Assessment of the National School Lunch Program in a Subset of Schools in San Juan, Puerto Rico: Participants vs. Non-Participants

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Objective: Extensive evaluations of the national school lunch program (NSLP) have been carried out on the U.S. mainland. Puerto Rico, a commonwealth of the U.S. is a participant in this program, but has never been included in assessment studies. Herein, we present assessment information and compare results with comparable mainland studies.

Methods: Multiple 24-hr recall questionnaires were administered to groups of participating (P) and non-participating (NP) children in the lunch program at 3 educational levels. Comparisons were made for children within the study as well as between comparable children in mainland studies for total intake of several macro- and micro-nutrients, contribution of the lunch to the total daily intake and adherence to U.S. Recommended Dietary Allowances (RDA's) or to Dietary Reference Intakes (DRI's) including acceptable macronutrient distribution ranges (AMDR's).

Results: Target intakes were met by P for % of the RDA of energy from protein, for all water soluble vitamins, iron, zinc and cholesterol. P did not achieve target intakes for total energy, energy from carbohydrates and fat nor for fat soluble vitamins, calcium, magnesium, phosphorus, potassium and fiber. Recommended levels were exceeded for sodium, total fat and saturated fat. Comparing P vs NP, the vast majority of both groups fell within AMDR recommendations for macronutrients but not all micronutrients.

Conclusion: For the most part, our results parallel those obtained in the National sample however, results suggest that P in the lunch program in Puerto Rico have a healthier intake of several nutrients than NP students. The unique feature of this study is that it is the first assessment of the NSLP in a completely Hispanic population. [*P R Health Sci J 2013;1:25-35*]

Key words: Nutritional assessment, School lunch program, Puerto Rico, Dietary Intake

Founded in 1946, the United States Department of Agriculture (USDA)- administered National School Lunch Program (NSLP) was established to provide about one third of children's nutrient needs required for age and gender adjusted participants as defined by the Recommended Dietary Allowances (RDA's) and to be achieved through adherence to food-based menu guidelines (1). This program has undergone periodic assessments so that modifications and improvements can keep pace with new dietary recommendations and guidelines (2-4). In 1993, the first School Nutrition Dietary Assessment Study (SNDA-I) reported many positive findings but also that meals were inconsistent with the goals for fat and saturated fat. In 1994, Congress passed the Healthy Meals for Healthy Americans Act which required schools to serve meals consistent with Dietary Guide (5) which included limits for fat and saturated fat. The program also formulated standards for minimum levels of food energy, protein, Vitamins A and C, calcium and iron, all based on RDA's. In addition, reduction of sodium and cholesterol and an increase of fiber were encouraged.

In 1998-1999, the USDA sponsored a second assessment study (SNDA-II) to determine the effect of how schools were progressing toward the new standards. Results showed improvement but still missing the goals for percent of energy from fat and from saturated fat (3). In 2005, nutritional guidelines were revised from RDA's to dietary reference intakes

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(DRI's) which required an updating for the nutrient content of school meals (6). In 2004-2005, the most comprehensive study to date was performed (SNDA-III) which incorporated previous guidelines and also measurement of the heights and weights of schoolchildren thus allowing exploration of the program on risk of overweight and obesity.

Puerto Rico (PR), a Commonwealth of the U.S. is an active participant of the NSLP. Children from families with income at or below 130 percent of the poverty level (which has been set at $28,665 for a family of four through the period of July 1, 2010 to June 30, 2011) are eligible for free meals (7). About 80 percent of children in PR attend public schools and 86 percent of these students satisfy the criteria for free meals (8). Due to its remoteness from the mainland as well as expense of the survey, Puerto Rican children have never been included as sample subjects in any of the national assessment studies. Implemented changes in the mainland program, based on data from mainland studies, may not have the same chance of success when they are transported into a distinct ethnic culture. To have a reasonable basis for testing the effectiveness of the NSLP in PR, a local study is called for. Therefore, we have carried out such as assessment based on methodology used for mainland studies. 24- hr food recall questionnaires were administered to representative elementary, middle and high school students either participating or not participating in the NSLP and our results compared to comparable groups in mainland assessments in terms of meeting dietary recommendations and nutritional guidelines. The 24-hr recall method also allowed us to determine the contribution of nutrients consumed at lunch as a percent of the total day's consumption.

Methods and Materials

Informed consent

This study was carried out in accordance to regulations on research with human subjects. Approval was obtained from the Institutional Review Board of the University of Puerto Rico, Medical Sciences Campus. Students and their parents signed informed consent documents. Permission to enter the schools was obtained from the Department of Public Instruction as well as principals and teachers from the participating schools.

Sample

Our study group, selected by convenience, included 101 children from elementary school (5th grade), 115 children from middle school (8th grade) and 105 children from high school (11th grade), 3 schools at each level, all within the area of Metropolitan San Juan, Puerto Rico. We have selected these 3 grade levels to permit consistency in the methods for data collection and allow measurements of patterns of dietary intake which vary greatly between childhood and adolescence (9, 10). Height and weight were measured according to published assessment methods (11) and body mass index (BMI) calculated as weight in kg divided by the square of the height in m (kg/m^2). Children were classified as participants (P) or non-participants (NP) in the NSLP based on self-report. Sampling was carried out for the period from August, 2004 through May, 2005.

Data collection

The 24-hr recall questionnaire was used to collect dietary information. In it, the respondent is asked to remember and report all foods, beverages, condiments, supplements, etc. consumed in the preceding day. Students were interviewed in the morning. 24-hr recall information has been the standard for many nutritional evaluation studies and provides high compliance, low cost and speed of use (12). To obtain more precise information, multiple 24-hr recalls were taken from each student, three to four, collected on Tuesday through Friday which represents intake from Monday through Thursday. Questionnaires were interviewer-administered using the multi-pass technique developed by the USDA (13). To help children estimate portion size, we made use of life-size color food photos developed by the American Dietetic Association (14). Special attention was given to elementary school children to improve their recall process such as target period and interview time as suggested by Baxter et al (15).

Critical to the success of a 24-hr questionnaire is proper training of the interviewer (16). To help verify the accuracy of the student's reported lunch for the 24-hr recall, direct observations were made by the interviewers based on the interobserver reliability (IOR) method described by Baglio et al (17). In IOR, interviewers watch subject's throughout the meal period taking notes of eating behaviors, amounts of foods consumed and/or spilled. IOR compares records of two simultaneous observations on identification and amounts of foods eaten. Adequate IOR is defined as at least 85% agreement between interviewer's recordings. IOR assessment checks were preformed for interviewers periodically throughout the sampling period.

Nutrient analysis

Nutrient content of foods appearing in our 24 hr recall questionnaires was determined using the Minnesota Nutrient Data System 32, (MNDS) which contains > 6000 brand- name foods, fast foods and > 16,000 other foods. In addition, it is a comprehensive nutrient data-base including data derived from the US Department of Agriculture tables, food manufacturers, the scientific literature and foreign food consumption tables, hence, it contains many ethnic food that are commonly eaten in Puerto Rico. Nutrients reported are (1) Energy-related: total calories, % protein, % carbohydrate, % fat and % saturated fat;

(2) Vitamins: A (Retinol), B1 (thiamine), B2 (riboflavin), B3 (niacin), B6 (pyridoxine), B9 (folate), B12 (cobalamin), C (ascorbic acid), D (cholecalciferol, and E (tocopherol); (3) Minerals: calcium, iron, magnesium, phosphorous, potassium, and zinc; (4) Others: Cholesterol, fiber, fiber/1000kcal, sodium and trans-fatty acids.

Statistical analysis

All analyses presented have been weighted to take into consideration differences in the number of recalls completed by participants. Study participants' characteristics such as demographics and body mass index percentiles based on age and sex were described and examined to assess whether differences existed between NSLP participants (P) and non-participants (NP). In order to compare the daily dietary intake between P and NP students, macronutrients, micronutrients and other dietary components were considered. Crude dietary daily intakes were analyzed and compared to the U.S. Dietary Reference Intakes (DRI's) adjusted for age and gender groups. Statistical analyses included estimation of means and proportions of key dietary components, stratified by school level, sex and school meal program utilization status. Two-tailed two-independent samples t-test was used to test the statistical significance of differences in energy intakes while Chi-square tests or Fisher's exact tests were used to test the statistical significance of differences in intakes of all other dietary components of school meal program participants and non-participants. Differences were identified if statistically significant at the 5% or 1% levels of significance. However, the relatively small sample sizes for school-level subgroups provided limited statistical power to detect significant differences between participants and non-participants. As a result, considerable large differences between participants and non-participants will be discussed even though statistical significance was not reached ($p>0.05$).

To correctly assess the proportion of participants with adequate or inadequate (poor or excessive) intakes in these aged-combined school levels subgroups, each participant's mean observed intake was divided by the appropriate standard (according to age and sex standards) as defined by the Acceptable Macronutrient Distribution Ranges (AMDRs) and then the resulting ratio used to categorized them as having adequate or inadequate intakes of mayor dietary components. For energy, the DRIs took into consideration the age and sex of the child but a "low active" level of physical activity was assumed because physical activity was not measured in the parent study.

In order to account for differences in energy intake between P and NP students, several methods for energy adjustment were explored and a dietary density measure was considered. The dietary density intake was computed by dividing nutrient values by total caloric intake. The dietary density intake measures were multiplied by 100 Kcal in order to make values more comprehensible. For macronuitrients, an analogous approach was used but expressed as a percentage of total caloric intake (18).

Results

Results from our study are herein reported which was collected from August, 2004 to May 2005, essentially at the same time as the SNDA-III which was collected in the second half of the school year 2004-2005 (19). Focus of the following data is on comparison of nutrient intake in our study vs the National sample and on comparison of intakes between program participants (P) and non-participants(NP) within our study. An important caveat is that due to differences in the sample design, comparisons of nutrients reported between the National and Puerto Rican surveys are presented in general terms rather than testing for statistical significance. Actual results from the National sample have been reproduced for comparative purposes with permission of Elsevier Publ. and can be found in supplementary material in the reference section of this paper.

Demographics of our sample population are shown in Table 1. Our convenience sample had overall participation in the lunch program of 59% which matches the National sample of 62% (19). The National Study selected representative children from elementary school (mean age 8.80 y), middle school (mean age 12.82 y) and high school (mean age 15.95 y) (Fox et al 2009) while our study sampled only 5th, 8th and 11th grades. Our mean ages were 10.97 y, 13.58 y, and 16.78 y respectively.

Regarding BMI, results from the National sample showed no statistical differences between participants and non-participants within its lunch program but expressed concern that children at all age groups were at risk of overweight or obesity (20). Our sample showed no differences with elementary and middle school children but high school participants have statistically greater BMI percentiles than non-participants which was especially true for females. Mean BMI percentiles at all age groups exceeded the values for the 60th percentile according to standardized age- adjusted weight scores (21) which puts our population at greater risk for future weight-associated maladies.

Table 2 shows our sampling schedule which is included since it differs from that of the National sample. All NSDA assessment studies obtained dietary information from one 24-hr recall questionnaire from each student and a second recall for about 30% of the population. To obtain more precise information, we conducted multiple 24-hr recalls, 3 to 4 per student. We also recorded the number of eating occasions per day which was slightly more for participants than for non-participants. There was a trend toward fewer eating occasions per day when classified by type of school with elementary children having more meals per day than middle school children with high school children eating the fewest number of times per day. Eating frequency was reported in NSDA-I which showed essentially no difference in number of eating occasions as a function of age but with the highest percent of children at all school levels eating 5 or more times per day (22).

Table 3 presents values for mean 24-hr energy and nutrient intakes of school aged children, overall and by school type. Children in elementary and middle schools had very similar intake of almost all nutrients while high school children consumed higher levels of sodium and cholesterol and a lower intake of Vitamin A than did the younger age groups. Of interest, vitamin D intake among elementary school children was appreciably higher than in both groups of older children. Comparing the National and the Puerto Rican results showed similar intakes of most nutrients; however differences between the two surveys were noted. Most prominent were higher amounts in the Puerto Rican survey of energy (100 kcal per day), sodium (600 mg/day) and cholesterol (60 mg/day) as well as lower amounts for calcium (350 mg/day) and fiber (2 mg/day). For readers interested in detailed comparisons, results from the National sample's table 1 showing the same parameters in our Table 3 have been reproduced with permission from the publisher and appear in the appendix. Trans fat intake, which was not included in the National sample was found to be 2.0% of total energy which is comparable to the value of 2.6% reported for the US population aged 3 years and older (23). Although information was collected for dietary supplements, types were varied and their use was relatively infrequent (about 20% in both P and NP groups) so their contribution to total nutrient intake was not included in the tables.

Table 4 reports percent of nutrients contributed by lunch as compared to total daily intake of the participants in the

Table 1. Selected characteristic of the National School Lunch Program participants and non-participants[a] in Puerto Rico

School level	Selected characteristics						
	n (%)	Age[b] (mean ± sd)	Sex[d] (%)		BMI percentile[b,c] (mean ± sd)		
			Females	Males	Total	Females	Males
Elementary							
Participants	67 (66.3)	10.87 ± 0.49*	65.7	34.3	65.55 ± 30.29	63.50 ± 31.31	69.46 ± 28.51
Non-Participants	34 (33.7)	11.18 ±0.63	52.9	47.1	68.66 ± 31.20	68.73 ± 35.86	68.58 ± 26.15
Total	101 (100)	10.97 ± 0.56	61.4	38.6	65.59 ± 30.48	65.02 ± 32.48	69.10 ± 27.22
Junior high							
Participants	64 (55.7)	13.59 ± 0.71	51.6	48.4	65.93 ± 30.91	70.07 ± 28.34	61.53 ± 33.33
Non-Participants	51 (44.3)	13.57 ± 0.76	66.7	33.3	68.71 ± 26.77	72.96 ± 23.72	60.21 ± 31.06
Total	115 (100)	13.58 ± 0.73	58.3	41.7	67.16 ± 29.06	71.53 ± 25.94	61.06 ± 32.22
High							
Participants	58 (55.2)	16.83 ± 0.73	50.0*	50.0	74.48 ± 26.58**	78.67 ± 21.55**	70.28 ± 30.61
Non-Participants	47 (44.8)	16.73 ± 0.83	70.2	29.8	55.43 ± 34.06	50.96 ± 36.32	65.97 ± 26.20
Total	105 (100)	16.78 ± 0.77	59.0	41.0	65.95 ± 31.48	63.92 ± 33.16	68.88 ± 29.01

a Tabulations are based on mean 24-hours recalls and weighted to take into consideration differences in the number of recalls completed by participants. b Double-sided two-independent samples t-test for mean differences between participants and non-participants. c BMI percentile – mean age-gender-adjusted percentiles. d Chi-square test for homogeneity of sex between participants and non-participants. * p-value<0.05, ** p-value<0.01

Table 2. Mean number of interviews, mean total number of eating occasions and mean number of eating occasions per day by school level and National School Lunch Program participation status during weekdays[a]

Weekdays (Mean ± SD)[b]	Elementary school		Junior high school		High school	
	Participants (n = 67)	Non-Participants (n = 34)	Participants (n = 64)	Non-Participants (n = 51)	Participants (n = 58)	Non-Participants (n = 47)
Number of interviews	3.55 ± .86	3.71 ± .58	3.69 ± 1.02	3.80 ± .90	3.07 ± .70	3.04 ± .75
Total eating occasions	19.16 ± 6.08	17.76 ± 3.84	18.84 ± 6.68	17.80 ± 5.96	14.31 ± 4.64	12.77 ± 4.65
Eating occasions /day	5.48 ± 1.17	4.85 ± .96**	5.15 ± 1.01	4.66 ± .95**	4.65 ± 1.27	4.34 ± .92**

a Tabulations are based on mean 24-hours recalls and weighted to take into consideration differences in the number of recalls completed by participants. b Double-sided two-independent samples t-test for mean differences between participants and non-participants. * p-value<0.05, ** p-value<0.01

Table 3. Mean 24-hour energy and nutrient intakes of elementary, middle and high school children attending public schools (participants and non-participants)[a]

Dietary components	All children (n=321)	Elementary school children (n=101)	Middle school children (n=115)	High school children (n=105)
Energy (kcal)		mean ± standard error		
Food energy	2295 ± 43.05	2233 ± 72.27	2272 ± 65.89	2380 ± 85.35
Macronutrients (% calories)				
Total fat	32.9 ± 0.24	32.8 ± 0.45	32.2 ± 0.40	33.7 ± 0.40
Saturated fat	11.5 ± 0.25	11.3 ± 0.21	10.6 ± 0.18	12.6 ± 0.69
Trans fat	2.0 ± 0.16	1.9 ± 0.08	1.9 ± 0.07	2.2 ± 0.12
Carbohydrates	53.7 ± 0.33	54.6 ± 0.57	54.9 ± 0.54	51.6 ± 0.54
Protein	13.6 ± 0.19	13.6 ± 0.22	13.7 ± 0.21	13.5 ± 1.49
Vitamins				
Vitamin A (ug RAE)	583 ± 18.71	600 ± 31.36	613 ± 29.31	535 ± 36.29
Vitamin C (mg)	91 ± 3.02	93 ± 5.27	87 ± 5.10	92 ± 5.37
Vitamin D (µg)	5.2 ± 0.20	6.3 ± 0.37	4.5 ± 0.24	4.9 ± 0.39
Vitamin E (mg)	7.4 ± 0.20	7.2 ± 0.36	7.0 ± 0.23	8.0 ± 0.43
Vitamin B-6 (mg)	1.9 ± 0.05	1.9 ± 0.07	1.8 ± 0.06	2.1 ± 0.10
Vitamin B-12 (ug)	4.6 ± 0.18	4.9 ± 0.27	4.0 ± 0.19	5.1 ± 0.45
Folate (ug DFE)	442 ± 11.54	433 ± 16.92	435 ± 17.80	460 ± 24.54
Vitamin B-3 Niacin (mg)	23.7 ± 0.54	22.2 ± 0.75	22.4 ± 0.72	26.7 ± 1.19
Vitamin B-2 Riboflavin (mg)	2.03 ± 0.05	2.9 ± 0.09	1.8 ± 0.07	2.0 ± 0.10
Vitamin B-1 Thiamin (mg)	1.9 ± 0.04	1.9 ± 0.07	1.9 ± 0.06	2.0 ± 0.09
Minerals				
Calcium (mg)	748 ± 20.76	806 ± 36.82	718 ± 32.27	728 ± 38.81
Iron (mg)	15.4 ± 0.34	15.7 ± 0.59	14.8 ± 0.53	15.8 ± 0.68
Magnesium (mg)	238 ± 4.72	244 ± 8.49	229 ± 6.96	240 ± 9.13
Phosphorus (mg)	1213 ± 24.84	1209 ± 43.07	1182 ± 37.85	1249 ± 48.42
Potassium (mg)	2382 ± 59.33	2445 ± 125.46	2331 ± 90.48	2378 ± 93.08
Sodium (mg)	4017 ± 83.42	3849 ± 136.33	3979 ± 128.03	4220 ± 167.10
Zinc (mg)	11.6 ± 0.29	11.4 ± 0.47	10.8 ± 0.38	12.5 ± 0.62
Other dietary components				
Fiber (g)	12.3 ± 0.26	12.6 ± 0.48	12.2 ± 0.44	12.1 ± 0.46
Fiber (g/1,000 kcal)	5.6 ± 0.12	5.7 ± 0.12	5.4 ± 0.12	5.8 ± 0.32
Cholesterol (mg)	270 ± 7.57	253 ± 12.58	258 ± 10.55	300 ± 15.67
Polyunsaturated/saturated fatty acids ratio	0.73 ± 0.01	0.68 ± 0.02	0.75 ± 0.02	0.76 ± 0.03

[a]Tabulations are based on mean 24-hours recalls and weighted to take into consideration differences in the number of recalls completed by participants.

lunch program. No data is presented for non-participants since the objective of this study is to specifically evaluate contribution of the lunch program and not outside eating sources. Federal guidelines recommend that lunches provide one third of nutrient requirements so using DRI values and dietary guidelines it can be seen that levels of most nutrients either satisfy or exceed requirements however recommended intakes of total energy, percent carbohydrate (mainly in females), Vitamins A, D, and E, calcium, manganese, phosphorous and fiber were not achieved and levels for fat, saturated fat and sodium were exceeded. Gender differences were minimal; however, male participants had a slightly higher protein intake which resulted in higher intake of the protein-associated nutrients –vitamin B12 and iron. Results of the National sample were similar with the vast majority of schools satisfying requirements for protein, vitamins and minerals. On the other hand, energy requirements were met in only about half the schools, one in five for total fat, less than one third for saturated fat and essentially zero percent for sodium (24).

Table 5 reports total daily nutrient intake in P vs NP at each school level and composite of all three levels. Important to note is that P consumed significantly more energy than NP which was mainly the result of increased calories at the elementary level. Regarding macronutrients, the vast majority of both groups consumed above or within AMDR recommendations for fat, carbohydrates and protein which was in concordance with results from the National Sample. Likewise, dietary guidelines were exceeded for saturated fat intake at levels similar to those found in the mainland study (25). Regarding micronutrients, P had significantly higher number of children meeting the EAR for Vitamins A, B-1, B-12, C and folate as well as for calcium, iron, magnesium, potassium, sodium and zinc. These differences

Table 4. Dietary intakes at lunch of National School Lunch Program, by school level and sex[a] - *Participants Only*

Dietary components	Target lunch intake	All children (n=189)	Elementary school children Females (n=44)	Elementary school children Males (n=23)	Middle school children Females (n=33)	Middle school children Males (n=31)	High school children Females (n=29)	High school children Males (n=29)
		Mean intake at lunch						
Food energy (% of the RDA)[b]	33	31	30	34	29	30	34	31
Protein (% of the RDA)	33	60	55	72	55	61	64	62
Macronutrients								
Carbohydrates (% of food energy)	>55	53	56	54	53	56	49	50
Total fat (% of food energy)	≤30	33	32	34	32	30	35	36
Saturated fat (% of food energy)	<10	11	11	12	13	10	11	11
Total trans fat (% of food energy)	As low as possible	1.7	1.2	1.4	1.8	1.9	2.2	2.0
Vitamins (% of the RDA)								
Vitamin A	33	23	23	25	21	31	18	18
Vitamin B-1 Thiamin	33	56	49	64	59	54	59	56
Vitamin B-2 Riboflavin	33	56	56	70	52	57	55	51
Vitamin B-3 Niacin	33	52	44	52	51	52	60	59
Vitamin B-6	33	51	49	59	46	50	51	57
Vitamin B-12	33	64	65	84	59	55	53	70
Vitamin C	33	43	47	59	42	38	28	45
Vitamin D (% of the AI)	33	29	31	37	22	26	30	30
Vitamin E	33	15	14	18	15	14	13	17
Folate	33	37	35	45	37	38	30	38
Minerals (% of the RDA)								
Calcium	33	15	14	18	16	14	16	16
Iron	33	44	44	55	39	46	28	52
Magnesium	33	26	30	36	22	26	22	23
Phosphorus	33	29	24	31	28	28	31	35
Potassium (% of the AI)[c]	33	19	17	21	16	20	18	23
Sodium	≤800	1399	1107	1417	1348	1369	1477	1838
Zinc	33	42	38	50	41	39	41	45
Other dietary components (mg)								
Fiber (% of the AI)	33	15	15	16	16	13	15	14
Cholesterol	≤100	77	56	79	77	73	94	95
Polyunsaturated/saturated fatty acids ratio	≥1.0	0.88	0.79	0.79	0.99	0.96	0.86	0.90

a Tabulations are based on mean 24-hours recalls and weighted to take into consideration differences in the number of recalls completed by participants. b RDA , recommended dietary allowances. c AI, adequate intake.

in the composite sample were most strongly influenced by the contribution of the middle school children. Vitamin D intake was below AI recommended levels for all children which is in agreement with mainland studies (26), noteworthy however, is that P had greater intake than NP. When correction for the increased amount of energy in P vs NP, statistical significant remained for Vitamins A, B-12, C and folate as well as for calcium, iron, magnesium and zinc. Compared with the National sample (25), similar high compliance to EAR recommendations were found for the water soluble vitamins as well as low compliance for the fat soluble vitamins. Our values for P resembled values for P on the National sample for most trace metals with the exception of calcium, which was lower. Our NP students had lower compliance than NP on the National sample for these same nutrients. Both our sample and the National sample greatly exceeded the recommended level of sodium and were well below the recommended level for potassium and fiber. Finally, our sample had poorer compliance for cholesterol intake especially evident in the high school students. Again, for readers interested in detailed comparisons, results from the National sample's table 5 showing the same parameters in our Table 5 have been reproduced with permission from the publisher and appear in the appendix.

Table 5. Percentage of National School Lunch Program participants and non-participants with acceptable, inadequate or excessive usual daily intakes[a]

Dietary components	All children (n=321)		Elementary school children (n=101)		Middle school children (n=115)		High school children (n=105)	
	Participants (n=189)	Non-participants (n=132)	Participants (n=67)	Non-participants (n=34)	Participants (n=64)	Non-participants (n=51)	Participants (n=58)	Non-participants (n=47)
	%							
Energy (mean ± sd)								
Intake(kcal)	2378 ± 792	2177 ± 728*	2340 ± 744	2024 ± 651*	2331 ± 662	2198 ± 759	2474 ± 964	2265 ±744
Estimated Energy Requirements (kcal)	2169 ± 327	2130 ± 269	1882 ± 87	1929 ± 113*	2185 ± 191	2125 ± 169	2417 ± 374	2267 ± 341*
Macronutrients (%)								
Total fat								
% within AMDR[b]	65.1	60.6	65.7	58.8	75.0	52.9	53.4	70.2
% > AMDR	30.2	34.8	28.4	38.2	20.3	37.3	43.1	29.8
% < AMDR	4.8	4.5	6.0	2.9	4.7	9.8	3.4	0.0
Saturated fat								
% > DGA[c]	63.5	64.4	67.2	82.4	64.1	58.8	58.6	57.4
Trans fat (mean ± sd)								
Amount ingested	4.95 ± 2.91	5.33 ± 3.18	4.93 ± 3.35	4.56 ± 2.40	4.66 ± 2.43	5.39 ± 3.01	5.27 ± 2.86	6.03 ± 3.72
Carbohydrates								
% < EAR[d]	<0.1	0.8	<0.1	2.9	<0.1	<0.1†	<0.1	<0.1†
% within AMDR	92.1	90.9	95.9	91.2	95.3	90.2	84.5	91.5
% > AMDR	2.6	3.0	3.0	0.0	3.1	5.9	1.7	2.1
% < AMDR	5.3	6.1	1.5	8.8	1.6	3.9	13.8	6.4
Protein								
% < EAR	10.6	7.6	3.0	2.9	9.5	13.7	20.7	14.9
% within AMDR	82.5	84.8	95.5	97.1	100.0	90.2*	79.3	78.7
% > AMDR	5.3	3.0	0.0	0.0	0.0	0.0	1.7	0.0
% < AMDR	12.2	12.1	4.5	2.9	0.0	9.8	19.0	21.3
Vitamins and Minerals (% < EAR)								
Vitamin A	33.3	57.6 **‡	17.9	44.1**	34.4	49	50.0	76.6**‡
Vitamin C	15.9	35.6**	6.0	17.6	21.9	35.3	20.7	48.9**
Vitamin D (% < RDA)	81.5	93.9**	79.1	82.4	89.1	100.0*	75.9	95.7**
Vitamin E	83.1	89.4	74.6	82.4	89.1	90.2	86.2	93.6
Vitamin B-6	5.8	11.4	1.5	5.9	3.1	15.7*‡	13.8	10.6
Vitamin B-12	5.8	15.2**	3.0	8.8	3.1	13.7*‡	12.1	21.3
Folate	15.3	35.6**‡	6.0	14.7	14.1	35.3**‡	27.6	51.1*‡
Vitamin B-3 Niacin	3.2	5.3	1.5	2.9	3.1	9.8	5.2	2.1
Vitamin B-2 Riboflavin	4.8	8.3	3.0	8.8	1.6	5.9	10.3	10.6
Vitamin B-1 Thiamin	1.1	6.1*‡	0.0	2.9	0.0	9.8*‡	3.4	4.3
Iron	2.6	8.3*‡	0.0	2.9	1.6	7.8	6.9	12.8
Magnesium	53.4	68.2**‡	28.4	38.2	57.8	70.6	77.6	87.2
Phosphorus	34.9	43.9	34.3	32.4	40.6	49.0	29.3	46.8
Zinc	13.8	28.0**‡	13.4	20.6	6.3	27.5**‡	22.4	34.0
Calcium, Potassium and Sodium								
Calcium (mean % AI)[e]	62.9	50.3*‡	64.9	56.2	60.2	49.0*‡	63.5	47.5**‡
Potassium (mean % AI)	54.9	47.3**	56.0	51.1	54.3	46.1*	54.4	45.9*
Sodium (% > UL)f	94.2	87.9*	95.5	91.2	96.9	86.3*	89.7	87.2
Other dietary components								
Fiber (mean % AI)	44.4	39.9*	47.8	41.3	43.3	40.1	41.7	38.6
Cholesterol (% > DGA)	37.6	30.3	29.9	23.5	29.7	25.5	55.2	40.4

a Tabulations are based on mean 24-hours recalls and weighted to take into consideration differences in the number of recalls completed by participants. b AMDR, Acceptable Macronutrients Distribution Range. c DGA, Dietary Guidelines for Americans 2005 recommendation (ref). d EAR, Estimated Average Requirement. e AI, Adequate Intake. f UL, Tolerable Upper Intake Level. *Difference between participants and non-participants is significantly different at the 0.05 significance level for Chi-square or Fisher's exact test for independent proportions, except for energy intake and estimated energy requirements in which a two-independent samples t-test or Mann-Whitney test was conducted. **Difference between participants and non-participants is significantly different at the 0.01 significance level for Chi-square or Fisher's exact test for independent proportions, except for energy intake and estimated energy requirements in which a two-independent samples t-test or a Mann-Whitney test was conducted. †Not tested due to constant proportions between subgroups. ‡ Differences remained statistically significant after adjusting for energy intake.

Discussion

Satisfying recommended intake of percent of energy from dietary fat and from saturated fat (30 and 10 % respectively) still remains problematic with only about one third of schools in the National study meeting these requirements for lunch preparation (24). Likewise, almost all groups of children from our schools consumed above recommended percentages of energy from fat and saturated fat. If, however, instead of strict adherence to the 30% dictum, the acceptable macronutrient distribution range (AMDR) (27) is used as a standard of comparison (in which fat is 25-35% of total energy) then 80% of children in the National sample and 60-75% of our sample fall within this range. This issue may be a moot point in recommendations for the next version of dietary guidelines as it is being recognized that percent calories from fat and saturated fat in the diet may have a lesser relationship to the risk of diseases than was previously suspected. A lively debate is currently going on as to inclusion of more healthful fats and their amounts in human diets (28).

Likewise, sodium intake is excessive in essentially all groups of children at both the National study as well as our study. In fact, both studies showed that participants in the lunch program had even greater intake than non-participants (25). Excessive dietary sodium consumption has been proven to increase blood pressure hence increasing risk of cardiovascular and renal problems(29). New research suggests that these risks can be further influenced by potassium levels in the diet with most favorable results occurring when intake levels are balanced at equal amounts (30). In our study, the sodium to potassium ratio was 1.7:1 which would put our population at increased risk. New guidelines suggest a further reduction in sodium levels for adults (31). It is unlikely that dietary patterns in our population would undergo radical changes so a more realistic solution to excess sodium intake would be to reduce the levels in prepared foods which is one approach being used by the school lunch program (24).

Although we have attempted to model our assessment study of the NSLP in Puerto Rico with the SNDA study, consideration should be taken as to wherein lie the similarities and differences in each approach. Similarities are that data was collected from a wide range of schoolchildren during the same time period using 24-hr recall questionnaires and analyzed for the same nutrient content employing equivalent reference standards. Differences are that the SNDA study used a national representative cross section sample population while ours was a convenience sample from fifth, eighth and eleventh grade of 9 schools in the greater San Juan metroplex. The SNDA study used (for the most part) data from one 24-hr recall questionnaire per subject while we used 3 to 4 questionnaires per subject study which provides a better estimate of usual intake. In addition, we included specific types of dietary supplements in our questionnaire while the National study simply asked if supplements were taken or not. This data indicated that about 20 % of our children consumed supplements, similar to the 22% of Hispanic children in NHANES (32) and that multi-vitamin was the form most commonly used.

Finally, we performed nutritional analysis for the additional dietary components- Vitamin D and trans-fatty acids. Vitamin D, apart from the well known role in bone health, is being recognized as having a role in conditions such as cancer, diabetes and cardiovascular disease (23). Daily intakes reported are consistently below AI recommendations, more-so for middle and high school students than for elementary school students and among NP than P. Likewise, the role of trans-fats in increased disease risk has been extensively documented (33). When the NSLP-I was initiated, awareness of Vitamin D and trans-fat intake to maintenance of health was less apparent, however we believe that it is time that both be added to the nutrient list for future national dietary assessments. To sum up, we do not believe the differences in approach and methodology are serious enough to invalidate making comparisons with the SNDS.

Of greater difference, is the actual food served in the Lunch program of Puerto Rico which, although required to comply with program guidelines, is prepared to appeal to local tastes and acceptability. We have analyzed food content of 96 menus from the Puerto Rican Lunch Program (34) and have noted vast differences between types and amounts of foods offered. For example, rice was found in 76% of meals in Puerto Rico but only 6% in the mainland US (35). The importance of this information is not that the NSLP requires uniformity in menus or food preparation but that it can be adapted to the environment in which the program is offered. This would appear to be the case in our entirely Hispanic population. The data suggests that participants in the program have a healthier balance of nutrients than non-participants. Even after adjusting for caloric intake, participants ingested greater amounts of Vitamins A,B-1, B-12, C and folate as well as of calcium, iron, magnesium and zinc. NSLP results showed few differences in levels of nutrient intake between participants and non-participants suggesting that the Program is a more important contributor to reaching nutritional requirements in Puerto Rico than on the mainland.

One caveat in interpretation of our data is that since the initiation of assessment studies, it should be mentioned that major changes apart from ethnic adaptations have been made in the environment. This involves the way in which the meal program operates including training of personnel, enhanced meal patterns, restriction of vending machines, etc (25). We realize that these and other school-implemented changes are contributing factors to our results, however, determination of the magnitude of their importance is beyond the scope of our investigation.

Our study shares weaknesses similar to the National assessment such as inaccurate reporting of the 24-hr recall information and lack of information on physical activities (25). It has been found that younger children often over-report intake and older children, particularly female adolescents under-report intake (36). Reporting errors are also influenced by body weight status (37).

Regarding physical activity, while our data show little differences in energy intake between P vs NP students, the overall BMI values for all grade levels are in the "at risk for overweight" category suggesting that lack of exercise is a likely contributing factor. In fact, data from the Center for Disease Control and Prevention indicates that Puerto Ricans on the island have the highest percent of physical inactivity in the entire nation (38).

To conclude, the latest national SNDS was designed to include sampling from ethnic minority groups however the study presented here is the first to sample a completely Hispanic population. Our evaluation has shown, that although ethnic differences exist in types of meals served in the Lunch Program in PR that most of the conclusions reached by the SNDS study in the mainland are very similar to those reached in Puerto Rico and data suggests that students who participate in the program have a healthier overall eating pattern than non-paticipants. The overall and more lasting importance of this survey and those at the National level is to use the results to determine strategies for the nutritional betterment of participants. Indeed, positive steps have been taken to achieve this goal. In January, 2011, the USDA has announced for the first time in 15 yrs that major adjustments will be Incorporated into the meals programs to start in 2012 (39). These changes will focus on caloric and fat reduction, incorporation of more whole grains, fruits and vegetables and bring standards into line with the new Dietary Guidelines for Americans (40).

Resumen

Objetivo: Los programas nacionales de nutrición en las escuelas (National School Lunch Program) han sido evaluados extensamente en los Estados Unidos. Sin embargo, Puerto Rico, un territorio de los E.U. que participa en estos programas, no ha sido incluido en estas evaluaciones. Aquí presentamos una evaluación de estos programas en Puerto Rico y su análisis dentro del contexto nacional. Métodos: Se encuestaron dos grupos de niños, uno de participantes (P) en los programas nutricionales de tres niveles educativos, y el otro de no no-participantes (NP). Se realizaron comparaciones entre los niños del estudio en Puerto Rico con niños de los EU considerando la ingesta total de macro- y micro nutrientes, la contribución del programa nutricional a la ingesta total diaria, y la adherencia a los Estándares de Dieta Permitidos en los EU y las ingestas Dietéticas de Referencia que incluye la Distribución de Rangos Aceptables de Macronutrientes. Resultados: Se encontró que los P cumplieron con las metas porcentuales en la ingesta para energía proveniente de la proteína, y para la ingesta de vitaminas solubles en agua, hierro, zinc y colesterol. Los P no cumplieron con las metas para la energía total, la energía proveniente de carbohidratos, y para las vitaminas solubles en grasa, calcio, magnesio, fosforo, potasio, y fibra. Los niveles de sodio, grasa total y grasa saturada se excedieron. La comparación de los P con los NP indica que éstos cumplieron con los rangos aceptables de macro-nutrientes, pero no con los de todos los micro-nutrientes. Conclusión: En general, nuestros resultados son comparables con los encontrados en Estados Unidos. Sin embargo, nuestros resultados muestran que los P de estos programas en Puerto Rico tienen una tendencia favorable para la ingesta de nutrientes cuando se comparan con los resultados de los NP. Este estudio es único porque es el primero realizado en una población hispana y relativamente homogénea en los EU.

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References

1. Burghardt JA, Devaney BL. Background of the School Nutrition Dietary Assessment Study. Am J Clin Nutr 1995;61(suppl):178S-181S.
2. Dwyer J. The School Nutrition Dietary Assessment Study. Am J Clin Nutr 1995;61(suppl):173S-177S.
3. Fox MK, Cripinsek MK, Connor P, Battaglia M. 2001; School Nutrition Dietary Assessment Study 2001; II:Final Report. Report No. CN-01-SN-DAII-FR. US Department of Agriculture, Food and Nutrition Service.
4. Story M. The third School Nutrition Dietary Assessment Study: Findings and policy implications for improving the health of U.S. children. J Am Diet Assoc 2009;109(suppl):S7-S13.
5. Dietary Guidelines for Americans. 1990; US Department of Health and Human Services and US Department of Agriculture 3rd edition, Washington DC: US Government Printing Office.
6. Dietary Guidelines for Americans. 2005; US Department of Health and Human Services and US Department of Agriculture 6th edition, Washington DC: US Government Printing Office.
7. Federal Register, Nutritional Standards in the National School Lunch and Breakfast Programs 2011;76:2494-2570.
8. Puerto Rico Facts available at: url: http://puerto-rico.educationbug.org/public-schools/ Accessed April 15, 2012.
9. Muñoz KA, Krebs-Smith SM, Bailard-Barbash R, Cleveland LE. Food intake of U.S. children and adolescents compared with recommendations. Pediatr 1997;100:323-329.
10. Frazao E (ed). America's eating habits: Changes and consequences. U.S. Department of Agriculture, Economic, Research Service, Food and Rural Economics Division. Agricuture Information Bulletin 1999; No. 750.
11. Gibson RL. Part 1- Dietary assessment. Nutritional Assessment-A Laboratory Manual. Oxford University Press, New York, 2003; p. 1-34.
12. Thompson FE, Byers T. Dietary assessment resource manual. J Nutr 1994;124(suppl):2245S-2317S.
13. Agricultural Research Service, U.S. Department of Agriculture 1997; Design and operation: the continuing survey of food intakes by individuals and the diet and health knowledge survey: 1994-96. Washington, D.C.
14. Hess MA (ed). Portion photos of popular foods. The American Dietetic Association, Center for Nutrition Education, University of Wisconsin, 1997.
15. Baxter SD, Hardin JW, Guinn CH, Royer JA, Mackelprang AJ, Smith AF. Fourth- grade children's dietary recall accuracy is influenced by retention interval (target period and interview time). J Am Diet Assoc 2009;109: 846-856.
16. McPherson RS, Hoelscher DM, Alexander M, Scanlon KS, Sewrdula MK. Dietary assessment methods among school-aged children: validity and reliability. Prevent Med 2000;31(suppl): S11-S33.

17. Baglio ML, Domel Baxter S, Guinn CH, Thompson WO, Shaffer NM, Frye FHA. Assessment of inter-observer reliability in nutrition studies that use direct observation of school meals. J Am Diet Assoc 2004;104:1385-1392.
18. Brown CC, Kipnis V, Freedman LS, Hartman AM, Schatzkm A, Wacholder S. Energy adjustment methods for nutritional epidemiology: The effect of categorization. Am J Epidemiol 1994;139:323-338.
19. Fox MK, Dodd AH, Wilson A, Gleason PM. Association between school food environment and practices and body mass index of US public school children. J Am Diet Assoc 2009;109(suppl):S108-S117.
20. Gleason PM, Dodd AH. School breakfast program but not school lunch program participation is associated with lower body mass index. J Am Diet Assoc 2009;109(suppl):S118-S128.
21. Ogden CL, Carroll MD, Curtin LR, Lamb MM, Flegal KM. Prevalence of high body mass index in US children and adolescents, 2007-2008. JAMA 2010;303:242-249.
22. Devaney BL, Gordon AR, Burghardt JA. Dietary intake of students. Am J Clin Nutr 1995;61(suppl):205S-212S.
23. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Calcium and Vitamin D. Washington, DC: The National Academies Press 2011.
24. Crepinsek MK, Gordon AR, McKinney PM, Condon EM, Wilson A. Meals offered and served by US public schools: Do they meet nutrient standards? J Am Diet Assoc 2009;109(suppl):S31-S43.
25. Clark MA, Fox MK. Nutritional quality of the diets of US public school children and the role of the school meals program. J Am Diet Assoc 2009; 109(suppl):S44-S56.
26. Bailey RL, Dodd KW, Goldman JA, Gahche JJ, Dwyer JT, Moshfegh AJ, Sempos T, Picciano MF. Estimation of total usual calcium and vitamin D intakes in the United States. J Nutr 2010;140:817-822.
27. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids. Washington, DC: The National Academy Press 2005.
28. Zelman K. The great fat debate: A closer look at the controversy-Questioning the validity of age-old dietary guidance. J Am Diet Assoc 2011; 111:655-658.
29. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Water, Potassium, Sodium, Chloride and Sulfide. Washington, DC: The National Academies Press 2004.
30. Yang Q, Liu T, Kuklina EV, Flanders WD, Hong Y, Gillespie C, Chang MH, Dowling, N, Khoury, MJ, Hu, FB. Sodium and potassium intake and mortality among US adults: prospective data from the Third National Health and Nutrition Examination Survey. Arch Intern Med 2011;171:1183-1191.
31. Gunn JP, Kuklina EV, Keenan NL, Labarthe DR. Sodium intake among adults-United States, 2005-2006. MMWR 2010;59:746-749.
32. Picciano MF, Dwyer JT, Radimer KL, Wilson DH, Fisher KD, Thomas PR, Yetley EA, Moshfegh AJ, Levy PS, Nielsen SJ, Marriott BM. Dietary supplement use among infants, children, and adolescents in the United States, 1999-2002. Arch Pediatr Adolesc Med 2007;161:978-985.
33. Ascherio A, Willett. WC Health effects of trans fatty acids. Am J Clin Nutr 1997;66:1006S-1010S.
34. Preston AM, Rodriguez C, Gomez-Flores IM. Dietary analysis of meals served in the breakfast and lunch programs of Puerto Rican schools. P R Health Sci J 1997;16:381-386.
35. Condon EM, Crepinsek MK, Fox MK. School meals: Types of foods offered to and consumed by children at lunch and breakfast. J Am Diet Assoc 2009;109(suppl):S67- S78.
36. Devaney B, Kim M, Carriquiry A, Camano-Garcia G. Assessing the Nutrient Intake of Vulnerable Subgroups. 2005; Final Report Submitted to the US Department of Agriculture, Economic Research Service. Princeton, NJ: Mathematica Policy Research.
37. Livingstone MBE, Robson PJ, Wallace JMW. Issues in dietary intake assessment of children and adolescents. Brit J Nutr 2004;92(suppl):S213-S222.
38. Center for Disease Control and Prevention. 2011; cdcinfo@cdc.gov. Accessed April 15, 2012.
39. United States Department of Agriculture Food and Nutrition Service. Available at: Url: http://www.fns.usda.gov/cnd/governance/legislation/nutritionstandards.htm. Accessed April 15, 2012.
40. Dietary Guidelines for Americans 2010; US Department of Health and Human Services and US Department of Agriculture 7th edition, Washington DC: US Government Printing Office.

Table 1. Mean 24-hour energy and nutrient intakes of elementary, middle, and high school children attending public schools[a]

Nutrient	All children (n=2,314)	Elementary school children (n=732)	Middle school children (n=787)	High school children (n=795)
	←	%± standard error		→
Energy (kcal)				
Food energy	2,109±24.5	2,056±32.7	2,024±31.8	2,260±43.3
Macronutrients (% of food energy)				
Total fat	31.9±0.23	31.4±0.33	32.0±0.35	32.8±0.35
Saturated fat	11.0±0.11	11.0±0.17	11.0±0.16	11.1±0.14
Carbohydrate	54.7±0.27	55.1±0.38	54.7±0.43	53.8±0.47
Protein	14.6±0.11	14.6±0.18	14.4±0.19	14.6±0.20
Vitamins				
Vitamin A (μg RAE[b])	622±14.5	657±21.5	588±19.7	585±19.2
Vitamin C (mg)	91±3.0	93±4.8	87±4.0	93±3.7
Vitamin E (mg)	6.2±0.15	6.0±0.25	6.0±0.20	6.8±0.18
Vitamin B-6 (mg)	1.8±0.04	1.7±0.06	1.7±0.06	1.9±0.04
Vitamin B-12 (μg)	5.3±0.11	5.2±0.18	5.2±0.16	5.3±0.18
Folate (μg DFE[c])	587±15.4	589±24.4	548±26.1	611±19.1
Niacin (mg)	21.8±0.34	21.1±0.51	20.5±0.51	23.9±0.47
Riboflavin (mg)	2.3±0.03	2.4±0.05	2.2±0.06	2.3±0.06
Thiamin (mg)	1.7±0.03	1.6±0.04	1.6±0.04	1.8±0.04
Minerals				
Calcium (mg)	1,091±19.7	1,140±28.2	1,033±32.4	1,047±34.2
Iron (mg)	15.4±0.31	15.3±0.46	14.4±0.43	16.4±0.42
Magnesium (mg)	252±3.4	253±4.7	237±5.2	261±5.7
Phosphorus (mg)	1,367±18.1	1,370±24.6	1,298±29.4	1,409±33.8
Potassium (mg)	2,499±30.2	2,518±42.9	2,343±46.6	2,574±54.5
Sodium (mg)	3,402±46.4	3,320±67.1	3,228±69.6	3,662±85.5
Zinc (mg)	11.6±0.19	11.2±0.28	11.2±0.36	12.4±0.30
Other dietary components				
Fiber (g)	14.1±0.21	14.4±0.30	13.0±0.35	14.2±0.37
Fiber (g/1,000 kcal)	6.8±0.08	7.1±0.12	6.6±.12	6.5±0.17
Cholesterol (mg)	213±5.9	208±10.1	195±5.0	234±8.1

[a]Data are from the third School Nutrition Dietary Assessment Study, 24-hour dietary recalls, school year 2004-2005. Tabulations are based on first 24-hour recall and weighted to be nationally representative of children in public National School Lunch Program schools. Sample sizes are unweighted.
[b]RAE=retinol activity equivalents.
[c]DFE=dietary folate equivalents.

APPENDIX. Results from the Third School Nutrition Dietary Assessment Study –Tables 1 and 5. Reprinted from Journal of the American Dietetic Association, Volume 109 Number 2, Supplement 1. Clark, M.A., Fox, M.K. Nutritional quality of the diets of US public school children and the role of the school meal programs. S44-S56, Feb. 2009 with permission from Elsevier.

Table 5. Percentage of School Breakfast Program (SBP) participants and matched nonparticipants with acceptable, inadequate, or excessive usual daily intakes[abc]

Dietary component	All Children: Participants (n=381)	All Children: Matched nonparticipants (n=302)	Elementary School Children: Participants (n=160)	Elementary School Children: Matched nonparticipants (n=118)	Middle School Children: Participants (n=127)	Middle School Children: Matched nonparticipants (n=99)	High School Children: Participants (n=94)	High School Children: Matched nonparticipants (n=85)
	mean± standard error							
Energy								
Intake (kcal)	2,230±30.3	2,153±35.6	2,153±40.6	2,094±50.5	2,177±54.1	2,034±62.1	2,569±76.3	2,515±104.0
Estimated Energy Requirement (kcal)	1,978±29.8	1,992±35.6	1,769±30.4	1,784±39.4	2,256±47.7	2,284±72.0	2,519±80.4	2,511±79.1
Macronutrients Total fat								
% within AMDR[d]	77.3±NA[e]	83.5±NA	70.6±NA	79.4±NA	63.5±NA	69.1±NA	74.0±NA	48.2±NA
% >AMDR	20.3[f]±8.17	14.4[f]±13.10	22.6±6.44	13.5[f]±9.55	34.2±9.54	30.9[f]±47.5	21.1[f]±21.70	38.4±6.75
% <AMDR	<3±3.74	<3±5.64	6.9[f]±5.03	7.1[f]±7.76	<3±5.50	<3±NA	5.0[f]±15.50	13.5[f]±8.56
Saturated fat								
% >DGA[g]	71.5±5.17	70.4±12.60	75.6±10.50	64.6±15.70	71.1±7.10	86.3[f]±37.40	59.8±10.10	70.3±12.30
Carbohydrate								
% <EAR[h]	<3±NA	<3±0.00	<3±NA	<3±0.19	<3±NA	<3±1.45	<3±0.13	<3±NA
% within AMDR	96.9±NA	97±NA	89.2±NA	>97±NA	95.2±NA	86.3±NA	94.0±NA	79±NA
% >AMDR	<3±1.62	<3±1.40	3.3[f]±3.12	<3±2.59	<3±3.36	<3±1.79	<3±10.60	3.2[f]±6.42
% <AMDR	<3±3.89	<3±6.47	7.5[f]±4.76	<3±3.40	3.5[f]±6.43	13.5[f]±21.40	4.0[f]±15.90	17.9[f]±12.30
Protein								
% <EAR	<3±NA	<3±NA	<3±NA	<3±NA	<3±NA	<3±NA	<3±NA	<3±NA
% within AMDR	>97±NA	>97±NA	>97±NA	>97±NA	>97±NA	>97±NA	93.7±NA	>97±NA
% >AMDR	<3±NA	<3±NA	<3±NA	<3±NA	<3±NA	<3±NA	<3±0.90	<3±NA
% <AMDR	<3±1.89	<3±1.99	<3±2.08	<3±3.02	<3±4.47	<3±2.66	5.9[f]±5.69	<3±4.60
Vitamins and minerals with EARs (% <EAR)								
Vitamin A	13.4[f]±5.56	26.6±3.76*	5.9[f]±6.05	13.9[f]±6.96	27.3[f]±16.80	44.8±5.76	34.2[f]±27.30	53.6±5.67
Vitamin C[i]	5.4[f]±4.23	<3±4.78	6.4[f]±4.38	<3±5.15	<3±5.84	18[f]±NA	10.2[f]±22.90	36.1±6.94
Vitamin E	82.4±5.91	82.5±5.42	75.9±7.46	76.2±7.29	88.1[f]±9.73	91[f]±12.20	>97±8.94	93.6[f]±8.11
Vitamin B-6	<3±1.37	<3±2.08	<3±0.70	<3±2.07	<3±4.50	5[f]±6.14	<3±7.09	<3±7.91
Vitamin B-12	<3±0.66	<3±1.72	<3±0.57	<3±1.70	<3±0.87	3.1[f]±5.86	<3±2.03	3.5[f]±7.01
Folate	<3±1.46	<3±2.44	<3±1.10	<3±0.70	<3±4.34	17.8[f]±9.30	6.6[f]±7.38	6.6[f]±9.45
Niacin[j]	<3±0.72	<3±0.91	<3±025	<3±0.70	<3±2.96	<3±3.44	3.3[f]±4.49	<3±2.25
Riboflavin	<3±0.37	<3±1.26	<3±NA	<3±0.54	<3±1.71	7.7[f]±4.68	<3±0.98	5.4[f]±4.72
Thiamin	<3±0.71	<3±1.77	<3±NA	<3±0.55	<3±1.70	11.4[f]±6.02	4.3[f]±4.76	5.5[f]±7.11
Iron[k]	<3±NA	<3±NA	<3±NA	<3±NA	<3±NA	3.6[f]±NA	7.7[f]±NA	8.5[f]±NA
Magnesium	20.6[f]±3.24	29.0[f]±3.11	6.0[f]±3.45	11.1[f]±5.41	40.8±5.82	57.1±4.84*	75.3[f]±12.90	72.9[f]±8.55
Phosphorus	7.4[f]±2.69	18.0±3.26*	3.9[f]±2.39	15.5±4.49*	19.6[f]±10.00	36.7±6.18	<3±11.70	25.4±6.56
Zinc	<3±2.22	9.1[f]±3.34	<3±2.50	5.0[f]±3.97	7.6[f]±10.60	25.5±6.46	10.1[f]±15.10	9.7[f]±9.56
Calcium, potassium, and sodium								
Calcium (mean % AI[l])	109.5[f]±1.51	99.3[f]±1.80	121.6[f]±1.82	109.6±2.59	81.5±2.93	69.8±2.79	91.1[f]±3.22	89.7[f]±4.38
Potassium (mean % AI)	63.3±9.43	57.1±9.04**	65.7±11.96	59.3±11.11*	55.7±12.09	48.5±17.52	61.9±20.66	57.5±21.29
Sodium (% >Tolerable Upper Intake Level)	>97[f]±2.62	86.8±4.08*	>97[f]±3.85	87.1±5.46	>97[f]±5.57	74.8±6.79**	>97[f]±4.08	94.6[f]±10.10
Other dietary components								
Fiber (mean % AI)	52.6±1.33	50.8±1.85	55.4±1.79	54.0±2.41	46.7±2.53	44.9±4.53	47.8±2.86	44.2±2.24
Cholesterol (% >DGA)	12.9[f]±5.34	18.6[f]±5.86	8.6[f]±8.53	13.8±7.20	6.2[f]±18.00	15.3±12.70	27.4[f]±12.60	45.5±7.65

[a]Data are from the third School Nutrition Dietary Assessment Study, 24-hour dietary recalls, school year 2004-2005. Tabulations are based on first and second 24-hour recalls and weighted to be nationally representative of children in public NSLP schools. Sample sizes are unweighted.
[b]Usual intake distributions were determined for each subgroup using the PC version of the Software for Intake Distribution Estimation (version 1.0, 2003, University of Iowa, Ames). Sample includes all children, including those who did not consume a breakfast.
[c]Matched sample constructed using propensity-score matching to adjust for differences in personal, family, and school characteristics between SBP participants and nonparticipants, including age, sex, race and ethnicity, height, household income relative to poverty, region, and several other characteristics, as described in text. Estimates weighted to account for sample design and the fact that children in the comparison group may be matched to multiple participants.
[d]AMDR=Acceptable Macronutrient Distribution Range.
[e]NA=not available. Standard error could not be estimated for percentages very close to 0 or 100 or for percent within AMDR.
[f]Statistic is potentially unreliable due to a small sample size and/or a coefficient of variation >30%.
[g]DGA=*Dietary Guidelines for Americans 2005* recommendation (16).
[h]EAR=Estimated Average Requirement.
[i]The EAR for vitamin C is 35 mg greater for smokers than nonsmokers. These tabulations used EARs for nonsmokers.
[j]Niacin intakes include preformed niacin only. EARs for niacin are expressed as niacin equivalents, including contributions from tryptophan. Therefore, prevalence of inadequate niacin intakes may be overestimated.
[k]Comparison to EAR was done using the probability approach. Standard errors were not estimated, and the significance of differences between participants and nonparticipants was not tested.
[l]AI=Adequate Intake.
*Difference between participants and matched nonparticipants is significantly different from zero at the 0.05 level.
**Difference between participants and matched nonparticipants is significantly different from zero at the 0.01 level.