

Methodology

To answer the research questions, we followed several steps for each food group:

Step 1: Identify the new Dietary Guidelines' recommendations relevant for this analysis

USDA's Food Guide in Appendix A-2 of the 2005 *Dietary Guidelines for Americans* specifies new daily recommendations for intake levels of each food group (p. 53). These recommendations are broken into 12 calorie levels ranging from 1,000 to 3,200 calories a day, depending on a person's age, gender, and physical activity. In particular, the Food Guide (table 1) provides:

“the suggested amounts of food to consume from the basic food groups, subgroups, and oils to meet recommended nutrient intakes at 12 different calorie levels. Nutrient and energy contributions from each group are calculated according to the nutrient-dense forms of foods in each group (e.g., lean meats and fat-free milk). The table also shows the discretionary calorie allowance that can be accommodated within each calorie level, in addition to the suggested amounts of nutrient-dense forms of foods in each group.”

For some food groups, the *Guidelines* implicitly suggest greater moderation in daily “servings” (i.e., cups or 1 ounce-equivalents (oz-eq) per day), while for other groups, they recommend increased consumption. In this report, we focused on the food groups for which the *Guidelines* encourage Americans to increase consumption to meet nutritional requirements “while staying within energy needs”: fruits, vegetables, milk products—particularly fat-free or low-fat milk or dairy products (e.g., nonfat yogurt and lower fat cheese)—and whole-grain products. We also examined refined-grain and total grain intake as part of our whole-grain analysis.

We used a 2,000-calorie-per-day reference level in our analysis, which is consistent with that used throughout the *Guidelines* in the USDA Food Guide and the DASH eating plan examples.³ The 2,000-calorie level is also used on all Nutrition Facts labels found on packaged foods. Recommended calorie intakes vary among individuals, depending on gender, age, and activity level; however, data do not exist on the distribution of all U.S. consumers with respect to the 12 calorie levels in the USDA Food Guide,⁴ thus hindering a more sophisticated analysis by calorie level.

The *Guidelines* recommend that Americans on a 2,000-calorie-per-day diet should consume 2 cups of fruit, 2.5 cups of vegetables, 3 cups of milk products, and 6 oz-eq of total grains daily. Half of the grain servings should be whole grain. The grains group includes all foods made from wheat, rice, oats, cornmeal, and barley, such as bread, pasta, oatmeal, breakfast cereals, tortillas, and grits. In general, 1 slice of bread, 1 small muffin, 1 cup of ready-to-eat cereal, 1 ounce of dry pasta or rice, or 1/2 cup of cooked rice,

³ The Dietary Approaches to Stop Hypertension (DASH) diet eating plan was sponsored by the National Institutes of Health and involves eating more low-fat or nonfat dairy and fruits and vegetables.

⁴ In the USDA Food Guide, the 2,000-calorie level is appropriate for many sedentary females age 19 to 30, many sedentary males age 51 to 70, and for some other age/gender groups who are more physically active (DGA, 2005, p. 10, footnote B).

pasta, or cooked cereal can be considered as 1 oz-eq from the grains group (DGA, 2005, p. 54).

The *Guidelines* encourage Americans to choose a variety of fruits and vegetables each day. In particular, they encourage Americans to select from all five vegetable subgroups several times a week because each subgroup provides a somewhat different array of nutrients (table 2). Recommended weekly intakes of vegetables for persons on a 2,000-calorie per day diet include the following: dark-green vegetables (3 cups), orange vegetables (2 cups), legumes (i.e., dry beans, peas, and lentils) (3 cups), starchy vegetables (3 cups), and other vegetables (6.5 cups).

Table 1

Daily amount of food from each group as recommended by the USDA Food Guide in the 2005 *Dietary Guidelines for Americans*

Food group	Daily calorie level ¹											
	1,000	1,200	1,400	1,600	1,800	2,000 ²	2,200	2,400	2,600	2,800	3,000	3,200
	<i>Servings</i>											
Fruit ³ (cups)	1.0	1.0	1.5	1.5	1.5	2.0	2.0	2.0	2.0	2.5	2.5	2.5
Vegetables ⁴ (cups)	1.0	1.5	1.5	2.0	2.5	2.5	3.0	3.0	3.5	3.5	4.0	4.0
Grains ⁵ Whole-grain portion (oz-eq)	3.0 1.5	4.0 2.0	5.0 2.5	5.0 3.0	6.0 3.0	6.0 3.0	7.0 3.5	8.0 4.0	9.0 4.5	10.0 5.0	10.0 5.0	10.0 5.0
Meat and beans ⁶ (oz-eq)	2.0	3.0	4.0	5.0	5.0	5.5	6.0	6.5	6.5	7.0	7.0	7.0
Milk ⁷ (cups)	2.0	2.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Oils ⁸ (tsp)	3.0	4.0	4.0	5.0	5.0	6.0	6.0	7.0	8.0	8.0	10.0	11.0
Discretionary calorie allowance ⁹	165	171	171	132	195	267	290	362	410	426	512	648

Note: oz-eq = ounce equivalent. ¹Calorie levels are set across a wide range to accommodate the needs of different individuals. This table can be used to help assign individuals to the food intake pattern at a particular calorie level. ²A 2,000-calorie level is used in this report to be consistent with the Nutrition Facts labels found on packaged foods. ³Fruit group includes all fresh, frozen, canned, and dried fruit and fruit juices. In general, 1 cup of fruit or 100 percent fruit juice, or 1/2 cup of dried fruit can be considered as 1 cup from the fruit group. ⁴Vegetable group includes all fresh, frozen, canned, and dried vegetables and vegetable juices. In general, 1 cup of raw or cooked vegetables or vegetable juice, or 2 cups of raw leafy greens can be considered as 1 cup from the vegetable group. According to the MyPyramid Plan, 1 cup of whole, mashed, or cooked dry legumes or 1 cup of 1/2 inch cubes of tofu count as 1 cup from the vegetable group. ⁵Grains group includes all foods made from wheat, rice, oats, cornmeal, and barley, such as bread, pasta, oatmeal, breakfast cereals, tortillas, and grits. In general, 1 slice of bread, 1 cup of ready-to-eat cereal, or 1/2 cup of cooked rice, pasta, or cooked cereal can be considered as 1 ounce equivalent from the grains group. At least half of all grains consumed should be whole grains. ⁶Meat and beans group includes, in general, 1 ounce of lean meat, poultry, or fish, 1 egg, 1 tablespoon of peanut butter, 1/4 cup of cooked dry beans, or 1/2 ounce of nuts or seeds can be considered as 1-ounce equivalent from the meat and beans group. ⁷Milk group includes all fluid milk products and foods made from milk that retain their calcium content, such as yogurt and cheese. Foods made from milk that have little to no calcium, such as cream cheese, cream, and butter, are not part of the group. Most milk group choices should be fat free or low fat. In general, 1 cup of milk or yogurt, 1½ ounces of natural cheese, or 2 ounces of processed cheese can be considered as 1 cup from the milk group. ⁸Oils include fats from many different plants and fish that are liquid at room temperature, such as canola, corn, olive, soybean, and sunflower oil. Some foods are naturally high in oils, such as nuts, olives, some fish, and avocados. Foods that are mainly oil include mayonnaise, certain salad dressings, and soft margarine. ⁹Discretionary calorie allowance is the remaining amount of calories in a food intake pattern after accounting for the calories needed for all food groups, using forms of foods that are fat-free or low-fat and with no added sugars.

Source: Prepared by USDA, Economic Research Service using data from *Dietary Guidelines for Americans*, 2005, Appendix A-2 "USDA Food Guide."

In the *Guidelines* (p. 36), legumes are considered “part of both the vegetable group and the meat and beans group as they contain nutrients found in each of these groups” but should be counted in only one group (p. 54).⁵ Here, we count legumes in the vegetable group, which is consistent with their placement in the ERS Food Guide Pyramid Servings data. According to the MyPyramid Food Guidance System, 1 cup of whole, mashed, or cooked dry legumes or 1 cup of ½-inch cubes of tofu counts as 1 cup from the vegetable group.

⁵ In the USDA Food Guide, ¼ cup of cooked dry beans or tofu is equivalent to 1 ounce of lean fish, meat, or poultry (DGA, 2005).

Step 2: Use ERS Food Guide Pyramid Servings data to calculate the percent change in per capita daily consumption needed to meet the dietary recommendation

We used the ERS Food Guide Pyramid Servings data to calculate the increase in per capita daily consumption needed to meet the new recommendations in the *Dietary Guidelines*. This data series comprises the ERS Food Availability data adjusted for nonedible food parts and food lost through spoilage, plate waste, and other losses in the home and marketing system and converted into daily per capita servings as defined by the new recommendations.⁶ It does not measure actual food intake. ERS compiles the Food Availability data annually to reflect the amount of food available for human consumption in the United States. This historical series measures the national food supply of several hundred foods, and it is the only source of time series data on food availability in the country. It extends back to 1909 for many commodities. ERS’s Food Availability data are normally calculated as the residual of a commodity’s total annual available supply after subtracting measurable uses, such as farm inputs (feed and seed), exports, ending stocks, and industrial uses. As these data represent the disappearance of food into the U.S. food marketing system, they are often referred to as food disappearance data. The annual data series also includes per capita food consumption estimates, which serve as a proxy for actual food intake and are useful for studying food consumption trends. In the mid-1990s, ERS developed new methods to adjust the Food Availability data for losses and express the data in terms of Food Guide Pyramid-based servings.

⁶ See www.ers.usda.gov/data/foodconsumption/ for detailed documentation of the data.

Table 2

Vegetable subgroup amounts per week as recommended by the USDA Food Guide in the 2005 *Dietary Guidelines*¹

Vegetable subgroup	Daily calorie level											
	1,000	1,200	1,400	1,600	1,800	2,000 ²	2,200	2,400	2,600	2,800	3,000	3,200
	<i>Cups per week</i>											
Dark green	1.0	1.5	1.5	2.0	3.0	3.0	3	3	3.0	3.0	3.0	3.0
Orange	.5	1.0	1.0	1.5	2.0	2.0	2	2	2.5	2.5	2.5	2.5
Legumes	.5	1.0	1.0	2.5	3.0	3.0	3	3	3.5	3.5	3.5	3.5
Starchy	1.5	2.5	2.5	2.5	3.0	3.0	6	6	7.0	7.0	9.0	9.0
Other	3.5	4.5	4.5	5.5	6.5	6.5	7	7	8.5	8.5	10.0	10.0

¹Vegetable subgroups include all fresh, frozen, canned, and dried vegetables and vegetable juices. In general, 1 cup of raw or cooked vegetables or vegetable juice, or 2 cups of raw leafy greens can be considered as 1 cup from the vegetable group. ²A 2,000-calorie level is used in this report to be consistent with the Nutrition Facts labels found on packaged foods.

Source: Prepared by USDA, Economic Research Service using data from *Dietary Guidelines for Americans*, 2005, Appendix A-2 “USDA Food Guide.”

To analyze the impact on agriculture from the new dietary recommendations, we first assessed and updated all of the conversion rates and assumptions for the serving sizes in the ERS Food Guide Pyramid Servings data, which had been previously based on the Food Guide Pyramid Bulletin (revised 1996). Prior to the release of the 2005 *Guidelines* and MyPyramid Food Guidance System, units of food were measured in *servings*. Now, the units are measured in cups for the fruit, vegetable, and milk groups, and *ounce-equivalents* for grains and meats. Because of the significant changes in conversion rates and assumptions as well as in daily intake recommendations, any dietary shortfalls and excesses quantified in this study are not comparable with those in previous analyses. For example, in the earlier recommendations, a “serving” of raw-leafy vegetables equaled 1 cup; now, 2 cups of raw-leafy vegetables equal 1 cup from the vegetable group.

Within each group, we assumed that the mix of foods was held constant at 2003 levels when estimating new levels of production and imports needed to meet the new dietary recommendations.⁷ For example, we assumed constant relative shares of apples, bananas, cranberries, etc., in the fruit group. Additionally, in the vegetable group, we fixed consumption of the five vegetable subgroups at levels recommended in the *Guidelines* and fixed the mix of foods within each vegetable subgroup (e.g., spinach, kale, and broccoli in the dark-green vegetable category). As explained further in the grains section, our analysis for whole grains focuses on whole-wheat flour and whole-wheat flour products. We assumed the current mix of these products remains constant (e.g., relative shares of bread, pasta, and other products). Due to data limitations, we looked at the milk group as a whole and did not make adjustments to the share of the different fat-content versions for each product (i.e., fat-free, low-fat, etc.). This limitation should be noted because the *Guidelines* and supporting guidance documents suggest that consumers should choose fat-free and low-fat options most often.

Our assumption that the mix of foods within a food group (e.g., strawberries and tangerines in the fruit group) is fixed could be relaxed in a more rigorous analysis. In reality, the mix of foods within a group is constantly changing in response to changes in supply (e.g., sudden supply shocks due to severe weather or widespread pest infestation) and consumer demand. For example, consumers might change the mix of foods they consume in response to relative prices and recommendations from popular fad diets (e.g., blueberries recommended by some diets for their antioxidant properties). The mix of foods in each food group will also continue to change as the U.S. population becomes more culturally diverse, as disposable incomes rise, and as a wider range of fresh and processed food options becomes available year-round (e.g., ready-to-eat carrots and pre-cut fruit). We have seen notable evidence of some demographic changes that have affected consumption trends. For example, population changes, such as the increase in the Hispanic population during the 1990s, boosted black bean consumption in Tex-Mex and Mexican cuisines (Lucier and Jerardo, August 2005). More recently, the popularity of other cuisines nationwide, such as Thai, have increased demand for a different mix of vegetables.

Next, we calculated changes needed to meet the daily dietary recommendations at the 2,000-calorie level as the difference between the new *Guidelines*’ recommendations and the current consumption estimates as

⁷ At the time of this report, 2003 was the latest year for which we had Food Guide Pyramid Servings data.

measured by the ERS Food Guide Pyramid Servings data for fruit, vegetables, milk products, and total- and whole-grain products in 2003. To meet the *Guidelines*, we calculate that Americans would need to increase daily consumption of fruit by 132 percent and vegetables by 31 percent (table 3). Additionally, consumers would need to alter the mix of vegetables. This change would include the consumption of more legumes, dark-green vegetables, and orange vegetables and less starchy vegetables. To meet the new recommendations, the average American would also need to increase daily consumption of milk and milk products by 66 percent. ERS servings data also imply that Americans would need to decrease total grain consumption by 27 percent and increase consumption of whole grains by 248 percent to meet the *Guidelines*' recommended number of grain servings.

Step 3: Multiply the percent change in consumption by the total availability of food in that food group in the United States to estimate the new level of food needed

We estimated the new level of food needed if all Americans fully meet the *Guidelines*' recommendations by multiplying the estimated percent change in consumption (table 3) by the *total availability* of that food group in the United States. As previously mentioned, total availability is a proxy for total U.S. consumption and is calculated here as domestic production plus imports minus exports.⁸ We used estimated average production, imports, and exports of food for 1999-2003.

⁸ Beginning and ending stocks and nonfood uses were not considered in this analysis.

Table 3

Daily ERS loss-adjusted food guide pyramid servings in 2003, compared with the recommendations from the 2005 Dietary Guidelines for Americans

Food group	Dietary Guidelines recommendations for a 2,000-calorie diet	2003 ERS Food Guide Pyramid Servings ¹	Change needed to meet <i>Guidelines</i> ' recommendations ²	
	Number per day	Number per day	Number	Percent
Fruit	2.0 cups	.9 cups	1.1 cups	132
Vegetables:	2.5 cups	1.9 cups	.6 cups	31
Dark green	.4 cups	.2 cups	.3 cups	175
Orange	.3 cups	.1 cups	.2 cups	183
Legumes	.4 cups	.1 cups	.3 cups	431
Starchy	.4 cups	.7 cups	-.2 cups	-35
Other	.9 cups	.9 cups	-- cups	2
Milk	3.0 cups	1.8 cups	1.2 cups	66
Total grains ³	6.0 oz-eq	8.2 oz-eq	-2.2 oz-eq	-27
Whole grains	3.0 oz-eq	.9 oz-eq	2.1 oz-eq	248

Note: oz-eq = ounce equivalent. -- means less than .1 cup. ¹The ERS estimate of .9 oz.-eq. for the whole-grain subset of total grains is the sum of the ERS-estimated whole-grain share of wheat flour (5 percent of the 5.22 oz-eq of wheat flour available per capita or 0.261 oz-eq.) plus an estimated 0.6 oz-eq. missing from the ERS Food Guide Pyramid Servings data from Putnam et al. (2002), which includes foods, such as popcorn. ²Computed from unrounded numbers. ³The ERS estimate of 8.2 oz-eq. includes 7.6 oz. eq. from the ERS Food Guide Pyramid Servings data plus the 0.6 oz-eq. missing whole-grain estimate by Putnam et al. (2002). In general, 1 slice of bread, 1 cup of ready-to-eat cereal, or 1/2 cup of cooked rice, pasta, or cooked cereal can be considered as 1-oz-eq. from the grains group.

Source: Prepared by USDA, Economic Research Service using data from *Dietary Guidelines for Americans*, 2005, Appendix A-2 "USDA Food Guide" and ERS food consumption (per capita) data system, Food Guide Pyramid Servings, www.ers.usda.gov/data/foodconsumption/

Step 4: Calculate change in U.S. production using consumption change estimates

We next estimated the levels of domestic production and imports needed to meet the new levels of food consumption calculated in step 3. To do so, we made two simplifying assumptions: we held exports constant at the average level for 1999-2003, and of the remaining food availability, we fixed the relative shares of domestic production and imports at the average of 1999-2003 levels.

The *Guidelines* encourage increased consumption of all food groups covered here (fruit, vegetables, dairy, and whole grains). Therefore, if Americans fully meet all of the recommendations, the demand for these foods would increase. As a result, prices of these foods would increase, making it more likely that imports and domestic production would increase and that exports would decrease. For simplicity, we assumed exports remain constant because some exports would still occur and exports of certain byproducts may even increase. For example, American cheeses are popular in some foreign countries, and fruit and vegetables produced here might complement seasonal production gaps in other countries. Additionally, if Americans switch to low-fat or nonfat milk and milk products, greater quantities of milkfat and products high in milkfat may be exported.

Step 5: Calculate domestic acreage needed to meet new production levels

In calculating the change in net acreage in the United States needed for Americans to meet the 2005 dietary recommendations for fruit, vegetables, and whole grains, we assumed that average yields per acre remained constant at the average of 1999-2003 levels. In particular, we assumed that the ratio between the average U.S. acreage for a particular crop during 1999-2003 and the average production from that acreage remained the same. We used harvested instead of planted acres due to data availability. Data limitations prevent estimates of changes in farmland devoted to dairy production or cropland adjustments needed to feed more dairy cattle.