Dietary Intake of Whole Grains

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Key words: whole grain, food consumption, nutrient intake, United States, dietary survey, Food Guide Pyramid, database

Objective: The objective of this study was to provide national estimates of whole-grain intake in the United States, identify major dietary sources of whole grains and compare food and nutrient intakes of whole-grain consumers and nonconsumers.

Methods: Data were collected from 9,323 individuals age 20 years and older in USDA's 1994–96 Continuing Survey of Food Intakes by Individuals through in-person interviews on two non-consecutive days using a multiple-pass 24-hour recall method. Foods reported by respondents were quantified in servings as defined by the Food Guide Pyramid using a new database developed by the USDA. Whole-grain and nonwhole-grain servings were determined based on the proportion, by weight, of the grain ingredients in each food that were whole grain and nonwhole grain. Sampling weights were applied to provide national probability estimates adjusted for differential rates of selection and nonresponse. Then, *t* tests were used to assess statistically significant differences in intakes of nutrients and food groups by whole-grain consumers and nonconsumers.

Results: According to the 1994–96 survey, U.S. adults consumed an average of 6.7 servings of grain products per day; 1.0 serving was whole grain. Thirty-six percent averaged less than one whole-grain serving per day based on two days of intake data, and only eight percent met the recommendation to eat at least three servings per day. Yeast breads and breakfast cereals each provided almost one-third of the whole-grain servings, grain-based snacks provided about one-fifth, and less than one-tenth came from quick breads, pasta, rice, cakes, cookies, pies, pastries and miscellaneous grains. Whole-grain consumers had significantly better nutrient profiles than nonconsumers, including higher intakes of vitamins and minerals as percentages of 1989 Recommended Dietary Allowances and as nutrients per 1000 kilocalories, and lower intakes of total fat, saturated fat and added sugars as percentages of food energy. Consumers were significantly more likely than nonconsumers to meet Pyramid recommendations for the grain, fruit and dairy food groups.

Conclusion: Consumption of whole-grain foods by U.S. adults falls well below the recommended level. A large proportion of the population could benefit from eating more whole grain, and efforts are needed to encourage consumption.

INTRODUCTION

Considerable epidemiological evidence indicates whole-grain foods reduce the risk for certain cancers [1–3], coronary heart disease [4–6] and all-cause mortality [7]. In addition, clinical studies have demonstrated that whole-grain oats reduce total blood cholesterol [8–10], a major risk factor for heart disease. Whole grains contain vitamins, minerals and fiber along with phenolic compounds and other bioactive phytochemicals that may work synergistically to reduce risk for chronic disease [11, 12].

Over the past 20 years, major governmental, scientific and nonprofit organizations have recommended whole grains as part of a healthful diet. Currently, increased whole-grain consumption is recommended by the U.S. Department of Agriculture (USDA) and U.S. Department of Health and Human Services (DHHS) in the publication *Nutrition and Your Health: Dietary Guidelines for Americans* [13], which provides the basis for Federal nutrition policy. Increased consumption is also recommended in *The Surgeon General's Report on Nutrition and Health* [14] and the National Research Council's *Recommended Dietary Allowances* [15] and *Diet and Health:*

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Implications for Reducing Chronic Disease Risk [16]. In addition, the American Cancer Society [17] and the American Dietetic Association [18] support increased intake. Grain foods form the base of *The Food Guide Pyramid*, which recommends consuming six to eleven servings each day, including "several" whole-grain servings [19,20].

A number of recent initiatives indicate broad interest in promoting greater whole-grain consumption. At a 1993 conference entitled *Narrowing the Whole Grain Gap: How Much and Why?*, the USDA and the American Dietetic Association jointly proposed the message "3 Are Key" to specifically quantify guidance on the number of servings of whole grains to eat daily [21]. In July 1999, the Food and Drug Administration approved a health claim for use on food labels of products that contain at least 51 percent whole grain by weight and are low in total fat, saturated fat and cholesterol [22]. The claim reads, "Diets rich in whole-grain foods and other plant foods and low in total fat, saturated fat, and cholesterol may reduce the risk of heart disease and some cancers." It is intended to help consumers identify whole-grain foods and encourage consumption by describing relationships between whole grains and disease prevention. In January 2000, new national nutrition objectives for the Year 2010 were released by the DHHS. For the first time, an objective was included that targeted whole-grain intake. It states, "Increase the proportion of persons aged 2 and older who consume at least 6 daily servings of grain products, with at least 3 being whole grains" [23]. To track progress on this objective, data will be monitored on the percentage of selected populations consuming six or more grain servings daily, the percentage consuming three or more whole-grain servings daily and the percentage meeting the dual goals simultaneously.

Despite long standing and general agreement that the population would benefit significantly from increased consumption of whole-grain foods, little is known about how much people actually eat. The evidence that is available suggests that consumption is well below desired levels. Albertson and Tobelmann reported that the average number of eating occasions of whole-grain products by adults was 0.5 per day based on data collected in 1990 and 1992 [24]. Survey participants in their study recorded foods consumed, but not quantities, so an eating occasion was not necessarily synonymous with a serving as defined by the Food Guide Pyramid. However, less than two percent reported two or more daily eating occasions of whole-grain products, and 23 percent consumed no whole grain over the 14-day data collection period.

More recently the USDA developed a database for use in converting food intake data from its 1994–96 Continuing Survey of Food Intakes by Individuals into Pyramid servings. This database represents a significant advance in providing the ability to estimate whole-grain intake and compare intake to recommendations. The purpose of this study is to present national estimates of whole-grain intake, identify major dietary sources of whole grains and compare food and nutrient intakes of whole-grain consumers and nonconsumers using the new USDA Pyramid Servings Data Set [25].

MATERIALS AND METHODS

Study Sample

Data for this study are from USDA's Continuing Survey of Food Intakes by Individuals, which was conducted in 1994, 1995, and 1996 (CSFII 1994–96). Details of the survey methodology have been presented elsewhere [26]. The survey was designed to provide a nationally representative sample of individuals of all ages from the 50 States and Washington, DC. Subjects for this study include the 9,323 individuals 20 years of age and older who provided dietary intake information. Over the three survey years, the overall response rate for two days of dietary intake was 76 percent.

Data Collection

Dietary intakes were collected by trained interviewers in respondents' homes on two non-consecutive days using a 24-hour multiple-pass recall method. The survey design called for separating the day 1 and day 2 interviews by three to ten days and conducting each on a different day of the week. Interviewers used standardized probes to obtain complete descriptions of types and amounts of foods eaten by respondents. For example, for bread, respondents were asked, "Was it white, rye, whole wheat, pumpernickel, multigrain, garlic, or something else?" Respondents who said the bread was whole wheat were asked to check the food label and answer the question, "Was that 100% whole wheat?" For ready-to-eat cereals, pancakes, breakfast bars, granola bars, corn chips, crackers, and pretzels, respondents were asked, "What was the brand?" Interviewers also probed for information on ingredients in foods such as soups, mixed dishes, casseroles, tacos, enchiladas, fajitas, sandwiches and salads. These standardized probes made it possible to assign each reported food to a food code and associated recipe that represented the proportion of whole-grain ingredients it contained. When a food contained some whole grain and some nonwhole grain ingredients, the recipe could be used to determine the fraction of the grain servings from each. The food coding database for CSFII 1994–96 contains 7,352 food codes. It links foods to their nutritive values via a recipe database intended to be representative of foods eaten in the United States.

Method for Determining Grain Servings

For this study, foods reported in the survey were quantified in servings as defined by the Food Guide Pyramid using the Pyramid Servings Database that was first released by USDA for public use in 1997 [27,28]. To develop the database, food

mixtures were separated into ingredients when necessary before categorizing foods into groups, and foods were categorized strictly according to Pyramid criteria. The database contains reference data for each food reported in the CSFII 1994–96 on servings per 100 grams from 30 Pyramid food groups and subgroups. Of the 30 groups, three are grain groups: total grain, whole grain, and nonwhole grain. For this study, grain servings were further identified according to the type of grain product from which they were derived: yeast bread; quick bread; breakfast cereal; pasta, rice; grain desserts such as cookies, cakes, pies; grain snacks such as crackers, chips, popcorn; and miscellaneous grains such as flour in gravies.

Definitions of grain serving sizes were derived from *The Food Guide Pyramid* and publications that describe its application. Operational definitions were developed based on the Pyramid's consumer-oriented descriptions to determine gram weights for servings by using standardized procedures. A grain serving was defined as one slice of bread; 1/2 of an English muffin, bagel or croissant; one small roll, biscuit or muffin; and 1/2 cup of cooked cereal, rice or pasta. For these foods, the CSFII 1994–96 food coding database was the source for gram weights of servings. For ready-to-eat breakfast cereals, a serving was defined as one ounce as specified by the Pyramid, but the weight of ingredients such as dried fruits, nuts, seeds, sugar and fat that the Pyramid categorizes in food groups other than the grain group were excluded from the determination of grain servings.

For foods for which the Pyramid does not list serving sizes, serving weights were determined based on the grain content of the food. This method was used to derive serving weights for many snack-type grain products, grain-based desserts, some quick breads and miscellaneous grains used in batters, breading and thickeners. A grain serving was defined as the grams of grain product containing 16 grams of flour—the amount in a standard slice of commercial white bread.

Tabulating Servings of Whole Grains from Grain Products

USDA food specialists classified all grain ingredients used in the CSFII 1994–96 recipe database as whole grain or nonwhole grain. Table 1 presents a list of ingredients that were classified as whole grain. Some grain ingredients, including oat bran and wheat bran, which are not strictly whole grain, were classified as such if they had a high fiber content because a major objective of whole-grain recommendations has focused on promoting adequate fiber consumption.

Mixed foods that are not grain products, but contain grain ingredients, such as soups, salads and casseroles, were separated into their ingredients, and then grain servings were determined for each ingredient based on the Pyramid definition of a serving. Since grain ingredients had been classified as whole grain and nonwhole grain, the process of tabulating whole-grain servings from these foods was relatively clear-cut. However, grain products, such as breads and muffins, were not separated into ingredients before tabulating servings because the Pyramid defines servings at the food rather than the ingredient level. For example, one slice of bread or one small muffin is a serving. Since grain products may contain both whole-grain and nonwhole-grain ingredients, a method had to be developed to determine the servings attributable to each.

Table 1. Food Ingredients Classified as Whole Grain in USDA's Pyramid Servings Database

Amaranth
Barley, pearled
Barley flour
Buckwheat
Buckwheat groats
Buckwheat flour, whole-groat
Bulgur
Corn bran, crude
Corn flour, whole-grain—yellow and white
Cornmeal, whole-grain—yellow and white
Popcorn
Non-digestible carbohydrate with dietary fiber
Oats
Oat cereals—regular, quick, instant
Oat flour
Oat bran, raw
Macaroni, whole-wheat
Psyllium seed, husks
Rice, brown—medium and long grain
Rice flour, brown
Rice, wild
Rye
Rye flour—dark, medium, and light
Spaghetti, whole-wheat
Triticale flour, whole-grain
Wheat—hard red spring, hard red winter, soft red winter, soft white
Wheat bran, crude
Wheat cereals, whole wheat
Wheat flour, whole-grain

For the Pyramid Servings Database, whole-grain servings from grain foods were calculated using the following method. First, for each such food reported in CSFII 1994–96, the total number of grain servings per 100 grams was determined. Then, this total was divided into whole-grain and nonwhole-grain servings based on the proportion of the grain ingredients by weight that were whole grain and nonwhole grain. For example, 100 grams of cracked wheat bread provides four grain servings. The bread contains three grain ingredients: white-wheat flour which was classified as a nonwhole grain, and whole-wheat flour and wheat bran which were classified as whole grains. White-wheat flour contributes 67 percent of the total grain ingredient weight and whole-wheat flour and wheat bran together contribute 33 percent. Thus, 100 grams of cracked wheat bread provides 2.7 nonwhole-grain servings ($4 \times .67$), and 1.3 whole-grain servings ($4 \times .33$).

Statistical Analysis

Sample weights were applied to the data to provide national probability estimates adjusted for differential rates of selection and nonresponse. The sampling weights calibrate the sample so that it matches the U.S. population for characteristics thought to be correlated with eating behavior, including age, race, ethnicity, income, household composition, region, urbanization, day of the week and season of the year. *t* tests were used to test for statistically significant differences in food and nutrient intakes of whole-grain consumers and nonconsumers, and to test the significance of differences in percentages of individuals consuming whole grains within categories of demographic and personal characteristics. In testing for differences in food and nutrient intakes, comparisons were made only between those who consumed no whole grain and those who consumed some whole grain. However, the findings should hold for comparisons between those who consumed no whole grain and those who consumed three or more whole-grain servings per day as well. All statistical analyses were done with SUDAAN software, which is appropriate for weighted data from complex samples [29].

RESULTS

Table 2 shows mean daily intakes of whole-grain and non-whole-grain servings and percentages of individuals consuming various numbers of servings of whole grains per day by socioeconomic characteristics. In 1994–96, individuals 20 years of age and over consumed an average of 6.7 grain servings per day. Of these, 15 percent or 1.0 serving was whole grain. Over the two survey days, 71 percent of individuals consumed some whole grain, with the largest proportion (36 percent) averaging less than one serving per day. Only eight percent met the recommendation to consume at least three whole-grain servings per day. Individuals who consumed some whole grain were more likely to be male, older, white, in a higher income category, more educated, non-smokers, exercisers, vitamin and/or mineral supplement users and not overweight (Table 3). Some of the gender difference is likely attributable to the fact that males eat more food than females.

Fig. 1 shows the major sources of whole-grain servings. Yeast breads and breakfast cereals each provided almost a third of the whole-grain servings. Grain snacks such as crackers, pretzels and popcorn provided about a fifth. Less than a tenth

Table 2. Mean Intake of Whole-Grain and Non-Whole-Grain Servings and Percentage of Individuals Consuming Specified Number of Whole-Grain Servings by Selected Characteristics, 2-Day Average, 1994–96

Characteristic	Number	Mean Number of Servings Per Day		Whole Grains: Percentage of Individuals Consuming Specified Numbers of Servings Per Day[1]				
		Whole-Grain	Nonwhole-Grain	0	0–1	1–2	2–3	≥3
Men and Women								
≥20 years	9323	1.0	5.7	29	36	19	9	8
Men								
20–39 years	1543	1.1	7.6	34	31	15	9	11
40–59 years	1663	1.1	6.4	28	34	17	11	11
≥60 years	1545	1.2	5.4	26	31	22	9	12
≥20 years	4751	1.1	6.8	31	32	17	10	11
Women								
20–39 years	1449	0.8	5.0	31	37	17	10	5
40–59 years	1694	0.9	4.7	28	39	20	8	5
≥60 years	1429	0.9	4.0	23	41	22	8	6
≥20 years	4572	0.9	4.6	28	39	20	8	5
Income Status[2]								
<131% poverty	2141	0.7	5.7	42	33	15	5	5
131–350% poverty	3706	1.0	5.5	31	36	18	9	8
>350% poverty	3476	1.1	5.8	23	37	21	10	10
Race								
White	7588	1.0	5.7	26	36	20	9	9
Black	1056	0.7	5.4	42	35	13	5	5
Region								
Northeast	1700	0.9	6.0	29	38	17	9	6
Midwest	2253	1.0	5.8	23	40	20	9	8
South	3394	0.9	5.4	34	34	17	8	8
West	1976	1.1	5.6	28	32	21	9	11

[1] Interpret column headings as follows: 0 = no whole-grain servings; 0–1 = less than 1 whole-grain serving per day but more than zero; 1–2 = at least 1 whole-grain serving per day but less than 2; 2–3 = at least 2 whole-grain servings per day but less than 3; and ≥3 = 3 or more whole-grain servings per day.

[2] Household income for the previous calendar year expressed as a percentage of the federal poverty threshold, adjusted for inflation.

Table 3. Percentage of Individuals 20 Years of Age and Older Consuming Whole Grains by Selected Characteristics, 2-Day Average, 1994–96

Characteristic	Individuals Consuming— >0 Whole-Grain Servings/Day	Individuals Consuming— ≥3 Whole-Grain Servings/Day
	---------%---------	
Gender		
Male	69[a]	11[a]
Female	72[a]	5[a]
Age		
20–39 years	67[a]	8
40–59 years	72[a]	8
60 years and over	76[a]	8
Race		
White	74[a]	9[a]
Black	58[a]	5[a]
National Origin		
Hispanic	55	5
Non-Hispanic	72	8
Region		
Northeast	71[a]	6[a]
Midwest	77[ab]	8
South	66[b]	8[b]
West	72	11[ab]
Income Status[1]		
<131% poverty	58[a]	5[a]
131–350% poverty	69[a]	8[a]
>350% poverty	77[a]	10[a]
Education		
<12th grade	56[a]	4[a]
12th grade/GED	67[a]	6[a]
>12th grade	78[a]	10[a]
Smoking		
Non-smoker	74[a]	9[a]
Current smoker	61[a]	6[a]
Body Mass Index		
Not overweight (BMI<25)	73[a]	9[a]
Overweight (BMI ≥25)	69[a]	7[a]
Frequency of Vigorous Exercise		
5–7 times/week	71[a]	10[a]
1–4 times/week	75[a]	9[b]
<1 time/week	68[a]	6[ab]
Vitamin/Mineral Supplement Use		
Often	78[a]	10[a]
Sometimes	73[a]	9[b]
Seldom/Never	65[a]	6[ab]

Statistical significance is indicated for comparisons within characteristics and columns. Estimates with the same superscript letter are significantly different ($p \leq .05$).

[1] Household income for the previous calendar year expressed as a percentage of the federal poverty threshold, adjusted for inflation.

came from quick breads, pasta, rice, cakes, cookies, pies, pastries and miscellaneous grains. Fig. 2 shows that although yeast breads contributed almost one-third of whole-grain servings, whole grains made up a relatively small percentage of the total yeast bread servings. Most yeast breads were nonwhole grain. In contrast, whole grains made up more than half of the grain servings from breakfast cereals.

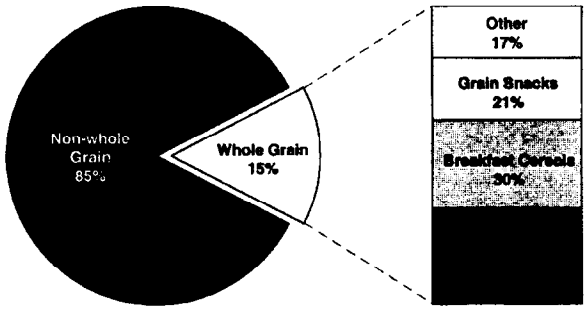

Figure 1. Proportion of total grain servings from whole grains and non-whole grains and major food sources of whole-grain servings.

Table 4 shows the percentage of adults who met Pyramid recommendations by whole-grain-consumption status. Compared to nonconsumers, those who consumed some whole grain were significantly more likely to meet Pyramid recommendations for the grain, fruit, and dairy groups ($p \leq .01$). Percentages meeting recommendations were about three-fold higher for those who consumed three or more whole-grain servings per day compared to those who consumed none.

Whole-grain consumers had significantly better intakes of nutrients and other dietary components than nonconsumers (Table 5). These intake estimates include only nutrients from foods, not those from vitamin or mineral supplements. Whole-grain consumers had intakes of carbohydrate and protein as percentages of food energy that were significantly higher and intakes of total fat, saturated fat and added sugars that were significantly lower than those of nonconsumers. Their intakes of vitamins and minerals as a percentage of the 1989 Recommended Dietary Allowances (RDA) were significantly higher for all nutrients studied. This effect was not totally explained by the fact that whole-grain consumers had significantly higher food energy intakes. Their intakes of vitamin A, vitamin E, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, calcium, magnesium, iron, zinc and dietary fiber per 1000 kilocalories were significantly higher than those of nonwhole-grain consumers.

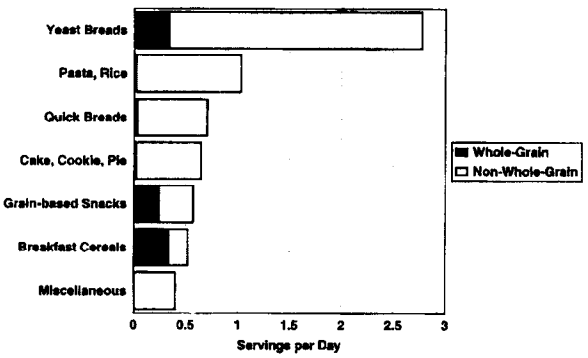

Figure 2. Food sources of whole-grain and non-whole-grain servings.

Table 4. Percentage of Individuals 20 Years and Over Meeting Food Guide Pyramid Recommendations[1] by Whole-Grain-Consumption Status, 2-Day Average, 1994–96[2]

Food Group	Whole Grain Consumption Status		
	None	>0 Servings/Day	≥3 Servings/Day
		----------%----------	
Grain	24[a]	40[a]	73
Vegetable[3]	45	47	45
Fruit	13[a]	26[a]	36
Dairy	12[a]	23[a]	35
Meat[3]	47	43	40

[1] Recommended servings were derived from sample patterns in "The Food Guide Pyramid" (USDA 1992). Individuals consuming less than 2,200 calories met the recommendation if they ate at least 6 servings of grain, 3 servings of vegetable, 2 servings of fruit, and 5 ounces of cooked lean meat equivalents per day. Individuals consuming 2200–2799 calories met the recommendation if they ate at least 9 servings of grain, 4 servings of vegetable, 3 servings of fruit, and 6 ounces of cooked lean meat equivalents per day. Individuals consuming ≥2800 calories met the recommendation if they ate at least 11 servings of grain, 5 servings of vegetable, 4 servings of fruit, and 7 ounces of cooked lean meat equivalents per day. Recommendations for the dairy group were 3 servings for women who were pregnant or lactating and for young adults ≤24 years and 2 servings for adults aged ≥25 years.

[2] Within rows, estimates with the same superscript letter are significantly different ($p \leq .01$). Statistical tests were not conducted to compare non-whole-grain consumers to those who consumed 3 or more whole-grain servings per day.

[3] Servings from dry beans and peas are tabulated with the vegetable group. Ounces of cooked lean meat equivalents from meat, poultry, fish, eggs, soybeans, tofu, meat analogues, nuts, and seeds are tabulated with the meat group.

DISCUSSION

The implications of low intake of whole grains by the U.S. population has received added scrutiny as research continues to explore and define health benefits of consuming whole grains at levels above the current average of 1.0 serving per day. This study shows that diets of individuals who consume three or more daily servings of whole grains—the recommended intake—are more nutrient-dense in many key micronutrients. The macronutrient profile and dietary fiber level of such diets are also more favorable. However, based on two-day intakes, less than 10 percent of American adults meet the recommendation.

Differences in nutrient intakes of those who meet *versus* those who do not meet the recommendation can be accounted for, at least in part, by the nutrient contribution of whole-grain foods themselves. Whole grains are higher than nonwhole grains in a number of micronutrients, including vitamin E, vitamin B6, folate, magnesium, zinc and copper, and some whole-grain foods, notably breakfast cereals, are fortified as well. However, differences in nutrient intakes may also result from a more health-conscious approach to dietary choices in general by whole-grain consumers. This conclusion is consistent with results showing that whole-grain consumers are more likely than nonconsumers to meet Pyramid recommendations for several food groups and to consume a lower percent of calories from fat and added sugars. They exhibit other health conscious behaviors as well. They are less likely to smoke or to be overweight and more likely to exercise and take dietary supplements. Although the research base for developing the Pyramid indicates that the nutrient profile of whole grains is superior to that of nonwhole grains [30], additional research is needed to determine the specific contributions of whole-grain foods to nutrient intake, including micronutrients and other compounds not included in the data set that are known to exist in whole-grain foods. Questions remain about how much of the improved nutrient profile relates to whole-grain food choices themselves and how much relates to other differences in food choices of whole-grain consumers compared to nonconsumers.

Nonetheless, it seems clear that a large proportion of the population could benefit from eating more whole grain, and efforts are needed to encourage consumption. Consumer awareness of health benefits of whole grains may be limited. Until recently, the only health messages on whole-grain products were fiber-content claims, so one might expect consumer understanding of their health benefits, beyond fiber content, to be limited. In a recent consumer market research study, approximately 25 percent of respondents said they were making a strong effort to eat whole grains [31]. Of these, over 66 percent were also making a strong effort to eat foods high in fiber. In the market research, demographic groups that reported the strongest effort to consume whole grains were generally the same as those with higher consumption levels in the present study. They were older, more likely to be white and had higher education and incomes than individuals less inclined to consume whole grains. New health messages, beyond those on fiber content, are likely to increase interest in whole-grain foods. Continued research on the positive effects of whole grain in the diet on various chronic disease conditions will also help strengthen and sustain the message.

Current efforts to encourage Americans to increase whole-grain consumption, such as the FDA's recently approved health claim for use on food packages, should help consumers identify whole-grain foods and recognize their health benefits. This along with advice from other governmental agencies should help solidify the message in the minds of consumers. Several manufacturers have already adopted the FDA health claim on their food packages. Past campaigns, such as those on fruit and vegetable intake and cancer [32], fiber intake and cancer [33], and fat reduction and blood cholesterol [34] have demonstrated that consumers are responsive to positive diet and health messages that are clear, actionable and sustained.

One of the major hurdles for some whole-grain foods is consumer perception of inferior taste and texture compared to those that are more highly refined. These present a challenge to the food industry to continue to explore new ways of making whole grain in the food supply more acceptable to consumers both as the dominant ingredient and as secondary ingredients.

Table 5. Mean Intake of Food Energy, Selected Nutrients and Other Dietary Components by Whole-Grain-Consumption Status, Individuals 20 Years and Over, 2-Day Average, 1994–96[1]

Nutrient/Dietary Component	Whole Grain Consumption Status		
	None	>0 Whole-Grain Servings Per Day	≥3 Whole-Grain Servings Per Day
Food Energy (kcal)	1852[a]	2049[a]	2511
Food Energy (% RDA[2])	76[a]	85[a]	100
Fat (% kcal)	34[a]	33[a]	31
Saturated Fat (% kcal)	11[a]	11[a]	10
Carbohydrate (% kcal)	48[a]	51[a]	54
Added Sugars[3] (% kcal)	15[a]	14[a]	12
Dietary Fiber (gm/1000 kcal)	7[a]	9[a]	11
Protein (% kcal)	16[a]	16[a]	15
Protein (% RDA)	129[a]	141[a]	162
Cholesterol (mg/1000 kcal)	153[a]	129[a]	106
Vitamin A (% RDA)	86[a]	122[a]	156
Vitamin E (% RDA)	76[a]	97[a]	125
Vitamin C (% RDA)	134[a]	169[a]	220
Thiamin (% RDA)	108[a]	135[a]	172
Riboflavin (% RDA)	107[a]	137[a]	170
Niacin (% RDA)	124[a]	149[a]	181
Vitamin B6 (% RDA)	82[a]	105[a]	138
Folate (% RDA)	104[a]	144[a]	205
Calcium (% RDA)	74[a]	96[a]	124
Magnesium (% RDA)	71[a]	92[a]	125
Iron (% RDA)	111[a]	149[a]	219
Zinc (% RDA)	72[a]	87[a]	109
Vitamin A (RE/1000 kcal)	454[a]	572[a]	640
Vitamin E (mg α-TE/1000 kcal)	3.8[a]	4.4[a]	4.8
Vitamin C (mg/1000 kcal)	48[a]	53[a]	57
Thiamin (mg/1000 kcal)	.76[a]	.84[a]	.93
Riboflavin (mg/1000 kcal)	.86[a]	.99[a]	1.04
Niacin (mg/1000 kcal)	11.2[a]	12.1[a]	12.4
Vitamin B6 (mg/1000 kcal)	.84[a]	.97[a]	1.09
Folate (μg/1000 kcal)	112[a]	143[a]	171
Calcium (mg/1000 kcal)	344[a]	398[a]	422
Magnesium (mg/1000 kcal)	126[a]	148[a]	173
Iron (mg/1000 kcal)	6.8[a]	8.3[a]	9.9
Zinc (mg/1000 kcal)	5.4[a]	5.9[a]	6.3

[1] Within rows, estimates with the same superscript letter are significantly different ($p < .01$). Statistical tests were not conducted to compare non-whole-grain consumers to those who consumed 3 or more whole-grain servings per day.

[2] 1989 RDA [15].

[3] Added sugars include all sugars used as ingredients in processed or prepared foods such as breads, cakes, soft drinks, jams, and ice cream, and sugars added to foods before eating. Examples are white sugar, brown sugar, corn syrup, honey, molasses, and artificial sweeteners containing carbohydrate. Added sugars do not include naturally-occurring sugars such as fructose in fruit and lactose in milk.

Additional hurdles to higher consumption include issues of availability, variety, price and preparation. With the majority of whole grain consumed as breads and breakfast cereals, there is clearly an opportunity for increased availability of good tasting, convenient whole-grain snack foods as well as main course offerings.

If appealing whole-grain products are made widely available and easily identifiable, and their health benefits are promoted, consumption by the U.S. population may begin to approach the goal of three servings per day. The next national survey of what Americans eat, scheduled for early in the new millennium, will provide the means of assessing progress towards this goal.

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