Characterizing Nutrient Intakes of Children by Sociodemographic Factors

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Synopsis

Data from 1,392 children ages 1 to 10, who were participants in the U.S. Department of Agriculture 1987-88 Nationwide Food Consumption Survey, were examined to determine how their diets compared with current dietary recommendations and to identify those sociodemographic factors associated with the greatest risk for not meeting the recommendations.

Vitamin A, vitamin E, vitamin C, calcium, iron, and zinc were the nutrients most often consumed below recommended levels. Percentage of calories from fat and saturated fat and mean sodium intakes were above recommended levels for the majority of the children. Of the total sample, 81 percent met guidelines for cholesterol intakes.

Multiple correlation regression analysis was used to determine the effect of the following factors on the children's nutrient intakes: geographic region, degree of urbanization, race, household size and income, age, education, and employment status of the male and female head of household. Age and sex of the child were entered as control variables.

Level of urbanization affected the most nutrient intake variables, followed by race. Living in a rural area and being black were significant predictors for higher intakes of total fat, saturated fat, cholesterol, and sodium. Mean annual household income had no significant effect on any of the diet quality measures. Many of the children in the sample, however, participated in Federal food and nutrition programs that provided additional resources for food.

CHILDREN HAVE BEEN IDENTIFIED as an important target group for national public health initiatives aimed at health promotion and disease prevention (*1*). It is easier to establish healthful habits during childhood than to attempt to change eating habits later in life. Thus, childhood offers an opportunity for nutrition education to influence the establishment of healthful lifelong eating patterns (*2*).

In developing nutrition education programs for children, health professionals benefit from information about the diet quality of diverse groups of children. Knowledge of children's dietary patterns allows for the targeting of nutrition information to groups where nutrition intervention is needed to improve risk factor profiles (*3*).

The information currently available is based on older national samples (*4*) and on smaller samples limited to a specific geographic area (*5*). Recent data from a large nationwide sample do not examine the effect of sociodemographic variables on nutrient intake (*6*). Hence, this study was designed to provide a description of the current dietary intake of a large sample of U.S. children and to identify those sociodemographic characteristics that placed the children at the greatest risk for poor diet quality.

Methods

The study sample. Key sources of information concerning the dietary intakes and practices of U.S. children are nationwide surveys, including the U.S. Department of Agriculture (USDA) 1987–88 Nationwide Food Consumption Survey (NFCS). USDA surveys have been the cornerstone for Federal monitoring of American food consumption patterns and nutritional well-being since 1936 (*7*).

The 1987–88 NFCS provides detailed information regarding food and nutrient intakes and extensive data on sociodemographic variables. There were 1,392 participants ages 1–10 years for whom 3 days of

dietary intake data were available. Trained interviewers conducted 24-hour recalls with the mothers and provided them with information on how to keep detailed food records for 2 additional days (*7*).

Thus, the dietary data for the children were typically provided by their mothers and were collected as one 24-hour diet recall followed by a 2-day food record. In the event the mother was unable to recall an entire meal for her child, the child was dropped from the survey. If only a few food items were not specified by the mother, default values for these foods were used. For example, if a mother remembered that her child ate cereal for breakfast but could not remember the brand, the most frequently mentioned breakfast cereal was used as a default, according to a personal communication from H. Riddick, PhD, USDA Human Nutrition Information Service, March 1993.

Measuring diet quality. Diet quality was measured using standards established by the National Research Council (NRC) (*8,9*) and the National Institutes of Health (*10*). Nutrient adequacy and nutrient overconsumption were examined using 3-day average nutrient intakes. Nutrient adequacy ratios (NARs), the ratios of nutrient intakes to the 1989 Recommended Dietary Allowances (RDAs), were determined for 15 essential nutrients for each child (*8*). With the exception of vitamin B6, NARs were calculated as follows:

NAR= Person's 3-day average intake of a nutrient ÷ Age- and sex-specific recommended dietary allowance for that nutrient (*8*)

Vitamin B6 needs are based on protein intake and thus inadequacy may be overestimated unless protein intake is considered in computing the NAR score (*11*). In the recommended dietary allowance, an intake of 0.02 milligrams (mg) of vitamin B6 per gram (g) of protein is used as the standard for children (*8*). Therefore, the NAR for vitamin B6 was calculated as follows:

[Person's 3-day average vitamin B6 intake (mg) ÷ Person's 3-day average protein intake (g)] ÷ .02

Nutrient overconsumption was assessed by examining the percentage of calories from total fat and saturated fat and average cholesterol and sodium intakes in the sample. The Food and Nutrition Board of the NRC, the National Cholesterol Education Program Report of the Expert Panel of Blood Cholesterol Levels in Children and Adolescents, and the American Academy of Pediatrics recommend a diet in which total fat is 30 percent or less of total kilocalories, saturated fat 10 percent or less of total kilocalories, and cholesterol 300 mg or less for all healthy children older than age 2 years (*9,10,12*). The NRC also recommends a sodium limit of 2,400 mg or less (*6*).

'Based on these data, it seems that dietary patterns are developing early in life that may contribute to the increase in risk factors for chronic disease for black people.'

Statistical analysis. The effects of selected sociodemographic factors on diet quality were assessed using multiple correlation regression analysis. The sociodemographic factors considered were household size, annual household income, degree of urbanization, geographic region, race, age of child, years of education and number of hours employed for both the male and female heads of household. The nominally scaled variables, urbanization, geographic region, and race, were entered into the regression equation as sets of dummy variables. All other sociodemographic variables were intervally scaled and were entered directly into the regression equation. Age and sex of the child were entered as control variables to control for variations in diet quality that otherwise might be attributable to them. The Statistical Analysis System (SAS) computer software program was used to analyze the data and the .05 probability level was used to determine statistical significance.

Results

Description of the sample. A total of 1,392 children were included in the sample. The children had a mean age of 5.5 years, included slightly more boys (51 percent) than girls, and were 81 percent white, 13 percent black, and 6 percent "other," which included Asians, Pacific Islanders, Aleuts, Eskimos, American Indians, and others. They lived in households with a mean annual income of $27,570. Eighty percent of the children resided in household with both parents present; 19 percent lived with their mother only, and 1 percent lived with their fathers only. Eighty-two percent of the fathers were employed full-time; 32 percent of the mothers were employed full-time, and 18 percent were employed part-time (table 1).

Table 1. Demographic data on 1,392 children participating in the U.S. Department of Agriculture 1987–88 Nationwide Food Consumption Survey

Category	Number	Percent
Residence:		
Northeast	255	18.3
Midwest	422	30.3
South	435	31.3
West	280	20.1
Urbanization:		
Central city	312	22.4
Suburban	654	47.0
Nonmetropolitan	426	30.6
Food stamp program:		
Yes	220	15.8
No	1,172	84.2
Women, Infants, and Children Program:		
Yes	78	14.0
No	479	86.0
School lunch:		
Yes[1]	700	50.3
No	692	49.7
School breakfast:		
Yes[2]	243	17.5
No	1,149	82.5

[1] Of those attending schools serving lunches, the mean number of school lunches consumed per week was 3.33, standard deviation (SD) ± 2.13.
[2] Of those attending schools serving breakfasts, mean number of breakfasts consumed per week was 1.81, SD ± 2.33.

Assessment of diet quality. The nutrient adequacy of the children's diets was assessed by examining their intakes of protein and 14 essential vitamins and minerals (table 2). Criteria suggested by Pao and Mickle (*13*) were adapted, and a nutrient was considered worthy of further attention if 20 percent or more of the children from any age group had intakes with an NAR of .77 or less. The value of .77 was used as a cutoff because this would be adequate for 50 percent of the persons, assuming that the requirements are normally distributed (*14*). With this criteria, vitamin A, vitamin E, vitamin C, calcium, iron, and zinc were selected for inclusion in the multiple correlation regression analysis as dietary outcome variables of interest.

Overconsumption of nutrients was assessed by examining the intakes of total fat, saturated fat, cholesterol, and sodium (table 3). The percentage of total calories from fat was higher than the current recommended level of 30 percent for the majority of the children. In addition, only a small percentage (13 percent) of the total sample took in 10 percent or less of their calories from saturated fat. The majority of the children, however, had less than the recommended upper limit of cholesterol intake. The children ages 1–3 years were more likely to meet the recommendation for less than 2,400 mg of sodium than the older children. This was probably related to the lower caloric intakes of the younger children. Since sodium values reported in the NFCS did not include the use of discretionary salt, the actual mean sodium intakes exceeded these figures.

Effects of sociodemographic variables. The sociodemographic variables that significantly affected mean nutrient intakes are shown in table 4. Household size was positively related to the NAR for iron (b value for every one person increase in household size = 0.046, P =.03). Annual household income had no statistically significant effect on the intake of the 11 nutrients considered in the analysis. The male and female heads of household's age and number of hours employed, as well as the female head's years of education, were not significantly related to any of the nutrient variables. The male head of household's years of education was negatively related to the percentage of calories from saturated fat (b value for every 1 year increase in male education = –.07, P=.02).

The degree of urbanization affected several nutrients (table 5). Children residing in nonmetropolitan areas had the highest intakes of calories, total fat, saturated fat, cholesterol, and sodium. The lowest intakes of these were reported by children residing in central cities.

Race was related to the intakes of several nutrients (table 6). White children had the highest NAR for vitamin A. Black children had the highest intakes of total fat, saturated fat, cholesterol, and sodium. Children of "other" races had the lowest intakes of all the nutrients except vitamin A (table 6). Region affected calcium intakes. Children living in the West had the highest calcium NAR followed by midwestern children and northeastern children, with those from the South having the lowest intakes.

Discussion

Dietary intake data from 1,392 U.S. children participating in the 1987–88 NFCS were examined to describe the quality of their diets. The 1987–88 NFCS had an individual response rate of 31 percent, much lower than in previous surveys. An expert panel examined the potential for nonresponse bias in the survey and concluded that it was not possible, with absolute certainty, to demonstrate either the presence or absence of nonresponse bias (*15*). The research sample was very similar, however, to U.S. population data collected during the same period for a number of social and demographic characteristics that could potentially affect nutrient intake, including race, head of household status, annual household income,

geographic distribution, family size, and years of maternal education (*16*). Thus, it is still appropriate to use this extensive data set to examine the dietary intakes of this large group of U.S. children.

The sample had low intakes (NAR < .77) of several nutrients including vitamins A, C, and E, calcium, iron, and zinc (table 2). The minerals calcium, iron, and zinc have been identified previously as nutrients of concern in children (*6,17–23*).

Vitamin E intakes have not been reported in earlier surveys. The major sources of vitamin E in the U.S. diet are vegetable oils (*24*). Since the major function of vitamin E is as an antioxidant to prevent peroxidation of polyunsaturated fatty acids (PUFA) in cell membranes, the requirement is related to intakes of PUFAs. Most oils contain enough vitamin E to cover these needs. More research is needed, however, on children's requirements for vitamin E and vitamin E content in various foods (*25*).

For vitamins E and C, calcium, iron, and zinc the percentage of children with NARs below .77 decreased with age. Toddlers from the age of 18 months to 3 years are known for developing strong food likes and dislikes as well as going on "food jags" where they will limit their intake to a few preferred foods for short periods (*26*). Aversions to nutrient-rich vegetables are common among toddlers (*27*). As children develop, however, in most cases they will accept a wider variety of foods, thus improving their overall nutrient intake (*26*).

Mean intakes of total fat and saturated fat exceeded recommended levels in the vast majority of the sample children; only 11 to 22 percent met recommended levels (table 3). Results of earlier governmental surveys support these findings (*17,21,22*). Early childhood should be considered a transition period during which fat and cholesterol content of the diet should gradually decrease to the recommended amounts (*12*). This was not evident in this sample, as the percentage of children meeting recommendations for fat, saturated fat, cholesterol, and sodium actually declined with age. This would suggest that, as a whole, mothers are not interpreting the recommendation to limit fat intake to 30 percent or less of total calories to mean that their children should avoid all fat. This would seriously compromise caloric intake, the availability of essential fatty acids, and the absorption of fat-soluble vitamins.

A number of sociodemographic variables were related to the nutrient intakes of the sample. Level of urbanization influenced the most nutrient intake variables (table 4). Children in urban areas had the lowest caloric intakes. Inner-city areas have often been the focus of domestic hunger programs, although more information is needed to estimate the prevalence of hunger in the United States (*28*). In the third National Health and Nutrition Examination Survey (NHANES III) information is being collected to measure the prevalence of reported food insufficiency in the U.S. population (*29*). In contrast, living

Table 2. Distribution of nutrient adequacy ratios (NARs) for 15 essential nutrients among 1,392 children, ages 1–10, participating in the 1987–88 Nationwide Food Consumption Survey

Nutrient	Percent below NAR of .77		
	Ages 1–3 (N = 408)	Ages 4–6 (N = 446)	Ages 7–10 (N = 538)
Protein	.5	.7	.6
Vitamin A (RE)[1]	13.5	15.2	24.9
Vitamin E (TE)[1]	69.4	57.6	37.5
Vitamin C[1]	21.3	17.9	11.0
Thiamin	5.4	6.3	5.4
Riboflavin	2.7	3.6	3.3
Niacin	11.0	9.2	5.6
Vitamin B6	8.3	9.9	10.4
Calcium[1]	40.2	26.2	19.1
Phosphorus	18.9	6.3	3.7
Magnesium	1.2	2.5	6.9
Iron[1]	45.3	21.3	10.8
Zinc[1]	73.0	48.0	28.3
Vitamin B12	0	0.4	0.2
Folate	0.5	1.1	1.0

[1]Nutrient included in multivariate analysis.
NOTE: NAR was calculated by dividing the child's 3-day average intake of a nutrient by the age- and sex- specific 1989 recommended dietary allowance for that nutrient.

Table 3. Intake of fat, saturated fat, cholesterol, and sodium for 408 children ages 1–3, 446 children, ages 4–6, and 538 children, ages 7–10, 1987–88 Nationwide Food Consumption Survey

Recommended intake and age group	Mean actual intake	Percent of children meeting recommendation
Total fat (30 percent or less of calories):		
1–3 years	35.5	22.1
4–6 years	35.5	17.7
7–10 years	36.6	13.8
Saturated fat (10 percent or less of calories):		
1–3 years	14.4	13.0
4–6 years	13.8	14.6
7–10 years	14.1	11.2
Cholesterol (300 milligrams or less):		
1–3 years	185.6	89.0
4–6 years	212.6	82.7
7–10 years	252.9	72.7
Sodium[1] (2,400 milligrams or less):		
1–3 years	1,936.5	78.9
4–6 years	2,482.5	50.9
7–10 years	2,942.9	28.8

[1]Does not include discretionary salt intake.

Table 4. Significant relationships between sociodemographic characteristics and mean 3-day intake of nutrients for 1,392 children, ages 1–10, 1987–88 Nationwide Food Consumption Survey, using multiple correlation regression analysis

Relationship	P value
Household size: and iron	$P < .05$
Male head's education: and saturated fat	$P < .05$
Urbanization:	
and calories	$P < .01$
and vitamin E	$P < .05$
and total fat	$P < .01$
and saturated fat	$P < .05$
and cholesterol	$P < .05$
and sodium	$P < .05$
Region: and calcium	$P < .05$
Race:	
and vitamin A	$P < .05$
and total fat	$P < .05$
and saturated fat	$P < .05$
and cholesterol	$P < .05$
and sodium	$P < .05$

NOTE: Child's age and sex are controlled for in the multivariate analysis. There was no correlation between nutrients and household income, age of male and female heads of household, female head's education, and the numbers of hours male and female head were employed.

Table 5. Adjusted mean nutrient values by degree of urbanization, controlling for all other sociodemographic variables in the model of 1,392 children, ages 1–10, 1987–88 Nationwide Food Consumption Survey

Nutrients	Central city (N = 312)	Non-metropolitan (N = 426)	Suburban (N = 654)	Overall F-value
Calories	1,606	1,798	1,672	[1]12.8
NAR[2] vitamin E	92	81	66	[1]2.9
Total fat (percent)	34.0	37.8	36.4	[1]3.6
Saturated fat (percent)	12.3	14.0	13.0	[1]3.5
Cholestrol (milligrams)	176	212	196	[1]3.9
Sodium (milligrams)	2,289	2,537	2,406	[1]10.8

[1] $P < .001$. [2] NAR = nutrient adequacy ratio.

Table 6. Adjusted mean nutrient values by race, controlling for all other sociodemographic variables in the model of 1,392 children, ages 1–10, 1987–88 Nationwide Food Consumption Survey

Nutrients	White (N = 1,123)	Black (N=179)	Other (N=90)	Overall F value
NAR[1] vitamin A	165	101	160	[2]22.1
Total fat (percent)	36.5	37.1	34.4	[3]3.6
Saturated fat (percent)	14.7	14.9	14.0	[3]3.5
Cholesterol (milligrams)	244	268	212	33.9
Sodium (milligrams)	2,825	2,976	2,537	[3]10.8

[1] NAR = nutrient adequacy ratio. [2] $P < .01$. [3] $P < .001$.

in a rural area was a significant predictor for higher intakes of calories from total fat, saturated fat, cholesterol, and sodium.

Race was a factor that affected several nutrient variables. Being black placed the children at the highest risk, with black children having the lowest vitamin A intakes and the highest total fat, saturated fat, cholesterol, and sodium intakes. Blacks are known to have higher incidences of cancer, cardiovascular disease, and hypertension than whites (*30*). Based on these data, it seems that dietary patterns are developing early in life that may contribute to the increase in risk factors for chronic disease for black people. These patterns may be a reflection of traditional family and cultural food patterns. Aggregating the "other" races was necessary due to the small numbers of these children. Thus, it is important not to overgeneralize the effects seen among this group. Overall there is a paucity of data on children from these "other" groups. Future surveys will need to oversample these children to allow for the identification of potentially important differences that may be hidden by grouped data.

In this sample, income had no significant effect on any of the diet quality measures. The lack of effect for income on nutrient intake has been shown previously in analyses of the HANES survey (*31*), the 1977–78 NFCS (*3*), as well as in smaller studies (*32*). As Van Schaik pointed out (*33*), there is an income level below which children starve, but above that level the amount of money spent on food is unrelated to its nutrient composition. Many of the sample children were receiving financial assistance in the form of Federal food and nutrition programs such as the Women's, Infants, and Children's (WIC) Program, Food Stamps, and school lunch and breakfast (table 1). This assistance provided to many lower income households additional resources for food that allowed them to participate more equitably in the food supply (*4*). National surveys such as the 1987–88 NFCS, however, are unlikely to capture the very lowest income households or the homeless where families may be constantly on the move and difficult to contact. Studies targeted towards the homeless or unemployed are needed to assure adequate sampling of these vulnerable subgroups (*29*).

The multiple correlation regression analysis used in this study tested the association between 11 sociodemographic variables and the intake of 11 nutrients, for a total of 121 relationships. Of these relationships, 14 were statistically significant. The sample size was large which could make small differences in nutrient intake statistically significant. In examining the data, however, the differences are

meaningful. For example, in comparing nonmetropolitan children with central city children, there was a 3.8-percent difference in calories from total fat and a 2.7-percent difference between black and other children. These are differences that nutritionists evaluating intervention programs designed to reduce fat intake would undoubtedly conclude were practically significant.

As a whole, the children in the sample consumed diets that were low in several essential vitamins and minerals and high in some nutrients related to increased incidence of chronic disease. There were groups of children, however, who exhibited food consumption patterns that made them especially vulnerable. Fat, saturated fat, cholesterol, and sodium intakes of rural and black children exceeded recommended levels of intake. Substantial changes are needed in these children's diets if they are to meet current recommendations. These changes can be difficult to achieve given the delicate balance between the need to reduce overconsumption of nutrients such as fat while avoiding nutrient inadequacies of key essential vitamins and minerals and maintaining a caloric intake sufficient to promote acceptable growth and development.

The current generation of nutritionists places significant emphasis on reducing dietary fat, cholesterol, and sodium in children's diets in an effort to reduce long-term risk of chronic disease. This is in contrast to earlier generations' concern for the underconsumption of essential vitamins and minerals and their resultant deficiency diseases. These two phenomena may not disentangle so easily. Perhaps it is time to reinforce the concept of eating a balanced diet comprised of a variety of foods. Moderation is a key word here; stress the types of foods that need to be added to children's diets, such as fruits, vegetables, and low fat meat and dairy products, not just the types of foods that need to be eliminated.

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