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Nutrient Intakes of Third Graders: Results from the Child and Adolescent Trial for Cardiovascular Health (CATCH) Baseline Survey

Leslie A. Lytle[1], **Mary Kay Eszery**[2], **Theresa Nicklas**[3], **Deanna Montgomery**[4], **Michelle Zive**[5], **Marguerite Evans**[6], **Patricia Snyder**[1], **Milton Nichaman**[4], **Steven H. Kelder**[4], **Debra Reed**[7], **Ellen Busch**[5], and **Paul Mitchell**[8]

1 *School of Public Health, Division of Epidemiology, University of Minnesota, Minneapolis, Minnesota 55454*

2 *Frances Stern Nutrition Center, New England Medical Center Hospital, Boston, Massachusetts 02111*

3 *School of Public Health, and Tropical Medicine, Tulane University, New Orleans, Louisiana 70112*

4 *School of Public Health, Center for Health Promotion Research and Development, University of Texas Health Science Center, Houston, Texas 77225*

5 *Department of Pediatrics, Community Pediatrics Division, University of California, San Diego, San Diego, La Jolla, California 92093-0927*

6 *Division of Epidemiology and Clinical Applications, National Heart, Lung, and Blood Institute, Bethesda, Maryland 20892*

7 *School of Human Ecology, Louisiana State University, Baton Rouge, Louisiana 70803-4300*

8 *New England Research Institute, Inc., Watertown, Massachusetts 02172*

Abstract

The purpose of this article is to report on baseline intakes of 1874 third-grade children representing a subsample of the Child and Adolescent Trial for Cardiovascular Health (CATCH) cohort. Intakes were assessed using a single, food record-assisted, 24-hour recall. The sample is unique in that it is drawn from four states and includes students from various ethnic backgrounds. Nutrients of interest include total energy, sodium, dietary cholesterol, and percent of energy from total fat and saturated fat. At baseline, third-grade students were consuming above nationally recommended levels of energy from fat, saturated fat, and sodium. The CATCH findings show a mean energy intake of 2031 kcal with significant differences by sex. Significant differences by site were seen for percent of energy from total fat, saturated fat, and dietary cholesterol. Children from Minnesota consumed the lowest proportion of energy from total fat and saturated fat while children from Texas had the highest proportion of energy from total fat and saturated fat. Intake of dietary cholesterol was lowest in Minnesota and highest in Louisiana. Nutrient differences by ethnic group were seen only for energy, with African Americans having the highest energy intake and Hispanics having the lowest energy intake. The number of meals consumed from school food service significantly influenced children's nutrient, intake; children consuming two meals from school food service had significantly greater intakes of energy, saturated fat, and dietary cholesterol compared to students consuming one or no meals from school food-service. The results are compared to other national nutritional surveys of children.

Address for correspondence: Leslie A. Lytle, Ph.D., R.D., Division of Epidemiology, School of Public Health, 1300 South Second Street, Suite 300, Minneapolis, MN 55454;Tel: (612) 624-3518; Fax: (612) 624-0315..

INTRODUCTION

Children's diets exceed national recommendations for intake of total fat, saturated fat, and sodium[1–5] and contribute to the presence of precursors of cardiovascular disease risk in youth.[6,7] There is a continuing need to monitor trends in children's dietary intake and to learn more about differences in intake by geographic location and by racial or ethnic group.

The Child and Adolescent Trial for Cardiovascular Health (CATCH) was a multicenter trial in 96 schools in California, Louisiana, Minnesota, and Texas to reduce cardiovascular disease risk factors in youth. CATCH evaluated classroom-based curricula, a family program, and school environment modifications aimed at reducing fat and sodium consumption and increasing physical activity in a cohort of children as they advanced from third to fifth grade. Eat' Smart, the CATCH cafeteria intervention program, was designed to reduce total fat, saturated fat, and sodium in meals offered to children at school.[8,9] CATCH classroom curricula taught students to engage in behaviors and skills for choosing healthful foods and increasing physical activity. Teachers were trained to use goal setting, role modeling, and skill building. To improve physical education, teachers were given instruction on how to increase students' enjoyment of and participation in moderate-to-vigorous activity. The food-service intervention helped school foodservice staff plan healthier menus and prepare meals with less total fat, saturated fat, and sodium. Additionally, the classroom intervention for fifth graders focused on avoiding tobacco use, including how to resist social pressure to start smoking. Schools were also given guidance on how to establish smoke-free policies. CATCH used family fun nights and activities for students to do at home to involve parents. The details of the CATCH intervention and research design are described elsewhere.[10–12]

The purpose of this article is to report on baseline intakes of selected nutrients of 1874 third-grade children representing a subsample of the CATCH cohort. Nutrients of interest include those nutrients targeted by the intervention: intake of sodium and proportion of energy from total and saturated fat. In addition, the overall composition of the diet (energy from fat, carbohydrate, and protein), total energy intake, and dietary cholesterol are reported. Mean nutrient intakes are examined by site, ethnicity, sex, and the number of meals children report eating from school food service. In addition, findings from CATCH are compared with other youth-based national nutritional surveys.

METHODS

Subjects

The subsample of the total CATCH cohort to be involved in the collection of 24-hour recalls was determined by randomly selecting 2826 third-grade students across the four sites. To augment the sample, 660 additional students who had consented to participate in CATCH were selected from a randomly ordered list of remaining students at each school. A total of 3486 students were eligible to participate, of which 268 were dropped since they were later determined to be noncohort (no blood cholesterol was available), leaving a sample of 3218. Dietary recalls were collected from 1920 consenting children, representing 60% of the children selected to participate in the substudy and 38% of the total CATCH cohort. There were slightly higher participation rates in Minnesota (64.4%) as compared to California (54.6%), Louisiana (58.3%), and Texas (61.9%). Nonparticipation by those students selected for the substudy was due to failure to bring in a signed consent form (26%), failure to bring in a completed food record (7%), and absenteeism on the day of the recall or food record administration (7%). Although there were no differences by sex between participating and nonparticipating students, a smaller proportion of African Americans (53.8%) participated compared to Caucasians (61.4%), Hispanics (58.3%), and children from other ethnic groups combined (58.8%). Data collection occurred during the fall of 1991. Human subjects' approval for data collection was obtained from the Committee on Human Subjects in Research at each participating institution. Procedural details and results of the baseline risk factor screening have been published elsewhere.[13]

Forty-six cases were eliminated from the final analysis based on the presence of unverified nutrient outliers. Nutrient values for energy, total fat, saturated fat, sodium, and cholesterol were compared to portions commonly eaten by children.[14] Those values greater than the 99th percentile (without documented verification during data collection of unusual amounts consumed) were flagged as unverified outliers and these recalls were eliminated from the analyses. Sixty-seven students classified as other than Caucasian, African American, or Hispanic were not included in the mixed-model analysis of variance (ANOVA) evaluating statistical differences by site, sex, ethnicity, and number of meals consumed from school meals because of the small sample size.

Table 1 presents participation rates and sample characteristics. The ethnic group and sex distributions of 24-hour recall subjects are similar to the distribution in the total CATCH cohort.[13]

Dietary assessment method

A food record-assisted 24-hour recall was used to assess children's diets. This diet assessment methodology was validated during the pilot phase of CATCH using observation at school and at home as the criterion measure to validate children's self-report of their previous day's intake.[15] On Day 1, CATCH staff instructed groups of children on how to keep a food record. Children were asked to list all foods they took "at least one sip or one bite of" from that morning until bedtime. On Day 2, those children returning a food record were individually asked to recall the food eaten in the last 24 hours, using the food record as a memory aid. Children were asked to estimate portion sizes with the help of three-dimensional food models, measuring utensils, and tableware. Information on salt used in food preparation or at the table was not obtained. The information was directly entered by a CATCH staff person into a laptop computer using the Nutrition Data System (NDS) (Version 2.2, 1990, Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN). These 24-hour dietary recalls were administered via a one-on-one interview between individual children and a CATCH staff person.

Centralized training for the dietary data collection was conducted at New England Research Institutes, the study's coordinating center, and included training on using the NDS and study-specific protocols. Site nutritionists and interviewers were certified after successfully completing training and certification exercises. Quality control was maintained by having a senior nutritionist at each site observe and provide feedback to each interviewer using a standardized checklist targeting important elements of the protocol. Quality control observations were conducted at least three times over the course of the baseline measurement period for each data collector. In addition, quality control site visits were conducted by personnel from the study's coordinating center to ensure that study protocols were being followed.

Use of school meal information in NDS and in data analysis

CATCH nutritionists collected information on school menus, recipes, and vendor products in order to assess changes in school food service resulting from the Eat Smart cafeteria intervention.[9,16] These school-specific data were used in the analysis of 24-hour recalls for children who reported eating a school-prepared meal. For example, if a child consumed pizza served at school lunch, specific vendor product or recipe information for pizza served at that school was used in analyzing the child's nutrient intake. This was accomplished by customizing the NDS software to allow school recipe and vendor product identification numbers and proportions eaten to be included in the nutrient summary files. Foodservice nutrient data were linked with 24-hour recall summary files for children who reported eating a school meal. All foodservice data were sent to the University of Minnesota's Nutrition Coordinating Center for central coding, data entry, and nutrient calculation.

It was important to be able to identify school-prepared foods and integrate this information into the 24-hour recalls for several reasons. First, a large percentage of 8- to 9-year-old children consume school-prepared meals, which may contribute as much as 50% to 60% of total daily nutrient intakes.[1] Yet, it may be difficult to determine what school meals consist of with respect to their nutrient components unless items are specified precisely.[17] Second, since fat and sodium modifications were expected for the 56 CATCH intervention schools participating in Eat Smart,[9] the inclusion of school-specific meal information instead of generic recipes and ingredients was essential for characterizing differences in eating patterns between children in intervention and control schools.

Statistical analysis

Mixed-model ANOVA was used to investigate the influence of site, ethnic group, sex, and the number of meals received from school food services on mean levels of nutrient intake at baseline. The child's school was included in each model as a random effect, nested within site and treatment group, to account for any between-school variation occurring within treatment groups and between sites. The treatment group was included in the models as a fixed effect.

The sample included in the mixed-model ANOVA includes those 1807 students classified as Caucasian, African American, or Hispanic. Students from other ethnic groups were not included in these analyses due to the small number of students thus classified.

Dependent variables included total energy (kcal), percent of energy from total fat, protein, carbohydrate, saturated fat, monounsaturated fat, and polyunsaturated fat, as well as total dietary cholesterol (mg) and sodium (mg). CATCH site (df = 3), sex (df =1), and ethnic group (df = 2) were included as fixed independent effects, in addition to an interaction term for sex and ethnic group. The number of meals received from school food service was never more than two, so this was entered into the models as a class-level, fixed effect.

Means obtained from the mixed-model ANOVA were adjusted for all factors entered in the model, including site, treatment group, number of meals received from school food services, ethnic group, sex, and the interaction of ethnic group and sex. The data were analyzed using the Statistical Analysis System.[18]

RESULTS

Mean energy and selected nutrient intakes by site and sex are presented in Table 2. The adjusted mean intake for all sites combined was 2031 kcal, with 33% of energy from fat, 15% from protein, and 54% from carbohydrates. The proportion of energy from saturated fat was 12.7% and the mean intake of dietary cholesterol and sodium was 220 mg and 2972 mg, respectively.

Significant differences were found by site for all nutrients except total energy, sodium, and percent of energy from protein. The percent of energy from fat ranged from 31% in Minnesota to 34% in Texas. Minnesota children consumed more energy from carbohydrate (56%) while children from Texas consumed the least amount of energy from carbohydrate (52%). Minnesota children consumed the least amount of energy from saturated fat (11.9%) and monounsaturated' fat (11.4%) while Texas children consumed the greatest proportion of energy from saturated fat (13.4%) and monounsaturated fat (12.5%). Louisiana children consumed more energy from polyunsaturated fat (6.2%) and more dietary cholesterol (238 mg) compared to children from Minnesota (5.3% energy from polyunsaturated fat and 198 mg from dietary cholesterol). When sodium intake is represented per 1000 kcal (data not shown), there is a significant difference by site ($p < .05$), with Louisiana children consuming the most sodium (1535 mg per 1000 kcal) and California children consuming the least sodium (1428 mg per 1000 kcal). Data on sodium intake are limited by the lack of information on children's salting practices and salting that may have occurred during meal preparation in the home.

Differences in intake by sex are evident, with males consuming more total energy ($p < .003$), less energy from polyunsaturated fat ($p < .05$), and more dietary cholesterol ($p < .003$) than females. However, when cholesterol intake is adjusted for total energy, the difference between sexes disappears.

Nutrient comparisons of adjusted means by ethnic group and by ethnicity and sex interaction are shown in Table 3. Significant differences by ethnicity are seen only for energy. African-American children consumed the most energy (2106 kcal) while Hispanic children had lower energy intakes (1937 kcal). No significant ethnicity and sex interactions were seen except when dietary cholesterol was adjusted for total energy. African-American females consumed the least amount of dietary cholesterol (98 mg per 1000 kcal) while Hispanic males consumed the greatest amount of dietary cholesterol (118 mg per 1000 kcal).

The majority of children (63%) consumed one meal from school food service, usually lunch, while 14% and 23% received two meals or no meals, respectively. The number of meals consumed from school food service had a significant effect on adjusted mean nutrient intake for all nutrients-except proportion of energy from fat, monounsaturated fat, and total sodium (Table 4). Children who ate two meals from school food service consumed significantly more total energy, a higher proportion of energy from saturated fat, and more dietary cholesterol as compared to children who ate no meals from school food service. Students who consumed no meals from school food service had a higher intake of energy from carbohydrate and polyunsaturated fat. Children consuming one meal from school food service had the highest intake of energy from protein while students consuming no meals from school have the lowest intake of protein.

DISCUSSION

We are unable to characterize an individual's diet or the nutritional adequacy of school meals from a single 24-hour recall or a single assessment of a school lunch due to intra-individual variation in what is consumed and in meals offered. However, pooling multiple single 24-hour recalls or pooling multiple school meals to derive a group mean allows us to consider intergroup variation. These CATCH baseline data combined over 1800 dietary recalls and examined differences by site, sex, and ethnicity. The differences that are seen between groups (e.g., energy from fat for Minnesota children equalled 31% as compared to 34% of energy from fat for children from Texas) may have little biological importance if considered at the individual level for a single day but have important implications when considering disease risk in populations.[22]

These CATCH baseline data, combined with results from other national nutrition surveys of youth, provide an additional point marking the trends in children's nutrient intakes. A summary of dietary studies in children, the methodology used for diet assessment, and nutrient comparisons across these studies is presented in Tables 5 and 6.

The studies compared span 20 years of nutritional survey information on children ranging in age from 6 to 11. The most common assessment method was a single 24-hour recall.

Energy intakes across the nine reviewed studies ranged from 1728 kcal in the Dietary Intervention Study in Children (DISC; a study of children with elevated LDL-cholesterol levels)[2] to 2220 kcal in the School Nutrition Dietary Assessment (SNDA) Study.[19] No trend or change in the pattern of energy intake over time was obvious.

A trend toward lower percent of energy from fat is evident across these studies. The CATCH baseline findings are consistent with the findings from the SNDA study,[19] DISC,[2] and NHANES III.[5] These studies, conducted between 1988 and 1993, using very similar methodology for data collection and similar nutrient databases, showed average energy from fat to be between 33% and 34% of calories. Earlier studies carried out between 1971 and 1988,[3,4,20,21] in which similar methodology for data collection was used (24-hour recall in-person interviews), show the proportion of energy from fat between 36% and 37%.

The trend toward lower fat intakes over time could be due to a variety of factors, including the increase of available lower fat foods in the marketplace, secular trends toward lower fat consumption in the population, an increase in reporting bias, or methodological differences in 24-hour recall protocol between studies. From an epidemiologic viewpoint, the reduction of fat in children's diets (assuming it represents a real reduction and not an artifact of assessment methodology) from 38%[3] to 34% of total energy seen in this study and other studies[5,19] represents a factor that may have an important impact on the incidence of heart disease. The maintenance of this lower fat eating pattern into and throughout adult life needs to be studied in order to evaluate the full importance of this finding. Moreover, it is yet to be determined if children's fat intake can be reduced to meet the national recommendation of no more than 30% of energy from total fat without compromising intake of other important nutrients.[22]

While the proportion of energy from total fat appears to be declining, the proportion of energy from saturated fat has remained fairly stable (13–14% of energy) and exceeds were not asked to estimate the amount of salt added to foods at the table. Pilot work showed that children were not able to estimate the amount of salt they added to foods at the table; therefore, dietary recalls did not probe for that information. In all of the studies reviewed, sodium intake exceeded dietary recommendations.

These CATCH baseline findings examining the nutrient contribution of school food service are an important replication of SNDA study findings.[19] As in the SNDA, children eating two meals from school food service consumed significantly more energy from saturated fat and more total energy as compared to children eating no meals from school food service. While SNDA showed significant differences in the percent of energy from total fat and sodium based on school meals consumed, the CATCH baseline results revealed a similar pattern but no significant differences ($p > .10$). In general, however, the CATCH data support the SNDA findings that children eating school meals consume more fat, saturated fat, cholesterol, and sodium than children not participating in the school lunch or breakfast programs. New recommendations from USDA regarding foods offered via school meal service are likely to positively impact fat and saturated fat content of school meals nationwide. It is also important to note that CATCH data suggest that students who consume two meals from school lunch have significantly higher intakes of calcium, phosphorus, and potassium as compared to students not participating in school foodservice programs.

Physiologic risk factors for chronic disease appear to differ by ethnic group;[25] however, nutritional intake by ethnicity has been examined in only a few surveys of children. The CATCH results allowed comparison of nutrient intake by ethnicity, sex, and site. Few significant differences in dietary intake were observed by ethnicity or sex. Energy intake was most influenced by sex and ethnicity, with males and African Americans consuming the most energy. Hispanic children had the lowest energy intake but consumed more energy from saturated fat than other racial groups. African-American children consumed the most sodium and Hispanic females consumed the least sodium.

Comparisons of nutrient intake by non-Hispanic white, non-Hispanic black, and Mexican-American children were reported in the NHANES III data. These results are not directly comparable to CATCH results since ethnic and racial groupings are slightly different between the studies, results of nutrient intake from CATCH are adjusted, and children aged 6 to 11 are grouped together in NHANES III. Data from NHANES III[5,26] do not report if mean differences in nutrient levels between groups are significantly different. Nevertheless, results reported from CATCH and NHANES III are similar across racial/ethnic groups. In NHANES III and CATCH, energy intake was highest in blacks and lowest in Mexican Americans. Comparable with CATCH, data show that Mexican Americans and non-Hispanic white children in NHANES III consumed more energy from saturated fat (12.9%) as compared to non-Hispanic black children (12.6%). As in CATCH, sodium consumption was found to be highest in non-Hispanic black children (3222 mg) and lowest in Mexican-American children (2922 mg). The National Growth and Health Study (NGHS)[27] also shows data by white and black. As in CATCH and NHANES III, energy intake was higher in black girls as compared to white girls. However, energy from saturated fat was equal between black and white girls.

Site differences were significant for most nutrients, suggesting that geographic location has an important influence on eating patterns among children. Regional foods or norms related to food-related behavior appear to influence what is consumed above and beyond the racial or ethnic mix in an area. The findings regarding racial/ethnic and site differences suggest that intervention efforts to alter the diet of America’s children should consider regional eating patterns and the influence of race and ethnic groups when formulating messages to modify eating patterns.

An examination of the vitamin and mineral intakes of the CATCH baseline sample is beyond the scope of this article due to space constraints. In brief, group mean levels of vitamin and mineral intakes were similar to those found in NHANES III and met the RDA.[26] Changes in the nutrient density of vitamin and mineral intake occurring concomitantly with efforts to reduce dietary fat will be examined in follow-up studies of CATCH.

Differences in socioeconomic status (SES) by site were not investigated and may be an important factor in explaining site differences. Children were relied upon for the vast majority of information obtained; interviewing parents to determine SES was not feasible.

CONCLUSIONS

CATCH’s large sample and the inclusion of both sexes and three racial groups in four states adds to our understanding of children’s dietary intake. In addition, the results of this study are an important confirmation of the SNDA study[19] in which the effect of school meals on children’s nutrient intakes was also evaluated. However, as in most studies assessing dietary intake, there are several limitations. The methodology used cannot adequately assess the long-term dietary intake of individual children; only group comparisons of mean nutrient intakes can be made.[28] Using a single 24-hour recall, a “snapshot” of children’s intake is provided, allowing group comparisons across site, ethnic group, sex, and participation in school meals. The actual nutritional health of these children cannot be ascertained without multiple days of intake information that assesses both intra- and interindividual variation of intake.

The use of self-report to assess children’s diets may result in inherent problems with memory, problems estimating portion size, and the possibility of response bias—all sources of potential error. The validation of the methodology, using observation as the reference standard,[15] provides us with some confidence in the quality of the assessment method. Using actual school foodservice recipe information also adds to our confidence in the data collected. Another limitation is that no data on weekend intake are available; there is evidence to suggest that weekend intakes may differ from weekday intakes.[21] Lack of information on students' SES is a constraint of this study.

While the results of CATCH add to the literature by presenting nutrient information on Caucasians, African Americans, and Hispanics, other subpopulations need to be studied to complete the picture of dietary intakes of American children. The CATCH baseline sample, which included 67 students classified as "other," was not large enough to include in analyses involving statistical comparisons. More information is needed on the nutritional intake of Asian and Native-American children. In addition, another subgroup of children being increasingly recognized and warranting nutritional surveillance is children living in poverty. It is estimated that, in 1990, nearly 11 million American children were living in poverty, an increase of 14% over the previous decade.[29] Future population surveys of children need to focus on the nutritional status of these children.

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Table 1

Participation in CATCH baseline 24-hour recalls.

Site	Number of Recalls	Participants (%)				
		Males	**Caucasian**	**African American**	**Hispanic**	**Other**
California	452	47	71	7	15	7
Louisiana	443	52	71	27	1	1
Minnesota	494	52	91	2	2	5
Texas	485	48	44	13	42	1
Total	1874	50	69	12	15	4

Table 2

Selected nutrient levels by site and sex.

Subgroup (n)	Energy (kcal)	% Energy from Fat	% Energy from Protein	% Energy from Carbohydrate	% Energy from SFA	% Energy from MFA	% Energy from PFA	Cholesterol (mg)	Sodium (mg)
All (1874)[a]	2031 (674)	32.6 (7.0)	14.7 (3.5)	53.9 (8.5)	12.7 (3.5)	11.9 (3.0)	5.7 (2.4)	220 (150)	2972 (1248)
California (419)[b]	2007 (39)	31.9 (0.4)	14.9 (0.2)	54.5 (0.5)	12.6 (0.2)	11.5 (0.2)	5.5 (0.2)	218 (9)	2820 (75)
Louisiana (440)[b]	2018 (40)	33.8 (0.4)	14.3 (0.2)	52.8 (0.5)	12.8 (0.2)	12.4 (0.2)	6.2 (0.2)	238 (9)	3085 (76)
Minnesota (468)[b]	2124 (39)	30.8 (0.4)	14.8 (0.2)	55.7 (0.5)	11.9 (0.2)	11.4 (0.2)	5.3 (0.2)	198 (9)	3035 (74)
Texas (480)[b]	1983 (40)	34.2 (0.4)	14.8 (0.2)	52.4 (0.5)	13.4 (0.2)	12.5 (0.2)	5.8 (0.2)	231 (9)	2954 (76)
Significance Level	$p < .07$	$p < .0001$	$p > .35$	$p < .0001$	$p < .0001$	$p < .0001$	$p < .006$	$p < .02$	$p < .08$
Males (899)[b]	2106 (24)	32.7 (0.2)	14.8 (0.1)	53.8 (0.3)	12.8 (0.1)	12.0 (0.1)	5.6 (0.1)	228 (6)	3059 (46)
Females (908)[b]	1961 (24)	32.7 (0.2)	14.6 (0.1)	53.9 (0.3)	12.6 (0.1)	11.8 (0.1)	5.8 (0.1)	214 (6)	2892 (46)
Significance Level	$p < .003$	$p > .75$	$p > .15$	$p > .40$	$p > .35$	$p > .20$	$p < .05$	$p < .003$	$p > .10$

[a] Unadjusted mean (standard deviation); n = 1874.

[b] Adjusted mean (standard error): site means adjusted for sex, sex means for site. All means additionally adjusted for ethnicity, treatment group, and number of meals received from school food service. Sample includes only those students identified as Caucasian, African American, or Hispanic; n = 1807.

SFA = saturated fat; MFA = monounsaturated fat; PFA = polyunsaturated fat.

Table 3

Selected nutrient levels by sex and ethnicity.

Race/Sex	Energy (kcal)*	% Energy from Fat	% Energy from Protein	% Energy from Carbohydrate	% Energy from SFA	% Energy from MFA	% Energy from PFA	Cholesterol (mg)	Sodium (mg)
Caucasian[a]									
Males (n = 664)	2122 (29)[a]	32.7 (0.3)	14.8 (0.2)	53.8 (0.4)	12.8 (0.1)	12.0 (0.1)	5.6 (0.1)	223 (6)	3110 (54)
Females (n = 633)	1964 (29)	32.8 (0.3)	14.7 (0.2)	53.7 (0.4)	12.6 (0.1)	11.9 (0.1)	5.9 (0.1)	217 (6)	2916 (55)
Total (n = 1297)	2043 (22)	32.7 (0.2)	14.7 (0.1)	53.8 (0.3)	12.7 (0.1)	11.9 (0.1)	5.7 (0.1)	220 (5)	3013 (42)
African American[a]									
Males (n = 100)	2141 (70)	32.3 (0.7)	14.7 (0.4)	54.2 (0.9)	12.4 (0.4)	12.1 (0.3)	5.4 (0.2)	254 (16)	2976 (131)
Females (n = 126)	2072 (62)	31.9 (0.6)	14.3 (0.3)	55.0 (0.8)	12.0 (0.3)	11.8 (0.3)	5.8 (0.2)	204 (14)	3017 (117)
Total (n = 226)	2106 (49)	32.1 (0.5)	14.5 (0.3)	54.6 (0.6)	12.2 (0.2)	11.9 (0.2)	5.6 (0.2)	229 (11)	2996 (92)
Hispanic[a]									
Males (n = 135)	2009 (63)	33.0 (0.6)	14.8 (0.3)	53.3 (0.8)	12.9 (0.3)	12.2 (0.3)	5.5 (0.2)	223 (14)	2895 (118)
Females (n = 149)	1865 (60)	32.9 (0.6)	14.4 (0.3)	54.0 (0.8)	13.0 (0.3)	11.9 (0.3)	5.7 (0.2)	207 (13)	2690 (112)
Total (n = 284)	1937 (47)	33.0 (0.5)	14.6 (0.2)	53.6 (0.6)	12.9 (0.2)	12.0 (0.2)	5.6 (0.2)	220 (11)	2793 (88)
Other[b]									
Males (n = 34)	2104 (841)	32.0 (7.0)	15.2 (3.0)	53.8 (8.0)	13.3 (3.6)	11.0 (3.1)	5.2 (2.7)	253 (166)	3055 (1390)
Females (n = 33)	1903 (661)	30.9 (6.9)	16.1 (5.5)	53.8 (9.3)	12.1 (3.4)	11.1 (2.9)	5.4 (3.9)	200 (111)	2806 (1127)
Total (n = 67)	2005 (759)	31.5 (6.9)	15.6 (4.4)	53.8 (8.6)	12.7 (3.5)	11.0 (3.0)	5.3 (3.3)	227 (143)	2932 (1264)

*Adjusted means (comparing Caucasian, African-American, and Hispanic students) are significantly different ($p < .04$).

[a]Adjusted mean (standard error). Means adjusted for site, sex, treatment group, and number of meals received from school food service; n = 1807.

[b]Unadjusted mean (standard deviation); n = 67.

SFA = saturated fat; MFA = monounsaturated fat; PFA = polyunsaturated fat.

Table 4

Selected nutrient levels by number of meals consumed from school food service.

Number of School Meals Consumed	Energy (kcal)	% Energy from Fat	% Energy from Protein	% Energy from Carbohydrate	% Energy from SFA	% Energy from MFA	% Energy from PFA	Cholesterol (mg)	Sodium (mg)
Zero Meals* from School (n = 420)	1991 (36)	32.2 (0.4)	14.2 (0.2)	55.1 (0.4)	11.9 (0.2)	12.0 (0.2)	6.0 (0.1)	203 (8)	2891 (67)
One Meal* from School (n = 1126)	2014 (22)	32.6 (0.2)	14.9 (0.1)	53.6 (0.3)	12.8 (0:1)	11.9 (0.1)	5.6 (0.1)	224 (5)	2969 (43)
Two Meals* from School (n = 261)	2180 (47)	33.6 (0.5)	14.6 (0.2)	52.8 (0.6)	13.5 (0.2)	12.0 (0.2)	5.8 (0.2)	235 (10)	3133 (88)
p value	p < .003	p < .08	p < .003	p < .005	p < .0001	p > .80	p < .001	p < .03	p < .10

*Adjusted mean (standard errors). Means adjusted for site, treatment group, ethnicity, sex, ethnicity x sex. Sample includes only those students identified as Caucasian, African American, or Hispanic; n= 1807.

SFA = saturated fat; MFA = monounsaturated fat; PFA = polyunsaturated fat.

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Table 5

Comparison of United States nutritional surveys of children: methodology.

Survey	Dates of Data Collection	Number of Subjects/Sex	Age Range (Mean Age)	Method of Diet Assessment	Data Source (Release Date)
NHANES I USDHHS, 1983[20]	1971–1974	2057 1026 males 1031 females	6–11	24-hr recall in-person interview	USDA Handbook 8 (1972)
NHANES II USDHHS, 1989[4]	1976–1980	1725 885 males 840 females	6–11	24-hr recall in-person interview	USDA Handbook 8 (Revised) (1976)
USDA NFCS Thompson et al., 1986[21]	1977–1978	4107	6–11	24-hr recall 2-day food records	USDA HNIS National Nutrient Databank (1980)
USDA NFCS Wright et al., 1990[3]	1987–1988	10172 4476 males 5696 females	6–11	24-hr recall 2-day food records	USDA HNIS National Nutrient Databank (1992)
NGHS baseline Crawford et al., 1995[27]	1987–1988	2149 females 1104 Caucasian 1045 African American	9–10	3-day food record	University of Minnesota/NCC Version 19
NHANES III McDowell et al., 1994[5] Alaimo et al., 1994[26]	1988–1991	1745 868 males 877 females	6–11	24-hr recall in-person interview	USDA NFCS 1994 (1993)
DISC Van Horn et al., 1993[2]	1990–1993	652 356 males 296 females	8–11 (9.6)	3 24-hr recalls: 1 in-person, 2 telephone interviews	University of Minnesota/NCC Version 20
SNDA Devaney et al., 1993[19]	1992	1383	6–10	24-hr recall in-person interview	University of Minnesota/NCC Version 20
CATCH baseline Lytle et al.	1991–1992	1874 933 males 941 females	(8.7)	24-hr recall in-person interview	University of Minnesota/NCC Version 19

HNIS = Human Nutrition Information Service; NCC = Nutrition Coordinating Center.