

Impact of Using Updated Food Consumption and Composition Data on Selected MyPyramid Food Group Nutrient Profiles

Sedigheh Yamini, PhD, RD¹; WenYen Juan, PhD²; Kristin Marcoe, MBA, RD²; Patricia Britten, PhD²

ABSTRACT

Objective: To examine the changes observed in 5 nutrients of selected USDA food subgroups by partitioning the overall changes into those caused by consumption changes over time, and those caused by nutrient database revisions.

Design: Population-weighted estimates of food group intakes (composites) were developed using 24-hour recall data from CSFII 1994-96 and NHANES 1999-2000. Nutrient profiles of these composites were developed using Standard Reference (SR) data (SR11 and SR16-1).

Subjects: A total of 14,262 and 8070 individuals over the age of 2 years from CSFII and NHANES, respectively, composed the study sample.

Outcome Measures: Absolute and percent change in food group nutrient content caused by food consumption changes and nutrient database updates.

Analysis: Changes due to consumption differences were determined by comparing nutrient profiles created with CSFII and NHANES using SR11. Changes due to nutrient database differences were determined by comparing nutrient profiles created from NHANES data using SR11 and SR16-1 nutrient values.

Results: Consumption differences resulted in some variations in the food group nutrient content, but a majority of the changes were associated with use of the updated nutrient database. For example, vitamin A level in the orange vegetable subgroup was increased by 2.4% owing to consumption (from CSFII to NHANES), whereas the level was decreased by 38% due to nutrient updates (from SR11 to SR16-1).

Conclusion and Implications: Consideration of the changes in nutrient databases, as well as in food consumption, is essential in monitoring both the trends in the food choices Americans make and the adequacy of their diets.

Key Words: MyPyramid, food intake patterns, food composition database

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INTRODUCTION

Tracking food consumption and nutrient intake patterns of a population over time is of interest to many public health

educators, health scientists, epidemiologists, policy makers, and professionals in private industry. Information about changes in food consumption and nutrient intake can be of use in: 1) developing dietary guidance materials for the American population; 2) targeting nutritional problems in specific groups (such as children or the elderly); 3) identifying relationships between diet and disease; 4) planning and assessing policies such as fortification of foods; and 5) predicting consumer needs for future market changes. The National Nutrition Monitoring and Related Research Program is a complex system of coordinated activities to monitor the nutritional status of the U.S. population.¹ As a basis of this program, national food consumption surveys provide information on food intake by Americans for use in policy formation, regulation, program planning and evaluation,

¹FDA Center for Food Safety and Applied Nutrition, formerly with USDA Center for Nutrition Policy and Promotion, Alexandria, VA

²USDA Center for Nutrition Policy and Promotion, Alexandria, VA

Address for correspondence: Sedigheh Yamini, PhD, Center for Food Safety and Applied Nutrition, Food and Drug Administration, 5100 Paint Branch Parkway, HFS830, College Park, MD 20740; Phone: (301) 436-1681; Fax: (301) 436-2636; E-mail: Essie.Yamini@fda.hhs.gov.

All of the figures in this article have also been compiled into an online slideshow. See www.JNEB.org, under supplementary material for this article.

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education, and research. These surveys include the Continuing Survey of Food Intakes by Individuals (CSFII), conducted by the United States Department of Agriculture (USDA),² and the National Health and Nutrition Examination Survey (NHANES), conducted by the Department of Health and Human Services (HHS).³ The datasets from these surveys are crucial for examining changes over time in the food choices of Americans and the adequacy of the diets resulting from these food choices.

The USDA Agricultural Research Service (ARS) develops the National Nutrient Database for Standard Reference (SR), the major source of food composition data in the United States,⁴ which is used in the development of specialized databases for the analysis of food intake survey data. The SR database is updated annually to reflect changes in foods on the market and to incorporate improved nutrient values. In general, changes in the nutrient values could be a result of many types of updates in the food composition database, including improved analytical techniques,⁴ better food sampling methods, changes to database food weights, enrichment or fortification, and reformulation.⁵ For example, an improved technique resulted in a more accurate and lower measurement of the cholesterol content of eggs.⁵ Updated nutrient values may substantially affect the results of analyses that rely on these data.

Earlier studies have illustrated that apparent changes in nutrient intakes over time can be explained, in part, by updates in food composition data because of improved analytical techniques.⁵⁻⁸

The changes in both consumption and composition of foods need to be considered when investigating and developing dietary recommendations for Americans, such as the food intake patterns for USDA's MyPyramid Food Guidance System (MyPyramid). These patterns were developed to meet current nutritional standards for adequacy and moderation. The patterns are based on foods commonly consumed by Americans, as determined from national food consumption surveys, to make the recommendations realistic and practical. The research reported here is based on a question that emerged as the nutrient profiles for MyPyramid were being developed. It provides additional information about these profiles and how they may be impacted by new food consumption or composition data. Original consumption and nutrient content estimates used to develop MyPyramid composites and nutrient profiles were calculated using the consumption data from CSFII 1994-96 and nutrient data from its Survey Nutrient Database (based on SR11). The detailed procedures for and results of establishing MyPyramid food group and subgroup composites, nutrient profiles, and food intake patterns are reported in accompanying articles.^{9,10} When more recent food consumption data became available, the investigators updated the food group composites with the NHANES 1999-2000 food consumption data. The nutrient data used in NHANES 1999-2000 were also based on SR11, with folate fortification updates for grain products from SR12. To update the nutrient values used to calculate MyPyramid nutrient profiles, the NHANES 1999-2000 dataset was modified to

incorporate nutrient data from SR16-1. NHANES 1999-2000 was used and updated with SR16-1 because at the time of developing the food composites, the Food and Nutrient Database for Dietary Studies (FNDDS)¹¹ and NHANES 2001-02 had not been released. The nutrient values for 144 food items were used to develop the food group and subgroup composites for MyPyramid. These food items were selected as "item clusters" to represent the 4108 food items reported consumed in NHANES. A detailed description for this process can be found in an accompanying article.⁹ The nutrient values for these representative food items were manually matched from SR16-1. There were no missing nutrient values for these representative foods.

Other studies⁵⁻⁸ have documented changes in estimated nutrient intake of the U.S. population due to food composition database updates. However, no study has specifically focused on how food composition and food consumption database updates affect the nutrient profile of MyPyramid food group composites and food intake patterns. The purpose of this research project was to determine the impact of using a more recent national food consumption survey and an updated food composition database on the nutrient profiles of food composites used to develop MyPyramid food intake patterns. In general, we sought to learn how much of the change in selected nutrient profiles for MyPyramid intake patterns was caused by the differences in consumption over time versus how much was due to upgraded nutrient values.

STUDY PROCEDURES

The development process for the food group composites, nutrient profiles, and food intake patterns for MyPyramid are reported in detail in accompanying articles.^{9,10} Food group composites, which represent the weighted average intake of foods within each food group and subgroup, were established based on national food consumption data. These food group composites were used in the iterative development of food intake patterns that included the types of foods Americans most commonly eat, but with the amounts from each food group and subgroup modified to represent healthful proportions. To determine these proportions, nutrient profiles were calculated using a weighted average of the nutrients supplied by the foods in that group, with weights based on nationwide consumption of the food items. The total amount of each nutrient in the pattern was calculated by using the nutrient profile multiplied by the amount recommended from that particular group. Then the total amount of each nutrient in the pattern was compared to the nutritional goal for that nutrient, and changes were made in the food patterns until goals were met.

We used food consumption data, collected via two non-consecutive 24-hour recalls, from the CSFII 1994-96 survey of 14,262 individuals over the age of 2 years with reliable dietary intake data for initial calculations. These data were used to determine initial food group and subgroup composites and nutrient profiles for the MyPyramid food intake patterns. The

initial nutrient profiles and food intake patterns were presented for public comment through a Federal Register notice in 2003.¹² A total of 8541 food items were reported to be consumed in the CSFII survey. The food composition database for this survey was based on SR11, which was released in 1996 by ARS.¹³ Later, food consumption data from the NHANES 1999-2000 survey, based on one 24-hour recall, were used to develop updated food group composites and nutrient profiles. About 8070 individuals over the age of 2 years old were included in this survey. About 4108 foods were reported to be consumed during this time period. The NHANES 1999-2000 survey also used SR11 nutrient values with updates from SR12 (released in 1998), to accommodate folate fortification of the grain products. Subsequently, we re-evaluated the nutrient profiles for the food intake patterns using NHANES 1999-2000 consumption data with SR16-1 nutrient data to reflect the new food composition values current at the time of the analyses.¹⁴ The food composite and nutrient profile updates were analyzed using SAS version 9.1 (SAS Institute, Inc., Cary, NC). Microsoft Excel 2003 (Microsoft Corp., Redmond, WA) was used to calculate the overall differences in nutrient profiles for each food group and subgroup among those based on NHANES-SR16-1 and those based on CSFII-SR11 (Figure 1). We then partitioned the differences in the nutrient profiles into the amount that was due to changes in consumption versus the amount that was due to changes in the food composition database (Figure 1). To determine changes due to consumption, we compared nutrient profiles based on NHANES-SR11 with those based on CSFII-SR11. To identify differences due to changes in the food composition database, we compared nutrient profiles based on NHANES-SR16-1 with those based on NHANES-SR11. We then converted all changes into percentages of the base and percentages of the RDA.¹⁵⁻²⁰ Since vitamins A and E in SR11 had not been updated to the preferred units (retinol activity equivalent [RAE] for vitamin A, alpha tocopherol for

vitamin E) at the time of this study, a manual conversion was performed. We also adjusted for the folate fortification updates in the grain products in CSFII-SR11.

The final food intake patterns in the accompanying article¹⁰ and on the MyPyramid Web site (www.MyPyramid.gov) are based on food group composites using NHANES 1999-2000 food intake data and nutrient profiles updated with SR17 nutrient values. However, during the analysis reported in this article, SR17 had not yet been released. Therefore, this paper reports findings based on SR16-1 and SR11.

We calculated the nutrient content in each food group and subgroup for energy, 9 vitamins, 8 minerals, 8 macronutrients, and dietary fiber, using both surveys and with both SR datasets. From these values, we calculated the overall nutrient content of the MyPyramid food intake patterns at 12 different calorie levels (1200 to 3200 calories) and compared the nutrient content of the patterns to the DRI intake recommendations for various age and gender groups.¹⁵⁻²⁰ To illustrate how the overall changes in nutrient levels of the MyPyramid food group composites can be separated into the differences caused by changes in consumption and by food composition database updates, data are presented on selected food subgroups (dark-green vegetables, orange vegetables, dry peas and beans, and whole grains) and nutrients (vitamins A, E, C, niacin, and folate). These 4 food subgroups and 5 nutrients were chosen to be illustrative of the magnitude of change exhibited in some of the subgroups' nutrient values. Some of the nutrients reported also represent nutrients of concern recently identified in the 2005 *Dietary Guidelines for Americans*.²¹

FINDINGS

Table 1 displays the nutrient profiles of food subgroups using different consumption surveys (CSFII 1994-96 and NHANES 1999-2000) and food composition databases (SR11 vs. SR16-1). The CSFII-SR11 values represent baseline nutrient levels; NHANES-SR11 values represent levels for updated consumption data with the same nutrient data as CSFII-SR11; and NHANES-SR16-1 values represent updated consumption and composition data. Table 2 shows selected sample food items from each of the food subgroups presented in Table 1 and illustrates the changes in nutrient values between SR11 and SR16-1. These sample food items represent the item clusters with the largest consumption within the selected MyPyramid food subgroup. Additional details on food items in each food group and subgroup and their relative consumption are reported in detail in an accompanying article.⁹

Overall Differences

Profound differences were observed in nutrient profiles of some food groups and subgroups (only selected data are reported here). For example, in the orange vegetable subgroup, vitamin A levels using NHANES-SR16-1 data were substantially

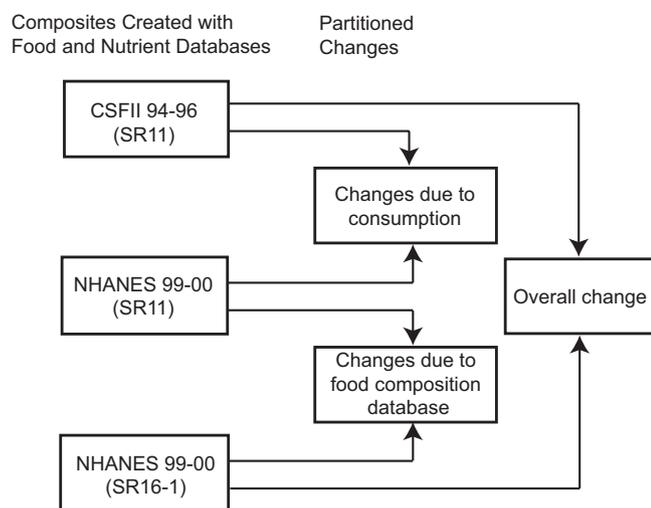


Figure 1. Schematic Diagram of the Process for Calculating and Partitioning Differences in Nutrient Content of Food Group Composites Due to Changes in Consumption Versus Changes in Food Composition Values

Table 1. Selected Nutrient Levels in Reference Amounts from Chosen Food Subgroups Using Different Sources of Food Consumption and Nutrient Data

Nutrients/ Food Subgroups and Amount	Vitamin A μg RAE		Vitamin E mg AT		Vitamin C mg		Niacin mg		Folate μg DFE	
	SR11	SR16-1	SR11	SR16-1	SR11	SR16-1	SR11	SR16-1	SR11	SR16-1
Dark-green vegetables, ½ cup										
CSFII ^a -SR11	124 ^c		0.90		40		0.42		62	
NHANES ^b -SR11	118		0.78		33		0.38		63	
NHANES ^b -SR16-1	167		1.00		30		0.36		81	
Orange vegetables, ½ cup										
CSFII ^a -SR11	872		0.24		5.8		0.47		11	
NHANES ^b -SR11	893		0.24		5.7		0.47		11	
NHANES ^b -SR16-1	554		0.61		4.8		0.63		10	
Dry beans & peas, ½ cup cooked										
CSFII ^a -SR11	0.50		0.09		0.81		0.32		78	
NHANES ^b -SR11	0.78		0.08		0.70		0.31		74	
NHANES ^b -SR16-1	0.03		0.58		0.45		0.33		111	
Whole grains, 1 oz equivalent										
CSFII ^a -SR11	54		0.18		1.46		1.41		28	
NHANES ^b -SR11	56		0.15		1.45		1.33		29	
NHANES ^b -SR16-1	26		0.09		0.61		1.31		37	

^aCSFII 1994-96^bNHANES 1999-2000^cAll numbers are rounded.

lower compared to the baseline levels using CSFII-SR11 data. However, the vitamin A content of dark-green vegetables with NHANES-SR16-1 data was higher than the baseline values. Other overall changes included higher folate levels in dark-green vegetables, dry beans and peas, and whole grains, and lower vitamin C in dark-green vegetables in NHANES-SR16-1 than CSFII-SR11 (Table 1).

Differences Attributable To Consumption Changes

Vitamin A levels in the orange vegetable, dry beans and peas, and whole grain composites were higher using NHANES in comparison to CSFII. In contrast, vitamin E levels were lower using NHANES versus CSFII for 3 of the

Table 2. Comparison of Selected Nutrients in Sample Food Items from Chosen Food Subgroups between Standard Reference Releases SR11 and SR16-1

Nutrients/ Food Items and Amount	Vitamin A μg RAE		Vitamin E mg AT		Vitamin C mg		Niacin mg		Folate μg DFE	
	SR11	SR16-1	SR11	SR16-1	SR11	SR16-1	SR11	SR16-1	SR11	SR16-1
	Dark-green vegetables									
Broccoli, cooked, ½ cup	64	90	1.24	1.33	69	60	0.53	0.51	46	99
Spinach, cooked, ½ cup	389	498	0.73	1.98	9.3	9.3	0.47	0.47	139	139
Romaine, raw, 1 cup	41	43	0.14	0.18	2.6	2.6	0.16	0.16	57	57
Orange vegetables										
Carrots, cooked, ½ cup	896	628	0.25	0.75	1.7	2.6	0.37	0.47	10	10
Carrots, raw, ½ cup	858	367	0.22	0.40	5.7	3.6	0.57	0.60	8.5	12
Sweet potatoes, cooked, ½ cup	1091	961	0.22	0.71	25	20	0.60	1.60	22	6
Dry beans & peas										
Pinto beans, cooked, ½ cup	0	0	0.65	0.81	1.8	0.70	0.35	0.17	149	149
White beans, cooked, ½ cup	0	0	0.15	0.76	0	0	0.12	0.12	71	71
Soy beans, cooked, ½ cup	5.6	0	0.01	0.01	0	0.25	0.24	0.66	55	19
Whole grains										
Whole-wheat bread, 1 slice	0	0	0.23	0.09	0	0	1.1	1.1	14	14
Whole-wheat ready-to-eat cereal Kellogg's Raisin Bran, 1 ounce	79	71	0.52	0.22	0	0.2	3.8	2.4	76	77
Corn tortilla, 1 tortilla	3	0	0.03	0.02	0	0	0.37	0.37	29	40

4 subgroups examined. Vitamins A, E, C, and niacin levels were also lower in the dark-green vegetable subgroup due to changes in consumption between CSFII and NHANES (Table 1).

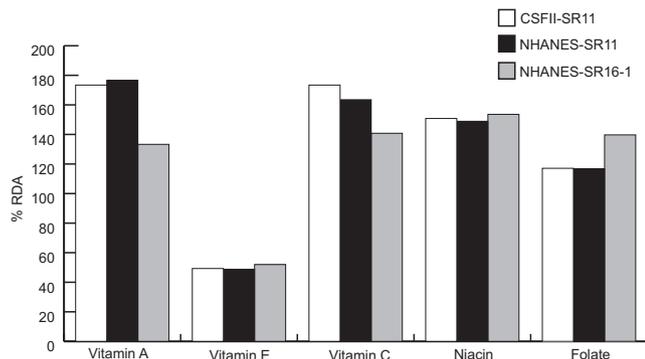
Differences Attributable To Food Composition Database Changes

In comparison to nutrient levels determined using the NHANES-SR11 data, NHANES-SR16-1 levels of vitamin A were lower by about 38%, 96%, and 54% in orange vegetables, dry beans and peas, and whole grains subgroups, respectively. Although the vitamin A content of orange vegetables is substantial, amounts in dry beans and peas and whole grains are very small, as these foods are not good sources of vitamin A (Table 1). Their values are presented for illustrative purposes only. In contrast to the decreased amount of vitamin A in these subgroups, its level was higher in the dark-green vegetable subgroup when using SR16-1 data. Folate levels were about 51% and 29% higher in the dry beans and peas and whole grains subgroups, respectively, with the updated food composition database.

In contrast, the changes seen in vitamin C and niacin levels with updated nutrient data were small in all subgroups. Vitamin E levels increased in dark-green and orange vegetables and dry beans and peas when comparing SR16-1 with SR11 data, but the amounts in each subgroup remained at modest levels (Table 1).

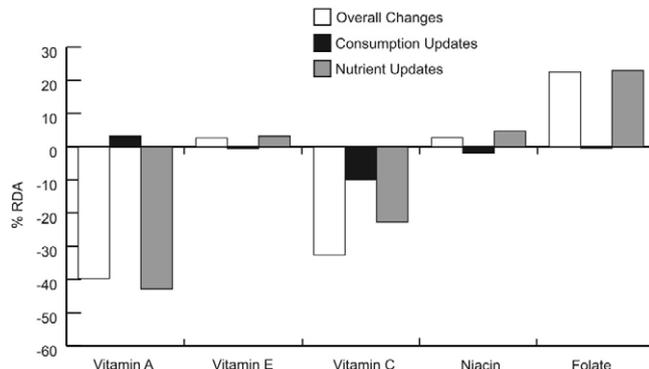
Differences In Overall Food Intake Pattern

To identify the overall impact of these changes in nutrient content due to consumption versus food composition database updates, we examined the nutrient levels in representative food intake patterns at various calorie levels using the different consumption and nutrient content data. The 1800-calorie pattern was selected for illustration here, and nutrient levels were expressed as the percentage of RDA for



All numbers are rounded.

Figure 2. Selected Total Nutrient Levels, Reported as a Percent of the RDA for Females 31 to 50 Years of Age, in the 1800-Calorie Daily Food Intake Pattern (based on composites)



Overall Changes = (nutrient levels as % of RDA in NHANES-SR16-1) - (nutrient levels as % of RDA in CSFII-SR11)
 Consumption Updates = (nutrient levels as % of RDA in NHANES-SR11) - (nutrient levels as % of RDA in CSFII-SR11)
 Nutrient Updates = (nutrient levels as % of RDA in NHANES-SR16-1) - (nutrient levels as % of RDA in NHANES-SR11)

Figure 3. Actual Differences in Selected Nutrient Levels, Reported as a Percent of the RDA for Females 31 to 50 Years of Age, in the 1800-Calorie Daily Food Intake Pattern (based on composites), Due to Changes in Food Consumption Versus Changes in Food Composition Database Updates

a 31-50 year old female (Figures 2 and 3). Figure 2 illustrates the nutrient levels in the overall food intake pattern, reported as a percentage of the RDA, and shows nutrient levels based on the different consumption and food composition databases. Figure 3 shows the changes in these overall nutrient levels, as a percentage of the RDA, based on consumption changes, nutrient updates, and overall changes.

As the figures illustrate, consumption differences resulted in some minor changes in nutrient content of the food intake pattern, whereas a majority of the overall changes were associated with updates in the food composition database. This was also the case for most of the other nutrients in the intake patterns (data not shown). For example, owing to consumption changes from CSFII-SR11 to NHANES-SR11 alone, the vitamin A level in the 1800-calorie food intake pattern increased by 3 percentage points, whereas changes in the vitamin A level owing to nutrient data update (SR16-1 to SR11) decreased by 43 percentage points (Figure 3). This finding resulted in an overall level of vitamin A in the intake pattern that was about 40 percentage points lower than it had been using older consumption and nutrient data. However, regardless of changes in the consumption and food composition database, vitamin A and most other nutrient levels (in addition to the ones shown in the figures) in the intake patterns remained above the recommended level (Figure 2). The exception was vitamin E, which exhibited little overall change but was below recommended levels regardless of the data used.

DISCUSSION

Although some changes in the nutrient profile were related to the different surveys (NHANES 1999-2000 vs. CSFII

1994-96), a majority of the changes were owing to updates in food composition databases (update from SR11 to SR16-1). Similar findings have been shown previously by others.⁵⁻⁸ Ahuja et al⁸ also reported significant differences in mean intake estimates for most nutrients when comparing CSFII 1994-96, 98 intake using the Survey Nutrient Database versus the multiyear version of FNDDS. They observed a greater difference in vitamin C and magnesium levels. These researchers attributed their differences to artifactual changes. In our study, the differences we identified in vitamin A levels between SR11 and SR16-1 can be attributed to a change in the nutrient values for foods examined with newer, more precise analytical techniques.²² The impact of this change can be seen in the orange vegetable nutrient values (Tables 1 and 2); orange vegetables are a major source of vitamin A. Although use of updated consumption and food composition data did not impact the overall adequacy of the MyPyramid food intake patterns (Figure 2), there were some relatively large changes in the nutrient content of the patterns for several nutrients (Figure 3).

There are many other changes that occur in a food composition database that may or may not impact nutrient values. Since 1985, over 30,000 revisions have been made to database nutrient values.⁵ More information on various changes and handling of the updates in the food composition database have been reported elsewhere.^{4,5}

About 773 new food items were reported in NHANES 1999-2000 that were not reported in CSFII 1994-96, whereas about 984 food items were included in the CSFII that were not reported in NHANES. This finding suggests that the food items available on the market are constantly changing. Additionally, consumer demands influence the food industry to reformulate many of their products or to market new items to meet the demands of a health-conscious American population. For example, since the release of the 2005 Dietary Guidelines, whole-grain ingredients have been added to or have replaced refined grains in many food items such as cereals. Using A.C. Nielsen data to compare the 8 weeks before and after the release of the 2005 Dietary Guidelines, researchers at the USDA Economic Research Service reported increased purchases of whole-grain bread, whole-grain rice, and whole-grain ready-to-eat cereals by 12%, 19%, and 16%, respectively.²³

To ensure that analyses of food intake and food composition are meaningful, the databases used for these analyses must be updated frequently to incorporate the latest information about foods consumed by Americans. The findings of this study show the importance of updating the food composition databases for the national food consumption survey to echo the changes in foods on the market, to incorporate new analytical data, and to reflect the fortification and formulation of the new foods eaten by the population. It is imperative that food composition databases accurately reflect the nutrient content of the food at the time when a survey was conducted and that the scientific community is aware of this important association, which might otherwise be overlooked. The Nu-

trient Data Laboratory at USDA/ARS provides general documentation, with the release of each new Standard Reference, on the categories of foods where changes have occurred in nutrient values.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Future updates to MyPyramid food intake patterns will continue to be grounded in research based on the most up-to-date food consumption and composition information that is available at the time. Any changes in MyPyramid food groups will be assessed, and these changes may impact potential new recommendations. Findings from this study and similar research⁵⁻⁸ underline the importance of identifying the sources of any changes seen in the nutrient content of diets, such as changes in food composition databases. If the same nutrient data are not used for analysis of different food consumption studies, artifactual differences may be much larger than differences due to consumption changes. When comparing food consumption or diets over time, practitioners also need to be aware that differences in nutrient values may be attributable to changes in nutrient data and may not reflect changes in consumer behavior, but rather updated analytical methods or new product formulations.

SUPPLEMENTARY DATA

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.jneb.2006.08.003](https://doi.org/10.1016/j.jneb.2006.08.003).

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