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Dietary diversity in the US population, NHANES II, 1976-1980

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Abstract The extent of diversity in the diets of black and white adults (n=11,658) aged 19 to 74 years was evaluated from 24-hour dietary recalls obtained in the second National Health and Nutrition Examination Survey. Each 24-hour recall was evaluated for the consumption of items from the dairy, meat, grain, fruit, and vegetable groups (Food Group Score). A second scoring method (Serving Score) evaluated every recall for consumption of at least two servings each from dairy, meat, fruit, and vegetable groups and four servings from the grain group. Only a third of the population surveyed reported consuming foods from all the food groups on the survey day; less than 3% reported consuming foods from all food groups in at least the recommended amount. Blacks scored lower on both types of diet diversity scores than whites. Both types of diversity scores showed a significant trend to increase with increasing income and level of education. Failure to consume any foods from the dairy, meat, grain, fruit, and vegetable groups was reported by 24%, 6%, 5%, 46%, and 18%, respectively, of the population on the survey day. The proportion of the population consuming at least the desired number of servings from each of these food groups was 51%, 71%, 29%, 29%, 61%, respectively. The results emphasize the need for major public campaigns directed at increasing the diversity of US diets. Special target groups include minorities and those with limited income and formal education. *J Am Diet Assoc. 1991; 91:1526-1531.*

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The history of the recommendation to increase the variety of foods in the US diet as a means to ensure adequate intake of essential nutrients dates back to at least 1916 (1-3). The latest revision of the Recommended Dietary Allowances (4) explicitly recommends selection of foods from different food groups in planning diets. Additionally, with the recognition that dietary factors affect the risk of major chronic diseases, dietary guidelines (5-9) for modifying intake of certain dietary components have been issued to the US population. Virtually all of these dietary recommendations for health benefits include suggestions for increasing the variety of foods in the daily diet along with modifying selected nutrients.

Relatively little is known about the extent to which this information has been translated into daily diet patterns consistent with the recommendation for variety in the US population. Some evidence suggests that a large proportion of the US population does not consume foods from one or more of the basic food groups on any given day (10-12). The purpose of our study was to assess the extent of diversity in US diets using a nationally representative sample of black and white adults (aged 19 to 74 years) and two different measures based on a modification of the traditional food groups (13).

Methods

The second National Health and Nutrition Examination Survey (NHANES II) was conducted from 1976 to 1980 on a nationwide probability sample of the civilian, noninstitutionalized population of the United States by the National Center for Health Statistics (NCHS). Details of survey design and data collection have been described (14). A single 24-hour dietary recall was administered to each participant by a trained dietary interviewer using three-dimensional food models to facilitate estimation of portion sizes. For the purpose of analyses reported in our article, a subset composed of all black and white individuals 19 to 74 years old (n=11,967) was created. We excluded 24-hour recalls considered to be unsatisfactory, incomplete, imputed, or obtained from surrogates (n=309), which left 11,658 men and women in the analytic sample (Table 1).

Two measures were developed for assessing the extent of variety in the 24-hour dietary recalls of NHANES II respondents. The first measure, Food Group Score, counts the number of food groups consumed daily from a total

Table 1. Frequency distribution of the Food Group and Serving scores by race, sex, and age, based on the second National Health and Nutrition Examination Survey (14)

sex/age group	no.	Food Group Score[a]				Serving Score[b]			
		0-2	3	4	5	0-8	9-12	13-16	17-20
		← % →							
all	11,658	6.2	20.1	40.0	33.7	12.9	31.9	39.1	16.1
white men									
all ages (years)	4,905	4.0	17.7	42.6	35.7	7.6	28.6	43.5	20.3
19-34	1,589	5.1	19.5	45.0	30.5	8.8	28.4	44.3	18.5
35-50	1,007	3.1	17.1	43.9	35.9	6.2	30.2	43.4	20.2
51-65	1,427	3.2	16.2	39.5	41.1	7.1	27.2	43.6	22.1
>65	882	3.8	15.5	35.0	45.7	8.1	28.2	39.5	24.2
black men									
all ages (years)	604	12.3	30.9	35.2	21.6	21.7	33.1	31.7	13.5
19-34	229	9.1	29.2	39.1	22.6	16.9	31.5	36.8	14.8
35-50	111	18.0	33.2	31.1	17.7	25.0	38.5	25.4	11.1
51-65	160	11.5	30.7	34.6	23.2	28.5	26.3	30.3	14.9
>65	104	12.2	32.7	29.5	25.6	19.2	39.8	30.4	10.6
white women									
all ages (years)	5,417	6.6	20.3	38.6	34.5	15.0	34.5	36.9	13.6
19-34	1,717	7.5	20.8	42.0	29.7	16.6	36.0	35.8	11.6
35-50	1,097	7.4	22.6	39.0	31.0	15.6	36.2	36.1	12.1
51-65	1,544	5.1	19.5	35.4	40.0	13.4	32.9	37.0	16.7
>65	1,059	4.4	14.1	31.7	49.8	10.6	28.2	42.8	18.4
black women									
all ages (years)	732	14.0	28.2	34.8	23.0	27.4	35.3	29.9	7.4
19-34	256	12.6	28.8	37.7	20.9	27.2	35.9	29.1	7.8
35-50	156	19.8	25.6	34.5	20.1	31.7	32.4	31.9	4.0
51-65	196	11.9	29.3	29.9	28.9	24.2	37.4	29.6	8.8
>65	124	6.8	30.7	32.3	30.2	21.2	37.5	27.6	13.7

[a]Food Group Score counts the number of food groups consumed daily from a total of five groups—dairy, meat, grain, fruit, and vegetable. Maximum score = 5; one point is counted for each food group consumed.
[b]Serving Score evaluates each 24-hour recall for the presence of two servings each from the dairy, meat, fruit, and vegetable groups, and four servings from the grain group. Maximum score = 20; four points are counted for each of the five groups.

of five groups—dairy, meat, grain, fruit, and vegetable. The maximum score is five; one point is counted for each food group consumed. In accordance with a recently suggested definition of dietary variety (15), this score evaluates variety among the major food groups.

The second measure, Serving Score, is a modification of the "dietary score" proposed and validated by Guthrie and Scheer (16). Serving Score evaluates each 24-hour recall for the presence of a desired number of servings from the various food groups—two servings each from the dairy, meat, fruit, and vegetable groups and four servings from the grain group. A maximum of four points is counted for each of the five groups, with a maximum score of 20 for the day. Thus, each serving of a food group other than grain contributes two points to the total score and each serving of grain contributes one point. Servings consumed in excess of these were not considered.

To evaluate each 24-hour recall in the manner described, the 2,244 foods reported consumed by adults in the NHANES II were assigned to one of the five food groups. All milk and milk products, excluding butter and liquid or powdered cream, were assigned to the dairy group. The meat group included both animal and plant protein sources (eg, beef, pork, lamb, veal, poultry, fish, shellfish, dried beans and peas, and nuts and seeds). The grain group included all grain products except cakes, pies, cookies, and pastries. The fruit group included all fruit juices and fresh, canned, frozen, and dried fruits, but excluded fruit drinks. The vegetable group included all raw, cooked, frozen, and canned vegetables. Food mixtures containing foods from various food groups (eg, mixed dishes with meat, grain, dairy and vegetables such as lasagna) were assigned to all the relevant food groups. Foods excluded from the five groups were grouped separately and were not included in our analysis.

We also excluded foods consumed in less than a minimum amount to avoid giving credit for consumption of a food group when the amounts reported were small. Thus, an individual reporting a slice of tomato on a hamburger would not be given credit for consuming a vegetable. For the meat, fruit, and vegetable groups, the minimum reported amount for inclusion in the diversity scores was 30 g (2 Tbsp) for all solid foods with a single ingredient and 60 g for all beverages and mixed dishes. For the dairy and grain groups, the minimum amount was 15 g (1 Tbsp) for all solids and 30 g for all liquids and mixed dishes. A lower minimum amount for the dairy and grain groups was chosen because many foods in these

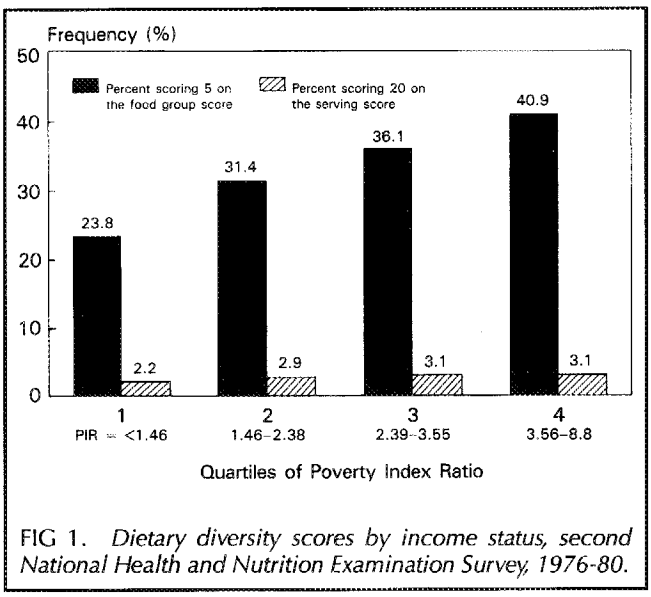

FIG 1. *Dietary diversity scores by income status, second National Health and Nutrition Examination Survey, 1976-80.*

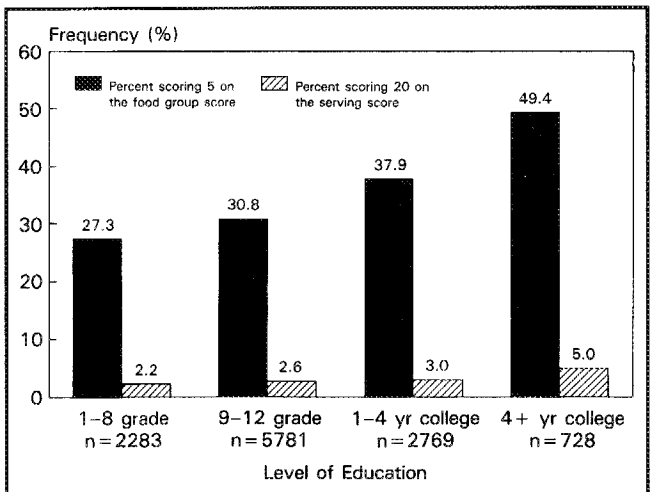

FIG 2. *Dietary diversity scores by level of education, second National Health and Nutrition Examination Survey, 1976-80.*

groups were reported consumed in quantities less than 30 and 60 g. For example, ready-to-eat breakfast cereals, toasted bread, and single slices of cheese were frequently reported consumed in amounts of <30 g per serving.

We chose the median gram weight of each food reported (across all subjects) as the serving size for use in the Serving Score. This approach was used because the amount of food constituting a serving varies with different types of foods and methods of preparation, and the median portion size reflects the amount of food survey respondents reported as a serving. In addition, median portion sizes of the frequently reported food items compared well with the standard portion sizes recommended by the US Department of Agriculture (USDA) (13).

Individuals who consumed amounts above the minimum but below the median amount were credited with consuming one serving; those consuming 1.5 times the median were considered to consume 1.5 servings of that food, and so on. For each 24-hour recall, servings of foods in each food group were combined to obtain a total for the group.

Statistical analyses

Each 24-hour recall was evaluated for Food Group Score, Serving Score, and descriptive statistics that were obtained by age, sex, race, education, and poverty income ratio (PIR). The PIR is based on total household income, family size, and income necessary to maintain that family on a nutritionally adequate food plan. Statistical analyses were performed using SAS (17) and were weighted using the estimated sample weights assigned to each individual by the NCHS to enable inference to the total US white and black noninstitutionalized population. Statistical software (SESUDAAN [18] and SURREGR [19]) appropriate for analysis of complex sample surveys was used to estimate variance and perform regression analyses. The relationship of measures of dietary diversity with age, education, and PIR for each sex-race group was analyzed using regression procedures.

Results

Frequency distribution of the Food Group and Serving scores for the US population by sex, race, and age is shown in Table 1. Mean (±standard error) Food Group Score was 4.0±0.01 in men and women. Nearly 65% of whites and 78% of blacks scored below 5 on the Food Group Score; they did not consume foods from all five groups on the day of the survey. More than 40% of all blacks scored 0 to 3 on the Food Group Score, compared with approximately 25% of whites. Mean Food Group Score increased with age in white men, white women, and black women.

Mean (±standard error) Serving Score was 14±0.1 for men and 12±0.1 for women. Only 16% of the US population reported diets with Serving Scores of 17 to 20. The proportion of the population scoring 20, signifying reported consumption of diets that contain foods from all the food groups in at least the desired number of servings, was negligible at 2.9%. Among whites, the largest group (40%) scored between 13 and 16, whereas among blacks the largest group (34%) scored between 9 and 12. Mean Serving Score declined with increasing age among black men. Among white women, mean Serving Score increased

Table 2. Food group consumption (proportion ± standard error) on 1 day by age, sex, and race based on the second National Health and Nutrition Examination Survey (14)

sex/age group	proportion of the population reporting no servings					proportion of the population reporting at least the recommended no. of servings[a]				
	dairy	meat	grain	fruit	vegetable	dairy	meat	grain	fruit	vegetable
	← % →									
all	24±1	6±0	5±0	46±1	18±1	51±1	71±1	29±1	29±1	61±1
white men										
all ages (years)	19±1	3±0	3±0	49±1	16±1	58±1	81±1	40±1	27±1	64±1
19-34	19±1	3±1	4±1	57±2	17±1	64±2	83±1	44±1	23±1	62±1
35-50	19±1	2±1	3±1	49±2	14±1	54±2	83±1	39±2	27±1	68±2
51-65	19±1	3±0	3±1	39±2	17±1	55±2	81±1	38±1	32±2	64±2
>65	20±2	5±1	3±0	32±2	17±1	51±2	73±1	36±1	39±2	62±2
black men										
all ages (years)	42±2	4±1	5±1	57±3	29±3	38±2	85±2	35±2	26±3	50±3
19-34	37±4	3±1	5±2	58±4	24±4	44±3	88±2	41±4	26±3	52±4
35-50	44±4	5±2	7±3	60±5	39±5	35±3	83±3	32±6	24±4	47±6
51-65	49±7	1±1	2±1	52±5	26±4	33±6	84±4	33±6	29±6	48±6
>65	46±6	8±2	3±2	51±7	26±5	33±4	80±4	21±5	22±7	51±5
white women										
all ages (years)	24±1	10±1	7±1	42±1	17±1	48±1	59±1	20±1	32±1	60±1
19-34	21±1	10±1	7±1	52±1	18±1	50±2	59±1	22±1	25±1	56±2
35-50	28±2	7±1	8±1	46±1	18±1	46±2	64±2	19±1	29±2	60±2
51-65	26±1	10±1	6±1	31±1	17±2	47±1	57±1	17±1	42±2	63±2
>65	22±2	13±1	3±1	20±2	16±2	47±2	50±2	20±1	50±2	63±2
black women										
all ages (years)	46±2	7±1	7±1	49±3	26±3	27±2	69±2	18±2	25±2	49±3
19-34	43±3	4±1	7±2	55±3	26±3	29±2	73±4	20±3	24±4	48±3
35-50	51±4	10±2	7±3	51±4	29±4	21±5	68±4	16±3	24±4	47±6
51-65	50±4	9±2	7±3	40±5	20±4	24±4	68±4	14±3	28±3	56±4
>65	38±6	10±3	4±1	36±7	27±6	40±6	47±6	18±5	34±5	47±6

[a]Recommended no. of servings for the dairy, meat, fruit, and vegetable groups is two; for the grain group, recommended no. of servings is four.

with increasing age. A clear relationship of age with mean Serving Score was not found among white men and black women.

Figures 1 and 2 depict the diversity scores by level of education and income status. Both the Food Group and Serving scores increased with increasing income and level of education in all sex-race groups. Although the proportion of respondents with a Serving Score of 20 increased with level of education, the proportion with this score was very low (2.2% to 5.0%) at all levels of education.

Table 2 lists the proportion of the population consuming no serving from each food group on the survey day by sex, race, and age. The most frequently missed food group was the fruit group, followed by the dairy and vegetable groups. Higher proportions of men and blacks reported no consumption of any fruit on the survey day compared with women and whites. The proportion reporting no fruit declined with age in all sex-race groups. Blacks were almost twice as likely to report consumption of no dairy products on the survey day as whites.

Table 2 also presents the proportion of the population consuming at least two servings each from the dairy, meat, fruit, and vegetable groups and at least four servings from the grain group on the survey day by sex, race, and age. Among the total population, only 29% consumed the desired number of servings of fruit and grain and nearly 51%, 71%, and 61% consumed the desired number of servings from the dairy, meat, and vegetable groups, respectively. Although nearly 95% of the population consumed at least one food from the grain group (Table 2), only 29% consumed four or more servings from this group.

With increasing level of education and income, the proportion of the population reporting no servings from the dairy, fruit, and vegetable groups decreased and the proportion reporting at least the recommended number of servings from the dairy, fruit, and vegetable groups increased (Table 3).

Discussion

Our study demonstrates that a high proportion of the US population does not consume diets that include all the major food groups. The reported consumption of approximately 2 Tbsp (or less for dairy and grain groups) of a food item on the survey day qualified its inclusion in the diet diversity measures reported here. Considering these liberal criteria, the observations that only 33% of the US population consumed foods from all five food groups on the survey day, and that the proportion consuming at least the desired number of servings from all of the various food groups was only 2.9%, suggest that typical US diets are

Table 3. Food group consumption by income, based on second National Health and Nutrition Examination Survey (14)

food group	quartiles of poverty income ratio[a]			
	Q1 <1.46	Q2 1.46-2.38	Q3 2.39-3.55	Q4 >3.55
	← % →			
proportion[b] of the population reporting no servings from the various food groups				
dairy	28±1	24±1	23±1	22±1
meat	8±1	7±1	6±1	5±1
grain	6±1	5±1	5±1	5±1
fruit	57±2	49±1	44±1	38±1
vegetable	24±1	18±1	16±1	15±1
Proportion[b] of the population consuming at least the recommended number of servings from the various food groups				
dairy	48±1	51±2	51±1	52±1
meat	69±1	71±1	71±1	71±1
grain	32±1	31±1	29±1	26±1
fruit	23±1	28±1	29±1	36±1
vegetable	51±1	60±1	64±1	66±1

[a]Poverty index ratio is a ratio of the total household income to income necessary for maintaining a family on a nutritionally adequate food plan. Ratios <1.0 are considered "below poverty."
[b]Proportion (±standard error) adjusted for race, sex, and age.

Table 4. Proportion of the population consuming no servings from the various food groups: a comparison of NHANES II[a] (1976-80) and CSFII[b] (1985)

sex/age group	no.	food group				
		dairy	meat	grain	fruit	vegetable
		← % →				
19- to 34-year-old men						
NHANES II	1,818	21	3	4	57	18
CSFII	626	28	7	7	58	17
35- to 50-year-old men						
NHANES II	1,118	22	2	3	50	17
CSFII	509	25	7	4	56	13
19- to 34-year-old women						
NHANES II	1,973	27	9	7	52	19
CSFII	854	22	13	5	52	17
35- to 50-year-old women						
NHANES II	1,253	24	8	8	47	19
CSFII	649	25	11	7	54	16

[a]NHANES II = second National Health and Nutrition Examination Survey (14).
[b]CSFII = Continuing Survey of Food Intakes of Individuals (10).

not consistent with current food group guidance. Analyses based on the USDA's "Better Eating for Better Health" guide (13) or the recent diet and health recommendations of the National Academy of Sciences (9) (which emphasize choices within the various food groups and a greater number of servings from grain, fruit, and vegetable groups) would indicate an even greater disparity between recommendations and practice.

It should be kept in mind that most dietary recommendations are for daily consumption from each food group. Thus, in spite of the limitations of a 24-hour dietary recall (20,21), it is clear that individuals who scored less than five on the Food Group Score did not include one or more food group(s) on the day of the survey, and have not met this daily criterion.

Our estimate of the proportion consuming all food groups in the recommended amount (2.9%) confirms a similar estimate of 3% reported by Crocetti and Guthrie (22) from an analysis of the 1977-1978 Nationwide Food Consumption Survey (NFCS) data. Our estimate is derived from the Serving Score, in which we have used the median gram weight of each food reported as a serving of that food. Possibly other such analyses using different methods for setting serving sizes may yield different results. Therefore, the similarity of the NHANES II and the NFCS estimates is remarkable because the NFCS estimate was obtained from a 3-day average, presumably using standard recommended portion sizes to estimate servings.

It is noteworthy that comparable scores based on the presence of major and minor food groups in the diet have been found to be associated with nutrient adequacy (15,22,23), but not with energy and fat intakes (15). Our preliminary findings also suggest that diets with higher diversity scores were more likely to be nutritionally adequate (24).

Data presented here are for the period 1976 to 1980. With increasing awareness of diet and health associations and widespread print and visual media exposure of these issues in the past decade, the public's knowledge and practice of healthful nutrition may have increased. A study of trends in food consumption patterns of American women from 1977 to 1985 showed favorable shifts in decreased consumption of higher-fat meats and milk; however, the percentage reporting use of high-fat cheeses and medium-fat meats was higher in 1985 (25). Additionally, the percent of total energy intake contributed by fat has changed minimally from 1977 to 1985 (10). Thus, although shifts (not obviously substantial or even in a beneficial direction) may occur in the selection of different foods within the broad food groups used in our analysis, it is unlikely that major changes have occurred in the percent of the population consuming foods from any one food group.

Our data on diet diversity not only provide a baseline for analyses of these measures in future nutrition surveys, but may also reflect the current state of dietary practices in the United States to a certain extent. A comparison (Table 4) of food intake data from the 1985 Continuing Survey of Food Intakes of Individuals (CSFII) (10) with NHANES II data illustrates this comparability in food group consumption. Generally, CSFII estimates of individuals missing the various food groups are higher than the NHANES II estimates, even though mere mention of a

food item qualified inclusion in the total count in the CSFII. However, the dairy and meat groups in the two surveys are not comparable; the dairy group in CSFII includes cream and the NHANES II estimate does not, and the meat group in CSFII excludes beans, legumes, and nuts, whereas those are included in the NHANES II meat group.

A high proportion of the US population does not eat from all the major food groups each day—only 33% consumed food from all five food groups on the survey day, and only 2.9% consumed the desired number of servings from each food group

Foods from the fruit and dairy groups appear to be most likely to be omitted on any given day (Table 2), which is in accordance with an analysis of food usage in the USDA's 1977-1978 NFCS (26). Mexican-American children were also reported to have low daily intakes of fruits and vegetables, consuming less than half the recommended four servings of these foods (12). Foods from the grain and vegetable groups were also likely to be consumed in less than the recommended amounts by the NHANES II respondents. Foods from these groups contribute nutrients to the diet and are also associated with decreased risk of certain chronic diseases (9).

The cost of foods in the fruit, vegetable, and dairy groups may be an important reason for their limited consumption. However, cost is unlikely to be the only reason as individuals in the highest quartile of income (Figure 1, Table 3) and education (Figure 2) also report disappointingly little variation in food group consumption. Many foods in the meat group (except dried beans and peas) are among the most expensive foods in the American food supply, but nearly 94% of the population surveyed reported intake of foods from this group on the survey day (Table 2). Foods from the fruit, dairy, grain, and vegetable groups may not be perceived as so important or palatable as the meat group and may be replaced by alternatives (eg, substituting fruit drinks for fruit juices and fruits and sweetened pastries for breads).

Recommendations

Data presented underscore the need for major public education efforts to increase consumption of the fruit, dairy, grain, and vegetable groups. Although all segments of the population would benefit from education on strategies for improving nutritional practices, special target groups include minorities and individuals with limited income and formal education. Additionally, in view of the relationship of income status to dietary diversity, the issue of increasing availability and affordability of food by increasing food purchasing power of these high-risk population groups needs to be addressed.

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