Higher Quality Intake From School Lunch Meals Compared With Bagged Lunches

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School Age

Higher Quality Intake From School Lunch Meals Compared With Bagged Lunches

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Abstract: *Studies show that nutritional quality of lunches brought from home is poor when compared with school lunches. Most of these studies were conducted in the United Kingdom, while studies of this type are limited in the United States. Therefore, this study compared lunch food, nutrient, and energy intake by lunch type (school lunch vs bagged lunch) in 2 schools in a Midwest metropolitan area of the United States. Food intake data were collected from 129 children with meal observation procedures. Energy, food, and nutrient intakes were estimated using Nutrition Data System for Research software and compared with* t *tests by lunch type. Children eating school lunches had higher intakes of protein; vitamins A, D, and K; and calcium and lower intakes of energy, fat, carbohydrate, vitamin E, and sugar compared with children eating bagged lunches. The ratios of mean protein and calcium consumption to minimum required values tended to be greater for children eating school lunches compared with those eating bag lunches. Children eating bag lunches had lower vegetable intake and higher whole grain and fruit intakes and higher meal energy density compared with children eating school lunch. Findings support parent nutrition education to improve the nutritional quality of bagged lunches.*

Keywords: school-aged children; school lunch; food and nutrient intake

> **"Many children in the United States are not meeting the recommendations for daily intake of fruits, vegetables, and whole grains."**

School meals provide a significant proportion of the usual intake of energy, food, and nutrients for elementary school students.[1] According to data from the third School Nutrition Dietary Assessment (SNDA) study, about 62% of all students in the United States participate in the National School Lunch Program (NSLP).[2] Additionally, children bring meals from home and may purchase supplemental foods from school cafeterias, school stores, and vending machines and trade foods with other students. In school and at home, the availability and accessibility of less healthy foods and beverages such as soft drinks, sweetened juices, and some a la carte offerings affect dietary intake among children.[3,4]

Many children in the United States are not meeting the recommendations for daily intake of fruits, vegetables, and whole grains.[5-7] Nationally representative data (2001-2004) showed that 9- to 13-year-old boys and girls consumed about 40% of the recommended intake of fruits and vegetables and about 20% of the recommended intake of whole grain foods. Results from the third SNDA study indicated that in 2004-2005, 94%, 95%, and 5% of NSLP elementary school lunch menus offered fruit, vegetables, and whole grain breads and rolls, respectively, based on school menu surveys.[8] According to 24-hour dietary recall data, a proportion of children participating in the NSLP consumed fruit (55%), vegetables (51%), and whole grain breads and rolls (1%) on the recall

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day, whereas nonparticipants had comparable intake of fruit and whole grain breads and rolls but fewer reported eating vegetables (24%). Fruit and vegetable intake may be an effective means to reduce meal energy density if prepared without added fat or sugar.[9]

The School Meals Initiative for Healthy Children (SMI) implemented in 1995[10] established standards for minimum levels of energy, protein, fat, saturated fat, vitamins A and C, calcium, and iron in school meals. The most recent SNDA III data indicated that the majority of schools surveyed met the standards for protein, vitamins, and minerals, whereas sodium and fat intake was high and fiber intake was low compared with recommendations.[11]

Although the nutritional quality of meals provided at school is constantly monitored according to government standards, bagged lunches do not get the same scrutiny. A recent meta-analysis of studies comparing intake of food and nutrients among British primary school children eating school meals and packed lunches showed that the nutritional quality of packed lunches was poor compared with school meals.[12] Children who brought a packed lunch consumed more energy, total sugar, saturated fat, and sodium than those who ate a school lunch. Similar results were reported based on a study with elementary students in the United States where fat intake among children who brought a bag lunch was higher than recommended and higher than the intake of those who ate a school lunch.[13] Studies related to the nutritional quality of bagged lunches among US children are limited whereas bagged lunches account for the noon meal intake for a significant number of school-aged children. The purpose of this study was to examine the differences in noon meal energy density and food and nutrient intakes among 4th- and 5th-grade children eating bagged lunches and those eating school meals in a Midwestern, suburban school district. Results can be used to support the rationale for interventions to promote healthier bagged lunches for school children.

Methods

Subjects

Students were 4th and 5th graders in 2 suburban elementary schools from 1 school district within the Minneapolis, Minnesota, metropolitan area participating in a whole grain intervention program from February to May 2005. Inclusion criteria included being in the 4th and 5th grade in these 2 elementary schools and not having scheduling conflicts (eg, band practice) with nutrition education intervention classes. Parents were asked to indicate if their child had any allergies to grain products on the parent consent form; however, no parent indicated that this was the case. Baseline lunch meal observation data from children in these schools were used in this report. The University of Minnesota Institutional Review Board approved the study, and parental consent and child assent were obtained prior to data collection. Parents and children received $10 to $50 for participating in the intervention program.

Procedure for Lunch Meal Observations

Ten hours of combined didactic and practicum training regarding direct meal observation methods were provided to a team of 5 observers prior to data collection. Training focused on visual portion size estimation and data entry using standardized recording forms and a tested protocol. Three children were observed simultaneously by each team member on each observation day (holidays excluded). Each child was observed 1 time, and the mean intake was calculated for the total group of children (n = 129). To observe all children 1 time, researchers collected observation data on 5 total observation days per school. Researchers stood in close proximity to the tables where the children they were observing were sitting. While children were aware that researchers were in the cafeteria to observe food intake, they were not informed as to the particular day that their intake would be observed. The amount of food recorded as consumed by each child through observation was verified by subtracting the measured amounts remaining on the tray at the end of the lunch period from the recorded amount of each food served at the beginning of the lunch period. The lunch food waste from children eating bagged lunches was placed on trays at the end of the lunch period to facilitate weighing the amount remaining. To ensure a high level of consistency between the different observers, interobserver reliability assessments were completed throughout the data collection.[14,15] Overall, mean agreement across the 5 observers based on 6 assessments was 91%. Meal observation data were analyzed using the Nutrition Data System for Research (version 2005, University of Minnesota) software by an interviewer certified by the Nutrition Coordinating Center, University of Minnesota.

Nutritional requirements for school lunch are based on the US Dietary Guidelines for Americans, 2005,[16] regarding percentage of calories from fat and saturated fat. SMI standards for school lunches include the provision of one third of the recommended dietary allowances of protein, vitamins A and C, iron, calcium, and calories.[10,17] Lunch meal energy density was calculated as mean lunch total energy in kilocalories divided by the mean lunch total amount of food and beverages in grams.[9] Water consumed as a beverage was included.

Data Analysis

Data were analyzed using SAS software (Statistical Analysis System, Version 9.1.3, 2002-2003, Cary, North Carolina). Descriptive statistics were used to describe demographic characteristics and dietary intake. Chi-square tests were used to compare demographic characteristics by lunch type (purchased at school or brought from home). *t* Tests were used to determine significant differences in food, nutrient, and energy intake and energy density between groups of children according to lunch type. All *P* values were 2-sided, and the significance level was set at $P < .05$.

Results

Participants were 129 children (n = 69 boys, n = 60 girls) with a mean age of 10.2 ± 0.8 years (Table 1). Most children

Table 1.

Characteristics of Children by Lunch Type

	Total (N = 129)	Bag Lunch (n = 44)	School Lunch (n = 85)	*P* Value
Gender				.568
Boys, n (%)	69 (53.5)	22 (50.0)	47 (55.3)	
Girls, n (%)	60 (46.5)	22 (50.0)	38 (44.7)	
Race/ethnicity				.046
White, n (%)	79 (61.2)	33 (75.0)	46 (54.1)	
Black, n (%)	9 (7.0)	0 (0.0)	9 (10.6)	
Hispanic, n (%)	6 (4.7)	1 (2.3)	5 (5.9)	
Others, n (%)	35 (27.1)	10 (22.7)	25 (29.4)	
Grade				.950
4th, n (%)	64 (49.6)	22 (50.0)	42 (49.4)	
5th, n (%)	65 (50.4)	22 (50.0)	43 (50.6)	

lived in 2-parent households (79%), and about 60% were non-Hispanic white. The majority (66%) participated in the NSLP on the meal observation day while 34% brought a bag lunch from home.

Intake of lunch meal energy, total fat, monounsaturated fatty acids, polyunsaturated fatty acids, and carbohydrate was significantly lower for children who ate school lunch compared with those who ate a bagged lunch (Table 2). Total and added sugars and energy density were also significantly lower for children who ate school lunch compared with those who ate a bagged lunch. Children who ate the school lunch consumed significantly more protein, omega-3 fatty acids, and total fruits and vegetables than those who ate a bagged lunch. Those who ate school lunch consumed more vegetables but less fruit and whole grain foods compared with children who ate a bagged lunch.

Children who ate the school lunch had significantly higher intakes of riboflavin; vitamins B_{12}, A, D, and K; calcium; sodium; and potassium and lower intakes of vitamin E compared with children who ate a bagged lunch (Table 3). The nutrient intake of children in both the school and bagged lunch groups met the nutrition standards for the NSLP except for energy, vitamin A, iron, and calcium[17] (Table 4). Children who ate the bagged lunch had a higher ratio of consumed versus required intake of energy (P = .049) and total fat (P = .055) than those who ate the school lunch. Children eating school lunch had a higher ratio of consumed versus required intake of protein, calcium, iron, and vitamin A compared with those who ate a bagged lunch, but these differences were not statistically significant.

Discussion

In general, the results of the current study indicate that eating a bagged lunch was associated with less healthy noon meal dietary intake compared with the school meal, supporting results of studies in the United Kingdom[12] and in the United States among elementary school children[13] and preschool children where sack lunches did not meet standards.[18] Rogers et al[19] reported that children who ate school meals had higher intakes of protein, nonstarch polysaccharides, and many vitamins and minerals and lower intakes of saturated fat and sugar compared with children bringing packed lunches from home. Compared with school lunches, other investigators also showed that packed lunches provided more sugar, saturated fat and sodium, and fewer vegetable servings but more fruit servings.[20]

In the current study, the amount of total and added sugars, total fat, and meal energy density was higher while the amount of total fruit and vegetables was lower for children who brought a bag lunch compared with those who ate a school lunch. This type of meal pattern indicates that consumption of less nutrient-dense foods may exert a negative influence on intake of nutrient-dense foods. Others have also documented this phenomenon showing that consumption of sugar-sweetened beverages, sugars, sweets, and sweetened grains negatively affected intake of nutrients such as calcium, folate, and iron in children and adolescents.[21] In US adults, high diet quality was associated with low-energy-dense diets.[22] Therefore, low-energy-dense eating patterns in children who eat school lunch may also be positively related to diet quality.

The very low intake of whole grain foods from school lunch in the current study was consistent with SNDA III data collected during the 2004-2005 school year, indicating that few schools offered whole grain bread and rolls at the lunch meal.[8] In recent years, more attention has been paid to providing whole grain foods for school meals by the food industry and to educate and promote whole grain foods among children and parents. These efforts are expected to increase whole grain intake by children from school and bagged lunches in the future.

On a national level in the United States, according to SNDA III results, most schools offered and served meals that met the standards for protein, vitamins, and minerals.[11] However, less than one third of schools met standards for energy from fat or saturated fat in the average school lunch. In the current study, those children eating lunch from either source did not meet standards for saturated fat and those eating bagged lunches exceeded the recommended total fat level. Increasing the quantity of fruits, vegetables, and whole grains offered may be a way to maintain acceptable levels of nutrients, while decreasing intake of fat and saturated fat. However, creative

Table 2.

Nutrient and Food Group Intake and Energy Density by Lunch Type[a]

	Total (N = 129)	Bag Lunch (n = 44)	School Lunch (n = 85)	*P* Value
Energy, kcal	465 ± 1985	513 ± 216	440 ±185	.048
Carbohydrate, g	60 ± 27	70 ± 28	54 ± 25	.002
% energy from carbohydrate	52 ± 13	57 ± 13	50 ± 11	.003
Protein, g	19.1 ± 10.1	14.9 ± 8.2	21.3 ± 10.3	<.001
% energy from protein	16.8 ± 6.9	11.5 ± 4.3	19.5 ± 6.4	<.001
Total fat, g	17.4 ± 9.5	20.7 ± 11.0	15.6 ± 8.1	.003
% energy from fat	32.4 ± 9.7	34.6 ± 10.5	31.3 ± 9.2	.071
Saturated fatty acids, g	5.7 ± 3.6	6.5 ± 4.6	5.3 ± 2.9	.086
Monounsaturated fatty acids, g	6.7 ± 3.8	8.0 ± 4.2	6.0 ± 3.3	.003
Polyunsaturated fatty acids, g	3.7 ± 3.2	5.0 ± 3.9	3.1 ± 2.5	.001
Omega-3 fatty acids, g	0.3 ± 0.3	0.2 ± 0.2	0.3 ± 0.4	.047
Dietary fiber, g	3.9 ± 2.0	4.1 ± 2.0	3.8 ± 2.1	.428
Water, g	283 ± 138	263 ± 148	293 ± 132	.233
Total sugar, g	28.3 ± 16.6	36.0 ± 20.1	24.3 ± 12.9	<.001
Added sugar, g	16.6 ± 15.0	26.4 ± 18.5	11.5 ± 9.5	<.001
Fruits, cups	0.4 ± 0.6	0.5 ± 0.7	0.4 ± 0.5	<.001
Vegetables, cups	0.4 ± 0.6	0.1 ± 0.2	0.5 ± 0.7	<.001
Fruits and vegetables, cups	0.8 ± 0.8	0.6 ± 0.7	1.0 ± 0.8	.005
Whole grains, oz equiv	0.09 ± 0.34	0.23 ± 0.54	0.02 ± 0.09	<.001
Dairy foods, cups	0.6 ± 0.5	0.5 ± 0.6	0.7 ± 0.5	.441
Energy density[b]	1.3 ± 0.6	1.5 ± 0.8	1.2 ± 0.4	.006

[a]Values represent mean ± standard deviation.
[b]Energy density = calories/gram weight of foods and beverages.

menu development would be necessary to serve these foods in a palatable manner without added fat or sugar.

The poor nutritional quality of bagged lunches could be explained by the limited variety of portable healthy foods. Conway et al[23] examined the bag lunch components among middle school students and reported that the most common components were beverages and sandwiches with fruits being more common than vegetables. Results from a survey of the bagged lunch contents among primary school children indicated that 52% of the bagged lunches included fruits or vegetables and 69% of

Table 3.

Vitamin and Mineral Intake for Children by Meal Type[a]

	Total (N = 129)	Bag Lunch (n = 44)	School Lunch (n = 85)	*P* Value
Water-soluble vitamins				
Thiamin, mg	0.4 ± 0.2	0.4 ± 0.2	0.4 ± 0.2	.503
Riboflavin, mg	0.5 ± 0.3	0.4 ± 0.3	0.5 ± 0.3	.010
Niacin, mg	5.0 ± 3.4	5.3 ± 4.6	4.8 ± 2.5	.369
Total folate, mg	89 ± 54	82 ± 52	92 ± 55	.306
Vitamin C, mg	22 ± 26	27 ± 36	19 ± 18	.100
Vitamin B_6, mg	0.3 ± 0.4	0.4 ± 0.7	0.3 ± 0.2	.500
Vitamin B_{12}, μg	0.9 ± 0.7	0.6 ± 0.6	1.0 ± 0.7	.002
Fat-soluble vitamins				
Total vitamin A activity, IU	1295 ± 2387	680 ± 1039	1614 ± 2799	.007
Vitamin D (calciferol), mcg	1.3 ± 1.3	0.8 ± 1.1	1.6 ± 1.2	<.001
Vitamin E, mg	2.1 ± 3.7	3.3 ± 5.9	1.4 ± 1.0	.035
Vitamin K, μg	12.8 ± 20.8	7.2 ± 5.2	15.7 ± 24.9	.003
Minerals				
Calcium	259 ± 164	207 ± 166	287 ± 157	.008
Phosphorus	318 ± 175	277 ± 187	340 ± 166	.061
Iron	3.1 ± 1.8	3.0 ± 1.9	3.2 ± 1.7	.556
Sodium	849 ± 481	728 ± 436	912 ± 494	.039
Potassium	600 ± 327	487 ± 265	659 ± 342	.004

[a]Values represent mean ± standard deviation.

Table 4.

Ratio of Minimum Nutrient and Energy Level for School Lunch by Lunch Type[a]

	Total (N = 129)	Bag Lunch (n = 44)	School Lunch (n = 85)	*P* Value
Energy	0.7 ± 0.3	0.8 ± 0.3	0.7 ± 0.3	.049
Total fat	1.1 ± 0.3	1.2 ± 0.4	1.0 ± 0.3	.055
Saturated fat	1.1 ± 0.5	1.1 ± 0.6	1.1 ± 0.4	.082
Protein	1.9 ± 1.0	1.5 ± 0.8	2.1 ± 1.0	.124
Calcium	0.9 ± 0.6	0.7 ± 0.6	1.0 ± 0.6	.088
Iron	0.9 ± 0.5	0.9 ± 0.6	1.0 ± 0.5	.088
Vitamin A	0.5 ± 0.4	0.4 ± 0.5	0.5 ± 0.3	.080
Vitamin C	1.4 ± 1.7	1.8 ± 2.4	1.3 ± 1.2	.362

[a]Ratio of mean consumption level/minimum values required.[17]

the bagged lunches contained a chocolate bar or biscuits.[24] Sanigorski et al[25] found that 68% of children in an Australian school had fruit in their lunchboxes, whereas more than 90% had energy-dense, micronutrient-poor snack foods. Examination of packed lunches in a cross-sectional study in British primary schools showed that 19% contained vegetables and 54% contained fruit.[26] Another possible reason for lower nutritional quality may be involvement of children in the preparation of bag lunches. A qualitative study based on in-depth interviews with parents of 10- to 13-year-old children indicated that many children are involved in preparing the lunch they bring to school.[27]

Limitations for the findings in the current study include the use of data from only 1 meal. However, the intake data used in the current study was based on observation that may be more accurate than recall

information. In future studies, usual intake from school meals should be examined over a period of several days as has been done in previous studies[12] to reduce day-to-day variation within children. Data for this study were collected from a small sample of children from 1 suburban area in a Midwestern state; therefore, findings cannot be generalized to a broader sample of children.

Conclusions and Implications

Children who ate school lunch were more likely to have a higher vegetable intake, more favorable macro- and micronutrient intakes, and lower meal energy density than children who brought a bag lunch from home. Thus, future research should identify strategies to increase the number of children eating meals provided by the school and to educate parents to improve contents of bag lunches. Parents should be encouraged to provide more vegetables and whole grain foods in bagged lunches and to limit sweets and high fat snack foods. Two previous intervention studies resulted in improvements in the food and nutrient content of bagged lunches,[28,29] suggesting that parent nutrition education can be effective in improving nutritional quality of bagged lunches. Optimized diet quality and energy density may contribute to maintenance of health and well-being among children. ■

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