Appendix G-2: Original Food Guide Pyramid Patterns and Description of USDA Analyses

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Note that the reports are presented as analyzed and submitted, using the food intake patterns that were current at the time the analysis was conducted. Data have not been updated to reflect later modifications to the patterns to increase potassium levels.

FOOD GUIDE PYRAMID AS IT APPEARED IN 2000 DIETARY GUIDELINES FOR AMERICANS

Number of servings recommended daily from each food group at three calorie levels.

Food Group	Children Ages 2 to 6 Years, Women, Some Older Adults (about 1,600 calories)	Older Children, Teen Girls, Active Women, Most Men (about 2,200 calories)	Teen Boys, Active Men (about 2,800 calories)
Bread, Cereal, Rice, and Pasta Group (Grains Group)	6	9	11
Vegetable Group	3	4	5
Fruit Group	2	3	4
Milk, Yogurt, and Cheese Group (Milk Group)—preferably fat free or low fat	2 or 3*	2 or 3*	2 or 3*
Meat, Poultry, Fish, Dry Bens, Eggs, and Nuts Group (Meat and Beans Group)—preferably lean or low fat	2, for a total of 5 ounces	2, for a total of 6 ounces	3, for a total of 7 ounces

*The number of servings depends on your age. Older children and teenagers (ages 9 to 18 years) and adults age 50years and older need three servings daily. Others need two servings daily. During pregnancy and lactation, the recommended number of milk group servings is the same as for nonpregnant women.

Source: Nutrition and Your Health: Dietary Guidelines for Americans, 5th ed. USDA and HHS, 2000.

LACTO-OVO VEGETARIAN FOOD INTAKE PATTERN ANALYSIS
May 21, 2004

REQUEST FROM THE NUTRIENT ADEQUACY SUBCOMMITTEE
How can the food intake patterns be modified for vegetarians and still meet nutritional goals?

BACKGROUND
Pyramid food intake patterns have grouped animal and plant protein sources into a single food group, the meat, poultry, fish, eggs, and nuts (MPFEN) group. The nutrient profile of this group was previously calculated assuming a proportionate intake of each food category equal to the proportion consumed by the population. The meats and poultry selected as representative items were the leanest choices within each food type. Food items selected in calculating the nutrient profile were those whose intake represents more than 1 percent of the total intake of the food group. Other foods (with less than 1 percent intake) in each category were grouped with the most similar food in calculating overall percentage consumption. Legumes also are recognized as an important plant protein source, but they have traditionally been grouped with other vegetables and are included as a separate vegetable subgroup in the food intake patterns.

Ounce equivalencies used in the MPFEN nutrient profiles were originally determined by identifying amounts of eggs and nuts that approximate the nutrient content of 1 ounce of meat, poultry, and fish. Protein content was the prime nutrient considered. A comparison of the nutrients in 1-ounce equivalent of each type of food in the group is shown in Addendum A.

While the number of vegetarians has increased markedly since the original development of the food patterns, there is still insufficient data on their food intake to develop totally separate food intake patterns for them. Therefore, it has been assumed that vegetarians could use the food intake patterns, selecting only protein sources from the MPFEN group that are acceptable to them and including additional legumes. The adequacy of this approach has never been fully explored, however. This analysis is intended to determine if lacto-ovo vegetarians can use the food intake patterns to select an adequate diet; to identify appropriate ratios of legumes, nuts, and eggs to meet nutrient needs; and to see what additional modifications in their food choices would be necessary.

METHODS
1. Used proposed food intake patterns (with updated intake recommendations to increase potassium) and nutrient profiles based on 1999–2000 NHANES consumption data and SR 16-1 nutrient data as the basis for this analysis.
2. Modified the composition of the MPFEN nutrient profile to include only eggs, nuts, and legumes (ENL). (Legumes were added to the profile.) Determined the changes in nutrient and calorie levels with varying proportions of these foods in the new vegetarian ENL nutrient profile. Note that no attempt was made to base the proportions of eggs, nuts, and legumes on actual intakes. (A qualitative assessment of the "reasonableness" of the proportions was made, however.) Amounts from the milk group were left unchanged, with 2 or 3 cups of milk per day in the various intake patterns.
3. Using the adjusted nutrient profiles for a vegetarian ENL group, analyzed the adequacy of the resulting food patterns. Adjusted proportions and amounts of eggs, nuts, and legumes in the nutrient profiles iteratively to meet nutrient needs within set calorie levels.
4. Assessed amounts of absorbed iron available in the vegetarian (ENL) food intake patterns by calculating absorbed iron using non-heme percent absorption.

5. Assessed adequacy of limiting essential amino acids in the vegetarian (ENL) food intake patterns. Addendum B also provides additional general information on protein in vegetarian diets.
6. Calculated recommended intakes for eggs, nuts, and legumes in the vegetarian patterns in food equivalents per day or per week for 5-, 6-, and 7-ounce equivalent intake levels.

RESULTS

1. Table G2-1 shows the original food subgroups used in developing the MPFEN food group, the percent of the total composite for each, and actual amounts this translates into in a food pattern that suggests 5-ounce equivalents per day from this group (the 1,600 or 1,800 calorie pattern). The percents are based on NHANES 1999–2000 consumption data for each subgroup.

Table G2-1. Original MPFEN Group and Amounts Recommended

Subgroups in the Original MPFEN Group	Percent of MPFEN Consumption	Amount in a Daily Food Pattern With 5-oz. eq. From Group
Meats (beef, ground beef, pork, lamb, ham, luncheon meats, and liver item groups)	55.7%	2.79 oz.
Poultry (chicken and turkey item groups)	24.5%	1.23 oz.
Fish (originally lean finfish, fatty finfish, tuna, and shellfish item groups*)	8.3%	0.42 oz.
Eggs (eggs)	7.8%	0.39 eggs
Nuts and seeds	3.6%	0.18-oz. eq. †

*See report on increasing fish consumption for new fish item groups now being used in analyses.
†Equal to approximately 0.27 ounces of nuts, or 0.38 tbsp of peanut butter.

A separate nutrient profile had been previously developed for each subgroup in the MPFEN group and for legumes. Addendum A shows these nutrient profiles. To determine appropriate amounts of eggs, nuts, and legumes to use in the vegetarian pattern, nutrient differences among these foods were examined. Nuts and legumes contain more calories per ounce equivalent than meat, poultry, or fish. The weighted average number of calories in each is 210 per 1-oz. eq. of nuts, 113 per 1-oz. eq. of legumes, 51 per oz. of meat, 53 per oz. of poultry, and 39 per oz. of fish. To develop isocaloric food intake patterns, the differences in energy levels were compensated for by decreasing overall amounts, including fewer ounce equivalents than are in the original MPFEN patterns. Amounts were decreased iteratively to lower caloric levels, using varying proportions from eggs, nuts, and legumes, until a nutrient intake level became marginal in at least one pattern. Because so many nutrients are provided in amounts above the recommended standards, it was possible to meet most nutrient needs with lower intakes of eggs, nuts, and legumes, and come close to an isocaloric food pattern. Also, iron, a limiting nutrient, is provided in high amounts by legumes. (See # 4 below for a discussion of absorbed iron intakes.)

2. Through these iterations, a vegetarian ENL group was developed that, with very limited exceptions, met all vitamin/mineral/macronutrient requirements at all 12 calorie levels. Table G2-2 illustrates the resulting percentage composition and amounts in the ENL group. Note that no attempt was made to base the proportions of eggs, nuts, and legumes on actual intakes.

   The percentages and amounts below represent the amounts of eggs, nuts, and legumes substituted for the MPFEN pattern. Since amounts of each were decreased to maintain isocaloric food patterns, the total percentages (seen in Table G2-2) do not total to 100 percent, and the amounts in the 5-oz. eq. daily food pattern do not total to 5 ounces. This was done so that the percentages and ounce equivalents in this table could be directly compared with Table G2-1.

Table G2-2. Vegetarian ENL Group and Amounts Recommended

Subgroups in the Vegetarian ENL Group	Percent of Each Subgroup in ENL Group*	Amount in a Daily Food Pattern With 5-oz. Eq. From Group
Meats	0%	0
Poultry	0%	0
Fish	0%	0
Eggs	7.8%	0.39 eggs
Nuts and seeds	16.0%	0.80 oz.eq. *
Legumes	23.0%	1.15 oz. eq.†

*Equal to approximately 1.2 ounces of nuts or 1.6 tbsp. of peanut butter.
†Equals about 0.58 cups of cooked legumes. Total legumes, including amounts recommended in the vegetable group, are about 1 cup.

The proposed vegetarian ENL group differs somewhat from the original MPFEN group in nutrient content. Table G2-3 summarizes the differences in the ENL group from the original MPFEN group in absolute terms, based on an assumed intake level of 5-oz eq. per day. Actual nutrient levels in the original MPFEN group and in the ENL group are found in Addendum A.

Table G2-3. Vegetarian ENL Nutrient Profile (Absolute Changes From the Original MPFEN Nutrient Profile Based on 5-oz. Eq. Daily Intake Level)

Vitamins	Change From MPFEN Profile	Minerals	Change From MPFEN Profile	Energy and Macro-Nutrients	Change From MPFEN Profile
Vitamin A	–55 µg RAE	Calcium	+66 mg	Calories	+36 kcal
Vitamin E	+2.18 mg AT	Phosphorus	–27 mg	Protein	–20 g
Vitamin C	+0.5 mg	Magnesium	+59 mg	Carbohydrate	+25 g
Thiamin	–0.11mg	Iron	+0.71 mg*	Fiber	+8.2 g
Riboflavin	–0.19 mg	Zinc	–2.48 mg	Linoleic acid	+3.19 g
Niacin	–5.36 mg	Copper	+0.33 mg	α-linolenic acid	+0.06 g
Vit. B6	–0.36 mg	Sodium	–441 mg	Cholesterol	–8 g
Folate	+139 µg	Potassium	+83 mg	Total fat	+4.17 g
Vit. B12	–2.59 µg			Sat. fat	–0.87 g
				Mono. fat	+2.22 g
				Poly. fat	+3.05 g

*Does not account for differences in absorption (see # 4).

As illustrated in Table G2-3, there was a 36-calorie-per-day increase in the energy content of the vegetarian ENL group, compared with the original MPFEN group, in food patterns, including 5-oz. eq. from the group per day. This was due to the amounts of nuts and legumes, which have higher calorie-to-protein ratios than animal-based protein sources. (Addendum A provides a comparison of all nutrients in per oz. eq. of these foods.) To maintain isocaloric patterns, vegetarian food patterns could be modified by slightly adjusting the amounts of added sugars, solid fats, and oils. This modification was not completed since the difference was small (from about 14 calories in the 1,000 calorie pattern to about 50 calories in the 3,200 calorie pattern).

Differences in the amounts of protein, niacin, zinc, and vitamin B12 that could have an impact on nutrient adequacy were also noted. Adequacy of these nutrients was evaluated in all patterns, as reported below.

3. The lacto-ovo vegetarian pattern that was developed in this scenario, with limited exceptions, met vitamin/mineral/macronutrient requirements at all 12 calorie levels for all age/sex groups. Table G2-4 shows amounts of the nutrients of concern that were identified above in selected intake food patterns. It also includes other nutrients that have been of concern, vitamin E and potassium. Iron is reported separately in Table G2-5. The intake patterns in the table are those with lowest nutrient intake levels.

Table G2-4. Nutrients of Concern in ENL Food Intake Patterns

Nutrient	Food Pattern	Age-Sex Group (sedentary)	MPFEN Patterns—Amount in Pattern as % of Nutritional Goal	ENL Vegetarian Patterns—Amounts in Pattern as % of Nutritional Goal
Protein	1800 (2m)	F 31-50	180%	137%
	2000 (3m)	M 51-70	171%	132%
	2200 (2m)	M 31-50	170%	127%
Niacin	1600 (3m)	F 51-70	140%	101%
	1800 (2m)	F 31-50	152%	113%
	1800 (3m)	F 14-18	153%	114%
	2200 (3m)	M 14-18	162%	105%
Zinc	2000 (3m)	M 51+	128%	105%
	2200 (2m)	M 31-50	131%	105%
Vitamin B_{12}	1800 (2m)	F 31-50	265%	157%
	2000 (2m)	F 19-30	277%	158%
	2200 (2m)	M 31-50	295%	166%
Vitamin E	1600 (3m)	F 51-70	49%	64%
	1800 (2m)	F 31-50	55%	70%
	1800 (3m)	F 14-18	55%	70%
Potassium*	1000 (2m)	M/F 2-3	68%	70%
	1200 (2m)	F 4-8	66%	68%
	1400 (2m)	M 4-8	77%	79%
	1800 (2m)	F 31-50	83%	85%
	2000 (2m)	F 19-30	85%	87%

*Based on energy-adjusted standards for potassium.

In addition to iron, the other nutrient that became limiting as amounts of eggs, nuts, and legumes were adjusted was niacin. Poultry and fish are especially rich in niacin, and nuts are also a rich source but at a higher calorie "cost". Amounts in all patterns decreased substantially, with amounts in the 1,600-calorie pattern just above the RDA in the final iteration.

Amounts of vitamin B_{12} also dropped dramatically, but all levels remained above the RDA. For vitamin E, the higher levels found in nuts made a substantial increase in the amounts in each pattern. Patterns at or above 2,800 calories met the RDA for vitamin E.

Other interesting changes in the patterns included the following:

- Vitamin A levels fell about 10 percent (for example, from 170 to 160 percent of the RDA), but remained adequate.
- Calcium levels rose slightly (about 5 percent of the AI), but the bioavailability of this calcium may be lower.
- Magnesium levels rose by 15 to 20 percent of the RDA.
- Sodium levels fell substantially. (Note that all legumes in the patterns are without added salt, while some luncheon meats that are higher in sodium are included in the MPFEN patterns.)
- Fiber levels rose by about 33 percent of the AI.

- Cholesterol levels fell substantially.
- Carbohydrates (as a percentage of calories) rose from the previous 55 to 59 percent to 59 to 63 percent of calories, and total fat rose slightly from the previous 27 to 29 percent to 28 to 30 percent of calories. Protein (as a percent of calories) decreased from 15 to 19 percent to 11 to 15 percent.
- Saturated fat (as a percent of calories) fell slightly from 6.9 to 7.7 percent to 6.4 to 7.2 percent (excluding 1,000-calorie pattern)

4. Amounts of iron in the patterns proved to be the most limiting, especially when differences in percent absorption were considered. The DRI report on iron includes a formula for calculating iron absorbed from a mixed diet, assuming 10 percent of overall iron is from heme sources. Heme iron absorption is assumed at 25 percent, and non-heme iron at 16.8 percent. The overall absorption from a mixed diet is then calculated to be 17.6 percent. Table G2-5 shows the levels of iron in the vegetarian patterns up to 2,400 calories and the amount of absorbed iron expected in each pattern based on these assumed rates of absorption.

Table G2-5. Iron in Vegetarian Patterns at Each Calorie Level in Comparison to Absorbed Iron Requirements for Appropriate Age/Sex Group

Calorie Level (cups of milk in pattern)	Age/Sex Group	Iron RDA	Absorbed Iron Requirement*	Iron in Food Pattern	Absorbed Iron in Pattern†	Percent of Requirement Met by Pattern
		(mg)	(mg)	(mg)	(mg)	(%)
1000 (2 milk)	M/F 1-3	7	1.23	8.0	1.34	109
1200 (2 milk)	F 4-8	10	1.76	11.0	1.85	105
1400 (2 milk)	M 4-8	10	1.76	13.1	2.20	125
1600 (3 milk)	F 9-13, 51-70	8	1.41	15.2	2.55	181
1800 (2 milk)	F 31-50	18	3.17	17.4	2.92	**92**
1800 (3 milk)	F 14-18	15	2.64	17.4	2.92	111
2000 (2 milk)	F 19-30	18	3.17	17.9	3.01	**95**
2000 (3 milk)	M 9-13, 51-70	8	1.41	18.0	3.02	215
2200 (2 milk)	M 31-50	8	1.41	20.2	3.39	241
2200 (3 milk)	M 14-18	11	1.94	20.3	3.41	176
2400 (2 milk)	M 19-30	8	1.41	22.0	3.70	262

* Calculated from DRI formula for mixed diet, factor = 0.176.
†Calculated from % non-heme absorption, factor = 0.168.

5. Analysis of the vegetarian ENL food pattern demonstrated that lysine, which is considered the most limiting essential amino acid in vegetarian diets, met or exceeded the RDAs for all age/sex groups. These levels were met by considering the protein available in both animal (eggs and milk) and plant (nuts, legumes, grains) products in the proposed ENL pattern. Based on our lysine analysis, it is unlikely that any of the other eight essential amino acids would be limiting, below their RDA, or of concern to those following the ENL food pattern.

6. The final ENL amounts were translated into daily/weekly intake recommendations at three intake levels, as shown in Table G2-6. For legumes, the amounts recommended as part of the vegetable group were added to the amount that is part of the ENL group to show total suggested intake levels per day and per week, in cups. For eggs, the suggested intake levels are shown as eggs per day and per week. For nuts, intakes are shown as ounces of nuts or tablespoons of peanut butter per day and per week.

Table G2-6. Daily and Weekly Intake Recommendations for ENL Intake Patterns

Food/Intake Pattern	Calculated Oz. Eq./Day	Suggested Intake/Day	Suggested Intake/Week
Eggs			
1800 kcal	0.74	~¾ eggs	~5 eggs
2200 kcal	0.89	~1	~6
2800 kcal	1.04	~1	~7
Nuts			
1800 kcal	0.80	~1 ¼ ounces nuts OR ~1 ½ T. peanut butter	~8 ounces nuts OR ~11 T. peanut butter
2200 kcal	0.96	~1 ½ ounces nuts OR ~2 T. peanut butter	~10 ounces nuts OR ~13 T. peanut butter
2800 kcal	1.12	~1 ¾ ounces nuts OR ~2 ¼ T. peanut butter	~12 ounces nuts OR ~16 T. peanut butter
Legumes			
1800 kcal			
--from ENL grp.	1.15		
--from vegetable	0.86		
--total	2.01	~1 cup	~7 cups
2200 kcal			
--from ENL grp.	1.38		
--from vegetable	0.86		
--total	2.44	~1 1/8 cup	~8 cups
2800 kcal			
--from ENL grp.	1.61		
--from vegetable	1.00		
--total	2.61	~1 1/3 cup	~9 cups

Discussion

The nutrient profile for legumes includes tofu, though in relatively small amounts. If vegetarians select more tofu and other soy-based meat analogs as part of their legume choices, the fiber content of the diet could be slightly lower, and other nutrients could be altered as well.

ADDENDUM A: NUTRIENT PROFILES OF THE MPFEN AND ENL GROUPS AND THEIR COMPONENT FOODS

Nutrient	MPFEN 1 oz. eq.	ENL 1 oz. eq.	Meat 1 oz.	Poultry 1 oz.	Fish 1 oz.	Eggs 1 large egg	Nuts 1 oz eq.	Legumes 1 oz eq.
VITAMINS								
VIT. A (µg RAE)	17.64	6.62	16.64	4.21	8.61	84.5	0.149	0.03
VIT. E (mg AT)	0.21	0.65	0.07	0.08	0.14	0.53	2.98	0.58
VIT. C (mg)	0.03	0.12	0.01	0.00	0.21	0.00	0.12	0.45
THIAMIN (mg)	0.07	0.04	0.09	0.02	0.05	0.03	0.10	0.11
RIBOFL. (mg)	0.08	0.04	0.07	0.05	0.05	0.26	0.05	0.05
NIACIN (mg)	1.75	0.68	1.47	2.52	2.15	0.03	3.76	0.33
VIT. B6 (mg)	0.12	0.04	0.11	0.13	0.13	0.06	0.12	0.08
FOLATE (µg)	5.12	33.04	2.47	1.72	3.57	22.00	36.39	110.87
VIT. B12 (µg)	0.56	0.04	0.78	0.09	0.72	0.56	0.00	0.00
MINERALS								
CALCIUM (mg)	6.16	19.32	2.89	4.46	5.74	25.00	28.43	55.76
PHOSPH. (mg)	65.74	60.35	62.09	55.65	55.92	86.00	170.14	114.86
MAGNESIUM (mg)	8.84	20.74	6.46	7.11	9.12	5.00	65.28	43.08
IRON (mg)	0.57	0.71	0.65	0.35	0.49	0.60	0.90	2.25
ZINC (mg)	1.05	0.56	1.38	0.62	0.30	0.53	1.80	0.99
COPPER (mg)	0.06	0.12	0.05	0.02	0.05	0.01	0.43	0.23
SODIUM (mg)	106.97	18.82	160.12	24.05	49.98	62.00	78.46	6.22
POTASSIUM (mg)	97.19	113.78	105.36	70.02	102.19	63.00	219.27	320.79
ENERGY AND MACRONUTRIENTS								
CALORIES (kcals)	58	66	51	53	39	78	210	113
PROTEIN (g)	7.56	3.62	7.56	8.21	6.57	6.29	8.09	7.99
CARBOHYDRATE (g)	0.47	5.45	0.32	0.00	0.00	0.56	6.81	18.78
FIBER (g)	0.09	1.74	0.00	0.00	0.00	0.00	2.56	5.79
Linoleic Acid (g)	0.40	1.04	0.091	0.38	0.06	0.59	5.66	0.37
α -linolenic Acid (g)	0.03	0.04	0.03	0.02	0.04	0.02	0.07	0.11
CHOLESTEROL (mg)	36	17	20	25	27	212	0	0
TOTAL FAT (g)	2.77	3.60	1.95	2.05	1.22	5.31	18.44	1.04
SAT. FAT (g)	0.82	0.65	0.76	0.57	0.23	1.63	3.01	0.16
MONO. FAT (g)	1.16	1.61	0.85	0.72	0.44	2.04	8.78	0.19
POLY. FAT (g)	0.47	1.04	0.11	0.47	0.42	0.71	5.73	0.49

ADDENDUM B: PROTEIN IN VEGETARIAN DIETS

Several points regarding protein and amino acids in vegetarian diets follow:

- It is the position of the American Dietetic Association (ADA) and Dietitians of Canada that appropriately planned vegetarian diets are healthful, nutritionally adequate, and provide health benefits in the prevention and treatment of certain diseases (ADA and Dietitians of Canada, 2002).
- Well-planned vegetarian and vegan diets are appropriate for all stages of the life cycle, including during pregnancy, lactation, infancy, childhood, and adolescence (1).
- Available evidence does not support recommending a separate protein requirement for vegetarians who consume complimentary mixtures of plant proteins (IOM, 2002).

PROTEIN

- Plant protein can meet requirements when a variety of plant foods are consumed and energy needs are met (ADA and Dietitians of Canada, 2002).
- Vegetarian diets that include complimentary mixtures of plant proteins can provide the same quality of protein as animal proteins (IOM, 2002).
- Typical protein intakes of lacto-ovo-vegetarians and of vegans appear to meet and exceed protein requirements. Athletes can also meet their protein needs on plant-based diets (ADA and Dietitians of Canada, 2002).
- Plant proteins are generally less digestible than animal proteins; however, digestibility can be altered through processing and preparation. Therefore, consuming a varied diet ensures an adequate intake of protein for vegetarians (IOM, 2002).

ESSENTIAL AMINO ACIDS

- There are nine essential amino acids: histidine, isoleucine, leucine, lysine, methionine (and/or cysteine), phenylalanine (and/or tyrosine), threonine, tryptophan, and valine.
- If a single essential amino acid in the diet is less than the individual's requirement, then it will limit the utilization of other amino acids and thus prevent normal rates of protein synthesis. Thus, the "limiting amino acid" will determine the nutritional value of the protein in the diet. In general, this is the most important factor that influences the nutritional value of a protein source (IOM, 2002).
- Protein from vegetarian-consumed animal products—such as eggs, milk, cheese, and yogurt—are "complete proteins" because they provide all nine essential amino acids (IOM, 2002).
- Protein from most plants, legumes, grains, nuts, seeds, and vegetables tend to be deficient in one or more essential amino acid and are called "incomplete proteins." Exceptions include soybeans, quinoa, and spinach. They are considered high quality proteins because they contain adequate amounts of the essential amino acids (IOM, 2002; Vegetarian Resource Group, 2004).
- Wheat/cereals tend to be low in lysine, an essential amino acid. Increased consumption of beans and soy products in place of other protein sources that are lower in lysine—or an increase in dietary protein from all sources—can ensure an adequate intake of lysine (ADA and Dietitians of Canada, 2002).
- While lysine is likely to be the most limiting of the essential amino acids in diets based predominantly on cereal proteins, the risk of lysine inadequacy is essentially removed by inclusion of relatively modest amounts of animal or other vegetable proteins, such as

those from legumes and oilseeds or through lysine fortification of cereal flour (IOM, 2002).

COMPLEMENTARY PROTEINS

- Previously, it was thought that vegetarians had to consume all essential amino acids at the same meal—from a mixture of foods that together contained all nine—in order to consume the necessary "complete" protein. Research indicates that an assortment of plant foods eaten during 1 day can provide all essential amino acids and ensure adequate nitrogen retention and use in healthy adults; thus, complementary proteins do not need to be consumed at the same meal (ADA and Dietitians of Canada).

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ALTERNATIVES FOR ENRICHED GRAINS IN FOOD INTAKE PATTERNS
December 13, 2003

REQUEST FROM THE NUTRIENT ADEQUACY SUBCOMMITTEE

Is it possible to offer more flexibility in the macronutrient composition of diets by not specifying the amount of enriched grains currently proposed in the Food Guide Pyramid food patterns?

RATIONALE FOR REQUEST

Since many of the nutrients enriched grains supply are easily met in the FGP patterns (thiamin, riboflavin, etc.), why not make them optional, like discretionary fat and added sugars, allowing people flexibility in the composition of their diet by replacing the calories from enriched grains with another food group or healthy oils, for example, in a lower carbohydrate diet?

CONTEXT FOR EXAMINING POSSIBLE CHANGES IN THE FOOD PATTERNS

1. **Total vs. Foundation Diet Approach:** The Food Guide Pyramid is a total diet system, which means that all calories must be accounted for in some way. This differs fundamentally from a foundation diet, which ensures nutrient adequacy, but allows free choice of any additional calories to meet energy needs. The free choice of some calories in a foundation diet approach is not compatible with moderation goals, such as limiting saturated fat intake. The total diet approach is used because some of the nutritional goals for the Pyramid specify ranges or maximum amounts rather than minimums. Also, specific calorie levels have been identified for various age/sex/activity level groups of people.

   Within a total diet system, flexibility of choice for the consumer is given where possible through choices within specific food categories. These food categories have similarities in their content of key nutrients, including their macronutrient composition. For example, the proposed food patterns for the Pyramid allow flexibility of choice within each food group or subgroup, and within the categories of additional solid fats, additional oils, and added sugars. Choices made within these categories maintain the overall nutritional profile of the diet.

2. **Defining "Optimal" Dietary Choices:** *The Pyramid does not set nutritional policy—it is an educational tool designed to help Americans implement current policy on what constitutes an "optimal" diet.* Operationally, an "optimal" diet is defined as meeting the current *Dietary Guidelines* and *Dietary Reference Intakes*. Quantified nutritional goals for the Pyramid's food patterns are set based on these standards. In addition, educational messages are developed to provide additional guidance where qualitative but not quantified goals are available.

3. **Selection of One Set of "Optimal" Choices:** There are an immense number of food patterns that could meet current nutritional adequacy and moderation goals. How can one set of food choices be selected over another? The premise used in determining food patterns for the Pyramid has been to start with what is actually consumed by Americans and adjust the amounts of various food categories (which include both "food groups" and "subgroups") into healthful proportions. Alterations are made in the amounts recommended from each category until nutrient goals (for adequacy and moderation) are met. Major shifts from actual consumption patterns may occur, *but only if they are needed to meet the stated goals*. This approach differs from some other food guidance approaches that use different criteria to identify other "optimal" dietary patterns.

Results of the Existing Process—How Do the Proposed Food Patterns Compare to Reported Food Consumption of Americans, Especially in Enriched Grain Intake?

For some food categories, the amounts recommended are more than current consumption, whereas for others the amounts recommended are less than consumption. Table G2-7 presents the amounts from each food group and subgroup *recommended* in the proposed food patterns; Table G2-8 presents the amounts *actually consumed* for each food group and subgroup as reported in the CSFII 1994–1996; and Table G2-9 presents a *comparison* of the recommended amounts to the amounts that individuals in various age/sex groups report eating, as a percentage of reported consumption.

These tables show that the proposed Pyramid food patterns (from the Federal Register notice of September 11, 2003) include substantial increases over reported consumption for legumes, dark green leafy vegetables, deep yellow vegetables, and whole grains. Conversely, recommended amounts of enriched grains, starchy vegetables, added fats, and added sugars are reduced substantially from reported consumption.

For example, Table G2-9 shows the following findings for adult women 31 to 50:

- The recommended intake of whole grains is 437 percent of reported consumption.
- The recommended intake of dark green vegetables is 431 percent of reported consumption.
- The recommended intake of enriched grains is 72 percent of reported consumption.
- The recommended intake of starchy vegetables is 68 percent of reported consumption.

Note that the percent change from reported to recommended intakes for the *overall* vegetable and grain groups are not large. However, shifts in recommended intakes *within* these groups result in substantial changes in each of the subgroups. In the grains group, these shifts from "enriched grains" to "whole grains" recommend a twofold to fivefold increase (across age/gender groups) in whole grain consumption and a decrease in enriched grains consumption to about ½ to ¾ of reported consumption. Changes of similar or greater magnitude also result among vegetable subgroups.

RESULTS OF PRELIMINARY ANALYSIS TO FURTHER DECREASE AMOUNTS OF ENRICHED GRAINS IN THE FOOD PATTERNS

1. **Nutrients Supplied by the Enriched Grain Subgroup:** Enriched grain products contribute important amounts of certain nutrients to the Pyramid food patterns. For example, in the 1,800-calorie food pattern (with two milk servings), the contribution of "enriched grains" to overall intake is

Folate	25 percent
Iron	24 percent
Calcium	9 percent
Magnesium	8 percent
Copper	12 percent
Dietary Fiber	10 percent

Enriched grains also supply 27 percent of the thiamin, 16 percent of the riboflavin, and 20 percent of the niacin in the food pattern, although these nutrients are provided in the overall pattern at levels well above requirements. Enriched grains also supply 17 percent of the calories and 22 percent of the carbohydrate in this food pattern.

2. **Shortfalls If Enriched Grains (But Not Whole Grains) Are Omitted From the Food Patterns:** Some of the nutrients mentioned above are supplied in amounts well above the nutrient's goal level. However, there are some nutrient shortfalls if enriched grains are not included in the patterns (while keeping the whole grains recommendations as proposed).

   The food subgroups that would provide the most similar mix of nutrients to make up these shortfalls are additional whole grains, legumes, and dark green vegetables. For these groups, recommendations in the food patterns are already much higher than reported consumption (see attached Table G2-9). Further increases in the recommendations for these food subgroups would move the food patterns even farther away from what Americans now eat. Potential substitution of these foods for enriched grains in the patterns is discussed further in item 3 below.

   The specific shortfalls due to removal of enriched grains from the patterns (keeping whole grains), without replacement from other food groups, are listed below. Resulting amounts that are <95 percent of the nutritional goal are included.

Nutrient	Food Pattern	Age-Sex Group (sedentary)	Existing Proposed Patterns—Amount in Pattern as % of Nutritional Goal	Without Enriched Grains—Amount in Pattern as % of Nutritional Goal
Folate	1600 (3m)	F 51+	103%	79%
	1800 (2m)	F31-50	117%	89%
	1800 (3m)	F14-18	120%	92%
Calcium	1600 (3m)	F 9-13	93%	87%
	1800 (2m)	F31-50	97%	88%
	1800 (3m)	M 9-13, F 14-18	98%	91%
	2000 (2m)	F19-30	101%	91%
	2200 (2m)	M 31-50	104%	92%
	2200 (3m)	M14-18	103%	94%
Magnesium	2000 (3m)	M 51+	97%	90%
	2200 (2m)	M31-50	95%	87%
Iron	1000 (2m)	M/F 2-3	103%	78%
	1200 (2m)	F 4-8	100%	76%
	1400 (2m)	M 4-8	121%	91%
	1800 (2m)	F31-50	97%	74%
	1800 (3m)	F 14-18	117%	90%
	2000 (2m)	F19-30	108%	82%
Fiber	1000 (2m)	M/F 2-3	88%	81%
	1200 (2m)	F 4-8	100%	91%
	1400 (2m)	M 4-8	100%	91%
	2200 (2m)	M31-50	102%	93%
	2200 (3m)	M 14-18	102%	93%

3. **Options for Modifying Patterns To Make Up for Shortfalls If Enriched Grains Are Omitted**:

   a. *Increase amounts of added sugars and fats.* This recommendation would make up for the loss of calories but not make up for any of the shortfall nutrients, with the exception of vitamin E. Increased oils in the patterns would increase the amount of vitamin E in diets, but even if all of the approximately 300 calories from enriched grains were substituted with an additional 35 grams of oil, the vitamin E in the 1,800-calorie pattern, for example, would be only 80 percent of the RDA. (Note that this change brings fat calories to 45 percent of total calories.)

   b. *Increase amounts of dark green vegetables and/or legumes in the patterns.* Dark green vegetables provide more folate, calcium, magnesium, and fiber per serving than enriched grains. However, they provide slightly less iron per serving (1.04 vs. 1.17 mg per serving). Legumes provide more of all the shortfall nutrients per serving but also have more calories per serving (107 vs. 83). A daily recommendation of more than 1 cup *each* of legumes and dark green vegetables would be needed in the 1,800-calorie pattern to make up for the shortfalls if no enriched grains were included in the food patterns.

   c. *Increase amounts of whole grains in the patterns.* The nutrient profiles of the whole grain and enriched grain subgroups are very similar for many of the nutrients of interest. For example, a serving of whole grain provides 84 percent of the folate in enriched grains, 96 percent of the calcium, 139 percent of the iron, and 94 percent of the calories in enriched grains. The amounts of magnesium (380 percent) and fiber (323 percent) are greater in whole grains than enriched. The nutritional integrity of the food patterns would be maintained if all whole grains were substituted for the enriched grains in the proposed patterns. Some practical concerns arise, however, if this approach is taken. For example, many of the grain products that Americans now select are a mix of whole and enriched grains. This issue is elaborated on below.

4. **Separation of Whole Grains From Enriched Grains Within Foods:** The process of assigning food group and subgroup servings to individual foods "decomposes" mixed foods into their various parts. This approach helps to accurately assign servings from each food group and subgroup to the many mixed dishes that are eaten. Food items that contain grains are assigned to *either or both* the whole grain and enriched grain subgroups. This means that the many grain products made of both whole and enriched grains—including many breads and ready-to-eat cereals—are calculated as part whole and part enriched grain.

   In practice, when a person selects a mixed grain bread or cereal, he gets *both* a whole grain portion and an enriched grain portion. Because of the desirable baking properties of enriched flour, these mixed grain products are often appealing to consumers who do not choose to eat 100 percent whole grains. For example, the most commonly eaten foods containing "whole grains" and the whole grains and enriched grains servings contained in 100 grams of the food are listed below. These food items make up about 70 percent of all the whole grains consumed by Americans according to the CSFII 1994–1996 food consumption survey.

Food (in order of the number of individuals reporting it in the CSFII 1994–1996 survey)	Approx. Whole Grain Servings per 100 g*	Approx. Enriched Grain Servings per 100 g*
100% whole wheat bread	3.4	0.1
Tortilla chips and corn chips	4.8	0.0
Popcorn	4.0	0.0
Pancakes	0.3	2.2
Oatmeal	0.8	0.0
Wheat bread/cracked wheat bread	1.3	2.7
Whole wheat bread (not 100%)	1.2	2.6
Multigrain/mixed grain breads	2.2	1.6
Rye and pumpernickel breads	1.4	2.4
Cheerios	3.3	0.1
Oatmeal cookies	0.9	0.3
Raisin bran cereal	1.8	0.8
Graham crackers	0.9	3.5
Granola bars	2.9	0.0
Bagels—not 100% whole wheat	0.9	2.6
Wheat crackers	2.5	2.6
Wheat/cracked wheat rolls	1.2	2.3

*Note: Whole and enriched grain servings per 100 grams are from the ARS Pyramid Servings Database that was developed for and is used in analysis of national food consumption surveys.

These sample choices demonstrate the types of foods that consumers most often select that include at least some whole grains. While many are not entirely whole grains, they provide some whole grains in the diets of those who might not otherwise select any. The proposed Pyramid food patterns suggest that half of all grain servings be whole grains. This approach allows these mixed products to fit readily into a person's food choices.

Recommendation

Pyramid food patterns are designed to meet nutritional goals with the minimum necessary change from typical American food choices. All nutritional goals (with the exception of vitamin E) can be met with the amounts of enriched grains in the proposed patterns, which are approximately 40 to 75 percent of average enriched grain consumption. Replacement of the enriched grains in the food patterns with whole grains does not compromise the nutritional integrity of the patterns. However, it does violate the premise that changes from typical consumption patterns will be made only if needed to meet nutritional goals and makes the Pyramid less practical for many to follow, given the popularity of many mixed grain food products.

Some consumers, though, may not want to consume as many enriched grains as are included in the food patterns. We want to provide flexibility of choice where possible. A sensible approach to increase choice within grains might be to state that "at least half of the total amount of grains selected should be whole grains." This statement would allow consumers to select only whole grains if they wished and still follow the Pyramid food patterns. In educational materials, examples of food products that are whole grains, mixed whole and enriched grains, and enriched grains could help clarify how consumers can follow the Pyramid while selecting foods of their choice.

TABLE G2-7. Amount of Food From Each Group Recommended in Proposed USDA Food Intake Patterns
(in standard size "servings", or other units as noted)

CALORIE LEVEL & AGE GROUPS	1000 child 2-3	1200 F 4-8	1400 M 4-8	1600 F 9-13 F 51+	1800 F 31-50 M 9-13 F 14-18	2000 F 19-30 M 51+	2200 M 31-50 M 14-18	2400 M 19-30	2600 M 19-30	2800 M 14-18	3000 M 19-30	3200 M 14-18
FOOD GROUPS												
FRUITS	1.5	1.5	2	2	2	3	3	3	4	4	5	5
VEGETABLES	1	2	2	3	4	4	4	5	6	6	7	7
Dark-green	0.29	0.43	0.43	0.57	0.86	0.86	0.86	1	1	1	1.14	1.14
Deep-yellow	0.14	0.29	0.29	0.43	0.57	0.57	0.57	0.71	0.86	0.86	1	1
Legumes	0.29	0.43	0.43	0.71	0.86	0.86	0.86	1	1	1	1.14	1.14
Starchy	0.14	0.43	0.43	0.57	0.71	0.71	0.71	1	1.29	1.29	1.29	1.29
Other	0.14	0.43	0.43	0.71	1	1	1	1.29	1.86	1.86	2.43	2.43
GRAINS	3	4	5	6	7	8	9	10	10	11	11	11
Whole grains	1.5	2	2.5	3	3.5	4	4.5	5	5	5.5	5.5	5.5
Enriched grains	1.5	2	2.5	3	3.5	4	4.5	5	5	5.5	5.5	5.5
MEAT AND BEANS (in ounce eq.)	2	3	4	5	5	5.5	6	6.5	6.5	7	7	7
MILK (2 serv pattern)	2	2	2	2	2	2	2	2	2	2	2	2
(3 serv pattern)				3	3	3	3	3	3	3	3	3
DISC FATS (in g.)	28	30	30	33	36	40	44	46	50	56	66	76
Solid fats	17	12	12	13	14	16	18	19	20	22	26	30
Oils/soft marg.	11	18	18	29	22	24	26	27	30	34	40	46
ADDED SUGARS (in tsp.)	5	5	5	6	8	10	12	14	16	18	20	28
TOTAL CALORIES	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200

TABLE G2-8. Average Amounts Consumed from Each Food Group

(CSFII 94-96, mean intake for each age/sex group, in "servings" or other units as noted)

CALORIE LEVEL	1000	1200	1400	1600	1600	1800	1800	1800	2000	2000	2200	2200	2400	2600	2800	3000	3200
AGE GROUP	child 2-3	F 4-8	M 4-8	F 9-13	F 51+	F 31-50	M 9-13	F 14-18	F 19-30	M 51+	M 14-18	M 31-50	M 19-30	M 19-30	M 14-18	M 19-30	M 14-18
FRUITS	1.25	1.51	1.72	1.45	1.70	1.32	1.38	1.20	1.19	1.80	1.31	1.38	1.22	1.22	1.31	1.22	1.31
VEGETABLES	1.61	1.87	1.93	2.40	3.00	3.10	2.80	2.71	3.01	3.79	3.81	4.19	4.37	4.37	3.81	4.37	3.81
Dark-green	0.07	0.07	0.05	0.07	0.21	0.20	0.08	0.08	0.14	0.21	0.10	0.17	0.11	0.11	0.10	0.11	0.10
Deep-yellow	0.08	0.09	0.09	0.10	0.20	0.17	0.11	0.10	0.15	0.22	0.10	0.18	0.14	0.14	0.10	0.14	0.10
Legumes	0.09	0.10	0.10	0.12	0.15	0.16	0.19	0.16	0.17	0.26	0.22	0.29	0.29	0.29	0.22	0.29	0.22
Starchy	0.82	0.96	1.00	1.22	0.94	1.05	1.40	1.28	1.21	1.35	2.00	1.64	1.99	1.99	2.00	1.99	2.00
Other	0.55	0.65	0.70	0.88	1.51	1.52	1.03	1.09	1.36	1.76	1.39	1.90	1.85	1.85	1.39	1.85	1.39
GRAINS	4.50	5.40	5.99	6.33	5.02	5.57	7.56	6.17	5.97	6.62	9.44	7.94	8.70	8.70	9.44	8.70	9.44
Whole grains	0.69	0.79	0.89	0.93	0.90	0.80	1.12	0.81	0.79	1.11	1.15	1.07	1.01	1.01	1.15	1.01	1.15
Enriched grains	3.79	4.71	5.29	5.42	4.15	4.89	6.51	5.46	5.09	5.59	8.33	7.17	7.66	7.66	8.33	7.66	8.33
MEAT&BEANS (in ounce equiv.)	2.52	2.87	3.25	3.31	3.76	4.07	4.33	3.80	3.90	5.48	5.91	6.71	6.80	6.80	5.91	6.80	5.91
MILK (2 serv pattern)	1.85	1.84	2.02			1.11			1.26			1.55	1.73	1.73		1.73	
(3 serv pattern)				1.86	1.01		2.27	1.38		1.32	2.34				2.34		2.34
DISC FATS (in grams)	40	46	50	52	40	48	63	51	49	57	79	74	75	75	79	75	79
Solid fats	23	27	29	30	23	28	36	30	28	33	46	43	43	43	46	43	46
Oils/soft marg.	17	19	21	22	17	20	26	22	21	24	33	31	31	31	33	31	33
ADD. SUGARS (in tsp.)	13	18	20	23	12	16	26	24	20	16	36	24	28	28	36	28	36
TOTAL CALORIES	1406	1604	1771	1836	1465	1665	2200	1835	1754	2035	2781	2538	2683	2683	2781	2683	2781

TABLE G2-9. Recommended Intakes in Proposed USDA Food Patterns Compared to Actual Mean Consumption

(recommended as a percent of actual, by age/sex group)

CALORIE LEVEL	1000	1200	1400	1600	1600	1800	1800	1800	2000	2000	2200	2200	2400	2600	2800	3000	3200
AGE GROUPS	child 2-3	F 4-8	M 4-8	F 9-13	F 51+	F 31-50	M 9-13	F 14-18	F 19-30	M 51+	M 14-18	M 31-50	M 19-30	M 19-30	M 14-18	M 19-30	M 14-18
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
FRUITS	120	99	116	138	117	151	145	166	253	166	229	217	246	327	305	409	382
VEGETABLES	62	107	103	125	100	129	143	148	133	106	105	96	114	137	158	160	184
Dark-green	434	642	925	799	277	431	1097	1060	633	419	898	501	896	896	1045	1021	1191
Deep-yellow	174	314	326	416	213	327	541	585	388	254	547	308	520	629	826	732	960
Legumes	319	435	437	598	468	542	447	548	515	336	394	299	346	346	458	394	522
Starchy	17	45	43	47	61	68	51	55	59	53	35	43	50	65	64	65	64
Other	25	66	62	80	47	66	97	92	74	57	72	53	70	101	134	132	175
GRAINS	67	74	83	95	120	126	93	114	134	121	95	113	115	115	117	126	117
Whole grains	217	254	279	322	334	437	313	434	504	359	393	419	495	495	480	544	480
Enriched grains	40	42	47	55	72	72	54	64	79	72	54	63	65	65	66	72	66
MEAT&BEANS	79	104	123	151	133	123	115	132	141	100	102	89	96	96	118	103	118
MILK (2 serv pattern)	108	108	99			180			159			129	116	116		116	
(3 serv pattern)				162	296		132	217		228	128				128		128
DISC FATS	70	65	60	64	82	76	57	70	82	70	56	60	61	67	71	88	96
Solid fats	73	45	41	43	56	51	39	47	56	48	39	42	44	46	48	60	65
Oils/soft marg.	65	93	85	92	119	110	84	102	117	99	78	84	86	95	102	127	138
ADDED SUGARS	38	28	26	26	50	50	31	33	49	62	33	50	50	58	50	72	77
TOTAL CALORIES	71	75	79	87	109	108	82	98	114	98	79	87	89	97	101	112	115

ALTERNATIVES FOR LEGUMES IN FOOD INTAKE PATTERNS ANALYSIS
April 5, 2004

REQUEST FROM THE NUTRIENT ADEQUACY SUBCOMMITTEE

Is it possible to offer more flexibility in food patterns for those who do not want to consume legumes by identifying alternative foods that will make up for nutrient shortfalls in the proposed patterns with no legumes?

BACKGROUND

Legumes provide a broad array of vitamins, minerals, and macronutrients. The most commonly consumed legumes are pinto beans, white beans, kidney beans, tofu, black beans, lentils, chickpeas, cowpeas, split peas, and lima beans. Because of their rich mix of nutrients, the amounts of legumes recommended in the proposed food intake patterns were increased above current consumption. However, recommended intakes are still fairly small in relation to other food groups. Therefore, for any given nutrient, the percent of total intake provided by legumes is modest. Table G2-10 provides information on current consumption levels and proposed recommendations for legume intake as background for this analysis.

Table G2-10. Total Vegetable and Legume Food Intake Pattern Recommendations in Comparison to Reported Consumption

		All Vegetables		Legumes			
Food Pattern in Calories	**Age/Sex Groups**	**Recom-mendation** (# ½ cup servings)	**Reported Consumption** (# ½ cup servings)	**Recom-mendation** (# ½ cup servings)	**Reported Consumption** (# ½ cup servings)	**Recommended Increase Over Current Consumption** (# ½ cup servings)	(Percent)
1000	Child 2-3	1	1.61	0.29	0.09	0.20	319
1200	F 4-8	2	1.87	0.43	0.10	0.33	435
1400	M 4-8	2	1.93	0.43	0.10	0.33	437
1600	F 9-13	3	2.40	0.71	0.12	0.59	598
	F 51+	3	3.00	0.71	0.15	0.56	468
1800	F 31-50	4	3.10	0.86	0.16	0.70	542
	M 9-13	4	2.80	0.86	0.19	0.67	447
	F 14-18	4	2.71	0.86	0.16	0.70	548
2000	F 19-30	4	3.01	0.86	0.17	0.69	515
	M 51+	4	3.79	0.86	0.26	0.60	336
2200	M 14-18	4	3.81	0.86	0.22	0.64	394
	M 31-50	4	4.19	0.86	0.29	0.57	299
2400	M 19-30	5	4.37	1.00	0.29	0.71	346
2600	M 19-30	6	4.37	1.00	0.29	0.71	346
2800	M 14-18	6	3.81	1.00	0.22	0.78	458
3000	M 19-30	7	4.37	1.14	0.29	0.85	394
3200	M 14-18	7	3.81	1.14	0.22	0.92	522

Note that the recommended increase in legume intake is large when expressed as a percentage of current consumption but modest in actual amount. For adults, the increase ranges from about ¼ cup (0.56 servings) to less than ½ cup (0.92 servings) per day.

METHODS

1. Used proposed food intake patterns and nutrient profiles based on 1999–2000 NHANES consumption data and SR 16 nutrient data as the basis for this analysis.
2. Identified nutrients provided by legumes.
3. Removed legumes from each food pattern and analyzed the adequacy of the resulting food patterns. Identified nutrient shortfalls.
4. Determined which other food groups would best compensate for these shortfalls within goal levels for calories.
5. Increased amounts of the identified food groups in each pattern and analyzed the adequacy of the resulting food patterns.

RESULTS

1. **Nutrients Provided by Recommended Amounts of Legumes in Food Patterns:** On average, legumes provide 4.3 percent of the calories in the food intake patterns. They also provide more than 5 percent of the following nutrients in the patterns (on average): vitamin E, folate, phosphorus, magnesium, iron, zinc, copper, potassium, protein, carbohydrate, fiber, and alpha-linolenic acid. Since some of these nutrients are provided by the food patterns in amounts far exceeding the RDA or AI, the nutrient contribution of legumes was also compared to specific nutrient standards. For example, in the 1,800-calorie food pattern (with two milk servings), the contribution of legumes to the recommended intake of each nutrient is shown in Table G2-11.

Table G2-11. Amounts of Nutrients in Legumes Recommended for Adult Females in Comparison to RDA for Each Nutrient

Nutrient		Amount in 0.43 Cups* Legumes	DRI for Nutrient (female 31–50)	% of RDA or AI per 0.43 Cups of Legumes (female 31–50)
Vitamin E	mg AT	0.50	15	3%
Thiamin	mg	0.09	1.10	9%
Riboflavin	mg	0.04	1.10	4%
Vitamin B6	mg	0.07	1.30	6%
Folate	mcg	95	400	24%
Calcium	mg	48	1000	5%
Phosphorus	mg	99	700	14%
Magnesium	mg	37	320	12%
Iron	mg	2	18	11%
Zinc	mg	1	8	11%
Potassium	mg	276	4700	6%
Calories	kcal	97	1800	5%
Protein	g	7	46	15%
Carbohydrates	g	16	130	12%
Dietary fiber	g	5	25	20%
Linoleic acid	g	0.32	12	3%
ALA	g	0.10	1.10	9%

*Note: 0.43 cups per day, or 3 cups per week, is the recommended amount of legumes in the proposed 1,800-calorie food intake pattern for sedentary adult women age 31 to 50 years.

2. **Impact of Removing Legumes From Food Patterns:** Some of the nutrients provided by legumes are supplied in amounts well above the nutrient's goal level. However, there are some nutrient shortfalls if legumes are not included in the patterns. The specific shortfalls due to removal of legumes from the patterns, without replacement from other food groups, are listed in Table G2-12. Resulting amounts that are <95 percent of the nutritional goal are included.

Note: Vitamin E and potassium are not included in the table. Vitamin E levels are below the RDA for all patterns; without legumes the levels of vitamin E decreased an additional 3 to 4 percent of the RDA. Potassium levels in almost all patterns are also below the AI; without legumes, the levels of potassium in all patterns decreased an additional 5 to 6 percent of the AI.

Table G2-12. Nutrient Shortfalls Without Legumes in Food Patterns

Nutrient	Food Pattern	Age-Sex Group (sedentary)	Existing Proposed Patterns—Amount in Pattern as % of Nutritional Goal	Without Legumes —Amount in Pattern as % of Nutritional Goal
Calcium	1600 (3m)	F 9-13	96%	93%
	1800 (2m)	F 31-50	101%	96%
	1800 (3m)	M 9-13, F 14-18	101%	97%
Magnesium	1600 (3m)	F 51+	100%	91%
	1800 (2m)	F 31-50	104%	92%
	1800 (3m)	F 14-18	100%	89%
	2000 (3m)	M 51+	94%	85%
	2200 (2m)	M 31-50	93%	87%
	2200 (3m)	M 14-18	101%	92%
	2400 (2m)	M 19-30	107%	97%
Iron	1000 (2m)	M/F 2-3	101%	92%
	1200 (2m)	F 4-8	98%	88%
	1800 (2m)	F31-50	96%	85%
	2000 (2m)	F19-30	107%	96%
Fiber	1000 (2m)	M/F 2-3	86%	74%
	1200 (2m)	F 4-8	97%	82%
	1400 (2m)	M 4-8	97%	84%
	1600 (3m)	F 9-13, F 51+	106%	88%
	1800 (2m)	F31-50	111%	92%
	1800 (3m)	F 14-18	111%	92%
	2000 (2m)	F19-30	112%	95%
	2000 (3m)	M 51+	112%	95%
	2200 (2m)	M31-50	109%	92%
	2200 (3m)	M 14-18	109%	92%
	2400 (2m)	M 19-30	112%	95%
	2600 (2m)	M 19-30	112%	97%
	2800 (3m)	M 14-18	110%	95%
	3000 (2m)	M 19-30	111%	96%
	3200 (3m)	M 14-18	105%	91%

The most widespread impact was on fiber, with decreases to less than the AI for almost all food intake patterns. Magnesium also decreases to less than the RDA for teens and adult men and women. Iron was less than the RDA for all premenopausal women and young children.

3. Options for Modifying Patterns To Make Up for Shortfalls If Legumes Are Omitted: The nutrients of concern with no legumes in the patterns are dietary fiber, magnesium, iron, calcium, vitamin E, and potassium. Other food groups and subgroups that provide substantial amounts of these nutrients and nutrient content in an amount approximating the calories in ½ cup of legumes were identified. In addition to the nutrients of concern, folate is included in Table G2-13 because legumes provide such a high percentage of the overall folate in the food patterns.

Dark green vegetables, whole grains, and other vegetables appear to provide the closest match with the nutrients provided by legumes. Orange vegetables do not provide sufficient iron or magnesium; starchy vegetables do not provide sufficient fiber or magnesium; and fruits do not provide enough fiber, iron, or magnesium. Whole grains provide sufficient fiber and other nutrients but at a slightly higher calorie level. Therefore, the amount of enriched grains was adjusted downward to compensate.

Table G2-13. Comparison of Nutrients in Other Foods to Amounts in Legumes

Food Group	Amount	Calories	Fiber	Magnes.	Iron	Calcium	Folate	Vit. E	Potass.
Legumes	**½ up**	**113**	**5.79**	**43.08**	**2.25**	**55.76**	**111**	**0.58**	**321**
Dk green veg.	1 ½ cups	60	6.17	74.29	2.88	150.38	244	3.02	687
Orange veg.	1 ½ cups	96	6.47	28.03	0.81	68.41	31	1.82	641
Starchy veg.	3/4 cup	110	2.55	28.06	0.59	11.31	20	0.03	430
Other veg.	3 cups	104	6.24	59.54	3.29	128.53	104	2.22	979
Whole grains	2 oz.	155	4.49	53.77	3.17	57.94	74	0.19	157
(minus 0.5 oz. enriched grains)		-42	-0.36	-3.56	-0.62	-15.34	-18	-0.03	-14
Fruits	1 cup	139	2.67	29.11	0.59	25.41	57	0.43	506

The results of the food pattern analysis with the following substitutions for legumes follow:

Increased amounts of whole grains and decreased amounts of enriched grains. For each ½ cup of legumes in a food pattern, whole grains were increased by 2 ounces and enriched grains decreased by 0.5 ounces. Overall, recommended amounts of grains increased by about ½ to 1½ ounces. Shortfalls of magnesium, iron, and calcium were totally replaced. Shortfalls of fiber were almost completely eliminated, with the exception of young children, whose intake levels were slightly below those in the original patterns (83 percent for age 2 to 3 years and 93 percent for age 4 to 8 years). Amounts of potassium in all food patterns decreased by 3 to 4 percent of the RDA and of vitamin E by 2 to 3 percent of the RDA from amounts in the original proposed patterns. Resulting food intake patterns would recommend about fourfold to sixfold increases in the amounts of whole grains over what is now consumed.

Increased amounts of dark green vegetables. For each ½ cup of legumes in a food pattern, dark green vegetables were increased by 1½ cups. Daily amounts of all vegetables recommended increased by ¼ to 1 cup, and amounts of dark green vegetables recommended increased by about ¼ to 1½ cups per day. For example, the proposed 1,800-calorie pattern (for adult women age 31 to 50 years) recommended 2 cups of vegetables, of which ½ cup would be dark green vegetables. A revised pattern with no legumes would recommend almost 3 cups of vegetables a day, with more than 1½ cups of that as dark green vegetables. With these changes to the intake patterns, shortfalls of magnesium, iron, calcium, and dietary fiber were totally replaced. Amounts of potassium in all food patterns increased by about 6 to 7 percent of the RDA and of vitamin E by about 14 to 18 percent of the RDA. However, the resulting food intake patterns would recommend about tenfold to fortyfold increases in the amounts of dark green vegetables over what is now consumed.

Increase amounts of other vegetables (tomatoes, lettuce, green beans, cabbage, onions, etc.) in the patterns. For each ½ cup of legumes in a food pattern, the amount of other vegetables was increased by 2 cups. Daily amounts of all vegetables recommended increased by 3/4 to 2 3/4 cups, amounts of other vegetables recommended increased by about 1 to 3½ cups per day. For example, the 1,800-calorie pattern (for adult women age 31 to 50 years) originally recommended 2 cups of vegetables, of which ½ cup would be other vegetables. A revised pattern with no legumes would recommend more than 4 cups of vegetables a day, with more than 3 cups of that as other vegetables. With these changes to the intake patterns, shortfalls of magnesium, iron, calcium, and dietary fiber were totally replaced. Amounts of potassium in all food patterns increased by 10 to 14 percent of the RDA and of vitamin E by 9 to 11 percent of the RDA. The resulting food intake patterns would recommend about threefold to fivefold increases in the amounts of other vegetables over what is now consumed and a doubling to tripling of overall vegetable consumption.

CONCLUSION

The proposed food intake patterns meet all nutritional goals, with the exception of vitamin E and potassium. Flexibility in the patterns is suggested through choices made within food groups or subgroups. However, some individuals may not choose to eat any foods from a particular group. For these individuals, nutrient adequacy will not be met unless compensating changes are made in other food choices. To maintain energy balance, the alternative foods selected should not increase calorie intake.

For those who choose not to eat any legumes, several alternative approaches will meet nutrient needs. Individuals who do not consume legumes can be encouraged to increase whole grain consumption, while decreasing enriched grain consumption slightly to balance energy intake. However, vitamin E and potassium intake are slightly decreased with this approach. Alternatively, they can substantially increase their intake of other vegetables, such as tomatoes, lettuce, green beans, and cabbage. The latter approach requires intake of a large quantity of these vegetables, about 3 or more cups each day for many adults, and a total vegetable intake of 4 or more cups per day. The third option, to increase dark green vegetable consumption, does not seem realistic, as increases of tenfold to fortyfold in dark green vegetable consumption would be required.

NUTRIENT CONTRIBUTIONS OF EACH FOOD GROUP

(Updated May 24, 2004 to Include Changes To Increase Potassium in Patterns)

PURPOSE: To determine the nutrient contributions of each food group and subgroup in the proposed food intake patterns.

METHODS

1. For each nutrient, calculate the percent of total in each food pattern that is contributed by each food group and subgroup. For example, the 1,800-calorie pattern (with two milk servings) contains 106 mg of vitamin C, of which 60 mg (56 percent) comes from the fruit group, and 43 mg (41 percent) comes from the vegetable group.
2. Calculate the average percent contributions across food patterns at all calorie levels.
3. For each food group, determine the nutrient(s) for which the food group is the major contributor and other nutrients for which the group provides substantial (>10 percent of total) contributions. This part of the analysis was completed for nutrients having adequacy goals only (not for moderation goals).

RESULTS

- Each food group is the major contributor of at least one nutrient. In addition, each group provides substantial contributions for many other nutrients. Table G2-14 summarizes the nutrient contributions of each food group and subgroup.
- Subgroup contributions are shown for the vegetable and grain groups. Note that the amount recommended to eat from each vegetable subgroup in a food pattern is small in comparison to the amounts recommended from other food groups. Therefore, for many nutrients, the contributions from each vegetable subgroup are not greater than 10 percent of the total. However, the vegetable subgroups provide smaller amounts of a wide range of nutrients.
- For a few nutrients, the food group that is the major contributor of a nutrient shifts from pattern to pattern. For example, for potassium the milk group is the major contributor in most food patterns, but in the higher calorie patterns with more fruit servings, the fruit group is the major contributor of potassium.
- For a few nutrients, a single food group provides a majority of the overall amount in the food patterns. This is true for vitamin C, for which the fruit group provides about 67 percent of the total; calcium, for which the milk group provides about 67 percent; iron, for which the grains group contributes 53 percent; and linoleic and alpha-linolenic acids, for which oils and soft margarines provide about 59 percent and 53 percent, respectively. For all other nutrients, no single food group provides more than half of the total nutrient in the food patterns.
- Each food group provides a wide array of nutrients in substantial amounts.

Table G2-14. Summary of the Nutrient Contributions of Each Food Group (averaged over food patterns at all energy levels)

Food Group	Major Contribution(s)	Substantial Contribution(s) (>10% of total)
Fruit group	Vitamin C	Thiamin Vitamin B6 Folate Magnesium Copper Potassium Fiber Carbohydrates
Vegetable group	Vitamin A Vitamin B6 (tie) Potassium Copper Fiber	Vitamin E Vitamin C Thiamin Niacin Vitamin B6 Folate Calcium Potassium Phosphorus Magnesium Iron Zinc Copper Carbohydrate Protein Fiber Alpha-linolenic acid
Vegetable subgroups: –Dark green vegetables		Vitamin A Vitamin C
–Orange vegetables	Vitamin A	
–Legumes		Folate Copper Fiber
–Starchy vegetables		Vitamin B6 Copper
–Other vegetables		Vitamin C

Food Group	Major Contribution(s)	Substantial Contribution(s) (>10% of total)
Grain group	Thiamin Folate Magnesium Iron Carbohydrate	Vitamin A Riboflavin Niacin Vitamin B6 Vitamin B12 Calcium Phosphorus Copper Zinc Protein Fiber Linoleic acid Alpha-linolenic acid
Grain subgroups:		
–Whole grains	Folate (tie) Magnesium Iron Carbohydrate (tie)	Thiamin Riboflavin Niacin Vitamin B6 Vitamin B12 Phosphorus Copper Zinc Fiber
–Enriched grains	Thiamin Folate (tie) Carbohydrate (tie)	Folate Riboflavin Niacin Iron Copper
Meat, poultry, fish, eggs, and nuts group	Niacin Vitamin B6 (tie) Zinc Protein	Vitamin E Thiamin Riboflavin Vitamin B12 Phosphorus Magnesium Iron Copper Potassium Linoleic acid

Food Group	Major Contribution(s)	Substantial Contribution(s) (>10% of total)
Milk group	Riboflavin Vitamin B12 Calcium Phosphorus	Vitamin A Thiamin Vitamin B6 Magnesium Zinc Potassium Carbohydrate Protein
Oils and soft margarines	Vitamin E Linoleic acid Alpha-linolenic acid	

FRUIT AND FRUIT JUICE ANALYSIS
April 8, 2004

REQUEST FROM THE NUTRIENT ADEQUACY SUBCOMMITTEE

What is the impact of removing fruit juice from the food patterns?

METHODS

Note: All items considered "fruit juice" in this analysis are 100 percent fruit juice. Fruit drinks and "ades" are not included.

1. Used proposed food intake patterns and nutrient profiles based on 1999–2000 NHANES consumption data and SR 16 nutrient data as the basis for this analysis.
2. Separated all item groups that comprise the fruit nutrient profile into four categories and created separate nutrient profiles for each:
    a. Citrus fruit, melons, and berries
    b. Citrus juices (orange and grapefruit)
    c. Other fruits (bananas, apples, grapes, peaches, pears, etc.)
    d. Other juices (apple and grape)
3. Created a nutrient profile for fruits only, eliminating all juices (b and d).
4. Analyzed the adequacy of the resulting food patterns first with the amounts of fruits held constant, then adjusted the amounts of fruits to compensate for the amount of juices removed. Citrus, melons, and berries were increased to compensate for citrus juices, and other fruits were increased to compensate for other juices.

RESULTS

1. Fruit intakes across all ages (2 years and older), based on NHANES 1999–-2000 consumption data, were approximately
    22 percent citrus fruit, melons, and berries
    25 percent citrus juices (orange and grapefruit)
    41 percent other fruits (bananas, apples, grapes, peaches, pears, etc.)
    12 percent other juices (apple and grape)

Total fruit juice intake was about 37 percent of all fruit intake, across all ages, with the majority of the juice intake as citrus juice. While not assessed separately in this analysis, previous analysis (CSFII 1989–1991) has shown that young children's intakes of fruit and fruit juice were approximately 47 percent juice (23 percent citrus and 24 percent other) and 53 percent fruits.

2. The nutrient profile for the fruit group was altered by removing juices and substituting their portion of the composite with fruits. Nutrients that had the greatest changes are shown in Table G2-15.

Table G2-15. Changes in the Nutrient Profile of the Fruit Group With All Juices Replaced With Fruits (Selected Nutrients)
(all values per one serving from the fruit group composite)

Nutrient	Original Nutrient Profile (Fruit Plus Juice)	Modified Nutrient Profile With Fruit Replacing Juices	Percentage Change
Vitamin A (mcg RAE)	18.7	33.38	+78.2%
Vitamin C (mg)	29.76	21.88	-26.5%
Folate (mcg)	28.30	14.02	-50.5%
Thiamin (mg)	0.066	0.040	-39.6%
Magnesium (mg)	14.559	13.289	-8.7%
Potassium (mg)	252.93	210.87	-16.6%
Calories	69.75	54.77	-21.5%
Fiber (g)	1.339	1.828	+36.6%
Alpha-linolenic acid (mg)	0.015	0.022	+43.5%

3. The impacts on overall dietary patterns of removing the juices and then replacing the juices with fruit are detailed below.

- **Vitamin C:** Removing the juices without replacement resulted in substantial decreases in vitamin C in all food patterns. Since C is well above the RDA level, the decrease created shortfalls for vitamin C only for the some age/sex groups, which are shown in Table G2-16. Replacing the juice with fruit corrected all of the shortfalls.

Table G2-16. Amounts of Vitamin C in Food Patterns With Fruit Intake Modified

Age/Sex Group (food pattern)	Vitamin C in Original Food Pattern (% RDA)	Vitamin C in Pattern Without Fruit Juice (% RDA)	Vitamin C in Pattern With Fruit Replacing Juice (%RDA)
Females 51–70 (1600 calories)	123%	74%	102%
Females 31–50 (1800 calories)	141%	92%	120%
Males 51–70 (2000 calories)	151%	89%	125%
Males 31–50 (2200 calories)	151%	90%	125%

- **Potassium:** The removal of juices exacerbated the shortfalls in potassium in all patterns. Amounts in each pattern were decreased about 5 percent of the RDA, and all patterns, except 3,200 calories, decreased to less than 100 percent of the RDA. With fruit replacing juice, in comparison to fruit and juice, potassium levels were about 2 percent of

the RDA less. For example, for females age 31 to 50 years, the original 1,800-calorie food pattern contained 66 percent of the RDA for potassium. Without fruit juice, the pattern contained 61 percent of the RDA, and with fruit replacing juice, 64 percent of the RDA.

- **Magnesium:** The removal of juices resulted in shortfalls in magnesium for some age/sex groups, as shown in Table G2-17. Magnesium intake was already marginal for some adult men.

Table G2-17. Amounts of Magnesium in Food Patterns With Fruit Intake Modified

Age/Sex Group (food pattern)	Magnesium in Original Pattern (%RDA)	Magnesium in Pattern Without Fruit Juice (%RDA)	Magnesium in Pattern With Fruit Replacing Juice (%RDA)
Females 51-70 (1600 calories)	100%	97%	100%
Females 14-18 (1600 calories)	100%	96%	99%
Males 51-70 (2000 calories)	94%	90%	93%
Males 31-50 (2200 calories)	93%	88%	92%
Males 14-18 (2200 calories)	101%	97%	100%

- **Fiber:** Fiber intake was not substantially affected by removing fruit juices from the patterns, as shown in Table G2-18. Intakes were somewhat improved by replacing juices with fruits for children age 8 and younger whose fiber intakes in the original patterns were marginal.

Table G2-18. Amounts of Fiber in Food Patterns With Fruit Intake Modified

Age/Sex Group (food pattern)	Fiber in Original Pattern (%AI)	Fiber in Pattern Without Fruit Juice (%AI)	Fiber in Pattern With Fruit Replacing Juice (%AI)
Children 1-3 (1000 calories)	86%	85%	91%
Females 4-8 (1200 calories)	97%	96%	101%
Males 4-8 (1400 calories)	97%	96%	102%

CONCLUSIONS

Fruit juices provide substantial contributions of several vitamins and minerals in higher amounts than do whole fruits. These include vitamin C, folate, and potassium. However, replacement of fruit juice with fruit does not result in shortfalls, with the exception of nutrients that are already in shortfall amounts in the food intake patterns.

Some types of fruit have more potassium than others. Since potassium is low in almost all food patterns, suggestions for selecting at least some fruit or juice rich in potassium could help to increase overall intakes. Of the subcategories created for this analysis of juice and fruit intake, citrus juices have the highest level of potassium. A table of rich sources of potassium is being prepared and could be included in the report.

The current analysis assumes that intake from the fruit group is approximately 1/3 juice and 2/3 fruit when averaged across all age groups. Previous analysis suggests that young children may, in fact, consume relatively more juice and less fruit. They also may consume relatively more apple and grape juice, and less citrus juice than other age groups. For children who consume mostly juice and little fruit, shortfalls in fiber would be increased. For children age 8 and younger, replacing some juice with fruit could help meet the fiber recommendations. Recommending intake of no more than 1/3 juice and no less than 2/3 fruit would promote adequate fiber intakes.

A recommendation to select at least 2/3 fruits and no more than 1/3 juice is consistent with current overall consumption. This recommendation for total juice intake is also consistent with the recommendation from the American Academy of Pediatrics to limit fruit juice to no more than 4 to 6 ounces per day for children age 1 to 6 years and 8 to 12 ounces per day for children age 7 to 18 years.

MILK PRODUCTS—NUTRIENT CONTRIBUTIONS
April 9, 2004

REQUEST FROM THE NUTRIENT ADEQUACY SUBCOMMITTEE

What are the nutrient shortfalls in the food intake patterns if milk and milk products are not consumed?

BACKGROUND

Milk and milk products provide more than 70 percent of the calcium consumed by Americans, based on food supply data. This contribution has remained relatively constant over time, with a gradual decrease from about 75 percent in the early 1970s to about 72 percent in 2000. (Note that the percent contributions of calcium by food groups from NHANES 1999–2000 is not yet available.) Foods included in the milk group include all fluid milks, cheeses, yogurt, and other dairy products such as puddings, flavored milks, milk shakes, milk-based meal replacements, and frozen desserts. Items excluded are those that are primarily fat (butter, cream, sour cream, and cream cheese).

Because they provide so much of the overall calcium in American diets, milk products have been traditionally identified as a separate food group to highlight their importance for meeting calcium needs. This analysis identifies calcium and other nutrients for which milk products make a substantial contribution and nutrient shortfalls if milk products are not consumed. Reported intakes from the milk group, intake recommendations, and the percentage of calcium provided by this food group in the proposed food patterns are presented in Table G2-19.

Table G2-19. Milk Group Intake Recommendations in Comparison to Reported Consumption and Percentage Contribution of Milk Group to Calcium Intake

Food Pattern (calories)	Age/Sex Groups	Milk Group Recommendation (1 cup eq. servings)	Reported Consumption (CSFII 94-96) (1 cup eq. servings)	Calcium Provided by Milk Group in Food Patterns (% of total calcium)
1000	Child 2-3	2	1.85	79
1200	F 4-8	2	1.84	73
1400	M 4-8	2	2.02	70
1600	F 9-13	3	1.86	73
	F 51+	3	1.01	73
1800	F 31-50	2	1.11	61
	M 9-13	3	2.27	70
	F 14-18	3	1.38	70
2000	F 19-30	2	1.26	58
	M 51+	3	1.32	68
2200	M 14-18	3	2.34	66
	M 31-50	2	1.55	56
2400	M 19-30	2	1.73	53
2600	M 19-30	2	1.73	52
2800	M 14-18	3	2.34	61
3000	M 19-30	2	1.73	49
3200	M 14-18	3	2.34	59

METHODS

1. Used proposed food intake patterns and nutrient profiles based on 1999–2000 NHANES consumption data and SR 16 nutrient data as the basis for this analysis.
2. Identified nutrients provided by the milk group.
3. Removed milk group from each food pattern and analyzed the adequacy of the resulting pattern. Identified nutrient shortfalls.

RESULTS

1. **Nutrients Provided by Recommended Amounts From the Milk Group in Food Patterns:** On average, the milk group provides 10 percent of the calories in the food intake patterns. The percentage varies from 16 percent of calories at 1,000 calories to 5 percent at 3,200 calories, because the intake amounts recommended from the milk group do not increase with increasing calorie intakes. The milk group also provides more than 10 percent of the following nutrients in the patterns (on average): riboflavin, vitamin B12, vitamin A, thiamin, vitamin B6, calcium, phosphorus, magnesium, zinc, potassium, protein, and carbohydrate

2. **Impact of Removing Milk Products From Food Patterns:** Some of the nutrients provided by milk products are supplied in amounts well above the nutrient's goal level. For example, even though milk products and the major contributor of riboflavin to the food patterns, intake levels are still above the RDA when milk products are excluded. Amounts of riboflavin drop from about 200 to 250 percent of the RDA to about 111 to 170 percent of the RDA. However, there are some other nutrient shortfalls in addition to calcium if milk products are not included in the patterns.

   The specific shortfalls due to removal of milk products from the patterns, without replacement from other food groups, are listed in Table G2-20. Nutrients are included if the resulting amount is <95 percent of the nutritional goal. Note that vitamin E is not included in the table. Vitamin E levels are below the RDA for all patterns, and without milk products, the levels of vitamin E in the patterns decrease by 1 percent or less of the RDA.

Table G2-20. Nutrient Shortfalls Without Milk Products in Food Patterns

Nutrient	Food Pattern	Age-Sex Group (sedentary)	Existing Proposed Patterns—Amount in Pattern as % of Nutritional Goal	Without Milk Products—Amounts in Pattern as % of Nutritional Goal
Calcium	1000 (2m)	M/F 2-3	155%	32%
	1200 (2m)	F 4-8	104%	28%
	1400 (2m)	M 4-8	110%	33%
	1600 (3m)	F 9-13	96%	26%
	1600 (3m)	F 51 to 70	104%	28%
	1800 (2m)	F 31-50	101%	40%
	1800 (3m)	M 9-13, F 14-18	101%	30%
	2000 (2m)	F19-30	105%	44%
	2000 (3m)	M 51+	113%	37%
	2200 (2m)	M31-50	109%	48%
	2200 (3m)	M 14-18	107%	37%
	2400 (2m)	M 19-30	115%	53%
	2600 (2m)	M 19-30	118%	57%
	2800 (3m)	M 14-18	117%	46%
	3000 (2m)	M 19-30	125%	64%
	3200 (3m)	M 14-18	120%	49%
Potassium	1000 (2m)	M/F 2-3	58%	33%
	1200 (2m)	F 4-8	56%	36%
	1400 (2m)	M 4-8	64%	43%
	1600 (3m)	F 9-13	71%	45%
	1600 (3m)	F 51+	68%	43%
	1800 (2m)	F31-50	66%	49%
	1800 (3m)	M 9-13	77%	52%
	1800 (3m)	F 14-18	74%	49%
	2000 (2m)	F19-30	73%	57%
	2000 (3m)	M 51+	81%	57%
	2200 (2m)	M31-50	75%	59%
	2200 (3m)	M 14-18	84%	59%
	2400 (2m)	M 19-30	83%	66%
	2600 (2m)	M 19-30	92%	76%
	2800 (3m)	M 14-18	103%	78%
	3000 (2m)	M 19-30	104%	88%
	3200 (3m)	M 14-18	112%	88%
Magnesium	1600 (3m)	F 51 to 70	100%	75%
	1800 (2m)	F 31-50	104%	87%
	1800 (3m)	F 14-18	100%	77%
	2000 (3m)	M 51+	94%	75%
	2200 (2m)	M 31-50	93%	80%
	2200 (3m)	M 14-18	101%	82%
	2400 (2m)	M 19-30	107%	94%
Phosphorus	1000 (2m)	M/F 2-3	193%	85%
	1600 (3m)	F 9-13	128%	69%
	1800 (3m)	M 9-13, F 14-18	137%	77%
	2200 (3m)	M 14-18	153%	93%
Vitamin A	1600 (3m)	F 51 to 70	122%	92%

The most widespread impacts were on calcium and potassium, with decreases to less than the AI for almost all food intake patterns. Intakes of magnesium, phosphorus, and vitamin A were also affected. Magnesium levels were low for all teen and adult men, and for many

teen and adult women. Phosphorus levels were low for teen and preteen males and females, and for children age 2 to 3 years. Vitamin A levels were low for women age 50 and older.

The DRI report for phosphorus notes that phosphorus is widely used as an additive in processed foods, and assessment of intakes may be difficult to ascertain, but intake data suggest an increase in consumption in the range of 10 to 15 percent over the past 20 years. In light of this, the issue of phosphorus intake is not further considered in this report.

3. **Options for Alternatives to Milk Products in the Food Patterns:** Alternatives within the milk group may be the most feasible recommendations for many individuals who avoid milk because of its lactose content. The same mix of nutrients found in regular milk products is also in lactose-reduced or low-lactose milk products.

   For those who do not wish to consume any dairy products, several considerations are important. First, the alternative must have high calcium and potassium levels. Second, the calcium must be in a form that is bioavailable. Also, consideration should be given to sources of magnesium and perhaps vitamin A.

   A table of potential alternatives for milk products is being prepared. No scenarios for replacement of milk products with other foods were developed, as this would necessitate enormous deviations from typical food choices. In addition, the most viable alternatives for many individuals may be alternative foods within the milk group or fortified foods such as fortified orange juice or fortified soy products.

CONCLUSION

Calcium and potassium intakes are severely compromised if milk products are not included in the food patterns. Calcium is already marginal for some age/sex groups in the patterns, and reported intakes for most groups are below recommendations. Potassium intakes in the population and in the proposed patterns are below new recommendations, as well.

While milk products are clearly, and correctly, associated with calcium, no food group, including the milk group, provides only a single nutrient. Any recommendations to increase flexibility in the food patterns by suggesting alternatives to milk products need to consider the impacts on the intake of potassium, magnesium, and vitamin A.

REPORT ON VARYING LEVELS OF FATS IN THE FOOD PATTERNS FEBRUARY 25, 2004

REQUEST FROM THE FATTY ACIDS SUBCOMMITTEE

Examine the adequacy of food patterns with varying levels of fat, from 20 to 35 percent of calories.

RATIONALE FOR REQUEST

To determine if food patterns at varying levels of fat content within the range recommended by the DRI can meet adequacy and moderation goals for other nutrients.

CONTEXT FOR THE ANALYSIS

1. **Total vs. Foundation Diet Approach:** The Food Guide Pyramid is a total diet system, which means that all calories must be accounted for in some way. This diet system differs fundamentally from a foundation diet, which ensures nutrient adequacy but allows free choice of any additional calories to meet energy needs. The free choice of some calories in a foundation diet approach is not compatible with moderation goals, such as limiting saturated fat intake. The total diet approach is used because some of the nutritional goals for the Pyramid specify ranges or maximum amounts rather than minimums. Also, specific calorie levels have been identified for various age/sex/activity level groups of people.

   Within a total diet system, flexibility of choice for the consumer is given where possible through choices within specific food categories. These food categories have similarities in their content of key nutrients, including their macronutrient composition. For example, the proposed food patterns for the Pyramid allow flexibility of choice within each food group or subgroup and within the categories of additional solid fats, additional oils, and added sugars. Choices made within these categories maintain the overall nutritional profile of the diet.

2. **Defining "Optimal" Dietary Choices:** *The Pyramid does not set nutritional policy—it is an educational tool designed to help Americans implement current policy on what constitutes an "optimal" diet.* Operationally, an "optimal" diet is defined as meeting the current *Dietary Guidelines* and *Dietary Reference Intakes*. Quantified nutritional goals for the Pyramid's food patterns are set according to these standards. In addition, educational messages are developed to provide additional guidance where qualitative but not quantified goals are available.

3. **Selection of One Set of "Optimal" Choices:** There are an immense number of food patterns that could meet current nutritional adequacy and moderation goals. How can one set of food choices be selected over another? The premise used in determining food patterns for the Pyramid has been to start with what is actually consumed by Americans and adjust the amounts of various food categories (which include both "food groups" and "subgroups") into healthful proportions. Alterations are made in the amounts recommended from each category until nutrient goals (for adequacy and moderation) are met. Major shifts from actual consumption patterns may occur, *but only if they are*

needed to meet the stated goals. This approach differs from some other food guidance approaches that use different criteria to identify other "optimal" dietary patterns.

4. **Discretionary Fats in the Food Patterns:** Within each food group and subgroup, food items in their lowest fat form are selected for use in determining the nutrient profile of the group or subgroup. However, some amount of fat remains in each group's nutrient profile and is termed "intrinsic" fat. The total amount of all intrinsic fat in the food patterns ranges from about 10 grams in the 1,000-calorie pattern to 35 grams in the 3,200-calorie pattern. To bring the amounts of total fat and essential fatty acids to recommended levels, a separate component—discretionary fats—is added. Discretionary fats represent the mix of fats that individuals may consume as part of their food choices or add to their food choices. For example, individuals may use portions of their discretionary fat "allowance" to select 1 percent milk rather than fat-free milk and to have mayonnaise on a sandwich.

   As part of the current revision of the food patterns, discretionary fats were separated into two components—"solid fats" and "oils and soft margarines." The solid fat component includes animal fats (beef, pork, chicken, and dairy fats), as well as hydrogenated vegetable fats (shortening and stick margarine). Because the solid discretionary fat component includes a higher percentage of saturated and trans fats, as well as cholesterol, the amounts in the food patterns have been restricted to 40 percent of total discretionary fats. This contrasts with the 58 percent of discretionary fats, as typically consumed, that are solid fats. The other component of discretionary fats—oils (soybean, cottonseed, and corn oils) and soft margarines—has been increased to 60 percent in the food patterns. As typically consumed, this component represents 42 percent of total discretionary fats.

METHODS

1. An analysis was conducted for each food pattern from 1,000 to 3,200 calories (each included 2 cups of milk). The same amount of solid fat, oil, and added sugars determined for these patterns was also inserted into the pattern containing three servings of milk.
2. For each level of fat (from 20 to 35 percent of calories), the grams of total fat required to reach the appropriate percentage of calories were determined. Then, the intrinsic fat within the food groups was subtracted from the total to determine the amount of discretionary fat allowed.
3. The discretionary fat was divided into solid fat and oil in a ratio of 40 percent solid to 60 percent oil. An exception was made for the 1,000-calorie pattern, which was left at the current consumption percentages of 60 percent solid and 40 percent oil, to allow for whole milk in the diets of young children.
4. The amounts of solid fats and oils were corrected by the factors .85 and .95, respectively, to account for the fact that fats and oils as eaten are not 100 percent lipid. For example, butter contains some water and milk solids in addition to lipids.
5. The corrected amounts of fats and oils were inserted into the food pattern spreadsheets, with added sugars set to zero. The caloric deficit was calculated, and sufficient added sugars were inserted to bring the total calories up to the target levels.
6. Percentages of the nutritional goals met for all nutrients with each level of fat were calculated.

SUMMARY OF RESULTS (see tables for detailed results)

Solid fats and oils contain many nutrients such as vitamin A, vitamin E, sodium, and calcium, in addition to the nutrients that are fat components (essential fatty acids). However, only vitamin E, linoleic acid, alpha-linolenic acid, and cholesterol were affected substantially by manipulating the fat content of the food intake patterns.

Few of the food patterns with any level of fat met the RDA for vitamin E. The RDA was met only at 35 percent calories from fat, and then only in the highest calorie patterns (3,000 and 3,200 calories). As would be expected, the percentage of the RDA for vitamin E in an intake pattern increased consistently with additional fat in the pattern.

Levels of linoleic acid and alpha-linolenic acid (ALA) were highly sensitive to the overall fat content of the pattern. At 20 percent of calories from fat, few patterns met the AIs or were within the AMDRs for these fatty acids. At 25 percent calories from fat, fewer patterns were below the AIs, and all were within the AMDRs. Patterns at 30 and 35 percent calories from fat all met both the AIs and AMDRs.

Because linoleic acid and ALA are found at higher levels in oils than in solid fats, the intake pattern at 20 percent of calories from fat was modified to use only oils and soft margarines in the patterns (no solid fats) to determine whether linoleic acid and ALA could be provided in sufficient quantities at 20 percent of calories from fat. While the results are an improvement over the original 20 percent patterns, the standards for linoleic acid and ALA were not met at many calorie levels.

For this exercise, calories in the pattern were balanced using added sugars. Tables G2-21–G2-24 show the amounts of added sugars in each pattern, in addition to the information provided on fat-related nutrients. Added sugars ranged from 13 to 46 teaspoons (52 to 184 grams) at 20 percent of calories from fat, to zero to 17 teaspoons (0 to 68 grams) at 35 percent. The amounts of added sugars allowed in the 35 percent pattern are quite limited at most calorie levels.

Additional findings include the following:

- At 20 percent of calories from fat, more than 65 percent of calories were supplied by carbohydrates at the highest calorie levels.
- At 35 percent calories from fat, cholesterol levels were above the standard of 300 mg at the highest calorie levels.

Detailed results are presented in the following tables. Note that some of the information in the tables is presented as a range, because several age/sex groups may have the same caloric needs but different RDAs or AIs. The ranges represent the percentages of the goal for different age/sex groups at that calorie level.

Table G2-21 shows the estimation of the shortfalls and percentage of calories from fat and carbohydrates if the amounts of fat in each pattern were set to 20 percent of calories. The table also presents the approximate amounts in each food pattern. Results that are less than (or more than) the goal appear in bold.

Table G2-21. 20 Percent of Calories From Fat

Pattern (20% kcal fat)	Calories From Fat (%)	Calories From CHO (%)	Added Sugars (tsp.)	Vitamin E (% RDA)	Linoleic Acid (% AI)	ALA (% AI)
1000	20	65	13	**45**	**72 (4.6%)**	**74 (0.4%)**
1200	20	64	13	**53**	**67**	**74 (0.5%)**
1400	20	63	15	**59**	**76 (4.9%)**	**82 (0.4%)**
1600	20	62	15	**33-45**	**71-78 (4.6%)**	**70-77 (0.5%)**
1800	20	63	18	**39-54**	**83-90 (4.8%)**	**83-91 (0.5%)**
2000	20	64	18	**43**	**79-92 (4.8%)**	**69-100 (0.5%)**
2200	20	65	23	**46**	**72-76 (4.8%)**	**75 (0.5%)**
2400	20	65	24	**51**	**79**	**82 (0.5%)**
2600	20	**66**	28	**58**	**87**	**92 (0.5%)**
2800	20	**66**	32	**60**	**99**	**98 (0.5%)**
3000	20	**67**	36	**68**	101	108 **(0.5%)**
3200	20	**68**	46	**71**	116	116 **(0.5%)**

*The percentage of calories shown only when less than AMDR. AMDR for linoleic acid is 5-10 percent kcal; AMDR for ALA is 0.6-1.2 percent kcal.

Table G2-22 shows the estimation of the shortfalls and percentage of calories from fat and carbohydrates if the amounts of fat in each pattern were set to 25 percent of calories. The table also presents the approximate amounts in each food pattern.

TABLE G2-22: 25 Percent of Calories From Fat

Pattern (25% kcal fat)	Calories From Fat (%)	Calories From CHO (%)	Added Sugars (tsp.)	Vitamin E (% RDA)	Linoleic Acid (% AI)	ALA (% AI)
1000	25	60	10	**53**	**92**	**93**
1200	25	59	10	**63**	**87**	**95**
1400	25	58	10	**71**	100	107
1600	25	57	10	**39-54**	**94**-102	**92**-100
1800	25	59	13	**47-64**	108-118	107-117
2000	25	59	12	**51-52**	103-120	**89**-129
2200	25	60	16	**55**	**94**-100	**97**
2400	25	60	17	**61**	103	106
2600	25	61	20	**68**	112	117
2800	25	61	24	**72**	129	125
3000	25	62	27	**80**	131	137
3200	25	63	38	**84**	150	148

Note: No patterns were less than AMDR for linoleic or ALA.

Table G2-23 shows the estimation of the shortfalls and percentage of calories from fat and carbohydrates if the amounts of fat in each pattern were set to 30 percent of calories. The table also presents the approximate amounts in each food pattern.

Table G2-23. 30 Percent of Calories From Fat

Pattern (30% kcal fat)	Calories From Fat (%)	Calories From CHO (%)	Added Sugars (tsp.)	Vitamin E (% RDA)	Linoleic Acid (% AI)	ALA (% AI)
1000	30	55	7	**62**	111	113
1200	30	54	6	**74**	108	116
1400	30	53	6	**83**	124	131
1600	30	53	5	**46-63**	116-127	131-123
1800	30	54	7	**54-74**	134-146	131-143
2000	30	54	6	**60**	149-127	109-158
2200	30	55	9	**64**	116-123	119
2400	30	55	10	**71**	126	130
2600	30	56	12	**79**	138	143
2800	30	56	15	**83**	158	153
3000	30	57	18	**92**	161	167
3200	30	58	27	**98**	184	179

Note: No patterns were less than AMDR for linoleic or ALA.

Table G2-24 shows the estimation of the shortfalls and percentage of calories from fat and carbohydrates if the amounts of fat in each pattern were set to 30 percent of calories. The table also presents the approximate amounts in each food pattern.

Table G2-24. 35 Percent of Calories From Fat

Pattern (35% kcal fat)	Calories From Fat (%)	Calories From CHO (%)	Added Sugars (tsp.)	Vitamin E (% RDA)	Linoleic Acid (% AI)	ALA (% AI)
1000	35	50*	4	**70**	131	132
1200	35	48	2	**84**	128	137
1400	35	48	2	**96**	147	156
1600	35	48	0	**53-72**	139-152	134-146
1800	35	48-49	2	**61-84**	159-173	155-169
2000	35	49	0	**68**	152-177	129-187
2200	35	50	3	**73**	137-146	1140-141
2400	35	50	3	**80**	150	154
2600	35	51	4	**89**	164	169
2800†	35	51	7	**95**	186	181
3000†	35	52	9	105	191	197
3200†	35	53	17	111	217	211

*The 1,000-calorie pattern contained 96 percent of the AI for carbohydrates.
†The 2,800-, 3,000-, and 3,200-calorie patterns contained 310, 314, and 319 mg. of cholesterol, respectively.

A scenario of using oils and soft margarines only in the patterns (no solid fats) was run to determine if linoleic acid and ALA could be provided in sufficient quantities at 20 percent of

calories from fat. This analysis was undertaken because the intake patterns with 20 percent of calories from fat, which were split between solid fats (40 percent) and oils/soft margarines (60 percent), were low in both linoleic acid and ALA across almost all calorie levels. Table G2-25 shows the results of this analysis.

Table G2-25. 20 Percent of Calories From Fat, With Oils/Soft Margarines Only

Pattern (20% kcal fat)	Calories From Fat	Calories From CHO	Added Sugars	Vitamin E	Linoleic Acid	ALA
	%	%	tsps.	% RDA	% AI (% kcal)	% AI (% kcal)
1000	20	65	13	**58**	103	**95**
1200	20	64	13	**60**	**82**	**85**
1400	20	63	15	**67**	**92**	**94 (0.5%)**
1600	20	62	15	**37-50**	**85-92**	**80-87 (0.5%)**
1800	20	63	18	**44-60**	**99-**108	**94-**103 **(0.5%)**
2000	20	64	18	**48-49**	**94-**110	**78-**104 **(0.5%)**
2200	20	65	23	**52**	**86-91**	**85 (0.5%)**
2400	20	65	24	**57**	**94**	**94 (0.5%)**
2600	20	**66**	28	**65**	105	105 **(0.5%)**
2800	20	**66**	32	**68**	120	112 **(0.5%)**
3000	20	**67**	36	**77**	123	124
3200	20	**68**	46	**81**	143	134 **(0.5%)**

* Percentage of calories shown only when less than AMDR.

CONCLUSIONS

The analysis suggests the following advice concerning fat intake:

- Keep fat intake to within 20 to 35 percent of calories as recommended by the DRI report. The proposed food intake patterns contain 27 to 28 percent of calories as fat, which is approximately midway within this range.
- Replace about half of the solid fats now eaten with oils (and/or soft margarines). The proposed patterns suggest that 40 percent of discretionary fats should be solid fats, about 50 percent less than is now consumed, and that increased oil (and/or soft margarine) intake replace these solid fats.
- Include cautions to ensure adequate intake of linoleic acid and ALA if an individual chooses to select a diet with less than 27 to 28 percent of calories as fat. Increasing the proportion of oils beyond 60 percent of discretionary fats and selecting oils high in these two fatty acids would help to ensure adequate intakes.
- Include cautions to limit cholesterol intake to less than the amounts in the patterns if an individual chooses to select a diet with more than 30 percent of calories as fat.
- Suggest ways to ensure adequate intake of vitamin E, such as choosing oils with high levels of vitamin E, E-rich nuts or seeds, or supplements.

REPORT ON FOOD PATTERNS WITH 35 PERCENT FATS AND 5 PERCENT ADDED SUGARS—MARCH 3, 2004

REQUEST FROM THE CARBOHYDRATES SUBCOMMITTEE

Examine the adequacy of food patterns with fat at 35 percent of calories and added sugars at 5 percent of calories, with other carbohydrate sources decreased to maintain calorie level.

RATIONALE FOR REQUEST

When calories from fat in the food patterns are increased to 35 percent, the amount of added sugars in many patterns drops to almost zero to compensate and maintain calorie levels. Some evidence suggests that keeping added sugars to at least 5 percent of calories is related to improved dietary nutritional quality. In food patterns with fat at 35 percent and added sugars at 5 percent of calories, would changes in other carbohydrate sources to compensate for the additional calories affect the adequacy of the patterns?

METHODS

1. This analysis was an extension of the analysis of various levels of fat in the food patterns and followed similar procedures. It was conducted for each food pattern from 1,000 to 3,200 calories (each included 2 cups of milk). The same amount of solid fat, oil, and added sugars determined for these patterns was also inserted into the pattern containing three servings of milk.
2. The food patterns with 35 percent of calories from fat were used as the starting point. Grams of added sugars required for 5 percent of calories was determined and added to each food pattern. Then, the total calories in the pattern were subtracted from the goal level to determine the caloric difference.
3. For most food patterns, the caloric level with 35 percent fat and 5 percent added sugars exceeded the goal energy level. Enriched grains were selected as the food group to use in compensating to maintain the goal energy level.
4. In each food pattern, the amount of enriched grains to equal the caloric excess was calculated, and the amount of enriched grains in each pattern was reduced by that amount. Amounts were rounded to the nearest 0.5 serving.
5. Percentages of the nutritional goals met for all nutrients were calculated with the modified food patterns.

RESULTS

For most food intake patterns, a decrease of 0.5 to 1 serving of enriched grains was necessary to include both 35 percent of calories as fat and 5 percent of calories as added sugars at the goal calorie level. Profiles from the resulting patterns are presented in Table G2-26:

Table G2-26. Profiles of Patterns With 35 Percent Calories as Fat and 5 Percent Calories as Added Sugars

Pattern	Calories From Fat (% kcal)	Calories From CHO (% kcal)	Added Sugars (% kcal)	Added Sugars (g)	Enriched Grains in Modified Pattern (servings)	Decrease From Original Pattern (servings)
1000	35	49	5	12	1.5	0
1200	35	48	5	15	1.5	0.5
1400	35	49	5	18	2.0	0.5
1600*	33	48	5	20	2.0	1.0
1800*	34-35	49	5	22	2.5	1.0
2000*	33-35	50-51	5	25	3.0	1.0
2200*	34-35	50	5	28	3.5	1.0
2400	35	50	5	30	4.0	1.0
2600	35	52	5	32	4.5	0.5
2800*	34	51	5	35	5.0	0.5
3000	35	52	5	37	5.5	0
3200*	34	53	9	72	5.5	0

* Percent of calories from fat is less than 35 percent because the pattern with three servings of milk is analyzed at this calorie level. The amount of fat and added sugars in the pattern is based on the pattern with two milk servings.

Enriched grain products contribute important amounts of certain nutrients to the Pyramid food patterns. On average, they provide more than 10 percent of the thiamin, folate, riboflavin, niacin, vitamin B6, calcium, iron, copper, and fiber in a food pattern.

The decreased amounts of enriched grains in most patterns resulted in slightly lower levels of many nutrients. Some of these nutrients are supplied in amounts well above the nutrient's goal level. For these nutrients, then, the 0.5 to 1 serving decrease in enriched grains did not result in shortfalls. However, for a few age/sex groups and for nutrients that were marginal in the original patterns, the decrease did result in or worsen a shortfall. These shortfall nutrients are shown in Table G2-27.

Table G2-27. Marginal or Shortfall Nutrients in Food Patterns With Modifications for 35% Calories as Fat and 5% as Added Sugars

Nutrient	Food Pattern	Age-Sex Group (sedentary)	Original Proposed Patterns—Amount in Pattern as % of Goal	With Less Enriched Grains—Amount in Pattern as % of Goal
Calcium	1600 (3m) 1800 (2m) 1800 (3m)	F 9-13 F31-50 M 9-13, F 14-18	96% 101% 101%	94% 98% 99%
Iron	1200 (2m) 1800 (2m)	F 4-8 F31-50	98% 96%	92% 89%
Fiber	1200 (2m) 1400 (2m)	F 4-8 M 4-8	97% 97%	95% 95%

CONCLUSIONS

The current analysis suggests the following, in addition to the conclusions from the prior analysis of food patterns at 35 percent of calories from fat:

- Food intake patterns with 35 percent of calories as fat and at least 5 percent of calories as added sugars are feasible for many age/sex groups. To maintain caloric balance, the amount of enriched grains selected can be decreased by 0.5 to 1 serving.
- Some age/sex groups have relatively high requirements for calcium and iron, and if sedentary, relatively low caloric needs. These groups are adult women age 31 to 50 years, girls age 9 to 18 years, and boys age 9 to 13 years. The intake of calcium and iron is already marginal for these groups, and reducing the amount of enriched grains results in or worsens shortfalls.

These vulnerable age/sex groups may need advice on selecting a nutrient dense diet, especially for calcium and iron. Increasing the amount of fat in the diet to 35 percent may not be compatible with nutrient adequacy for these groups, especially if they are sedentary.

HIGH OMEGA-3 FISH ANALYSIS
April 16, 2004

REQUEST FROM THE FATTY ACIDS SUBCOMMITTEE

What is the impact of increasing fish and/or high omega-3 fish consumption to 8 or 9 ounces per week?

BACKGROUND

In developing the Pyramid food intake patterns, fish have been grouped with red meats, poultry, eggs, nuts, and seeds into a single food group. The nutrient profile of this group has been calculated by assuming a proportionate intake of each category of food equal to the proportion consumed by the population. The meats and poultry selected as representative items have been the leanest choices within each food type. Food items selected in calculating the nutrient profile have been those whose intake represents more than 1 percent of the total intake of the food group. Other foods (with less than 1 percent intake) in each category are grouped with the most similar food in calculating overall percent consumption. For example, since shrimp is the most widely consumed shellfish, all shellfish have been grouped with shrimp to calculate total shellfish consumption, and shrimp nutrient values have been used to represent shellfish in the nutrient profile.

The original food item groups used in developing the proposed food patterns and percent consumption according to NHANES 1999–2000 data are listed in Table G2-28.

Table G2-28. Subgroups and Item Groups in the Meat, Poultry, Fish, Egg, and Nut (MPFEN) Composite According to NHANES 1999–2000 Intake Data

Subgroups and Item Groups in Each	Percent of MPFEN Consumption
Meats (beef, ground beef, pork, lamb, ham, luncheon meats, and liver item groups)	55.7%
Poultry (chicken and turkey item groups)	24.5%
Fish (lean finfish, fatty finfish, tuna, and shellfish item groups)	8.3%
Eggs (eggs)	7.8%
Nuts and seeds	3.6%

In developing the original nutrient profile for fish, finfish were sorted by overall fat content into lean and fatty item groups, and the most consumed fish in each was selected for use in representing the group. Flounder represented lean finfish, and catfish represented fatty finfish. Tuna was considered a separate item group to represent all canned fish, because its consumption was greater than 1 percent of the overall MPFEN group. As stated earlier, shrimp represented all shellfish.

Because the item groups used for fish were separated by overall fat content rather than omega-3 fatty acid content, a re-grouping of fish into new item groups was necessary to complete the requested analysis.

METHODS

1. Using NHANES 1999–2000 consumption data, identify intake for each individual type of fish. Create a separate item group for each individual type of fish consumed (salmon, herring, etc.). Calculate total consumption for each item group.
2. Separate all fish item groups into low omega-3 (LO3) or high omega-3 (HI3) subgroups. The cutoff value for placement into the LO3 or HI3 group was 500 mg of EPA plus DHA in a 3-ounce serving of the fish. This cutoff was based on the recommendation of the DGAC fatty acid subcommittee. Addendum A lists the EPA and DHA content of fish used in this analysis.
3. Calculate a nutrient profile for each subgroup, using a weighted average based on consumption of each item group.
4. Tuna was handled separately because NHANES does not distinguish between types of tuna (light or white). Therefore, all tuna was grouped together to calculate the overall amount consumed. Then, 75 percent of the total amount of tuna consumed was assigned to light tuna and 25 percent to white tuna on the basis of an estimate obtained from ARS. Light tuna was then added to the LO3 group, and white tuna was added to HI3 group. New weights based on consumption were assigned to calculate an overall nutrient profile for each subgroup (low or high omega-3 fish), including tuna.
5. These nutrient profiles were used to calculate two new nutrient profiles for the MPFEN group, assuming an increase in fish or HI3 fish as recommended. Nutrient profiles are based on percent of intake for each subgroup within the overall group. The 8 ounces per week amount was based on food intake patterns having a total of 5 ounces per day from the MPFEN group. The percentage of the MPFEN group assigned to each subgroup (meat, poultry, etc.) was adjusted to accommodate intake of (1) 8 ounces of fish per week and (2) 8 ounces of HI3 fish per week. For the 8 ounces of fish per week scenario, the ratio between LO3 and HI3 fish was maintained at current intake levels. For the 8 ounces of HI3 fish per week, all fish intake was assumed to be HI3 fish, and LO3 fish intake was set to zero.
6. The two new nutrient profiles were used in all food intake patterns to assess nutrient outcomes, including EPA and DHA intakes. For this analysis, EPA and DHA intakes from foods other than fish were assumed to be zero. Data are not readily available for many foods, and amounts of these fatty acids were assumed to be negligible for other foods included in the food intake patterns.

RESULTS

1. Based on NHANES 1999–2000 consumption data, the majority of fish intake (63 percent) is finfish low in omega-3 fatty acids. The most popular single fish is tuna (22 percent), with shrimp (16 percent), salmon (9 percent), mixed fish (8 percent), and crab (7 percent) also commonly reported. Addendum B lists each type of fish reported in NHANES and also its consumption relative to other fish in its omega-3 group and overall.

   Overall tuna intake was split assuming 25 percent was white tuna (albacore) and 75 percent light tuna, according to estimates of light vs. white tuna consumption. Proportionate amounts were added to the two fish subgroups. Proportionate overall fish intake with tuna added is shown in Table G2-29.

Table G2-29. Fish Consumption by Subgroup, With Tuna in HI3 (25 Percent) and LO3 (75 Percent) Groups

Group	Percent of Total Fish Consumption
	%
HI3 fish	14.35
White tuna (est.)	5.53
HI3 fish with tuna	19.88
LO3 fish	63.53
Light tuna (est.)	16.59
LO3 fish with tuna	80.12
Total	100.00

2. The resulting amounts of EPA and DHA in fish subgroups, including tuna, are shown in Table G2-30. The amounts are weighted averages of the EPA and DHA content of each fish in the group, with weights based on relative consumption of the fish. Values are expressed in grams per ounce of cooked fish, for most fish. For a few fish, only raw values were available and were used.

Table G2-30. EPA and DHA Content of Fish Groupings

	EPA	DHA	EPA Plus DHA
	(g/oz.)	(g/oz.)	(g/oz.)
HI3 fish	0.282	0.125	0.407
LO3 fish	0.048	0.057	0.105

3. New MPFEN nutrient profiles were calculated, including either 8 ounces of total fish or 8 ounces of HI3 fish per week. The proportion of foods in the revised MPFEN nutrient profiles is shown in Table G2-31.

Table G2-31. Proportional Intakes for the MPFEN Group, Assuming Recommendations for 8 Ounces of Fish or 8 Ounces of HI3 Fish per Week

Subgroups	Percent of MPFEN Consumption	
	With 8 ounces total fish per week	With 8 ounces HI3 fish per week
Meats	45.7%	45.7%
Poultry	20.1%	20.1%
HI3 fish	4.6%	22.9%
LO3 fish	18.3%	0.0%
Eggs	7.8%	7.8%
Nuts and seeds	3.5%	3.5%

Using the new MPFEN nutrient profiles, amounts of DHA and EPA in each food intake pattern were calculated. Since other sources of EPA and DHA were considered negligible,

only the MPFEN values for these fatty acids are reflected in the total amounts in each food intake pattern. These amounts are shown in Table G2-32.

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Table G2-32. EPA and DHA Content of Food Intake Patterns, With 8 Ounces of Fish or 8 Ounces of HI3 Fish per Week

Calorie Level	8 Ounces Fish per Week EPA+DHA	8 Ounces HI3 Fish per Week EPA+DHA
	g	g
1000	0.076	0.186
1200	0.113	0.279
1400	0.151	0.372
1600*	0.189	0.466
1800*	0.189	0.466
2000	0.208	0.512
2200	0.227	0.559
2400	0.246	0.605
2600	0.250	0.615
2800	0.265	0.652
3000	0.265	0.652
3200	0.265	0.652

* Base patterns for analysis with 5 ounces of MPFEN per day. These patterns would include 8 ounces of fish (or HI3 fish) per week. Other patterns would have more or less fish, with approximately 3 ounces per week in the 1,000-calorie pattern and 11 ounces per week in the 3,200-calorie pattern.

4. The impact on other nutrients of substituting more fish or HI3 fish for some meat and poultry was quite small. For most nutrients, no change was evident when expressed as a percentage of the RDA or AI. For iron, a decrease of 2 to 4 percent was seen in the patterns with the 8 ounces of HI3 fish but not in the patterns with 8 ounces of all fish. For several nutrients, a change of 1 to 2 percent was seen, but this did not affect the adequacy of the patterns. Changes in total fat, saturated fat, and cholesterol are shown in Table G2-33.

Table G2-33. Changes in Fat Content With Increase in Fish or HI3 Fish in Selected Food Patterns

Nutrient/Pattern	Original Amount (g/% kcal)	With 8 Ounces Fish (g/% kcal)	With 8 Ounces HI3 Fish (g/% kcal)
Total fat			
1800	56.2/28%	55.5/28%	57.1/29%
2200	68.5/28%	67.6/28%	69.6/28%
2600	77.3/27%	76.4/27%	78.6/27%
Saturated fat			
1800	14.8/7.5%	14.3/7.3%	14.7/7.4%
2200	18.1/7.4%	17.6/7.2%	18.0/7.3%
2600	20.2/7.0%	19.6/6.9%	20.1/7.0%
Cholesterol	(mg)	(mg)	(mg)
1800	211	209	203
2200	253	251	244
2600	278	275	267

5. Amounts of fish in the suggested patterns relative to actual consumption also were examined. Since fish with HI3 levels are consumed less than other fish, the suggested increase in intake would be greater if 8 ounces of HI3 fish were recommended. Therefore, a comparison was made of the potential increases over actual consumption for both scenarios. The increases are shown in Table G2-34. The potential increase with an intake of 8 ounces of fish recommended is about 5 ounces, which is about a 1¾ times additional intake on top of current intake levels. The increase with a recommended intake of 8 ounces of HI3 fish is about 7½ ounces, which is more than a twelvefold increase above current intake levels.

Table G2-34. Increased Intakes—Recommendations in Comparison to Current Consumption

Recommendation	Original Intake (oz./wk)	Rec. Intake (oz./wk)	Increase (oz./wk)	Increase (%)
8 oz. fish per week—all fish	2.92	8.00	5.08	174%
LO3 fish	2.34	6.40	4.06	174%
HI3 fish	0.58	1.60	1.02	174%
8 oz. HI3 fish per week	0.58	8.00	7.42	1270%

An additional consideration in examining current intake levels is that these are national averages, and there are probably widespread regional differences in overall fish intake and in the type of fish consumed. We were not able to consider these factors in the current analysis.

SUMMARY

About 80 percent of current fish intake is from species that are relatively lower in omega-3 fatty acid content. Note that the cutoff level for determining fish that fell into the "HI3" group or the "LO3" group was set at 500 mg per 3-ounce serving, in compliance with a suggestion from the subcommittee.

A recommendation to eat 8 ounces of HI3 fish per week would provide from 186 to 652 mg of EPA and DHA per day combined in food patterns with 1,000 to 3,200 calories, respectively. A recommendation to eat 8 ounces of fish per week would provide from 76 to 265 mg of EPA plus DHA per day over the same calorie range, if intakes followed current consumption patterns. The recommendation for 8 ounces of HI3 fish per week does differ greatly from current consumption.

OTHER CONSIDERATIONS AND QUESTIONS:

1. Note that in this analysis no intake of EPA or DHA from sources other than fish, or conversion of ALA to these fatty acids, was considered because of data limitations. How should potential intake from other sources be handled as an alternative to fish consumption?
2. How would any specific recommendation for fish intake apply to vegetarians? What other types of flexibility could or should be considered for any recommendation about fish intake? For example, lactose-free alternatives to milk are being considered for those who are lactase deficient.

3. Given that all other recommendations incorporated into the food patterns have been based on meeting identified nutrient standards set by the IOM, on what standard would a recommendation on fish intake be based?

Addendum A: EPA and DHA Content of Fish Species (Data From NDB SR 16-1)

(Fish listed in bold indicate the form of the fish used in the analysis—usually the most commonly eaten, without added fat.)

Fish Species and Description	DHA per 100 g	EPA per 100 g	DHA+EPA per 100 g	DHA+EPA per 85 g (3 oz.)
Crustaceans, crab, Alaska king, cooked, moist heat	**0.118**	**0.295**	**0.413**	**0.351**
Crustaceans, crab, blue, cooked, moist heat	0.231	0.243	0.474	0.403
Crustaceans, crab, Dungeness, cooked, moist heat	0.113	0.281	0.394	0.335
Crustaceans, crab, queen, cooked, moist heat	0.145	0.332	0.477	0.405
Crustaceans, crayfish, mixed species, farmed, cooked, moist heat	**0.038**	**0.124**	**0.162**	**0.138**
Crustaceans, crayfish, mixed species, wild, cooked, moist heat	0.047	0.119	0.166	0.141
Crustaceans, lobster, northern, cooked, moist heat	0.031	0.053	0.084	0.071
Crustaceans, shrimp, mixed species, cooked, moist heat	**0.144**	**0.171**	**0.315**	**0.268**
Crustaceans, spiny lobster, mixed species, cooked, moist heat	**0.139**	**0.341**	**0.480**	**0.408**
Fish, anchovy, European, raw	**0.911**	**0.538**	**1.449**	**1.232**
Fish, anchovy, European, canned in oil, drained solids	1.292	0.763	2.055	1.747
Fish, bass, freshwater, mixed species, cooked, dry heat	0.458	0.305	0.763	0.649
Fish, bass, striped, cooked, dry heat	0.750	0.217	0.967	0.822
Fish, bluefish, cooked, dry heat	0.665	0.323	0.988	0.840
Fish, turbot, cooked, dry heat	0.123	0.09	0.213	0.181
Fish, carp, cooked, dry heat	**0.146**	**0.305**	**0.451**	**0.383**
Fish, catfish, channel, farmed, cooked, dry heat	**0.128**	**0.049**	**0.177**	**0.150**
Fish, catfish, channel, wild, cooked, dry heat	0.137	0.100	0.237	0.201
Fish, caviar, black and red, granular	3.800	2.741	6.541	5.560
Fish, cod, Atlantic, cooked, dry heat	**0.154**	**0.004**	**0.158**	**0.134**
Fish, cod, Pacific, cooked, dry heat	0.173	0.103	0.276	0.235
Fish, croaker, Atlantic, raw	**0.097**	**0.123**	**0.22**	**0.187**
Fish, dolphin fish, cooked, dry heat	0.113	0.026	0.139	0.118
Fish, drum, freshwater, cooked, dry heat	0.368	0.295	0.663	0.564
Fish, eel, mixed species, cooked, dry heat	**0.081**	**0.108**	**0.189**	**0.161**
Fish, fish portions and sticks, frozen, preheated	0.128	0.086	0.214	0.182
Fish, flatfish (flounder and sole species), cooked, dry heat	**0.258**	**0.243**	**0.501**	**0.426**
Fish, grouper, mixed species, cooked, dry heat	0.213	0.035	0.248	0.211
Fish, haddock, cooked, dry heat	**0.162**	**0.076**	**0.238**	**0.202**
Fish, halibut, Atlantic and Pacific, cooked, dry heat	**0.374**	**0.091**	**0.465**	**0.395**
Fish, halibut, Greenland, cooked, dry heat	0.504	0.674	1.178	1.001
Fish, herring, Atlantic, cooked, dry heat	**1.105**	**0.909**	**2.014**	**1.712**
Fish, herring, Atlantic, kippered	1.179	0.97	2.149	1.827
Fish, herring, Pacific, cooked, dry heat	0.883	1.242	2.125	1.806
Fish, lingcod, cooked, dry heat	0.130	0.133	0.263	0.224
Fish, mackerel, Atlantic, cooked, dry heat	0.699	0.504	1.203	1.023
Fish, mackerel, king, cooked, dry heat	0.227	0.174	0.401	0.341
Fish, mackerel, Pacific and jack, mixed species, cooked, dry heat	**1.195**	**0.653**	**1.848**	**1.571**
Fish, mackerel, Spanish, cooked, dry heat	0.952	0.294	1.246	1.059
Fish, mullet, striped, cooked, dry heat	**0.148**	**0.18**	**0.328**	**0.279**

Fish species and description	DHA per 100 g	EPA per 100 g	DHA+EPA per 100 g	DHA+EPA per 85 g (3 oz.)
Fish, ocean perch, Atlantic, cooked, dry heat	0.271	0.103	0.374	0.318
Fish, perch, mixed species, cooked, dry heat	**0.223**	**0.101**	**0.324**	**0.275**
Fish, pike, northern, cooked, dry heat	**0.095**	**0.042**	**0.137**	**0.116**
Fish, pike, walleye, cooked, dry heat	0.288	0.11	0.398	0.338
Fish, pollock, Atlantic, cooked, dry heat	**0.451**	**0.091**	**0.542**	**0.461**
Fish, pompano, Florida, cooked, dry heat	**??**	**??**	**??**	**0.620 est**
Fish, rockfish, Pacific, mixed species, cooked, dry heat	0.262	0.181	0.443	0.377
Fish, roe, mixed species, cooked, dry heat	**1.747**	**1.26**	**3.007**	**2.556**
Fish, roe, mixed species, raw	1.363	0.983	2.346	1.994
Fish, roughy, orange, raw	0	0.001	0.001	0.001
Fish, sablefish, cooked, dry heat	0.920	0.867	1.787	1.519
Fish, sablefish, smoked	0.945	0.891	1.836	1.561
Fish, salmon, Atlantic, farmed, cooked, dry heat	**1.457**	**0.69**	**2.147**	**1.825**
Fish, salmon, Atlantic, wild, cooked, dry heat	1.429	0.411	1.84	1.564
Fish, salmon, Chinook, cooked, dry heat	0.727	1.01	1.737	1.476
Fish, salmon, chum, cooked, dry heat	0.505	0.299	0.804	0.683
Fish, salmon, chum, drained solids with bone	0.702	0.473	1.175	0.999
Fish, salmon, coho, farmed, cooked, dry heat	0.871	0.408	1.279	1.087
Fish, salmon, coho, wild, cooked, dry heat	0.658	0.401	1.059	0.900
Fish, salmon, pink, cooked, dry heat	0.751	0.537	1.288	1.095
Fish, salmon, sockeye, cooked, dry heat	0.700	0.53	1.23	1.046
Fish, sardine, Atlantic, canned in oil, drained solids with bone	**0.509**	**0.473**	**0.982**	**0.835**
Fish, scup, raw (Porgy—assigned to low omega-3 group)	no data	no data	no data	no data
Fish, sea bass, mixed species, cooked, dry heat	**0.556**	**0.206**	**0.762**	**0.648**
Fish, sea trout, mixed species, cooked, dry heat	0.265	0.211	0.476	0.405
Fish, shad, American, raw	1.321	1.086	2.407	2.046
Fish, shark, mixed species, raw	**0.527**	**0.316**	**0.843**	**0.717**
Fish, sheepshead, cooked, dry heat	0.107	0.083	0.19	0.162
Fish, smelt, rainbow, cooked, dry heat	0.536	0.353	0.889	0.756
Fish, snapper, mixed species, cooked, dry heat	**0.273**	**0.048**	**0.321**	**0.273**
Fish, spot, cooked, dry heat	0.526	0.282	0.808	0.687
Fish, sturgeon, mixed species, cooked, dry heat	0.119	0.249	0.368	0.313
Fish, sucker, white, cooked, dry heat	0.371	0.244	0.615	0.523
Fish, sunfish, pumpkin seed, cooked, dry heat	0.092	0.047	0.139	0.118
Fish, swordfish, cooked, dry heat	**0.681**	**0.138**	**0.819**	**0.696**
Fish, tilefish, cooked, dry heat	0.733	0.172	0.905	0.769
Fish, trout, mixed species, cooked, dry heat	**0.677**	**0.259**	**0.936**	**0.796**
Fish, trout, rainbow, farmed, cooked, dry heat	0.820	0.334	1.154	0.981
Fish, trout, rainbow, wild, cooked, dry heat	0.520	0.468	0.988	0.840
Fish, tuna, fresh, bluefin, cooked, dry heat	1.141	0.363	1.504	1.278
Fish, tuna, light, canned in oil, drained solids	0.101	0.027	0.128	0.109
Fish, tuna, light, canned in water, drained solids	**0.223**	**0.047**	**0.27**	**0.230**

Fish species and description	DHA per 100 g	EPA per 100 g	DHA+EPA per 100 g	DHA+EPA per 85 g (3 oz.)
Fish, tuna, skipjack, fresh, cooked, dry heat	0.237	0.091	0.328	0.279
Fish, tuna, white, canned in water, drained solids	**0.629**	**0.233**	**0.862**	**0.733**
Fish, tuna, yellowfin, fresh, cooked, dry heat	0.232	0.047	0.279	0.237
Fish, whitefish, mixed species, cooked, dry heat	1.206	0.406	1.612	1.370
Fish, whiting, mixed species, cooked, dry heat	**0.235**	**0.283**	**0.518**	**0.440**
Fish, wolffish, Atlantic, cooked, dry heat	0.405	0.393	0.798	0.678
Frog legs, raw			**0.034**	**0.020**
Mollusks, abalone, mixed species, raw	0	0.049	0.049	0.042
Mollusks, clam, mixed species, cooked, moist heat	**0.146**	**0.138**	**0.284**	**0.241**
Mollusks, conch, baked or broiled	**0.072**	**0.048**	**0.12**	**0.102**
Mollusks, cuttlefish, mixed species, cooked, moist heat	0.132	0.078	0.21	0.179
Mollusks, mussel, blue, cooked, moist heat	**0.506**	**0.276**	**0.782**	**0.665**
Mollusks, octopus, common, cooked, moist heat	**0.162**	**0.152**	**0.314**	**0.267**
Mollusks, oyster, eastern, farmed, cooked, dry heat	**0.211**	**0.229**	**0.44**	**0.374**
Mollusks, oyster, eastern, wild, cooked, dry heat	0.291	0.26	0.551	0.468
Mollusks, oyster, Pacific, cooked, moist heat	0.500	0.876	1.376	1.170
Mollusks, scallop, mixed species, cooked, breaded and fried	**0.103**	**0.086**	**0.189**	**0.161**
Mollusks, whelk, unspecified, cooked, moist heat	0.012	0.008	0.02	0.017

Addendum B: Fish Intake, Grouped by Omega-3 Fatty Acid Content—From NHANES 1999–2000 (Tuna shown as a separate group)

Fish type	Percent of Subgroup Consumption	Percent of All Fish Consumption
High Omega-3 fish	%	%
Anchovy	0.35	00.05
Mackerel	0.23	0.03
Pompano	0.22	0.03
Salmon	61.93	8.87
Sardines	4.81	0.69
Sea bass	12.99	1.86
Swordfish	7.85	1.13
Trout	11.61	1.67
Total--HI3 fish	**100.00**	**14.35**
Low Omega-3 fish	%	%
Carp	0.69	0.44
Catfish	6.58	4.18
Clams	3.85	2.44
Conch	0.15	0.10
Cod	8.08	5.13
Crab	11.76	7.47
Croaker	0.39	0.25
Flounder	7.11	4.52
Frog	0.15	0.10
Haddock	2.23	1.41
Halibut	0.16	0.10
Lobster	1.13	0.72
Mullet	0.59	0.37
Octopus/squid	0.97	0.61
Oysters	1.35	0.86
Perch	1.24	0.79
Pike	1.01	0.64
Pollock	1.99	1.26
Porgy	3.67	2.33
Scallops	1.76	1.12
Shrimp	25.37	16.12
Snapper	0.12	0.08
Whiting	1.58	1.00
Mix of fish	12.72	8.08
Don't know type	5.35	3.40
Total—LO3 fish	**100.00**	**63.53**
	%	%
Tuna—mixed types	**100.00**	**22.12**
OVERALL TOTAL		**100.00**

NUTRIENT INTAKES AND OVERALL DIET QUALITY IN MODERATE DRINKERS

RESEARCH QUESTION

The question posed was "What is the relationship between consuming 4 or less alcoholic beverages daily and calorie and nutrient intakes, overall diet quality (HEI), physical activity, and body weight?" or, more specifically, "In 1999-2000, what were the mean nutrient and calorie intakes, overall diet quality scores (Healthy Eating Index), and body mass index for men and women in the U.S., age 21 years and older, who consumed on average more than 0 but less than 1, 1, 2, 3, and 4 alcoholic beverages per day, respectively?"

The physical activity data (METs codes) from NHANES 99-00 have not yet been released so that part of the question was not answered.

METHODOLOGY

Operational definition for number of drinks

From the NHANES 99-00 dataset, researchers at USDA/CNPP calculated a variable, based on the self-reported average number of alcoholic drinks per drinking day consumed over the past 12 months and the average number of drinking days per month. The categories used in the tabulations were defined as follows:

<1 drink = 0.1 - 0.49; 1 drink = 0.5 - 1.49; 2 drinks = 1.5 - 2.49; 3 drinks = 2.5 - 3.49; 4 drinks = 3.5 - 4.49.

Nutrients tabulated

The NHANES 99-00 dataset has about 50 nutrient intake variables of which 28 were included. They were the nutrients used to develop the new food patterns: energy, protein, carbohydrate, dietary fiber, total fat, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, linoleic acid, alpha-linolenic acid, cholesterol, vitamin A, vitamin E, vitamin C, thiamin, riboflavin, niacin, vitamin B-6, folate, vitamin B-12, calcium, phosphorus, magnesium, iron, zinc, copper, sodium (excluding salt added at the table), and potassium. Macronutrient intakes are presented in the tables both as a percentage of energy intake and as absolute intakes, and the micronutrient intakes are presented as nutrients densities (per 1,000 kcal) and as absolute intakes.

RESULTS

Among moderate drinkers, age 21 years and older, in the United States in 1999-2000, body mass index generally decreased with increasing amounts of alcohol consumed (Table G2-35). Energy and nutrient intakes generally increased with increasing amounts of alcohol (Table G2-35); while nutrient density of the diet generally decreased with increasing amounts of alcohol (Table 2G-36). Among women, the Healthy Eating Index (HEI) increased with increasing amounts of alcohol (Table G2-35); whereas, among men, the highest HEI was found among men who consumed an average of 2 drinks per day.

Some exceptions to these general conclusions were found. Men who consumed 3 or 4 drinks per day had lower vitamin A intakes than those who drank less, and the highest calcium intakes were by men who had 2 drinks per day. Vitamin C intakes by men decreased with increasing alcohol intake. Among women, carbohydrate intake decreased with increasing alcohol intake. Dietary fiber intakes by women consuming 2 or 3 drinks per day were lower than those who drank less. Total, saturated, monounsaturated, and polyunsaturated fat intakes were highest (in grams) among women who had an average of 1 drink per day. An exception for nutrient density results (Table G2-36) was that magnesium density in the diets of men increased with increasing alcohol intake.

Table G2-37 demonstrates the internal validity of the alcohol data. Mean alcohol intake as measured by 24-hour recalls increased with increasing amounts of alcohol as determined via self-reported frequency of drinking days over the past year and average number of drinks consumed per drinking day.

Table G2-35. Estimated mean body mass index (BMI), Healthy Eating Index (HEI), and daily energy and nutrient intakes for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000

Average number of drinks per day	Sample size (unweighted)	Body Mass Index	SE a/	Healthy Eating Index	SE	Energy (kcal)	SE
Men:							
<1 c/	631	27.9	0.4	62.8	0.8	2519	52
1	336	26.9	0.4	62.2	0.8	2685	63
2	128	26.8	0.4	64.0	1.6	2728	120
3	78	26.5	0.7	62.9	1.7	3010	174
4	19	28.8	1.1	62.4	3.1	3678	397
Women d/:							
<1 c/	721	27.8	0.4	63.9	0.9	1901	40
1	162	26.9	0.7	63.6	1.4	2066	99
2	46	26.3	0.7	65.9	2.2	1903	96
3	9	25.8	2.5	66.0	4.9	1937	353
4	3	22.9	2.0	70.2	8.8	1979	591

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-35. Estimated mean body mass index (BMI), Healthy Eating Index (HEI), and daily energy and nutrient intakes for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000 (cont.)

Average number of drinks per day	Vitamin A (mcg RE)	SE	Vitamin E (mg a-TE)	SE	Vitamin C (mg)	SE	Thiamin (mg)	SE	Riboflavin (mg)	SE
Men:										
<1 c/	1007	61	10.3	0.4	108	6	1.94	0.05	2.25	0.06
1	1071	123	10.6	0.5	104	6	1.97	0.08	2.29	0.11
2	963	126	9.4	0.5	90	8	1.97	0.12	2.32	0.12
3	951	212	10.0	0.8	115	12	1.95	0.14	2.47	0.18
4	1164	363	12.6	1.9	e/	e/	1.91	0.27	2.70	0.36
Women d/:										
<1 c/	996	82	9.0	0.4	92	6	1.44	0.05	1.71	0.06
1	1005	103	9.0	0.7	94	11	1.46	0.09	1.83	0.10
2	1029	261	7.4	0.7	79	8	1.33	0.12	1.63	0.10
3	e/	e/	e/	e/	52	13	e/	e/	e/	e/
4	e/	e/	7.4	2.1	e/	e/	e/	e/	e/	e/

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-35. Estimated mean body mass index (BMI), Healthy Eating Index (HEI), and daily energy and nutrient intakes for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000 (cont.)

Average number of drinks per day	Niacin (mg)	SE	Vitamin B-6 (mg)	SE	Folate (mcg)	SE	Vitamin B-12 (mcg)	SE	Calcium (mg)	SE	Phosphorus (mg)	SE
Men:												
<1 c/	26.8	0.6	2.08	0.06	428	14	5.9	0.3	951	34	1504	35
1	30.1	1.2	2.23	0.09	437	16	7.2	1.6	968	38	1581	40
2	29.4	1.6	2.29	0.14	402	24	6.0	0.7	1005	72	1603	75
3	32.0	2.1	2.62	0.21	487	40	5.4	0.7	956	78	1679	100
4	39.5	5.1	3.09	0.48	476	59	e/	e/	803	116	1868	281
Women d/:												
<1 c/	20.1	0.6	1.59	0.06	331	13	4.5	0.4	757	26	1144	32
1	20.9	0.9	1.63	0.08	342	23	3.9	0.3	836	59	1257	55
2	20.6	1.7	1.69	0.18	278	21	4.7	0.7	728	45	1137	58
3	e/	e/	e/	e/	e/	e/	e/	e/	1078	283	1272	281
4	e/	e/	e/	e/	e/	e/	4.6	1.1	864	206	1344	317

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-35. Estimated mean body mass index (BMI), Healthy Eating Index (HEI), and daily energy and nutrient intakes for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000 (cont.)

Average number of drinks per day	Magnesium (mg)	SE	Iron (mg)	SE	Zinc (mg)	SE	Copper (mg)	SE	Sodium b/ (mg)	SE
Men:										
<1 c/	327	8	17.8	0.5	13.6	0.3	1.47	0.03	4131	107
1	344	11	17.8	0.7	14.2	0.4	1.60	0.07	4258	157
2	351	17	17.2	1.2	14.6	1.0	1.56	0.09	4068	202
3	416	28	17.8	1.3	14.5	1.1	1.83	0.12	4444	291
4	476	73	18.0	2.7	e/	e/	2.23	0.46	4321	558
Women d/:										
<1 c/	250	8	13.8	0.5	10.2	0.4	1.15	0.03	3062	71
1	278	13	13.3	0.8	10.2	0.6	1.23	0.06	3243	155
2	274	21	11.4	0.8	10.0	0.8	1.31	0.11	2960	203
3	258	53	e/	e/	e/	e/	0.94	0.11	2789	505
4	277	81	e/	e/	e/	e/	e/	e/	e/	e/

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-35. Estimated mean body mass index (BMI), Healthy Eating Index (HEI), and daily energy and nutrient intakes for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000 (cont.)

Average number of drinks per day	Potassium (mg)	SE	Protein (g)	SE	Carbohydrate (g)	SE	Dietary fiber (g)	SE	Cholesterol (mg)	SE
Men:										
<1 c/	3137	76	94.8	2.0	314.8	7.4	17.4	0.6	331	13
1	3207	100	101.6	2.7	312.0	10.8	17.7	0.7	344	15
2	3361	164	104.8	5.8	299.9	12.6	16.5	1.1	360	29
3	3651	282	103.0	6.4	324.6	22.2	21.6	2.4	337	32
4	3870	402	131.9	18.4	334.2	25.7	17.6	2.6	485	81
Women d/:										
<1 c/	2444	73	70.0	1.9	239.8	6.0	13.8	0.6	243	7
1	2671	123	75.9	3.2	247.7	14.5	13.9	0.9	278	23
2	2717	146	73.9	4.4	189.7	12.1	12.3	1.1	282	38
3	2521	621	66.5	12.6	239.5	55.0	11.7	1.9	e/	e/
4	e/	e/	e/	e/	e/	e/	e/	e/	e/	e/

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-35. Estimated mean body mass index (BMI), Healthy Eating Index (HEI), and daily energy and nutrient intakes for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000 (cont.)

Average number of drinks per day	Total fat (g)	SE	Saturated fat (g)	SE	Monounsaturated fat (g)	SE	Polyunsaturated fat (g)	SE
Men:								
<1 c/	96.2	2.8	32.2	1.1	37.2	1.0	19.4	0.7
1	101.3	3.2	33.8	1.1	39.6	1.3	20.1	1.0
2	96.4	5.2	32.6	2.0	38.0	2.1	18.4	1.3
3	102.9	7.8	34.1	2.8	40.4	3.2	20.7	1.8
4	130.2	19.3	39.5	6.0	49.0	7.6	31.8	5.3
Women d/:								
<1 c/	72.7	1.9	24.2	0.7	27.3	0.8	15.8	0.5
1	74.9	4.3	25.4	1.6	28.1	1.6	15.8	1.0
2	67.5	5.6	23.6	1.7	24.7	2.4	14.0	1.7
3	67.1	14.5	23.2	5.4	23.5	5.2	15.9	4.0
4	e/	e/	e/	e/	23.6	6.2	e/	e/

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-35. Estimated mean body mass index (BMI), Healthy Eating Index (HEI), and daily energy and nutrient intakes for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000 (cont.)

Average number of drinks per day	Linoleic acid (g)	SE	Linolenic acid (g)	SE
Men:				
<1 c/	17.3	0.7	1.6	0.1
1	17.9	0.9	1.7	0.1
2	16.4	1.2	1.5	0.1
3	18.6	1.6	1.7	0.2
4	27.6	4.6	2.9	0.6
Women d/:				
<1 c/	14.1	0.5	1.4	0.1
1	13.9	0.9	1.5	0.1
2	12.4	1.5	1.3	0.2
3	13.9	3.5	e/	e/
4	e/	e/	e/	e/

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-36. Estimated mean nutrient intakes, expressed per 1,000 kilocalories of energy intake or as a percentage of energy intake, for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000

Average number of drinks per day	Vitamin A (mcg RE per 1000 Kcal)	SE a/	Vitamin E (mg a-TE per 1000 Kcal)	SE	Vitamin C (mg per 1000 Kcal)	SE	Thiamin (mg per 1000 Kcal)	SE	Riboflavin (mg per 1000 Kcal)	SE	Niacin (mg per 1000 Kcal)	SE
Men:												
<1 c/	429	27	4.1	0.1	45	3	0.80	0.02	0.92	0.02	11.1	0.2
1	421	43	4.0	0.2	41	2	0.74	0.02	0.86	0.03	11.5	0.3
2	349	44	3.5	0.2	35	3	0.75	0.04	0.86	0.03	11.3	0.5
3	306	53	3.4	0.2	40	4	0.67	0.03	0.84	0.04	11.1	0.7
4	e/	e/	3.3	0.3	e/	e/	0.51	0.05	0.74	0.05	10.7	0.8
Women d/:												
<1 c/	546	42	4.7	0.2	51	3	0.77	0.02	0.93	0.03	10.9	0.2
1	508	52	4.4	0.3	50	6	0.73	0.04	0.93	0.05	10.7	0.5
2	539	129	3.8	0.3	42	4	0.73	0.07	0.88	0.04	11.1	0.7
3	e/	e/	e/	e/	30	6	0.77	0.19	1.11	0.29	10.4	2.4
4	e/	e/	3.7	0.2	44	12	1.11	0.17	1.54	0.24	16.5	3.0

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-36. Estimated mean nutrient intakes, expressed per 1,000 kilocalories of energy intake or as a percentage of energy intake, for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000 (cont.)

Average number of drinks per day	Vitamin B-6 (mg per 1000 Kcal)	SE	Folate (mcg per 1000 Kcal)	SE	Vitamin B-12 (mcg per 1000 Kcal)	SE	Calcium (mg per 1000 Kcal)	SE	Phosphorus (mg per 1000 Kcal)	SE	Magnesium (mg per 1000 Kcal)	SE
Men:												
<1 c/	0.86	0.02	175	6	2.5	0.2	384	12	611	10	136	3
1	0.86	0.03	165	5	2.7	0.5	362	12	599	7	132	3
2	0.88	0.05	152	7	2.1	0.2	358	21	588	16	134	7
3	0.88	0.04	163	7	1.9	0.2	330	20	569	20	140	4
4	0.84	0.08	132	9	1.8	0.5	229	35	492	35	127	10
Women d/:												
<1 c/	0.87	0.03	180	6	2.4	0.2	405	11	615	11	136	3
1	0.85	0.04	177	11	2.0	0.2	409	24	623	20	142	5
2	0.91	0.08	151	11	2.4	0.3	388	22	603	19	147	9
3	0.92	0.26	199	46	e/	e/	541	81	648	62	131	11
4	1.59	0.35	e/	e/	2.2	0.5	428	58	666	96	137	7

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-36. Estimated mean nutrient intakes, expressed per 1,000 kilocalories of energy intake or as a percentage of energy intake, for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000 (cont.)

Average number of drinks per day	Iron (mg per 1000 Kcal)	SE	Zinc (mg per 1000 Kcal)	SE	Copper (mg per 1000 Kcal)	SE	Sodium b/ (mg per 1000 Kcal)	SE	Potassium (mg per 1000 Kcal)	SE	Cholesterol (mg per 1000 Kcal)	SE
Men:												
<1 c/	7.3	0.2	5.5	0.1	0.60	0.01	1654	28	1301	26	136	5
1	6.7	0.2	5.3	0.1	0.61	0.02	1601	37	1245	29	133	6
2	6.4	0.4	5.4	0.3	0.59	0.02	1517	67	1283	59	124	6
3	6.1	0.3	5.0	0.3	0.61	0.02	1542	88	1233	85	115	10
4	4.8	0.4	4.8	1.1	0.56	0.05	1178	98	1082	86	134	25
Women d/:												
<1 c/	7.6	0.2	5.5	0.2	0.63	0.01	1641	23	1341	31	132	4
1	6.8	0.3	5.2	0.3	0.63	0.03	1633	45	1394	58	140	10
2	6.0	0.3	5.2	0.3	0.69	0.05	1557	99	1476	63	143	18
3	6.9	1.9	e/	e/	0.52	0.05	1476	153	1253	182	103	23
4	e/	e/	e/	e/	0.64	0.03	1188	162	1381	148	96	10

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-36. Estimated mean nutrient intakes, expressed per 1,000 kilocalories of energy intake or as a percentage of energy intake, for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000 (cont.)

Average number of drinks per day	Dietary fiber (g per 1000 Kcal)	SE	Protein (% Kcal)	SE	Carbohydrate (% Kcal)	SE	Total fat (% Kcal)	SE	Saturated fat (% Kcal)	SE	Monoun-saturated fat (% Kcal)	SE
Men:												
<1 c/	7.1	0.2	15.5	0.2	50.2	0.6	33.8	0.5	11.3	0.2	13.0	0.2
1	6.8	0.2	15.5	0.3	46.6	0.8	33.5	0.7	11.1	0.2	13.1	0.3
2	6.3	0.4	15.5	0.6	45.1	1.0	30.6	0.9	10.2	0.4	12.1	0.4
3	7.3	0.6	14.2	0.7	42.8	1.4	31.2	1.6	10.3	0.6	12.2	0.7
4	4.9	0.7	13.9	0.6	37.7	2.8	31.3	2.6	9.5	0.8	11.8	1.1
Women d/:												
<1 c/	7.6	0.3	15.1	0.3	50.7	0.6	34.1	0.6	11.3	0.2	12.7	0.2
1	7.2	0.5	15.4	0.7	47.5	1.6	32.4	0.9	10.8	0.4	12.1	0.4
2	6.8	0.6	15.7	0.7	41.1	1.9	31.5	1.6	11.1	0.6	11.6	0.7
3	6.2	0.4	13.8	1.6	49.3	4.7	30.7	4.7	10.8	2.0	10.7	1.4
4	e/	e/	12.6	1.9	49.6	6.8	29.5	2.4	9.2	0.8	10.7	0.6

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-36. Estimated mean nutrient intakes, expressed per 1,000 kilocalories of energy intake or as a percentage of energy intake, for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000 (cont.)

Average number of drinks per day	Polyunsaturated fat (% Kcal)	SE	Linoleic acid (% Kcal)	SE	Linolenic acid (% Kcal)	SE
Men:						
<1 c/	6.9	0.2	6.1	0.2	0.6	0.0
1	6.7	0.3	6.0	0.2	0.6	0.0
2	5.9	0.3	5.2	0.3	0.5	0.0
3	6.2	0.4	5.6	0.4	0.5	0.0
4	7.6	0.9	6.7	0.8	0.7	0.1
Women d/:						
<1 c/	7.5	0.2	6.6	0.2	0.6	0.0
1	7.0	0.4	6.1	0.3	0.7	0.1
2	6.4	0.6	5.7	0.5	0.6	0.1
3	7.1	1.4	6.2	1.2	0.7	0.2
4	7.1	1.2	6.3	1.0	e/	e/

a/ Standard error of the mean.
b/ Excludes salt added at the table.
c/ Greater than 0, but less than 1.
d/ Excludes pregnant and lactating.
e/ Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000

Table G2-37. Estimated mean alcohol intakes for men and women, age 21 years and older, who drank moderate amounts of alcoholic beverages in the United States, 1999-2000

Average number of drinks per day [a]	Sample size (unweighted)	% of population (weighted)	Alcohol [b,c] (grams)	SE [d]
Men:				
<1 [e]	631	38.3	7	1
1	336	22.5	22	2
2	128	9.6	39	5
3	78	5.3	59	13
4	19	1.5	97	27
Women [f]:				
<1 [e]	721	42.9	5	1
1	162	11.2	19	4
2	46	3.7	38	4
3	9	0.7	[g]	[g]
4	3	0.4	[g]	[g]

[a] Calculated from self-reported average number of drinks on drinking days and frequency of drinking days over the past 12 months.
[b] Calculated from 24-hour recalls of dietary intake.
[c] 12 oz beer = 12.8 grams alcohol; 5 oz wine = 13.5 grams alcohol; 1.5 oz 80 proof distilled spirits = 14.0 grams alcohol.
[d] Standard error of the mean.
[e] Greater than 0, but less than 1.
[f] Excludes pregnant and lactating.
[g] Coefficient of variation is greater than or equal to 30 percent.

Source: National Health and Nutrition Examination Survey, 1999-2000