

chapter 2



Adequate Nutrients Within Calorie Needs

OVERVIEW

Many Americans consume more calories than they need without meeting recommended intakes for a number of nutrients. This circumstance means that most people need to choose meals and snacks that are high in nutrients but low to moderate in energy content; that is, meeting nutrient recommendations must go hand in hand with keeping calories under control. Doing so offers important benefits—normal growth and development of children, health promotion for people of all ages, and reduction of risk for a number of chronic diseases that are major public health problems.

Based on dietary intake data or evidence of public health problems, intake levels of the following nutrients may be of concern for:

- Adults: calcium, potassium, fiber, magnesium, and vitamins A (as carotenoids), C, and E,
- Children and adolescents: calcium, potassium, fiber, magnesium, and vitamin E,
- Specific population groups (see below): vitamin B₁₂, iron, folic acid, and vitamins E and D.

At the same time, in general, Americans consume too many calories and too much saturated and *trans* fats, cholesterol, added sugars, and salt.



DISCUSSION

Meeting Recommended Intakes Within Energy Needs

A basic premise of the *Dietary Guidelines* is that food guidance should recommend diets that will provide all the nutrients needed for growth and health. To this end, food guidance should encourage individuals to achieve the most recent nutrient intake recommendations of the Institute of Medicine, referred to collectively as the Dietary Reference Intakes (DRIs). Tables of the DRIs are provided at <http://www.iom.edu/Object.File/Master/21/372/0.pdf>

An additional premise of the *Dietary Guidelines* is that the nutrients consumed should come primarily from foods. Foods contain not only the vitamins and minerals that are often found in supplements, but also hundreds of naturally occurring substances, including carotenoids, flavonoids and isoflavones, and protease inhibitors that may protect against chronic health conditions. There are instances when fortified foods may be advantageous, as identified in this chapter. These include providing additional sources of certain nutrients that might otherwise be present only in low amounts in some food sources, providing nutrients in highly bioavailable forms, and where the fortification addresses a documented public health need.

Two examples of eating patterns that exemplify the *Dietary Guidelines* are the DASH Eating Plan and the USDA Food Guide. These two similar eating patterns are designed to integrate dietary recommendations into a healthy way to eat and are used in the *Dietary Guidelines* to provide examples of how nutrient-focused recommendations can be expressed in terms of food choices. Both the USDA Food Guide and the DASH Eating Plan differ in important ways from common food consumption patterns in the United States. In general, they include:

- *More* dark green vegetables, orange vegetables, legumes, fruits, whole grains, and low-fat milk and milk products.
- *Less* refined grains, total fats (especially cholesterol, and saturated and *trans* fats), added sugars, and calories.

KEY RECOMMENDATIONS

- Consume a variety of nutrient-dense foods and beverages within and among the basic food groups while choosing foods that limit the intake of saturated and *trans* fats, cholesterol, added sugars, salt, and alcohol.
- Meet recommended intakes within energy needs by adopting a balanced eating pattern, such as the USDA Food Guide or the DASH Eating Plan.

Key Recommendations for Specific Population Groups

- *People over age 50.* Consume vitamin B₁₂ in its crystalline form (i.e., fortified foods or supplements).
- *Women of childbearing age who may become pregnant.* Eat foods high in heme-iron and/or consume iron-rich plant foods or iron-fortified foods with an enhancer of iron absorption, such as vitamin C-rich foods.
- *Women of childbearing age who may become pregnant and those in the first trimester of pregnancy.* Consume adequate synthetic folic acid daily (from fortified foods or supplements) in addition to food forms of folate from a varied diet.
- *Older adults, people with dark skin, and people exposed to insufficient ultraviolet band radiation (i.e., sunlight).* Consume extra vitamin D from vitamin D-fortified foods and/or supplements.

Both the USDA Food Guide and the DASH Eating Plan are constructed across a range of calorie levels to meet the nutrient needs of various age and gender groups. Table 1 provides food intake recommendations, and table 2 provides nutrient profiles for both the DASH Eating Plan and the USDA Food Guide at the 2,000-calorie level. These tables illustrate the many similarities between the two eating patterns. Additional calorie levels are shown in appendixes A-1 and A-2 for the USDA Food Guide and the DASH Eating Plan. The exact amounts of foods in these plans do not need to be achieved every day, but on average, over time. Table 3 can aid in identification of an individual's caloric requirement based on gender, age, and physical activity level.



Variety Among and Within Food Groups

Each basic food group⁵ is the major contributor of at least one nutrient while making substantial contributions of many other nutrients. Because each food group provides a wide array of nutrients in substantial amounts, it is important to include all food groups in the daily diet.

Both illustrative eating patterns include a variety of nutrient-dense foods within the major food groups. Selecting a variety of foods within the grain, vegetable, fruit, and meat groups may help to ensure that an adequate amount of nutrients and other potentially beneficial substances are consumed. For example, fish contains varying amounts of fatty acids that may be beneficial in reducing cardiovascular disease risk (see ch. 6).

Nutrient-Dense Foods

Nutrient-dense foods are those foods that provide substantial amounts of vitamins and minerals (micronutrients) and relatively few calories. Foods that are low in nutrient density are foods that supply calories but relatively small amounts of micronutrients, sometimes none at all. The greater the consumption of foods or beverages that are low in nutrient density, the more difficult it is to consume enough nutrients without gaining weight, especially for sedentary individuals. The consumption of added sugars, saturated and *trans* fats, and alcohol provides calories while providing little, if any, of the essential nutrients. (See ch. 7 for additional information on added sugars, ch. 6 for information on fats, and ch. 9 for information on alcohol.)

Selecting low-fat forms of foods in each group and forms free of added sugars—in other words nutrient-dense versions of foods—provides individuals a way to meet their nutrient needs while avoiding the overconsumption of calories and of food components such as saturated fats. However, Americans generally do not eat nutrient-dense forms of foods. Most people will exceed calorie recommendations if they consistently choose higher fat foods within the food groups—even if they do not have dessert, sweetened beverages, or alcoholic beverages.

If only nutrient-dense foods are selected from each food group in the amounts proposed, a small amount of calories

...meeting nutrient recommendations must go hand in hand with keeping calories under control.

can be consumed as added fats or sugars, alcohol, or other foods—the *discretionary calorie allowance*. Appendixes A-2 and A-3 show the maximum discretionary calorie allowance that can be accommodated at each calorie level in the USDA Food Guide. Eating in accordance with the USDA Food Guide or the DASH Eating Plan will also keep intakes of saturated fat, total fat, and cholesterol within the limits recommended in chapter 6.

Nutrients of Concern

The actual prevalence of inadequacy for a nutrient can be determined only if an Estimated Average Requirement (EAR) has been established and the distribution of usual dietary intake can be obtained. If such data are not available for a nutrient but there is evidence for a public health problem associated with low intakes, a nutrient might still be considered to be of concern.

Based on these considerations, dietary intakes of the following nutrients may be low enough to be of concern for:

- Adults: calcium, potassium, fiber, magnesium, and vitamins A (as carotenoids), C, and E,
- Children and adolescents: calcium, potassium, fiber, magnesium, and vitamin E,
- Specific population groups: vitamin B₁₂, iron, folic acid, and vitamins E and D.

⁵ The food groups in the USDA Food Guide are grains; vegetables; fruits; milk, yogurt, and cheese; and meat, poultry, fish, dry beans, eggs, and nuts. Food groups in the DASH Eating Plan are grains and grain products; vegetables; fruits; low-fat or fat-free dairy; meat, poultry, and fish; and nuts, seeds, and dry beans.



Efforts may be warranted to promote increased dietary intakes of potassium, fiber, and possibly vitamin E, regardless of age; increased intakes of calcium and possibly vitamins A (as carotenoids) and C and magnesium by adults; efforts are warranted to increase intakes of calcium and possibly magnesium by children age 9 years or older. Efforts may be especially warranted to improve the dietary intakes of adolescent females in general. Food sources of these nutrients are shown in appendix B.

Low intakes of fiber tend to reflect low intakes of whole grains, fruits, and vegetables. Low intakes of calcium tend to reflect low intakes of milk and milk products. Low intakes of vitamins A (as carotenoids) and C and magnesium tend to reflect low intakes of fruits and vegetables. Selecting fruits, vegetables, whole grains, and low-fat and fat-free milk and milk products in the amounts suggested by the USDA Food Guide and the DASH Eating Plan will provide adequate amounts of these nutrients.

Most Americans of all ages also need to increase their potassium intake. To meet the recommended potassium intake levels, potassium-rich foods from the fruit, vegetable, and dairy groups must be selected in both the USDA Food Guide and the DASH Eating Plan. Foods that can help increase potassium intake are listed in table 5 (ch. 5) and appendix B-1.

Most Americans may need to increase their consumption of foods rich in vitamin E (α -tocopherol) while decreasing their intake of foods high in energy but low in nutrients. The vitamin E content in both the USDA Food Guide and the DASH Eating Plan is greater than current consumption, and specific vitamin E-rich foods need to be included in the eating patterns to meet the recommended intake of vitamin E. Foods that can help increase vitamin E intake are listed in appendix B-2, along with their calorie content. Breakfast cereal that is fortified with vitamin E is an option for individuals seeking to increase their vitamin E intake while consuming a low-fat diet.

In addition, most Americans need to decrease sodium intake. The DASH Eating Plan provides guidance on how to keep sodium intakes within recommendations. When

using the USDA Food Guide, selecting foods that are lower in sodium than others is especially necessary to meet the recommended intake level at calorie levels of 2,600/day and above. Food choices that are lower in sodium are identified in chapter 8.

Considerations for Specific Population Groups

People Over 50 and Vitamin B₁₂

Although a substantial proportion of individuals over age 50 have reduced ability to absorb naturally occurring vitamin B₁₂, they are able to absorb the crystalline form. Thus, all individuals over the age of 50 should be encouraged to meet their Recommended Dietary Allowance (RDA) (2.4 μ g/day) for vitamin B₁₂ by eating foods fortified with vitamin B₁₂ such as fortified cereals, or by taking the crystalline form of vitamin B₁₂ supplements.

Women and Iron

Based on blood values, substantial numbers of adolescent females and women of childbearing age are iron deficient. Thus, these groups should eat foods high in heme-iron (e.g., meats) and/or consume iron-rich plant foods (e.g., spinach) or iron-fortified foods with an enhancer of iron absorption, such as foods rich in vitamin C (e.g., orange juice). Appendix B-3 lists foods that can help increase iron intake and gives their iron and calorie content.

Women and Folic Acid

Since folic acid reduces the risk of the neural tube defects, spina bifida, and anencephaly, a daily intake of 400 μ g/day of synthetic folic acid (from fortified foods or supplements in addition to food forms of folate from a varied diet) is recommended for women of childbearing age who may become pregnant. Pregnant women should consume 600 μ g/day of synthetic folic acid (from fortified foods or supplements) in addition to food forms of folate from a varied diet. It is not known whether the same level of protection could be achieved by using food that is naturally rich in folate.

Special Groups and Vitamin D

Adequate vitamin D status, which depends on dietary intake and cutaneous synthesis, is important for optimal calcium absorption, and it can reduce the risk for bone



loss. Two functionally relevant measures indicate that optimal serum 25-hydroxyvitamin D may be as high as 80 nmol/L. The elderly and individuals with dark skin (because the ability to synthesize vitamin D from exposure to sunlight varies with degree of skin pigmentation) are at a greater risk of low serum 25-hydroxyvitamin D concentrations. Also at risk are those exposed to insufficient ultraviolet radiation (i.e., sunlight) for the cutaneous production of vitamin D (e.g., housebound individuals). For individuals within the high-risk groups, substantially higher daily intakes of vitamin D (i.e., 25 μg or 1,000 International Units (IU) of vitamin D per day) have been recommended to reach and maintain serum 25-hydroxyvitamin D values at 80 nmol/L. Three cups of vitamin D-fortified milk (7.5 μg or 300 IU), 1 cup of vitamin D-fortified orange juice (2.5 μg or 100 IU), and 15 μg (600 IU) of supplemental vitamin D would provide 25 μg (1,000 IU) of vitamin D daily.

Fluid

The combination of thirst and normal drinking behavior, especially the consumption of fluids with meals, is usually sufficient to maintain normal hydration. Healthy individuals who have routine access to fluids and who are not exposed to heat stress consume adequate water to meet their needs. Purposeful drinking is warranted for individuals who are exposed to heat stress or perform sustained vigorous activity (see ch. 4).

Flexibility of Food Patterns for Varied Food Preferences

The USDA Food Guide and the DASH Eating Plan are flexible to permit food choices based on individual and cultural food preferences, cost, and availability. Both can also accommodate varied types of cuisines and special needs due to common food allergies. Two adaptations of the USDA Food Guide and the DASH Eating Plan are:

Vegetarian Choices

Vegetarians of all types can achieve recommended nutrient intakes through careful selection of foods. These individuals should give special attention to their intakes of protein, iron, and vitamin B12, as well as calcium and vitamin D if avoiding milk products. In addition, vegetarians could select only nuts, seeds, and legumes from the meat and beans group, or they could include eggs if so desired. At the 2,000-calorie level, they could choose about 1.5 ounces of nuts and $\frac{2}{3}$ cup legumes instead of 5.5 ounces of meat, poultry, and/or fish. One egg, $\frac{1}{2}$ ounce of nuts, or $\frac{1}{4}$ cup of legumes is considered equivalent to 1 ounce of meat, poultry, or fish in the USDA Food Guide.

Substitutions for Milk and Milk Products

Since milk and milk products provide more than 70 percent of the calcium consumed by Americans, guidance on other choices of dietary calcium is needed for those who do not consume the recommended amount of milk products. Milk product consumption has been associated with overall diet quality and adequacy of intake of many nutrients, including calcium, potassium, magnesium, zinc, iron, riboflavin, vitamin A, folate, and vitamin D. People may avoid milk products because of allergies, cultural practices, taste, or other reasons. Those who avoid all milk products need to choose rich sources of the nutrients provided by milk, including potassium, vitamin A, and magnesium in addition to calcium and vitamin D (see app. B). Some non-dairy sources of calcium are shown in appendix B-4. The bioavailability of the calcium in these foods varies.

Those who avoid milk because of its lactose content may obtain all the nutrients provided by the milk group by using lactose-reduced or low-lactose milk products, taking small servings of milk several times a day, taking the enzyme lactase before consuming milk products, or eating other calcium-rich foods. For additional information, see appendixes B-4 and B-5 and NIH Publication No. 03-2751.⁶

⁶ NIH Publication No. 03-2751, U.S. Department of Health and Human Services, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, March 2003. <http://digestive.niddk.nih.gov/ddiseases/pubs/lactoseintolerance/index.htm>.



TABLE 1. Sample USDA Food Guide and the DASH Eating Plan at the 2,000-Calorie Level^a

Amounts of various food groups that are recommended each day or each week in the USDA Food Guide and in the DASH Eating Plan (amounts are daily unless otherwise specified) at the 2,000-calorie level. Also identified are equivalent amounts for different food choices in each group. To follow either eating pattern, food choices over time should provide these amounts of food from each group on average.

Note: Table updated to reflect 2006 DASH Eating Plan.

Food Groups and Subgroups	USDA Food Guide Amount ^b	DASH Eating Plan Amount	Equivalent Amounts
Fruit Group	2 cups (4 servings)	2 to 2.5 cups (4 to 5 servings)	½ cup equivalent is: <ul style="list-style-type: none"> • ½ cup fresh, frozen, or canned fruit • 1 med fruit • ¼ cup dried fruit • ½ cup fruit juice
Vegetable Group	2.5 cups (5 servings)	2 to 2.5 cups (4 to 5 servings)	½ cup equivalent is: <ul style="list-style-type: none"> • ½ cup of cut-up raw or cooked vegetable • 1 cup raw leafy vegetable • ½ cup vegetable juice
<ul style="list-style-type: none"> • Dark green vegetables • Orange vegetables • Legumes (dry beans) • Starchy vegetables • Other vegetables 	3 cups/week 2 cups/week 3 cups/week 3 cups/week 6.5 cups/week		
Grain Group	6 ounce-equivalents	6 to 8 ounce-equivalents (6 to 8 servings ^c)	1 ounce-equivalent is: <ul style="list-style-type: none"> • 1 slice bread • 1 cup dry cereal • ½ cup cooked rice, pasta, cereal • DASH: 1 oz dry cereal (½–1¼ cup depending on cereal type—check label)
<ul style="list-style-type: none"> • Whole grains • Other grains 	3 ounce-equivalents 3 ounce-equivalents		
Meat and Beans Group	5.5 ounce-equivalents	6 ounces or less meat, poultry, fish	1 ounce-equivalent is: <ul style="list-style-type: none"> • 1 ounce of cooked lean meats, poultry, fish • 1 egg^e • USDA: ¼ cup cooked dry beans or tofu, 1 Tbsp peanut butter, ½ oz nuts or seeds • DASH: 1½ oz nuts, 2 Tbsp peanut butter, ½ oz seeds, ½ cup cooked dry beans
		4 to 5 servings per week nuts, seeds, and legumes ^d	
Milk Group	3 cups	2 to 3 cups	1 cup equivalent is: <ul style="list-style-type: none"> • 1 cup low-fat/fat-free milk, yogurt • 1½ oz of low-fat, fat-free, or reduced fat natural cheese • 2 oz of low-fat or fat-free processed cheese
Oils	27 grams (6 tsp)	8 to 12 grams (2 to 3 tsp)	DASH: 1 tsp equivalent is: <ul style="list-style-type: none"> • 1 tsp soft margarine • 1 Tbsp low-fat mayo • 2 Tbsp light salad dressing • 1 tsp vegetable oil
Discretionary Calorie Allowance	267 calories		DASH: 1 Tbsp added sugar equivalent is: <ul style="list-style-type: none"> • 1 Tbsp jelly or jam • ½ cup sorbet and ices • 1 cup lemonade
<ul style="list-style-type: none"> • Example of distribution: • Solid fat^f • Added sugars 	18 grams 8 tsp	~2 tsp (5 Tbsp per week)	

^a All servings are per day unless otherwise noted. USDA vegetable subgroup amounts and amounts of DASH nuts, seeds, and dry beans are per week.

^b The 2,000-calorie USDA Food Guide is appropriate for many sedentary males 51 to 70 years of age, sedentary females 19 to 30 years of age, and for some other gender/age groups who are more physically active. See table 3 for information about gender/age/activity levels and appropriate calorie intakes. See appendixes A-2 and A-3 for more information on the food groups, amounts, and food intake patterns at other calorie levels.

^c Whole grains are recommended for most grain servings to meet fiber recommendations.

^d In the DASH Eating Plan, nuts, seeds, and legumes are a separate food group from meats, poultry, and fish.

^e Since eggs are high in cholesterol, limit egg yolk intake to no more than 4 per week; 2 egg whites have the same protein content as 1 oz of meat.

^f The oils listed in this table are not considered to be part of discretionary calories because they are a major source of the vitamin E and polyunsaturated fatty acids, including the essential fatty acids, in the food pattern. In contrast, solid fats (i.e., saturated and *trans* fats) are listed separately as a source of discretionary calories.



TABLE 2. Comparison of Selected Nutrients in the Dietary Approaches to Stop Hypertension (DASH) Eating Plan^a, the USDA Food Guide^b, and Nutrient Intakes Recommended Per Day by the Institute of Medicine (IOM)^c

Estimated nutrient levels in the DASH Eating Plan and the USDA Food Guide at the 2,000-calorie level, as well as the nutrient intake levels recommended by the Institute of Medicine for females 19–30 years of age.

Note: Table updated to reflect 2006 DASH Eating Plan.

Nutrient	DASH Eating Plan (2,000 kcals)	USDA Food Guide (2,000 kcals)	IOM Recommendations for Females 19 to 30
Protein, g	105	91	RDA: 46
Protein, % kcal	20	18	AMDR: 10–35
Carbohydrate, g	281	271	RDA: 130
Carbohydrate, % kcal	54	55	AMDR: 45–65
Total fat, g	60	65	–
Total fat, % kcal	26	29	AMDR: 20–35
Saturated fat, g	12	17	–
Saturated fat, % kcal	6	7.8	ALAP ^d
Monounsaturated fat, g	25	24	–
Monounsaturated fat, % kcal	12	11	–
Polyunsaturated fat, g	16	20	–
Polyunsaturated fat, % kcal	7	9.0	–
Linoleic acid, g	14	18	AI: 12
Alpha-linolenic acid, g	2.2	1.7	AI: 1.1
Cholesterol, mg	136	230	ALAP ^d
Total dietary fiber, g	34	31	AI: 28 ^e
Potassium, mg	4,721	4,044	AI: 4,700
Sodium, mg	2,096 ^f	1,779	AI: 1,500, UL: <2,300
Calcium, mg	1,406	1,316	AI: 1,000
Magnesium, mg	554	380	RDA: 310
Copper, mg	1.9	1.5	RDA: 0.9
Iron, mg	22	18	RDA: 18
Phosphorus, mg	1,955	1,740	RDA: 700
Zinc, mg	14	14	RDA: 8
Thiamin, mg	1.7	2.0	RDA: 1.1
Riboflavin, mg	2.7	2.8	RDA: 1.1
Niacin equivalents, mg	50	22	RDA: 14
Vitamin B ₆ , mg	2.9	2.4	RDA: 1.3
Vitamin B ₁₂ , μg	5.6	8.3	RDA: 2.4
Vitamin C, mg	162	155	RDA: 75
Vitamin E (AT) ^g	19	9.5	RDA: 15.0
Vitamin A, μg (RAE) ^h	925	1,052	RDA: 700

^a DASH nutrient values are based on a 1-week menu of the DASH Eating Plan. Visit www.nhlbi.nih.gov.

^b USDA nutrient values are based on population-weighted averages of typical food choices within each food group or subgroup.

^c Recommended intakes for adult females 19–30; RDA = Recommended Dietary Allowance; AI = Adequate Intake; AMDR = Acceptable Macronutrient Distribution Range; UL = Upper Limit.

^d As Low As Possible while consuming a nutritionally adequate diet.

^e Amount listed is based on 14 g dietary fiber/1,000 kcal.

^f The DASH Eating Plan also can be used to follow at 1,500 mg sodium per day.

^g AT = mg d-α-tocopherol

^h RAE = Retinol Activity Equivalents

TABLE 3. Estimated Calorie Requirements (in Kilocalories) for Each Gender and Age Group at Three Levels of Physical Activity^a

Estimated amounts of calories needed to maintain energy balance for various gender and age groups at three different levels of physical activity. The estimates are rounded to the nearest 200 calories and were determined using the Institute of Medicine equation.

Gender	Age (years)	Activity Level ^{b,c,d}		
		Sedentary ^b	Moderately Active ^c	Active ^d
Child	2–3	1,000	1,000–1,400 ^e	1,000–1,400 ^e
Female	4–8	1,200	1,400–1,600	1,400–1,800
	9–13	1,600	1,600–2,000	1,800–2,200
	14–18	1,800	2,000	2,400
	19–30	2,000	2,000–2,200	2,400
	31–50	1,800	2,000	2,200
	51+	1,600	1,800	2,000–2,200
Male	4–8	1,400	1,400–1,600	1,600–2,000
	9–13	1,800	1,800–2,200	2,000–2,600
	14–18	2,200	2,400–2,800	2,800–3,200
	19–30	2,400	2,600–2,800	3,000
	31–50	2,200	2,400–2,600	2,800–3,000
	51+	2,000	2,200–2,400	2,400–2,800

^a These levels are based on Estimated Energy Requirements (EER) from the Institute of Medicine Dietary Reference Intakes macronutrients report, 2002, calculated by gender, age, and activity level for reference-sized individuals. "Reference size," as determined by IOM, is based on median height and weight for ages up to age 18 years of age and median height and weight for that height to give a BMI of 21.5 for adult females and 22.5 for adult males.

^b Sedentary means a lifestyle that includes only the light physical activity associated with typical day-to-day life.

^c 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 light physical activity associated with typical day-to-day life.

^d 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 light physical activity associated with typical day-to-day life.

^e The calorie ranges shown are to accommodate needs of different ages within the group. For children and adolescents, more calories are needed at older ages. For adults, fewer calories are needed at older ages.