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STUDY REVIEW

Tracking Nutrient Changes for Trends Analysis in the United States

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Knowledge of food and nutrient consumption patterns over time is important to various types of research related to the health and well-being of the population. To ensure that food consumption trend analyses are meaningful, food databases must be updated frequently to incorporate the latest information. Systems should also be in place to categorize and track the types of changes that occur as food databases are updated. The Food Surveys Research Group at USDA has implemented a Survey Nutrient Database for Trends Analysis for use with food consumption surveys in the United States. Within this system, items may be added, or existing items may be revised. "Data Improvements", such as new nutrient values representing improved analytical methods, replace existing values and may be applied retroactively to previous nutrient analyses. Revisions classified as actual "Food Changes" are inserted into the database, with older values remaining to represent the food items as they previously existed. Dates accompany each database value to indicate the time period for which it is valid. Since 1985, over 30 000 revisions have been made to the database nutrient values. Package sizes, portion weights, food names, and recipes used for nutrient calculations are also tracked within the system.

Key Words: nutrient database; food and nutrient consumption; trends analysis; database updates; data improvements; food changes.

INTRODUCTION

Tracking food and nutrient consumption patterns of a population is an important research activity that has many applications. Knowledge about consumption trends helps health scientists and epidemiologists identify relationships between diet and disease. Public health educators use consumption data to develop dietary guidance materials for the general population and to target nutritional problems in certain groups. Government policy makers rely on these data to plan and evaluate food policies such as nutrient enrichment and fortification of foods. In the private sector, consumption data serve as a resource for predicting future consumer needs.

To ensure that food and nutrient consumption analyses are meaningful, the databases used for these analyses must be updated frequently to incorporate the latest information about the food supply. For comparative studies, nutrient intake data

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collected in earlier years may require adjustments to improve comparability with more current intakes. Previous analyses have indicated that changes in the nutrient database due to improved analytical techniques and better food sampling methods can cause artifactual differences in some nutrients when intakes were compared over time (Guenther *et al.*, 1994; Guenther and Perloff, 1990). To accurately track changes in intake over time and avoid artifactual differences, food databases must reflect real differences in food composition as well as data improvements that are applied retroactively. This article will discuss the food and nutrient tracking characteristics of the Survey Nutrient Database for Trends Analysis developed to process food intake data from the U.S. Department of Agriculture's (USDA) Continuing Survey of Food Intakes by Individuals 1994–1996, 1998 (CSFII), popularly known as "What We Eat in America" (Tippett and Cypel, 1997).

SURVEY NUTRIENT DATABASE FOR TRENDS ANALYSIS IN THE U.S. SYSTEM COMPONENTS

USDA's Survey Nutrient Database for Trends Analysis is a large, complex system consisting of four main components: nutrient values, recipes, food descriptions, and food weights (U.S. Department of Agriculture, 2000). There are over 7600 food items in the database, and each food item has a set of nutrient values and gram weights for various measures associated with it. Many of these food items are mixtures for which nutrients are calculated based on a recipe. Each recipe consists of various ingredients that determine the nutrient content of the food item. Tracking and categorizing changes in nutrient values are done at the level of these basic ingredients. A change to a recipe results in a change to the nutrient profile of that food item. The database contains approximately 3300 of these unique ingredient items which function as recipe components, or represent basic food items such as milk or cheese. Each of these 3300 ingredient items has values for 52 nutrients and other food components. Thus, over 171 000 different values are currently maintained in the database. All of the values used in the database system are provided by USDA's Nutrient Data Laboratory (NDL). The majority of the nutrient values come from the USDA Nutrient Database for Standard Reference (U.S. Department of Agriculture, 1999). A complete list of the 52 nutrients and other components is shown in Table 1.

Food descriptions are another part of the database system that are updated on a regular basis. Although changes to food descriptions do not directly impact nutrients, it is often useful to keep track of this information for a historical perspective, especially for brand name foods. In terms of coding survey data, a database with updated food names makes locating and selecting the correct food item easier, and the quality of the coded data is enhanced. One example of a food name change is the baby formula Carnation® Alsoy®, which was formally called I-Soyalac®. Breakfast cereals also undergo frequent name changes. Another example is milk with 2% fat which used to be called "low-fat" milk, but due to changes in labeling regulations, is now called "reduced fat" milk.

The database currently contains over 33 000 gram weight records. Changes to database food weights are quite common and may generate changes in nutrient values in some instances. Changes to individual-sized manufactured food packages are of particular interest due to their potential impact on nutrient levels. For example, if the weight of a typical single-serving package of crackers decreases, then the amount of nutrients corresponding to the gram weight of "1 individual package" will also decrease.

TABLE 1

Fifty-two food components included in the Survey Nutrient Database for Trends Analysis

Food energy	Cholesterol
Protein	Total saturated fatty acids
Total fat	Total monounsaturated fatty acids
Carbohydrate	Total polyunsaturated fatty acids
Moisture	
Total dietary fiber	Individual fatty acids
Alcohol	4:0
Caffeine	6:0
Theobromine	8:0
	10:0
Calcium	12:0
Iron	14:0
Magnesium	16:0
Phosphorus	16:1
Potassium	18:0
Sodium	18:1
Zinc	18:2
Copper	18:3
Selenium	18:4
	20:1
Vitamin A (IU)	20:4
Vitamin A (RE)	20:5
Carotenes (RE)	22:1
Vitamin E (α-tocopherol eq.)	22:5
Vitamin C	22:6
Thiamin	
Riboflavin	
Niacin	
Vitamin B_6	
Folate	
Vitamin B_{12}	

DATABASE SYSTEM UPDATES

Additions

To keep pace with an ever-expanding food supply, new additions to the database must occur regularly. Additions to the database may be in the form of new food items, new nutrients, or new gram weights. A new food name, values for all 52 food components, recipe ingredients, and gram weights for several common measures must be added for every new food item included in the database. Take Control® spread as one example of a new food product added to the database recently. In 1998, values for the micronutrient selenium were added to the nutrient profiles of each of the 3300 basic food items in the database. Gram weights for new or additional measures are frequently added to existing food items. For example, weights for “grab-size bags”, which are larger than the typical 1–$1\frac{1}{4}$ ounce (28–35 g) single-serving bags, were added to the applicable food items in the database, namely potato chips and corn chips. Likewise, a new weight for an “extra large muffin” was added a few years ago to all the muffin food items in the database.

Revisions

Adding new items is just one method of maintaining an updated, timely database. Frequently, existing database values need revising. Since the inception of the database

TABLE 2

Examples of Food Changes to the CSFII 1994–1996, 1998 nutrient database due to folate fortification

Food item	Folate (μg/100 g)	Start date	End date
Biscuit	7.0	01/01/1994	11/30/1997
	59.0	12/01/1997	11/30/1998
White bread	34.0	01/01/1994	11/30/1997
	95.0	12/01/1997	11/30/1998
Beef noodle soup	3.5	01/01/1994	11/30/1997
	15.0	12/01/1997	11/30/1998
Bagel	22.0	01/01/1994	11/30/1997
	88.0	12/01/1997	11/30/1998

system in 1985, over 30 000 changes have been made in the database files. Database changes are categorized based on the fundamental reason for the change. If a database value changes because the food itself has actually changed, then the revision is called a Food Change. When an improvement in the available data causes a database value to change, the change is described as a Data Improvement. These two types of changes are handled differently by the system.

Food Changes. When a Food Change occurs, the older value remains in the system with dates attached to indicate the time period for which the value is valid. The new value is inserted with the appropriate date designating when it became effective. Thus, every Food Change will have at least two values with effective dates associated with it. For example, all enriched grain products have one folate value that represents the product *before* the folate fortification requirement by the Food and Drug Administration (FDA) became mandatory in 1998, and another folate value that represents the time *after* the requirement became mandatory (Table 2). Sometimes it is difficult to assign an effective date to a Food Change, especially when the change is made to reflect an industry trend. Even for a specific brand of a food, one date usually does not reflect the exact time period that a product becomes available to consumers nationwide. NDL, the suppliers of the nutrient data for the database, often recommends dates after consultations with the food industry and trade organizations to determine the most representative dates possible. Dates that correspond to the beginning of a survey year are usually selected in order to minimize the processing effort. However, the database system can function with any date selected.

The nutrient values, recipes, and gram weights are the main database components that undergo Food Changes. One or more Food Change has occurred in 21% of the food items in the database. The majority of Food Changes occur to the nutrient values. Food Changes that affect the nutrient values are assigned one of four codes to indicate the reason for the change: 1 = Enrichment or fortification, 2 = Reformulation, 3 = Other agricultural/processing change, 4 = Nutrition Labeling and Education Act (NLEA). Folate fortification is one example of a recent Food Change to the database nutrient values. As of 1998, the folate value was increased in over 350 basic food items representing enriched grain products. Another example of a nutrient value Food Change is the reformulation of saltine crackers. Fatty acid values were revised in 1991 to reflect an industry trend of replacing animal fat with vegetable fat. A number of food products (especially breakfast cereals) were reformulated, or the level of added nutrients was altered, when NLEA became effective in 1995. All of these types of changes have been coded in the system as an NLEA-related change. In 1989, pork

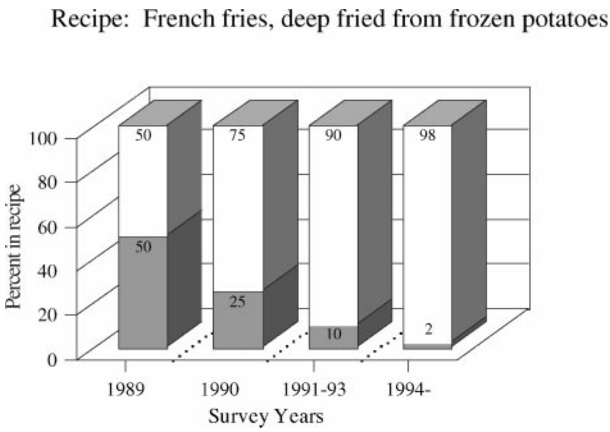

FIGURE 1. Recipe Food Change example: shift from animal to vegetable fat for frying: □, Potatoes fried in vegetable oil; ■, Potatoes fried in beef tallow.

items in the database were revised to capture an industry trend toward leaner pork products. Since these products resulted from the breeding of leaner animals and the trimming away of more external fat from the various cuts of meat, these Food Changes are coded under the broad category of "other agricultural/processing change".

Changes to database recipes are also tracked. Within a recipe, Food Changes may occur to the type of ingredient, the amount of ingredient, or the retention factor applied to an ingredient. Figure 1 illustrates an example of a Food Change made to ingredient amounts in a recipe for "French fries, deep fried from frozen potatoes". The recipe contains two ingredients, potatoes fried in vegetable oil and potatoes fried in beef tallow. The proportion of each ingredient in the recipe has changed several times over the years, reflecting a shift from animal fat to vegetable fat by the food industry. In 1989, the two ingredients were equally proportioned, but as time progressed, the amount of the vegetable oil ingredient increased as the beef tallow ingredient decreased. NDL suggested these proportions after consultation with industry contacts.

Food Changes may also occur to gram weights. A common scenario of a gram weight Food Change is a food manufacturer altering the size of a food item or package. Around the year 1996, some baby food manufacturers began to reduce the size of baby food jars from 4.5 ounces to 4 ounces. This change in packaging was recorded as a Food Change in the gram weights component of the database, with the heavier jar weight having valid dates prior to 1996 and the lighter jar weight being effective from 1996 onward. Another example is a commercial cookie manufacturer that increased the weight of a brand name cookie from 7 to 12.5 g. Like the baby food jar, there are two gram weight entries in the database for the cookie, with each gram weight having effective dates attached.

Manufacturers' decisions to alter product names and new Federal food labeling regulations often result in changes to the database food item descriptions. Changes that apply to food names but not nutrient values are dealt with in a simplified fashion, with both old and new names captured in one record using the notation, "(formerly ...)". One example is "Light ice cream, chocolate (formerly ice milk)" which came about in 1998 from the elimination of the ice milk standard of identity by the FDA. Having both names available in the description is helpful during the coding process.

Data improvements. Since 1985, the majority of revisions made to the database have been Data Improvements. Over 20 000 Data Improvements have been applied to the database food composition values, affecting 66% of the food items. Data Improvements occur when better analytical procedures or sampling methods result in improved data values. Data Improvements are handled differently from Food Changes. Whereas a Food Change generates two database entries defined by effective dates, a Data Improvement appears as just one database entry. The improved data value *replaces* the old value in the database and is considered to be retroactive; the new improved value applies to food intakes collected in previous years.

Data Improvements may be applied to the nutrient values, food weights, food descriptions, and recipe components of the database. Two significant Data Improvements to the database nutrient values in the 1980s involved cholesterol content of eggs and iron content of meat. New analytical data determined that cholesterol in eggs had previously been overestimated by approximately 20%. Likewise for meat, iron was found to be overestimated by approximately 33% in most beef items and by approximately 25% in most pork items. Database gram weights, especially those associated with frequently consumed food items, are examined on a regular basis to determine if more reliable data are available. Recently, average cup weights for potato chips were improved based on a greater number of food samples. Data Improvements to food descriptions typically enhance the clarity of the description and do not affect nutrients. For example, the food description "Onions, spring (include tops and bulb), raw" was expanded by adding the phrase "or scallions" after the word "spring". Database recipes may also undergo Data Improvements. Last year, when values for caffeine were added to the nutrient database, some recipe ingredients were replaced with new caffeinated/decaffeinated ingredients that better represented the caffeine content in the recipe. Most of the recipes affected by this Data Improvement were for coffee, tea, and soft drink food items.

IMPACT OF REVISIONS

The impact of Food Changes and Data Improvements on consumption data depends on the scope and degree of the revised database value. When applied to an individual's intake, a change in the database values for a frequently consumed food item may have a substantial impact on a person's nutrient consumption. Usually, a change in one food has little effect on mean intake values of a population. This is true even for a frequently consumed food item such as French fries. To demonstrate this point, 1989 nutrient values for French fries were applied to intake data from CSFII 1994–1996, 1998 and compared to results based on the current nutrient values. Virtually no differences were detected in mean intakes for saturated and monounsaturated fatty acids (Table 3), even though the recipe for French fries changed from equal parts beef

TABLE 3

Impact of recipe Food Change on fatty acid mean intakes.
Recipe: French fries, deep fried, from frozen potatoes[1]

Mean intakes, 0–9 years, 1 day, CSFII 1994–1996, 1998	Total saturated fatty acids (g)	Total monounsaturated fatty acids (g)
Using 1998 fatty acid values	22.6	22.5
Using 1989 fatty acid values	22.7	22.4

[1]Proportion of potatoes fried in beef tallow decreased from 50% in 1989 to 2% in 1998.

TABLE 4

Impact of nutrient Food Change on folate mean intakes[1]

Mean intake, women 19–49 years, 1 day, CSFII 1994–1996	Folate (μg)
Using 1994–1996 folate values	226
Using new 1998 folate values	317

[1]Folate fortification of enriched grain products required as of 1998.

tallow and vegetable oil in 1989 to be predominantly vegetable oil in the current database (Figure 1).

However, a Food Change or Data Improvement that applies to a large number of food items in the database may indeed cause a noticeable impact on intake means. The effect of Food Changes attributed to folate fortification of enriched grain products is illustrated in Table 4. Mean folate intakes of women surveyed in CSFII 1994–1996 were calculated using the correct values for those years, and then means were estimated by applying the 1998 folate values. If foods had been fortified during the 1994–1996 survey years, the folate intake of women would have been approximately 40% higher. To show the effect Data Improvements could have on mean intakes, the "new" improved cholesterol value for eggs was applied to CSFII 1985 intake data for women. The revised mean intake was estimated to be 277 mg, about 10% lower than the original mean intake of 304 mg based on the "old" cholesterol value available in 1985. This example demonstrates how improvements to database values may generate artifactual differences in mean intake data collected and compared over time. It is important to recognize that Data Improvements should apply to previously collected intake data before comparisons between different time periods are made.

CONCLUSIONS

The Survey Nutrient Database for Trends Analysis was designed to track changes in the database and facilitate analysis of intake trends in the United States. Frequent additions to the database help to keep pace with an expanding food market and advances in nutrient analyses of food. Categorizing changes as Data Improvements or Food Changes allows for more accurate comparisons of food and nutrient intake data. The ability to apply improved data values to previously collected intake data is important for avoiding artifactual differences when comparing intake analyses over time. Although this trends analysis system was designed particularly for databases used in USDA food surveys, the concepts described here may be applied to other database systems.

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