (e.g., prospective cohort studies and clinical trials), similar to the evidence available for the other types of diets is sparse.

Traditional Japanese dietary patterns emphasize soybean products, fish, seaweeds, vegetables, fruit, and green tea, and are reduced in meats (Shimazu, 2007). Nonetheless, it should be recognized that this diet is high in salt, likely accounting for the high incidence of stroke in this population. Similar to other dietary patterns, Japanese dietary patterns have evolved over time.

The longevity of Okinawans is among the highest in the world. Researchers attribute the longeveity and health of Okinawans, in large part, to diet composition or some other aspect of their diet, such as energy restriction (Willcox, 2007). The indigenous Satsamu sweet potato, which is rich in nutrients, is the food staple that provides the bulk of energy intake. Other prominent foods are a wide variety of seaweeds, Okinawan tofu, and herbaceous plants. Okinawan food culture also includes a modest amount of fish and pork. The estimated carbohydrate content of this diet is extremely high, at more than 80 percent of calories. Salt intake is the lowest of all Japan. However, the traditional Okinawan diet has changed such that fast foods and processed foods are increasingly consumed.

What is the Effect of Different Dietary Patterns (DASH, Mediterranean, Vegetarian, and Other) on Blood Pressure in Adults?

The 2010 DGAC performed a literature search to identify research, with no date limits, on the effect of the above dietary patterns on blood pressure in adults. Some articles were reviewed that included dietary patterns that were characterized using dietary cluster or factor analysis. The NEL search identified 146 potential articles (11 reviews/meta-analyses and 135 primary studies). Of these, 126 were excluded. A total of 20 articles, all of them primary studies, met the eligibility criteria and were reviewed (Table B2.6).

Of the 12 studies that evaluated a DASH-style dietary pattern (Appel, 2005; Appel, 1997; Appel, 2003; Azadbakht, 2005; Dauchet, 2007; Forman, 2009; Miller, 2002; Nowson, 2009; Nowson, 2005; Nowson, 2004; Sacks, 2001; Schulze, 2003), nine were randomized controlled trials (Appel, 2005;

Appel, 1997; Appel, 2003; Azadbakht, 2005; Miller, 2002; Nowson, 2009; Nowson, 2005; Nowson, 2004; Sacks, 2001), and three were prospective cohort studies (Dauchet, 2007; Forman, 2009; Schulze, 2003). In aggregate, the DASH diet lowered systolic blood pressure in 12 studies (Appel, 2005; Appel, 1997; Appel, 2003; Azadbakht, 2005; Dauchet, 2007; Forman, 2009; Miller, 2002; Nowson, 2009; Nowson, 2005; Nowson, 2004; Sacks, 2001; Schulze, 2003) and diastolic blood pressure in 10 of the 12 studies that reported diastolic blood pressure (Appel, 2005; Appel, 1997; Appel, 2003; Azadbakht, 2005; Dauchet, 2007; Forman, 2009; Miller, 2002; Nowson, 2005; Nowson, 2004; Schulze, 2003). In several instances, blood pressure reduction occurred as part of a multi-factorial intervention that tested the DASH dietary pattern concomitantly with other interventions (Appel, 2003; Miller, 2002; Sacks, 2001).

Few studies examined the effects of a Mediterranean-style diet on blood pressure. In the one available study (Núñez-Córdoba, 2009) a cohort study, a Mediterranean-style diet, lowered systolic and diastolic blood pressure.

Four trials tested the effects of vegetarian diets on blood pressure (Hakala and Karvetti, 1989; Margetts, 1986; Rouse, 1983; Sciarrone 1993). Vegetarian-style dietary patterns lowered systolic blood pressure in all four trials and diastolic blood pressure in three trials (Hakala and Karvetti, 1989; Rouse, 1983; Sciarrone, 1993).

One randomized, cross-over trial found that, within the context of a traditional Japanese diet, increased vegetables and fruit intake and decreased sodium intake significantly reduced systolic blood pressure in normotensive and hypertensive free-living rural Japanese (Takahashi, 2006).

What is the Effect of Different Dietary Patterns (DASH, Mediterranean, Vegetarian, and Other) on Cardiovascular Disease, Stroke, and Total Mortality in Adults?

The 2010 DGAC performed a literature search to identify research, with no date limits, on the effect of these dietary patterns on cardiovascular disease, stroke, and total mortality in adults. Some articles were reviewed that included dietary patterns that were characterized using dietary clusters or factor analysis. The search identified 197 potential articles (11 reviews/meta-analyses and 186 primary studies). Of these, 168 were excluded. A total of 29 articles, 27 primary studies, one systematic review/meta-analysis, and one systematic review, met the eligibility criteria and were reviewed. Of the 27 primary studies, two were randomized controlled trials, 20 were prospective cohort studies (two were follow-up of RCTs and one was non-concurrent), three were case-control studies, one was a med adherence analysis, and one was a time series (Table B2.7).

Of the 10 studies that evaluated a DASH-style dietary pattern, nine were prospective cohort studies (Folsom, 2007; Fung, 2001; Fung, 2008; Heidemann, 2008; Hu, 2000; Levitan, 2009; Osler, 2001; Parikh, 2009; Singman, 1980) and one was a randomized trial in which estimated coronary heart disease risk was the outcome (Appel, 2005). Of the 10 that evaluated a relationship of a DASH-style dietary pattern with CVD, nine studies documented that consumption of a DASH-style diet was associated with a reduced risk of CVD (Appel, 2005; Fung, 2001; Fung, 2008; Heidemann, 2008; Hu, 2000; Levitan, 2009; Osler, 2001; Parikh, 2009; Singman, 1980), and one (Folsom, 2007) found no such relationship. For total mortality, six of seven studies that reported data on mortality documented an inverse relation (Fung, 2008; Heidemann, 2008; Hu, 2000; Levitan, 2009; Osler, 2001; Parikh, 2009) and one (Folsom, 2007) found no such relationship. In the two available studies with stroke (Fung, 2008; Parikh, 2009), consumption of a DASH-style pattern prevented stroke.

Several studies examined the effects of a Mediterranean style diet on CVD and total mortality. Of the 13 studies, one was a systematic review/meta-analysis (Mente, 2009), one was a meta-analysis (Sofi, 2008), nine were prospective cohort studies (Fidanza, 2004; Fung, 2009; Harriss, 2007; Knoops, 2004; Mitrou, 2007; Panagiotakos, 2009; Trichopoulou, 2003; Trichopoulou, 2009; Waijers, 2006), one was an adherence analysis (Alberti, 2008), and one was a case-control study (Panagiotakos, 2005). Of the 10 studies that evaluated a relationship of a Mediterranean-style dietary pattern with CVD, each documented a beneficial effect (Fidanza, 2004; Fung, 2009; Harriss, 2007; Knoops, 2004; Mente, 2009; Mitrou, 2007; Panagiotakos, 2009; Panagiotakos, 2005; Sofi, 2008; Trichopoulou, 2003). Likewise, of the 10 studies with data on total mortality, each documented an inverse relation (Alberti, 2008; Fidanza, 2004; Fung, 2009; Harriss, 2007; Knoops, 2004; Mitrou, 2007; Sofi, 2008; Trichopoulou, 2003; Trichopoulou, 2009; Waijers, 2006). In the one available study with stroke, consumption of a Mediterranean-style pattern prevented stroke (Fung, 2009).

Five studies examined the effects of a vegetarian diet on CVD and total mortality. Of the five studies, three were prospective cohort studies (Chang-Claude, 2005; Key, 1996; Mann, 1997), one was a meta-analysis (Key, 1998), and one was a time series analysis (Fraser, 2005). Of the five studies with CVD as the study outcome, all found that vegetarian diets were associated with a reduced risk of CVD compared to non-vegetarian diets (Chang-Claude, 2005; Fraser, 2005; Key, 1998; Key, 1996; Mann, 1997). For total mortality, four studies (Fraser, 2005; Key, 1998; Key, 1996; Mann, 1997) documented that a vegetarian diet was associated with a reduced risk of death, and one study (Chang-Claude, 2005) did not detect an association.

One prospective cohort study (Shimazu, 2007) assessed the association between dietary patterns among the Japanese and CVD mortality. Three diet patterns were identified: 1) Japanese pattern including soybean products, fish, seaweed, vegetables, fruit and green tea, 2) animal food pattern, and 3) high-dairy, high-fruit and vegetable, low alcohol (DFA) pattern. The Japanese pattern was associated with a decreased risk of CVD mortality, while the animal food pattern was associated with increased risk. The DFA pattern was not significantly associated with a change in CVD risk.

Conclusion

The totality of evidence documenting a beneficial impact of plant-based, lower-sodium dietary patterns on CVD risk is remarkable. Indeed, several distinct dietary patterns are associated with lower blood pressure and a reduced risk of CVD and total mortality. When explicitly tested, a reduced sodium intake further lowers blood pressure. A common feature of these diets is an emphasis on plant-based foods. Accordingly, fiber intake is high while saturated fat typically low. When total fat intake is high, that is, over 30 percent of calories, the predominant fat is monounsaturated or polyunsaturated fat. Carbohydrate intake is often, but not necessarily high; the predominant forms appear to be complex carbohydrates, often from whole grain products with minimal processing.

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Table B2.5. Selected dietary patterns with documented cardiovascular health benefits (adjusted to 2000 calories)

Dietary Pattern	DASH with Reduced Sodium	Mediterranean Diet (Greece)	Mediterranean Diet (Spain)	Mediterranean Diet (US)	Japanese	Okinawan
Citation	Karanja et al, 1999 and Lin et al, 2003	Trichopoulou et al, NEJM 2003	Nunez-Cordoba 2008 (SUN Study; MAI high score)	Fung et al, 2009	Wilcox et al, 2007 (Circa 1950)	Wilcox et al, 2007 (Circa 1949)
Qualitative Description						
Emphasizes	Potassium-rich vegetables, fruits, and low-fat dairy products	Plant- foods, vegetables, fruits, grains, beans, nuts and seeds, olive oil, and fish	Plant- foods, vegetables, fruits, breads, other cereals potatoes, beans, nuts and seeds, olive oil, and fish	Plant foods, vegetables, fruits, whole grains, legumes, fish	Rice, legumes, soy foods, vegetables, seaweed, and fish	Plant-foods, primarily Okinawan sweet potatoes, rice, legumes, soy foods, other vegetables, and nutrient rich foods of low energy density
Includes	Whole grains, poultry, fish, and nuts	Lean meat Red wine	Cheese, yogurt Red wine	Lean meat	Fruit Meat and eggs	
Limits (small amount)	Red meats, sweets, and sugar-containing beverages		Red meat Sweets	Potatoes	Milk products	Fruit Meat, eggs Milk products
Nutrients						
Calories (kcal)	2000	2000	2000	2000	2000	2000
Carbohydrates (% total kcal)	58%	nd	47%	39.1%	79%	85%
Protein (% total kcal)	18%	nd	18%	15.1%	13%	9%
Total Fat (% total kcal)	27%	~42.7 (summed)	33%	nd	8%	6%
Saturated Fat (% total kcal)	7%	13.1 %	10%	10% (Incl. trans)	2.0%	1.9%
Monounsaturated (% total kcal)	10%	22.7%	15 %	9.5%	2.3%	1.8%
Polyunsaturated (% total kcal)	8%	6.9%	5.1 %	nd	3.5%	2.4%
Cholesterol (mg)	143	nd	nd	nd	nd	nd
Fiber (g)	29	nd	29	20	22	26
Potassium (mg)	4371	nd	4589	nd	2623	5826
Sodium (mg)	1095	nd	2532	nd	2370	1269

Table B2.5 (continued). Selected dietary patterns with documented cardiovascular health benefits (adjusted to 2000 calories)

Dietary Pattern	DASH with Reduced Sodium	Mediterranean Diet (Greece)	Mediterranean Diet (Spain)	Mediterranean Diet (US)	Japanese	Okinawan
Food Groups						
Vegetables: total (c)	2.1	4.1	1.2	2.2	nd	nd
- Dark Green (c)	Nd	nd	nd	nd	<0.1 (seaweed)	<0.1 (sea weed)
- Legumes [2](c)	Nd	<0.1	0.4	0.3	0.3	0.5
- Red Orange (c)	Nd	nd	nd	nd	0.5 (Asian sweet potatoes)	6.6 (Asian sweet potatoes)
- Other Veg (c)	Nd	nd	nd	nd	1.3; + 0.3 (pickled veg)	0.9
- Starchy Veg (c)	Nd	0.6	nd	No potatoes	0.3 (other potatoes)	<0.1 (other potatoes)
Fruit & juices (c)	2.5	1.0 (fruit & nuts) 1.5 (juice & other bev)	1.3 (fruit & juice) 0.1 (dried fruit & nuts)	1.6	0.2 (papaya & tomato = veg)	<0.1 (papaya & tomato = veg)
Grains: total (oz)	7.3	5.4	2.0	nd	2.4; 1.7 (rice)	1.1; 0.9 (rice)
- Whole grains (oz)	3.9	nd	nd	1.6	nd	nd
Milk & milk products, Whole	0.7	1.0	0.8	nd	<0.1	<0.1
- Low-fat (c)	1.9	nd	1.3	nd	nd	nd
Animal Proteins:						
- Meat (oz)	1.4	3.5	3.6	2.4	0.4	0.1
- Poultry (oz)	1.7	nd	nd	nd	nd	nd
- Eggs (oz)	Nd	nd	1.9	nd	0.3	<0.1
- Fish (total) (oz)	1.4	0.8	2.4	1.5	2.1	0.6
-- Hi N3 (oz)	Nd	nd	nd	nd	nd	nd
-- Low N3 (oz)	Nd	nd	nd	nd	nd	nd
Plant Proteins:						
- Legumes (oz)	0.4	nd	0.4	nd	0.4 (Incl soy)	0.3 (Incl soy)
- Nuts & seeds (oz)	0.9	See fruit above.	See fruit above.	0.5	< 1 g	<0.1
- Soy products (oz)	Nd	nd		nd	See legumes.	See legumes.
Oils (g)	24.8	40.3 (olive oil)	19.0 (olive oil)	nd	nd	nd
Solid Fats (g)	Nd	nd	nd	nd	nd	nd
Added Sugar (g)	12	24.3	nd	nd	7.7	3.4
Alcohol (g)	Nd	7.9[2]	7.1 (red wine)	7.3	30.0 (flavors and alcohol)	7.8 (flavors and alcohol)

Table B2.6. Dietary patterns and blood pressure in adults

Author and Year	Study Type	Quality	Population/Location	Sig SBP Reduction	Sig DBP Reduction	Caveats
DASH	**N = 12** (9 RCT, 3 prospective cohort)	12 Positive 2 Neutral		12 +	10 + 1 Ø 1 n/d	
Appel LJ et al., 2005	RCT (OmniHeart)	Positive	N = 164 adult with prehypertension or stage 1 hypertension US	+	+	Overall Between Diet Differences - SBP: Pro vs.Cho diet: P =0.002; Unsat Fat vs. Cho: P = 0.005 DBP: Pro vs.Cho diet: P <0.001; Unsat Fat vs. Cho: P = 0.02
Appel LJ et al., 1997	RCT	Positive	N = 459; 234 males; 225 females Normo and hypertensive subjects US	+	+	SBP: P< 0.001 DBP: Males P <0.001; Females P = 0.003
Appel LJ et al., 2003	RCT	Positive	N = 810 free living adults Normo and Hypertensive US	+	+	SBP and DBP: P <0.001
Azadbakht L et al., 2005	RCT	Neutral	N =116 subjects with metabolic syndrome BP $\geq$ 130/85 Iran	+	+	For both men and women P<0.001
Dauchet L et al., 2007	Longitudinal and cross-sectional analysis	Positive	N= 6,119 (2596 men, 3523 women); free living France	+	+	SBP: P <0.05 DBP: P < 0.01 Longitudinal results: DASH score: SBP: P<0.002; DBP: P<0.02
Forman JP et al., 2009	Prospective cohort study	Positive	N = 83,882 females; Nurse's Health Study II Normotensive US	+	+	Outcome in multivariate HR (95% CI) for incident HTN
Miller ER et al., 2002	RCT	Positive	N = 43 US	+	+	SBP, DBP: P <0.001
Nowson CA et al., 2009	RCT	Positive	N = 111 females (menopausal) Australia	+ + **	Ø +**	SBP: P = 0.38, 0.21** DBP: P = 0.61, 0.27** ** With HTN meds

Table B2.6 (continued). Dietary patterns and blood pressure in adults

Author and Year	Study Type	Quality	Population/Location	Sig SBP Reduction	Sig DBP Reduction	Caveats
DASH	**N = 12** (9 RCT, 3 prospective cohort)	12 Positive 2 Neutral		12 +	10 + 1 Ø 1 n/d	
Nowson CA et al., 2004	RCT	Positive	N = 94 males and females Australia	+	+	SBP: P = 0.001 DBP: P = 0.05
Sacks FM et al., 2001	RCT (cross-over)	Positive	N = 390 (males, females; black and white) US	+	n/d	SBP: P < 0.001
Schulze MB et al., 2003	Prospective cohort study	Positive	N = 8,552 females Normotensive Germany	+	+	HR (95% CI) for incident HTN
MEDITERRANEAN	N = 1 cohort	1 Positive		1+	1+	
Núñez-Córdoba JM et al., AJE 2009	Prospective cohort study (6 yr f/u)	Positive	N = 9,408 adults; 3,583 males, 5,825 females Spain	+	+	SBP: P = 0.01 DBP: P = 0.05
VEGETARIAN	N = 4 RCT	3Positive 1 Neutral		4+	3 + 1 Ø	
Hakala P and Karvetti RL, 1989	RCT	Positive	N = 110 adults Finland	+	+	SBP: P = 0.05 DBP: P = 0.01
Margetts BM et al., 1986	RCT (cross-over)	Neutral	N = 58; 42 males, 16 females Untreated mild hypertensives Australia	+	Ø	SBP: P , 0.05
Rouse IL et al., 1983	RCT (cross-over)	Positive	N = 59 males and females Australia	+	+	SBP, DBP: P <0.01
Sciarrone SE et al., 1993	RCT	Positive	N = 21 males Australia	+	+	Ovo-lacto vegetarian
Japanese/Okinawan	N = 1 RCT	1 Positive		1+	1 Ø	
Takahashi Y 2006	RCT	Positive	N = 550 (202 males, 348 females) Japan	+	Ø	SBP: P = 0.007 Japanese diet with ↑Vitamin C, carotene, Fruits and vegetables ↓ Sodium intake

Table B2.7. Dietary patterns, cardiovascular disease (CVD), and mortality in adults

Author and Year/ Quality/ Study Type	Population/ Location	CVD	Mortality	Outcomes	Comments/Caveats
DASH and DASH Variations	**N=10** 1 RCT 9 Cohort				
Appel et al., 2005 Randomized, 3-period Crossover Trial Positive	N=164 (mean age = 53.6 yr; 45% women) Omni-Heart US	+	ND	Compared with baseline, all diets lowered estimated CHD risk. Compared with the high carbohydrate diet, estimated 10-yr CHD risk was lower and similar on the high protein and high unsaturated fat diets. Compared to high carbohydrate diet, high UFA diet decreased SBP; increased HDL-C; decreased TG, no change in LDL-C	Addresses **total fat question**: High UFA diet replaced 10% energy from CHO (total fat=37% E; 21% MUFA; 10% PUFA; 6% SFA). High UFA improved CHD risk, BP, and serum lipids, compared to high CHO (SFA constant).
Folsom et al., 2007 Prospective Cohort Study Neutral	N = 20,993, 55-69 yrs at baseline Iowa Women's Health Study Non-hypertensive	Ø	Ø	Incidence of hypertension inversely associated w/ degree of concordance with DASH diet (*P* for trend = 0.02), After adjustment for additional risk factors, little evidence that any endpoint assoc w/ DASH score	DASH diet concordance score calculated w/ baseline FFQ in1986, subjects followed through 2002.
Fung et al., 2001 Prospective Cohort Study Positive	N = 69,017, 38 - 63 yrs at baseline Nurses' Health Study US	+	ND	Higher **prudent- pattern** score assoc w/ lower risk total CHD (RR Q5 vs Q1=0.61, 95%CI: 0.49-0.76, P for trend <0.001); after adjustment for BMI, smoking, caloric intake, supplemental use, hormone replacement therapy, and other coronary risk factors (RR=0.76, 95% CI: 0.60-0.98, P for trend = 0.03). Higher **western-pattern** score assoc w/ higher risk total MI after adjusting for age (RR Q5 versus Q1= 1.44, 95%CI: 1.16-1.78, P for trend <.001); remained sig. after multivariate adjustment (RR=1.46, 95%CI: 1.07-1.99).	12 y follow-up: 1984-1996 Baseline=1984 All FQQs using 1984 format (116 item)
Fung et al., 2008 Prospective Cohort Study Positive	N = 88,517, 34 - 59 yrs at baseline Nurses' Health Study US	+ **and Stroke**	+	RR of CHD across quintiles of DASH score = 1.0, 0.99, 0.86, 0.87 and 0.76 (95% CI: 0.67 - 0.85, P for trend <0.001) Magnitude of risk difference was similar for nonfatal MI and fatal CHD DASH score assoc w/ ↓ risk of stroke	24y follow-up: 1980-2004 Baseline=1980 Included data from older 1980 FFQ (61 item) and 1984 FFQ
Heidemann et al., 2008 Prospective Cohort Study Positive	N = 72,113 Nurses' Health Study US	+	+	**Prudent** pattern assoc w/ 28% lower risk of cardiovascular mortality and 17% lower risk of all-cause mortality, **Western** pattern assoc w/ 22% higher risk of cardiovascular mortality, 16% higher risk of cancer, and 21% higher risk of all-cause mortality.	18 y follow-up: 1984-2002 Baseline=1984 All FQQs using 1984 format (116 item)

Table B2.7 (continued). Dietary patterns, cardiovascular disease (CVD), and mortality in adults

Author and Year/ Quality/ Study Type	Population/ Location	CVD	Mortality	Outcomes	Comments/Caveats
DASH and DASH Variations	**N=10** 1 RCT 9 Cohort				
Hu et al., 2000 Prospective Cohort Study Positive	N=44,875 men, 40-75 y at baseline Health Professionals Follow-up Study	+	+	Two patterns explaining < 20% of the variance identified by factor analysis: **Prudent** and **Western** Higher **Prudent score** assoc w/ monotonic lower risk of CHD (RR across quintiles: 1.0, 0.84, 0.76, 0.71, 0.66 (95% CI: 0.54-0.80, P for trend < 0.0001 For fatal CHD after adjustment for age, smoking, BMI, and other CHD risk factors (RR across increasing quintiles: 1.0, 0.83, 0.78, 0.81, 0.70 (95%CI: 0.54, 0.91, P for trend=0.03 Higher **Western score** assoc w/ monotonic higher risk of CHD (RR across quintiles (P<0.0001) CHD RR (highest Prudent vs lowest Western) = 0.50 (95%CI: 0.34, 0.74).	8 y follow-up from 1986 Authors conclude dietary patterns derived from their FFQ predict CHD risk independent of other lifestyle factors.
Levitan et al., 2009 Prospective Cohort Study Neutral	36,019 women, 48-83 y at baseline Swedish Mammography Cohort	+	+	Top quartile of DASH score had 37% lower rate of heart failure (HF); rate ratios across quartiles = 1 (ref), 0.85 (95% CI: 0.66-1.11), 0.69 (95% CI: 0.54-0.88), and 0.63 (95% CI: 0.48-0.81), P for trend <0.001. Both HF-assoc hospitalization and death were determined	7 y follow-up; dietary intake only measured at baseline Hypertension was based on self-report.
Osler et al., 2001 Prospective Cohort Study Neutral	N= 5,872 (2,994 men, 2,878 women) Random equal-sized samples 30,40,50, 60-y at baseline Danish World Health Organization MONICA survey	+	+	**Prudent** pattern inversely assoc w/ all-cause (hazard ratios =0.63 in women =0.75 in men) and cardiovascular mortality **Western** pattern not associated w/ mortality	
Parikh et al., 2009 Prospective Cohort Study Neutral	N=5532 adults w/ hypertension NHANES III (1988-1994) US	+	+ **and Stroke**	DASH-like group had lower unadjusted mortality rates per 1,000 person-yrs for all-cause mortality (P=0.02), stroke mortality (P<0.001), and cancer mortality (P=0.05). DASH-like group, after adjusting for multiple confounders, assoc w/ lower mortality from all causes (HR=0.69, 95% CI 0.52-0.92, P=0.01) and stroke (HR=0.11, 95%CI 0.03-0.47, P=0.003). CVD mortality risk (HR=0.92, 95%CI 0.63-1.35, P=0.67), IHD (HR=0.77, 95%CI 0.47-1.14, P=0.28), and cancer (HR=0.51, 95%CI 0.23-1.10, P=0.09) not stat significant	8.2 person-years follow-up Secondary outcomes included specific causes of mortality CVD, ischemic heart disease, stroke, and cancer

Table B2.7 (continued). Dietary patterns, cardiovascular disease (CVD), and mortality in adults

Author and Year/ Quality/ Study Type	Population/ Location	CVD	Mortality	Outcomes	Comments/Caveats
DASH and DASH Variations	**N=10** 1 RCT 9 Cohort				
Singman et al., 1980 Prospective Cohort Study Neutral	N=1,113 men experimental and 467 men control US	+	ND	Prudent diet group in both age categories (40-49 y & 50-59 y) had lower CHD incidence rates	
MEDITERRANEAN	**N=13** 1 Index 1 Systematic Rev 1 Meta Analysis 9 Cohort 1 Case Control				
Alberti et al., 2008 Analysis of Mediterranean Adequacy Index (MAI) Neutral	5 data sets on 23 populations	ND	+	Inverse correlation between MAI and 25 y CHD death rate and total mortality	MAI: divide the sum of the percentages of dietary energy from food groups typical of a healthy reference Mediterranean diet, by the sum of the percentages of dietary energy of food groups that are not characteristic of a healthy reference Mediterranean diet
Fidanza et al., 2004 Prospective Cohort Study Neutral	N=12,763 men, 40-59 yrs at baseline US	+	+	The coefficient of linear correlation between the MAI and CHD death rates in the 16 cohorts was -0.72 (P=0.001)	MAI Index
Fung et al., 2009 Prospective Cohort Study Neutral	N = 76,522 , 38 - 63 yrs at baseline Nurses' Health Study US	+ **and Stroke**	+	Top aMed quintile ↓risk CHD and stroke: RR CHD = 0.71, 95% CI: 0.62-0.82, P for trend < 0.0001, RR stroke = 0.87, 95% CI: 0.73-1.02, P for trend = 0.03 CVD mortality ↓: top quintile RR=0.61, 95% CI:0.49-0.76, P for trend <0.0001	20 y follow-up: 1984-2004 Baseline=1984 All FQQs using 1984 format
Harriss et al., 2007 Prospective Cohort Study Neutral	N= 40,653 (16,673 men, 23,908 women) Melbourne Collaborative Study	+	+	Mediterranean dietary factor inversely assoc w/ CVD and IHD mortality IHD, HR (highest compared w/ lowest quartile) = 0.59 (95% CI: 0.39-0.89, P for trend=0.03) Excluding subjects w/ prior CVD (HR=0.51, 95% CI: 0.30-0.88, P for trend = 0.03)	Mean follow-up = 10.4 y Involved migrants to Australia from Mediterranean countries (24% of subjects were Mediterranean born)

Table B2.7 (continued). Dietary patterns, cardiovascular disease (CVD), and mortality in adults

Author and Year/ Quality/ Study Type	Population/ Location	CVD	Mortality	Outcomes	Comments/Caveats
MEDITERRANEAN	**N=13** 1 Index 1 Systematic Rev 1 Meta Analysis 9 Cohort 1 Case Control				
Knoops et al., 2004 Prospective Cohort Study Neutral	N= 40,653 (1,507 men, 832 women) HALE cohort Netherlands	+	+	Mediterranean diet (HR = 0.77, 95% CI: 0.68 - 0.88) assoc w/ ↓ risk all-cause mortality Similar results were observed for mortality from coronary heart disease, cardiovascular diseases, and cancer	10 y mortality from all causes (CVD, CHD, and Cancer)
Mente et al., 2009 Systematic Review/ Meta-analysis Positive	146 prospective cohort studies + 43 RCTs (pub1950-2007) Europe, Asia, US	+	ND	Among the dietary exposures with strong evidence of causation from cohort studies, only the Mediterranean dietary pattern is related to CHD in RCTs	Used Bradford Hill guidelines to derive causation score based on 4 criteria (strength, consistency, temporality, and coherence) for each dietary exposure in cohort studies and examined for consistency with the findings of RCTs.
Mitrou et al, 2007 Prospective Cohort Study Positive	N= 352,497 (196,158 men, 156,339 women) median age = 62 NIH-AARP Diet and Health Study US	+	+	Men: multivariate HR all-cause mortality = 0.79 (95%CI: 0.76 - 0.83), CVD mortality = 0.78 (95% CI: 0.69 - 0.87), cancer mortality = 0.83 (95% CI: 0.76 - 0.91). Women: ↓ risks = 12% cancer mortality (P for trend = 0.04); = 20% all-cause mortality (P for trend < 0.001).	5 y follow-up Used 9-point score to assess conformity with Mediterranean dietary pattern (components included vegetables, legumes, fruits, nuts, whole grains, fish, monounsaturated fat-saturated fat ratio, alcohol, and meat)
Panagiotakos et al., 2005 Case-control Study Positive	N= 848 w/ 1st CHD event and 1,078 age- and sex-matched controls (aged 49 - 75) CARDIO2000 Study Greece	+	ND	10-unit increase in Mediterranean diet score assoc w/ 27% (95% CI: 0.66 - 0.89) decrease odds of non-fatal acute coronary syndromes	Secondary prevention
Panagiotakos et al., 2009 Prospective Cohort Study Neutral	N = 2,101 ATTICA Study Greece	+	ND	Pattern characterized by cereals, small fish, and olive oil assoc w/ ↓ CVD risk (HR = 0.72, 95% CI: 0.52 - 1.00) Pattern characterized by fruit and vegetables using olive oil in cooking (HR = 0.80, 95% CI: 0.66 - 0.97) Patterns characterized by sweets, red meat, margarine, salty nuts, hard cheese and alcohol assoc w/ ↑ CVD risk	5 y follow-up Exclusion of CVD done by detailed clinical evaluation

Table B2.7 (continued). Dietary patterns, cardiovascular disease (CVD), and mortality in adults

Author and Year/ Quality/ Study Type	Population/ Location	CVD	Mortality	Outcomes	Comments/Caveats
MEDITERRANEAN	**N=13** 1 Index 1 Systematic Rev 1 Meta Analysis 9 Cohort 1 Case Control				
Trichopoulou et al., 2003 Prospective Cohort Study Neutral	N = 22,043, 38-63 yrs at baseline EPIC Study Greece	+	+	Higher adherence to Med diet assoc w/ ↓ total mortality (adjusted HR =0.75, 95% CI: 0.64 - 0.87); inverse assoc w/ CHD death (adjusted HR = 0.67, 95% CI: 0.47 - 0.94) and cancer death (adjusted HR = 0.76, 95% CI: 0.59 - 0.98).	44 month follow-up
Trichopoulou et al., 2009 Prospective Cohort Study Neutral	N = 23,349 EPIC Study Greece	ND	+	Higher adherence to a Med diet assoc w/ ↓ total mortality (adjusted mortality ratio = 0.864, 95% CI: 0.802 - 0.932).	8.5 y follow-up
Waijers et al., 2006 Prospective Cohort Study Neutral	N = 5,427 women (aged >60 years) EPIC Study Netherlands	ND	+	Principal component analysis identified 3 diet patterns: Mediterranean, Traditional Dutch, and Healthy Dutch Healthy trad Dutch pattern assoc w/ ↓ mortality rate; women in highest tertile 30% ↓mortality risk	8.2 y follow-up
VEGETARIAN	**N=5** 4 Cohort 1 Time series				
Chang-Claude et al., 2005 Prospective Cohort Study Neutral	N = 1,904; 858 males, 1,046 females 1,165 lacto-ovo, 679 non-veg, 60 vegans. Germany	+	ø	↓ risk ischemic heart disease (RR = 0.70, 95% CI: 0.41 - 1.18) No effect on mortality (RR = 1.10, 95% CI: 0.89 - 1.36)	A cohort study of vegetarians and health-conscious persons in Germany was followed-up prospectively for 21 years, including 1,225 vegetarians and 679 health-conscious nonvegetarians
Fraser et al., 2005 Time series Neutral	(N=30,292 males, N=50,562 females) California Seventh Day Adventists (N=297,126 male, 344,401 female) Stanford Five-City Project US	+	+	Rate ratio (RR) (Adventist/Stanford study) 1st event fatal CHD = 0.59 (95% CI, 0.43-0.80) men and 0.49 (0.32-0.76) women. Vegetarian Adventists, RR = 0.45 (0.24-0.84) and 0.20 (0.06-0.63) men and women, respectively. 1st event MI RR = 0.60 (0.47-0.78) and 0.46 (0.33-0.65). Vegetarian Adventists RR = 0.37 (0.20-0.66) and 0.62 (0.35-1.09) men and women, respectively.	Two concurrent California observational studies,one with unusual dietary habits, are compared. Similar diagnostic criteria were used in both the Adventist Health Study and the Stanford Five-City Project.

Table B2.7 (continued). Dietary patterns, cardiovascular disease (CVD), and mortality in adults

Author and Year/ Quality/ Study Type	Population/ Location	CVD	Mortality	Outcomes	Comments/Caveats
VEGETARIAN	**N=5** 4 Cohort 1 Time series				
Key et al., 1996 Prospective Cohort Study Neutral	N = 10,771; 4,336 males, 6,435 females UK	+	+	Daily consumption of fresh fruit assoc w/ ↓ mortality ischemic heart disease (rate ratio = 0.76, 95% CI: 0.60 - 0.97), cerebrovascular disease (rate ratio = 0.68, 95% CI: 0.47 - 0.98), and all causes (rate ratio = 0.79, 95% CI: 0.70 - 0.90)	Mortality ratios measured for vegetarianism and for daily versus less than daily consumption of wholemeal bread, bran cereals, nuts or dried fruit, fresh fruit, and raw salad in relation to all cause mortality and mortality from ischaemic heart disease, cerebrovascular disease, all malignant neoplasms, lung cancer, colorectal cancer, and breast cancer.
Key et al., 1998 Meta-analysis: 5 Prospective Cohort Studies Neutral	N = 76,172 men and women US	+	+	Compared to non-vegetarians, vegetarians had 24% ↓ IHD mortality (rate ratio = 0.76, 95% CI:0.62-0.94) Reduction in mortality among vegetarians varied significantly with age at death. Regular meat consumers compared to semi-vegetarians (fish or meat <1X/wk), IHD rate ratios=0.78 (95% CI:0.68-0.89) in semi-vegetarians and 0.66 (95% CI:0.53-0.83) in vegetarians (P for trend <0.001).	Vegetarians were those who did not eat any meat or fish (n = 27,808). Non-vegetarians were from a similar background to the vegetarians within each study.
Mann et al., 1997 Prospective Cohort Study Neutral	N = 10,802; 4,102 males, 6,700 females Health conscious, mean age=33-34 United Kingdom	+	+	An increase in mortality for IHD was observed with increasing intakes of total and saturated animal fat and dietary cholesterol-death rate ratios in the third tertile compared with the first tertile: 329, 95% confidence interval (CI) 150 to 721; 277, 95% CI 125 to 613; 353, 95% CI 157 to 796, respectively. No protective effects for dietary fiber, fish or alcohol	13.3 y follow-up Prospective observation of vegetarians, semi-vegetarians, and meat eaters
Japanese/Okinawan	**N=1 Cohort**				
Shimazu et al., 2007 Prospective Cohort Study Neutral	N=40,547, 40-79 yrs at baseline Japan	+	+	3 patterns identified by principal components analysis: i) a Japanese dietary pattern highly correlated with soybean products, fish, seaweeds, vegetables, fruits and green tea, (ii) an 'animal food' dietary pattern and (iii) a high-dairy, high-fruit-and-vegetable, low-alcohol (DFA) dietary pattern. Japanese pattern assoc w/ ↓ risk CVD mortality (HR = 0.73, 95% CI 0.59-0.92, *P* for trend=0.003)	7 y follow-up

ND = Not determined.