

Appendix E-3.2: Food Group Contributions to Nutrients in USDA Food Patterns and Current Nutrient Intakes

RESEARCH QUESTIONS

- (1) What is the contribution of whole grain foods, fruits and vegetables, and other food groups to (a) total fiber intake and (b) total nutrient intake in the USDA Food Patterns?
- (2) What is the contribution of fruits and vegetables to current nutrient intake (focus on nutrients of concern, including fiber)?

BACKGROUND

Note: Please see DGAC Report Appendix E3.1, *Modeling Analysis: Adequacy of USDA Food Patterns* for more background information about development of the USDA food patterns.

The USDA Food Patterns are intended to represent the types and amounts of foods that will provide sufficient nutrients to meet IOM nutrient recommendations and Dietary Guidelines for Americans recommendations, within calorie needs. They are updated every five years during the deliberations of the Dietary Guidelines Advisory Committee, and are presented to the Committee for their assessment of how well the Patterns meet their goals. As part of the update, amounts recommended from each food group may be modified to reach all or most of the specified goals.

Food Patterns are created at 12 energy levels. Each level is assigned nutrient goals for one or more age-gender groups, for whom the energy level is appropriate, based on IOM Estimated Energy Requirement equations.

The patterns do not reflect actual intakes of Americans from each food group. Amounts recommended from each food group may be more or less than are typically consumed, so that the overall patterns reach nutrient and other goals. However, the recommended amounts from each food group are compared to usual dietary intake patterns of Americans, and kept within the broad range of consumption for Americans (between the 5th and 95th percentiles of consumption).

In addition, the patterns do not reflect the form in which foods are typically consumed. In each group, food choices are represented by nutrient-dense forms of the foods, such as fat-free milk for all fluid milk, leanest beef cuts for all beef, and ready-to-eat cereals low in added sugars for all ready-to-eat cereals.

METHODS

1. Identify the amount of each nutrient analyzed for the overall patterns that comes from each food group and subgroup.

The nutrients included in the analysis of the USDA Food Patterns for adequacy are listed in Table 1. For the purposes of this report, a subset of nutrients of interest to the DGAC were selected for evaluation. These include total dietary fiber, calcium, vitamin D, potassium, sodium, saturated fatty acids, and energy.

Table 1. Nutrients included in food patterns analysis.

Vitamins	Minerals	Macronutrients	Fats & Fatty Acids
Vitamin A*	Calcium	Energy	Cholesterol
Vitamin E	Iron	Protein	Saturated Fatty
Vitamin D	Magnesium	Total lipid (fat)	Acids
Vitamin C	Manganese	Carbohydrate	Monounsaturated
Thiamin	Phosphorus	Fiber, total dietary	Fatty Acids
Riboflavin	Potassium		Polyunsaturated
Niacin	Sodium		Fatty Acids
Vitamin B-6	Zinc		18:2 Linoleic Acid
Vitamin B-12	Copper		18:3 Linolenic Acid
Choline	Selenium		EPA
Vitamin K			DHA
Total Folate**			

*Includes provitamin A carotenoids, measured in µg RAE

** measured in µg DFE

The amount of each nutrient from each food group in each of the 12 patterns was calculated. This amount was then divided by the total amount of that nutrient in each pattern, to identify the percent of the total nutrient amount attributable to each food group or subgroup. Food groups and subgroups in the patterns are listed in table 2.

Table 2. Food groups, subgroups, and additional components in the USDA Food Patterns.

Food Group	Subgroups
Dairy	
Fruits	
Vegetables	Dark Green, Red/Orange, Starchy, Beans and Peas, Other
Grains	Whole, Refined
Protein Foods	Meats, Poultry, Seafood high in N-3 fatty acids, Seafood low in n-3 fatty acids, Eggs, Nuts and Seeds, Soy Products (including tofu)
Oils	
Solid Fats	
Added sugars	

Summarize data and note differences across patterns

The percents of the total intake from each food group, subgroup, and food pattern component (i.e., oils, solid fats, added sugars) for selected nutrients at all 12 calorie levels were

averaged. The average percent contribution to each nutrient total from each food group was calculated and for some, specific food sources by item cluster were identified and reported.

2. Calculate intakes of fruits and vegetables as a percent of recommendations.

To answer the second question, the actual intake of fruits and vegetables as a percent of the recommended intake level for each age/sex group was calculated. This provided a proportion to use in estimating nutrient intakes from consumption amounts.

3. Estimate amount of fiber and potassium in amounts of fruits and vegetables consumed. Compare estimated amounts from fruits and vegetables with the total intake of the nutrient to find the percent contribution.

Use the proportion actual to recommended fruit and vegetable intake to estimate the contributions of fiber and potassium from fruits and vegetables in amounts consumed. Fruits and vegetables contribute little to calcium and vitamin D intakes, even when consumed in recommended amounts (see Table 3). Therefore, only potassium and fiber were included in this calculation.

RESULTS

Contributions of nutrients by each food group in the USDA Food Patterns

Most nutrients (e.g., dietary fiber, potassium, and sodium) are provided in substantial amounts by multiple food groups, while for other nutrients (e.g., calcium and vitamin D), multiple food groups are sources, but there is one food group that is the predominant source. The contribution of each food group and food pattern component (i.e., oils, solid fats, added sugars) to the overall amount of energy and selected nutrients in the patterns, averaged across the 12 energy levels, is shown in Table 3. Contribution from each subgroup within the Vegetable and Protein Foods Groups is shown in Table 4.

The percent contribution for each nutrient is a function of (1) the amount of the nutrient in the foods within the group, and (2) the amount of the food group in the patterns. Food groups and subgroups included in the patterns in larger amounts are likely to contribute more than those included in smaller amounts. This is also true for contributions of individual foods (item clusters) within each group. Item clusters that represent a larger proportion of the food group, because they are more commonly consumed, may contribute more of a nutrient than those that are a smaller proportion of the group average due to limited consumption. The proportional composition of each food group by item cluster is not presented here, but is available as Table E3.1.A2 in the additional materials for to the Adequacy of the USDA Food Patterns modeling report (DGAC Report Appendix E3.1).

Table 3. Percent contribution of each food group and food component to selected nutrient totals in the USDA Food Patterns. Nutrients include nutrients of public health concern, shortfall nutrients, and additional nutrients of interest. Shown as percent of the total amount in the pattern, averaged across patterns at all calorie levels.

Food Group	Energy	Dietary Fiber	Calcium	Vitamin D	Potassium	Sodium	Saturated Fat	Protein	Iron	Folate	Magnesium	Vitamin A*	MUFA**	PUFA**
	% total	% total	% total	% total	% total	% total	% total	% total	% total	% total	% total	% total	% total	% total
Fruits	9%	16%	3%	0%	17%	0%	1%	2%	4%	6%	10%	3%	0%	1%
Vegetables	13%	38%	7%	0%	36%	6%	3%	10%	19%	23%	23%	34%	7%	4%
Whole Grains	15%	32%	12%	8%	10%	16%	5%	12%	42%	35%	29%	16%	4%	8%
Refined Grains	13%	9%	7%	1%	3%	18%	5%	9%	20%	27%	7%	4%	5%	5%
Protein Foods	14%	3%	3%	25%	13%	24%	20%	38%	13%	5%	14%	7%	22%	13%
Dairy	11%	2%	67%	64%	21%	33%	9%	28%	2%	4%	17%	32%	3%	1%
Oils	12%	0%	0%	0%	0%	0%	21%	0%	0%	0%	0%	1%	36%	58%
Solid Fats	7%	0%	0%	2%	0%	2%	36%	0%	0%	0%	0%	3%	21%	10%
Added sugars	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

*Includes provitamin A carotenoids;

**MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids

Table 4. Percent contribution of Vegetable and Protein Foods subgroups to selected nutrient totals in the USDA Food Patterns. Shown as percent of the total amount in the pattern, averaged across patterns at all calorie levels.

Food Group	Energy	Dietary Fiber	Calcium	Vitamin D	Potassium	Sodium	Saturated Fat
	% total	% total	% total	% total	% total	% total	% total
Vegetables:	13%	38%	7%	0%	36%	6%	3%
-Dark Green	0%	3%	1%	0%	3%	1%	0%
-Red and Orange	2%	7%	1%	0%	10%	1%	0%
-Beans and Peas	3%	12%	1%	0%	5%	0%	0%
-Starchy	7%	10%	1%	0%	13%	3%	2%
-Other	1%	6%	2%	0%	5%	1%	1%
Protein Foods:	14%	3%	3%	25%	13%	24%	20%
-Meat	4%	0%	0%	2%	5%	10%	7%
-Poultry	4%	0%	0%	1%	3%	5%	4%
-Seafood	2%	0%	1%	16%	3%	6%	1%
-Nuts/seeds	2%	3%	1%	0%	2%	1%	3%
-Eggs	2%	0%	1%	6%	1%	1%	4%
-Soy Products	0%	0%	0%	2%	0%	0%	0%

Dietary Fiber: Vegetables (38%) and Whole Grains (32%) provide the largest amounts of fiber in the USDA Food Patterns. Within the Vegetable Group, the bean and pea and starchy vegetable subgroups provide the largest amounts of fiber, 12% and 10% of total fiber, respectively. Fruits (16%) also contribute a substantial amount of fiber, and Refined Grains provide close to 10% of the total fiber in the patterns. The small amount of fiber contributed by the Dairy Group (2%) comes from ingredients used in ice cream and cheese production, probably gums. The small amount attributable to Protein Foods (3%) is from nuts and seeds.

Calcium: As would be expected, the majority of calcium in the patterns comes from the Dairy Group (67%). Whole Grains (12%), Refined Grains (7%), and Vegetables (7%) also contribute to the total calcium in the patterns, while Fruits and Protein Foods each provide a small percent of the total (3%). The calcium in Whole Grains comes from a variety of sources (data not shown): ready-to-eat cereals fortified with calcium (Cheerios, corn puffs), non-fortified cooked oatmeal and ready-to-eat cereals (shredded wheat), whole wheat quick breads (pancakes), commercial whole wheat breads, and whole wheat English muffins. The quick breads, breads, and muffins may include milk as an ingredient. See the note on calcium at the end of this document for more details about calcium sources in the vegetables group.

Vitamin D: Again, the majority of vitamin D in the patterns is from the Dairy Group (64%), with most of the rest from Protein Foods. Seafood accounts for 16% of the total vitamin D, eggs (6%) and other Protein Foods subgroups provide small amounts. Whole and Refined Grains also contribute small amounts from fortified ready-to-eat cereals.

Potassium: Most food groups contribute to the total potassium in the patterns. Vegetables provide the largest percent (36%), then Dairy (21%), Fruit (17%), Protein Foods (13%), and Whole Grains (10%). In the Protein Foods and Whole Grain Groups, small amounts of potassium are contributed by many subgroups or individual foods.

Sodium: The food patterns are constructed from nutrient-dense forms of foods. Foods prepared without added salt are considered nutrient-dense for this purpose, and the patterns are much lower in sodium than if they included foods in their typically consumed (salted) forms.* For example, the total sodium in the 2000 calorie patterns is about 1750 mg. Therefore, the sodium in the current food patterns comes mostly from foods with intrinsic sodium, Dairy (33%) and Protein Foods (24%), and foods in which the added salt is a necessary component of the product, such as breads and baked goods in the Refined (18%) and Whole (16%) Grain Groups. While vegetables in their nutrient dense forms contribute only 6% of the total sodium, in typically consumed forms vegetables are likely to be much higher in sodium. For example, beans and peas in these patterns contain only 3 mg of sodium per cup (cooked), but beans and peas as typically consumed may contain over 600 mg per cup.

*(See the 2010 Dietary Guidelines Advisory Committee report, Appendix E-3, for the sodium amounts from a Food Pattern modeling analysis “Typical Choices” Food Patterns, which selected foods in their most-consumed forms.)

Saturated Fat: As with sodium, the saturated fat in the patterns is much lower than typical intakes. In each food group, foods are selected in their lowest-fat or leanest form. Therefore, the majority of saturated fat in the patterns is from solid fats (36%) and oils (21%). Protein Foods contribute 20% of the saturated fat, with 7% from meats, 4% each from eggs and poultry, 3% from nuts and seeds, and 1% from seafood. Dairy contributes 9%, and Whole and Refined Grains 5% each. Solid fats are not considered essential in the patterns. They are included to balance calories and allow some added fats or food group choices in higher fat forms. The oils category is considered essential, as it provides the majority of the essential fatty acids and vitamin E in the patterns.

Contributions of nutrients by fruits and vegetables in amounts actually consumed

The mean intakes of fruits and vegetables by each age/sex group were identified from WWEIA 2007-10. The percent that this intake represents of the recommended intake in the USDA Food Patterns were calculated. These percents, shown in Table 6, range from 43% (males 14 to 18) to 90% (females 51 to 70) of vegetable recommended intakes, and from 45% (males and females 19 to 30) to 150% (males and females 1 to 3) of recommended fruit intakes.

Table 5. Mean intakes of fruits and vegetables by age/sex group, from WWEIA NHANES 2007-10, amount in USDA Food Patterns appropriate for each age/sex group, and intakes as a percent of amounts in the Food Patterns.

Age/sex group	Food Pattern	Mean intake vegetables cup eq	Amount of vegetables in Food Pattern cup eq	Intake of vegetables as % of Food Pattern amount %	Mean intake of fruit cup eq	Amount of fruit in Food Pattern cup eq	Intake of fruit as % of Food Pattern amount %
MALES							
1 to 3	1000	0.7	1	70%	1.5	1	150%
4 to 8	1400	0.8	1.5	53%	1.2	1.5	80%
9 to 13	1800	1.1	2.5	44%	1.1	1.5	73%
14 to 18	2200	1.3	3	43%	1	2	50%
19 to 30	2400	1.7	3	57%	0.9	2	45%
31 to 50	2200	1.9	3	63%	0.9	2	45%
51 to 70	2000	1.9	2.5	76%	1.2	2	60%
71+	2000	1.7	2.5	68%	1.4	2	70%
FEMALES							
1 to 3	1000	0.7	1	70%	1.5	1	150%
4 to 8	1200	0.8	1.5	53%	1.2	1	120%
9 to 13	1600	1	2	50%	1.1	1.5	73%
14 to 18	1800	1.1	2.5	44%	0.8	1.5	53%
19 to 30	2000	1.4	2.5	56%	0.9	2	45%
31 to 50	1800	1.6	2.5	64%	0.9	1.5	60%
51 to 70	1600	1.8	2	90%	1.2	1.5	80%
71+	1600	1.5	2	75%	1.3	1.5	87%

The fiber and potassium content and contribution from actual intakes of fruits and vegetables were then estimated using this percent of the recommended intakes.

Tables 6 and 7 show the fiber and potassium content of recommended amounts of fruits and vegetables in each Food Pattern, the mean total intake by each age/sex group, the estimated amounts from fruits and vegetables, and the estimated percent of total fiber and potassium intake from fruits and vegetables. Estimated intake of fiber from fruits and vegetables ranged from 5.4 (males and females 4 to 8) to 10.3 (males 51 to 70) grams per day. These intakes represent about 42% (males 4 to 8) to 65% (females 1 to 3) of total fiber intake. Estimated intakes of potassium from fruits and vegetables ranged from 743 (males and females 4 to 8) to 1262 (males 51 to 70) milligrams per day. These intakes represent about 33% (males 4 to 8) to 48% (females 51+) of total potassium intake.

Table 6—Fiber from fruits and vegetables in USDA Food Patterns and estimated intakes of fiber from fruits and vegetables.

Age/sex group	Fiber from vegetables in USDA Food Patterns g/day	Fiber from fruit in USDA Food Patterns g/day	Mean actual fiber intake (NHANES 2007-10) g/day	Estimated intake of fiber from vegetables* g/day	Estimated intake of fiber from fruit* g/day	Estimated intake of fiber from fruit + vegetables g/day	% of total fiber intake from fruits + vegetables %
MALES							
1 to 3	4	2.3	10.3	3	3.5	6.3	61%
4 to 8	5	3.4	12.8	3	2.7	5.4	42%
9 to 13	10	3.4	14.5	4	2.5	6.9	48%
14 to 18	12	4.5	15.5	5	2.3	7.5	48%
19 to 30	12	4.5	17.3	7	2.0	8.8	51%
31 to 50	12	4.5	19	8	2.0	9.6	51%
51 to 70	10	4.5	18.3	8	2.7	10.3	56%
71+	10	4.5	17	7	3.2	10.0	59%
FEMALES							
1 to 3	4	2.3	9.6	3	3.5	6.3	65%
4 to 8	5	2.3	12.2	3	2.8	5.4	44%
9 to 13	8	3.4	13.5	4	2.5	6.5	48%
14 to 18	10	3.4	12.6	4	1.8	6.2	49%
19 to 30	10	4.5	13.4	6	2.0	7.6	57%
31 to 50	10	3.4	14.9	6	2.0	8.4	57%
51 to 70	8	3.4	15.8	7	2.7	9.9	63%
71+	8	3.4	14.5	6	2.9	8.9	62%

*Intake of fruit or vegetables as percent of recommendation x g fiber from recommended amount of fruit or vegetables in Food Patterns

Source: What We Eat in America, NHANES 2007-10

Table 7—Potassium from fruits and vegetables in USDA Food Patterns and estimated intakes of potassium from fruits and vegetables.

Age/sex group	Potassium from vegetables in USDA Food Patterns mg/day	Potassium from fruit in USDA Food Patterns mg/day	Mean actual potassium intake (NHANES 2007-10) mg/day	Estimated intake of potassium from vegetables* mg/day	Estimated intake of potassium from fruit* mg/day	Estimated intake of potassium from fruit + vegetables mg/day	% of total potassium intake from fruits + vegetables %
MALES							
1 to 3	468	311	2039	328	467	794	39%
4 to 8	693	467	2108	370	374	743	35%
9 to 13	1169	467	2335	514	342	857	37%
14 to 18	1407	623	2756	610	312	921	33%
19 to 30	1407	623	2925	797	280	1078	37%
31 to 50	407	623	3240	891	280	1171	36%
51 to 70	1169	623	3135	888	374	1262	40%
71+	1169	623	2750	795	436	1231	45%
FEMALES							
1 to 3	468	311	1964	328	467	794	40%
4 to 8	693	311	1985	370	373	743	37%
9 to 13	916	467	2042	458	342	800	39%
14 to 18	1169	467	1927	514	249	763	40%
19 to 30	1169	623	2132	655	280	935	44%
31 to 50	1169	467	2358	748	280	1028	44%
51 to 70	916	467	2493	824	374	1198	48%
71+	916	467	2252	687	405	1092	48%

*Intake of fruit or vegetables as percent of recommendation x mg potassium from recommended amount of fruit or vegetables in Food Patterns.

Source: What We Eat in America, NHANES 2007-10

Estimates of the intakes of fiber and potassium from fruits and vegetables indicate that substantial proportions of the total intakes of both come from fruit and vegetable intakes. About 40% to 65% all fiber intake and about one-third to half of total potassium intake comes from fruits and vegetables combined. However, these proportions are based on overall low intake levels. For both fiber and potassium, total intakes are far below amounts in the USDA Food Patterns. Table 8 shows the intake of fiber and potassium from fruits and vegetables as a percent of the recommended intakes for these nutrients.

Table 8. Estimated intakes of fiber and potassium from fruits and vegetables as a percent of recommended intake amounts, by age/sex groups.

Age/sex group	Estimated intake of fiber from fruits and vegetables as a percent of recommended intake	Estimated intake of potassium from fruits and vegetables as a percent of recommended intake
MALES		
1 to 3	45%	26%
4 to 8	27%	20%
9 to 13	28%	19%
14 to 18	24%	20%
19 to 30	26%	23%
31 to 50	31%	25%
51 to 70	37%	27%
71+	36%	26%
FEMALES		
1 to 3	45%	26%
4 to 8	32%	20%
9 to 13	30%	18%
14 to 18	25%	16%
19 to 30	27%	20%
31 to 50	34%	22%
51 to 70	45%	25%
71+	41%	23%

SUMMARY:

In the USDA Food Patterns each food group contributes to a range of nutrients in varying amounts. The percent of the total contributed for each nutrient is a function of the amount of the nutrient in the foods within the group, and the amount of these foods in the patterns. Food groups with larger amounts in the patterns, as well as those with higher levels of the nutrient within the group, are likely to contribute more than those with smaller amounts in the patterns. The largest percent of total fiber comes from Vegetables (38%) and Whole Grains (32%). The majority of calcium (67%) and vitamin D (64%) are from the Dairy group, with much smaller amounts from other food groups. Potassium is found in all food groups, with most coming from Vegetables (36%), Dairy (21%), and Fruit (17%) Groups. The largest amount of sodium in the patterns comes from the Dairy (33%) and Protein Foods (24%) Groups, because these food groups have the most intrinsic sodium. The majority of saturated fat is from solid fats (36%) and oils (21%), because the foods representing each food group are in nutrient-dense (lean or low-fat) forms.

Estimates of the intakes of fiber and potassium from fruits and vegetables indicate that substantial proportions of the total intakes of both come from fruit and vegetable intakes.

However, these proportions are based on overall low intake levels. For both fiber and potassium, total intakes are far below amounts in the USDA Food Patterns.

NOTE--Calcium in the Vegetables Group:

The best vegetables sources of calcium per cup equivalent are cactus (245 mg per cup eq), garlic (245 mg per cup eq), cowpeas (245 mg per cup eq), turnip greens (217 mg per cup eq), cooked spinach (203 mg per cup eq), collard greens (183 mg per cup eq), and soybeans (179 mg per cup eq). The contribution of a specific vegetable to the calcium in the USDA Food Patterns depends not only on its calcium content, but also the proportion of a subgroup it represents, and the amount of the subgroup included in the a pattern. On that basis, the largest contributors to the calcium in the 2000-calorie Pattern, from within the vegetable group, are cooked tomatoes (7.5 mg) white beans (6.6 mg), pinto beans (6.4 mg), cooked broccoli (4.3 mg), cooked spinach (3.4 mg), cooked green beans (3.3 mg), and cooked carrots (3.2 mg). Other vegetables with a higher calcium content per cup do not contribute as much because they are consumed in relatively lower amounts, and therefore contribute less to the overall nutrient profiles of their respective vegetable subgroup. The total amount of calcium in the 2000-calorie Pattern that comes from all vegetables is 86 mg of the total of 1274 mg of calcium in this pattern.