Original Investigation

Quality and Cost of Student Lunches Brought From Home

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IMPORTANCE The nutritional quality and cost of lunches brought from home are overlooked and understudied aspects of the school food environment.

OBJECTIVES To examine the quality and cost of lunches brought from home by elementary and intermediate school students.

DESIGN, SETTING, AND PARTICIPANTS An observational study was conducted in 12 schools (8 elementary and 4 intermediate) in one Houston, Texas, area school district from October 6, 2011, to December 5, 2011. Participants included 242 elementary and 95 intermediate school students who brought lunches from home.

EXPOSURES Lunches brought from home.

MAIN OUTCOMES AND MEASURES Foods brought and amounts eaten were recorded along with student grade level and sex. Nutrient and food group content were calculated and compared with current National School Lunch Program (NSLP) guidelines. Per-serving prices for each item were collected from 3 grocery stores in the study area and averaged.

RESULTS Compared with the NSLP guidelines, lunches brought from home contained more sodium (1110 vs ≤640 mg for elementary and 1003 vs ≤710 mg for intermediate students) and fewer servings of fruits (0.33 cup for elementary and 0.29 cup for intermediate students vs 0.50 cup per the NSLP guidelines), vegetables (0.07 cup for elementary and 0.11 cup for intermediate students vs 0.75 cup per the NSLP guidelines), whole grains (0.22-oz equivalent for elementary and 0.31-oz equivalent for intermediate students vs 0.50-oz minimum per the NLSP guidelines), and fluid milk (0.08 cup for elementary and 0.02 cup for intermediate students vs 1 cup per the NSLP guidelines). About 90% of lunches from home contained desserts, snack chips, and sweetened beverages, which are not permitted in reimbursable school meals. The cost of lunches from home averaged $1.93 for elementary and $1.76 for intermediate students. Students from lower-income intermediate schools brought significantly higher-priced ($1.94) lunches than did students from middle-income schools ($1.63).

CONCLUSIONS AND RELEVANCE Lunches brought from home compared unfavorably with current NSLP guidelines. Strategies are needed to improve the nutritional quality of lunches brought from home.

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In 2010, Congress passed the Healthy Hunger-Free Kids Act, the first update to the US Department of Agriculture's core children's nutrition program in more than 30 years.[1] Integral to this bill was the requirement that school meals meet the Dietary Guidelines for Americans. School meal criteria were based on a 2009 Institute of Medicine report[2] and implemented in the fall of 2012. Major changes included the establishment of minimum and maximum calorie allowances; increased servings of fruits, vegetables, and whole grains; vegetable variety; the elimination of high-fat fluid milk options; and a gradual reduction in sodium content.[1] For the 2013-2014 school year, schools received reimbursements for each free ($2.93), reduced-price ($2.53), and full-pay ($0.28) reimbursable meal served.[3]

While the new regulations changed National School Lunch Program (NSLP) meals, they did not address foods brought in lunches from home. Surprisingly, there are only a few published articles on the quality or costs of lunches brought from home. Three previous studies found that elementary NSLP meals were of higher nutritional quality than lunches brought from home, suggesting a potential need for interventions to improve the nutritional quality of lunches from home.[4-6] Only one study, conducted in 4 schools in North Texas in the 2005-2006 school year, assessed the cost; lunches from home averaged between $1.52 and $1.80.[5] Therefore, the objectives of this study were to assess the quality and cost of elementary and intermediate school children's lunches from home compared with the new US Department of Agriculture NSLP guidelines. Differences in lunch costs based on sex, grade level (elementary vs intermediate), and school socioeconomic status (based on eligibility rates for free or reduced-price [FRP] meals) were also explored.

Methods

This study examined the quality and cost of lunches brought from home by students from 12 schools (8 elementary and 4 intermediate) in one Houston, Texas, area school district from October 6, 2011, to December 5, 2011. The school district had 39 037 students (26.0% Hispanic, 8.3% African American, 13.4% Asian, 52.3% white) in 26 elementary (kindergarten-grade 5) and 10 intermediate schools (grades 6-8). A total of 28.1% district students were eligible for FRP meals. The Child Nutrition Director selected the schools based on eligibility for FRP meals in the district schools. Four low-income (FRP >49%) and 4 middle-income (FRP <18%) elementary schools and 2 low-income (FRP >34%) and 2 middle-income (FRP <20%) intermediate schools were selected. This study was approved by the Baylor College of Medicine Institutional Review Board for Human Subject Research. Because the data collection method consisted of anonymous observations of student food selection and consumption in school cafeterias, consent forms were not required.

Seven research staff (4 registered dietitians, 2 staff with nutrition degrees, and 1 college undergraduate) attended a 3-hour cafeteria training session to review procedures and learn how to use the meal observation form that listed common lunch food items in the first column by category: sandwiches, fruit, vegetables, drinks, desserts, and snack foods. There were columns for the observers to check off the food item the student brought, with space for writing in specific information and items not on the form. The remaining columns were used to document the amount of the items that were consumed, as well as food items obtained from other sources. Each observer conducted 2 to 4 practice observations, with the research coordinator also recording consumption. Acceptable interrater reliability was obtained (>90%). One trained observer conducted quality control checks once per month.

Observations were conducted during lunch periods; observers were assigned specific schools that they were to visit, unannounced, once per week. In the elementary schools, each classroom was assigned a table; this information was used to obtain 4 observations per grade level (kindergarten-grade 5) in each school (24 observations per school). The intermediate schools did not have specific lunch periods for the different grades and students chose their own seat. Therefore, only *intermediate grade level* was recorded on the 20 observations obtained from each intermediate school. The observer developed a rotation plan so that all tables would be observed.

There was a continuous influx of elementary school students into the cafeteria lunch line every 10 minutes; the intermediate schools had 3 lunch periods each day. Each data collector selected and observed 3 to 4 students who brought a lunch from home during each lunch period. They observed unobtrusively from a distance. Foods brought from home and amount consumed were recorded on observation sheets, along with student grade level and sex. Observers also recorded food obtained from other sources, given away, or spilled. Data were entered into Nutrition Data System for Research diet analysis software (version 2011; Nutrition Coordinating Center, University of Minnesota, Minneapolis). Two files were created: one included foods brought from home, and the other included the amount of all foods that were consumed during lunch.

Nutrient and food group content of lunches brought from home and from the amounts consumed was calculated from the data in the Nutrition Data System for Research software. The percent of energy and food groups consumed was calculated. The energy content of extra foods that students purchased at school or received from friends was also calculated for each student. A 1-sample *t* test was used to compare food groups brought from home with the NSLP guidelines for fruit, vegetables, whole grains, fluid milk, and sodium content. The percentage of students who brought dessert, snack chips, or sweetened beverages in their lunches was calculated.

A grocery list was prepared from the Nutrition Data System for Research files on food brought from home. Combination food items (ie, sandwiches) were disaggregated into their individual components. Two research assistants collected food costs from 3 grocery stores within the school district. No generic products or sale prices were recorded. One dietitian calculated the per-serving costs for the individual food items as needed (eg, the cost of 1 slice of bread) and entered costs into a spreadsheet. The average cost per food item was used to calculate total cost of the meals. Differences in average costs by sex, grade level, and school socioeconomic status were also as-

Table 1. Comparison of School Meal Guidelines and Lunches From Home for Elementary School Students

Guideline	NSLP School Meal Guidelines	Mean (SD) Brought (n = 242)	Mean (SD) Eaten (n = 242)	Mean Consumed, %[a]
Energy, kcal	550-650	661 (187)	559 (196)	85.1
Saturated fat, % total kcal	<10	9.92 (3.80)	9.75 (4.22)	Met requirement
Sodium, mg	≤640	1110 (462)	910 (475)	82.4
Fruits, cups	2.5 (0.5)[b]	0.33 (0.40)	0.24 (0.34)	72.8
Vegetables, cups	3.75 (0.75)[b]	0.07 (0.23)	0.05 (0.20)	70.4
Whole grains, oz equivalent	4-4.5 (0.5)[b]	0.22 (0.38)	0.19 (0.35)	88.5
Total grains, oz equivalent	8-9 (minimum 1)[b]	2.80 (1.24)	2.29 (1.28)	82.1
Meat/meat alternative, oz equivalent	8-10 (minimum 1)[b]	1.87 (0.82)	1.49 (0.90)	80.5
Fluid milk, cups	5 (1)[b]	0.08 (0.30)	0.10 (0.34)	99.1
Sweetened beverages, oz	NA	4.43 (4.81)	3.84 (4.01)	90.2
Snack chips, servings	NA	0.58 (0.65)	0.54 (0.60)	90.7
Desserts, servings	NA	0.67 (0.78)	0.62 (0.73)	92.6

Abbreviations: NA, not applicable; NSLP, National School Lunch Program.

[a] Percent consumed for food groups calculated only for students bringing those items.

[b] Weekly average; daily amount in parentheses.

Table 2. Comparison of School Meal Guidelines and Lunches From Home for Intermediate School Students

Guideline	NSLP School Meal Guidelines	Mean (SD) Brought (n = 95)	Mean (SD) Eaten (n = 95)	Mean Consumed, %[a]
Energy, kcal	600-700	616 (213)	606 (235)	98.4
Saturated fat, % total kcal	<10	9.03 (3.69)	9.18 (3.92)	Met requirement
Sodium, mg	≤710	1003 (463)	1000 (592)	98.3
Fruits, cups	2.5 (0.5)[b]	0.29 (0.43)	0.22 (0.34)	81.3
Vegetables, cups	3.75 (0.75)[b]	0.11 (0.32)	0.08 (0.29)	76.8
Whole grains, oz equivalent	4-5 (0.5)[b]	0.31 (0.40)	0.30 (0.38)	92.8
Total grains, oz equivalent	8-10 (minimum 1)[b]	2.72 (1.15)	2.62 (1.22)	96.6
Meat/meat alternative, oz equivalent	9-10 (minimum 1)[b]	1.63 (0.96)	1.59 (1.20)	96.1
Fluid milk, cups	5 (1)[b]	0.02 (0.12)	0.02 (0.15)	85.6
Sweetened beverages, oz	NA	3.76 (5.37)	3.34 (4.90)	91.8
Snack chips, servings	NA	0.74 (0.66)	0.75 (0.64)	98.7
Desserts, servings	NA	0.49 (0.67)	0.58 (0.70)	101.8[c]

Abbreviations: NA, not applicable; NSLP, National School Lunch Program.

[a] Percent consumed for food groups calculated only for students bringing those items.

[b] Weekly average; daily amount in parentheses.

[c] Students obtained food from friends or purchased in snack bar.

sessed using analysis of variance. IBM SPSS Statistics, version 20 (IBM Corp), was used for all analyses.

Results

A total of 242 elementary students and 95 intermediate students who brought their lunches from home were observed during the data collection period. In the elementary group, 121 (50.0%) students were male and 135 (55.8%) students attended a lower-income school. There were approximately 5543 students enrolled in these 8 schools. In the intermediate group, 43 (45.3%) students were male and 40 (42.1%) students attended a lower-income school. There were approximately 3782 students enrolled in these 4 schools. The average nutrient and food group content of lunches brought from home for elementary school students is presented in **Table 1**. As provided, lunches met NSLP guidelines for 3 categories: percent of energy from saturated fat, minimum ounces of meat/meat alternative, and minimum ounces of total grains.

Compared with the NSLP guidelines, the lunches from home contained a significantly greater amount of sodium ($P < .001$ for both grade levels) and significantly less vegetables ($P < .001$ for both grade levels) and fluid milk ($P < .05$ for elementary and $P < .001$ for intermediate school students). There were no significant differences for fruit or whole grains. About 90% of lunches from home contained desserts, snack chips, and sweetened beverages, which are not permitted in reimbursable school meals.

Nine elementary and 27 intermediate school students purchased a la carte foods. Mean consumption for these elementary students was 105 kcal of a la carte foods; the intermediate school students consumed an average of 188 kcal of a la carte foods. The least expensive item for purchase cost $0.60. Twenty elementary and 9 intermediate school students obtained food from a friend, consuming an average of about 105 and 83 kcal from this source, respectively.

On average, elementary school students consumed 85.1% of total energy provided in packed lunches (Table 1). The food categories with the highest average consumption (>90%) were fluid milk, sweetened beverages, desserts, and snack chips. The lowest consumption was for vegetables (70.4%). Lunches consumed by intermediate school students met the NSLP guidelines for energy, percent calories from saturated fat, mini-

Table 3. Cost of Lunch Brought From Home by Students

Characteristic	Elementary, $		Intermediate, $	
	No.	Mean (SD) [Range]	No.	Mean (SD) [Range]
Total	242	1.93 (0.66) [0.69-4.78]	95	1.76 (0.72) [0.63-3.91]
Sex[a]				
Boy	121	1.92 (0.70) [0.80-4.78]	43	1.78 (0.75) [0.76-3.81]
Girl	118	1.92 (0.62) [0.69-3.75]	52	1.74 (0.70) [0.63-3.91]
Low income				
Yes	135	1.92 (0.62) [0.69-4.58]	40	1.94[b] (0.75) [0.76-3.81]
No	107	1.94 (0.71) [0.80-4.76]	55	1.63[b] (0.64) [0.63-3.91]

[a] Sex was not recorded for 3 students.

[b] $P < .05$.

mum total grains, and minimum servings of meat/meat alternative (**Table 2**). The lunches exceeded guidelines for sodium and provided too few servings of vegetables, fruits, whole grains, and fluid milk. On average, intermediate students consumed 98.4% of total energy provided in lunches from home (Table 2). Desserts and snack chips had the highest average consumption (≥98%). The lowest average consumption was for vegetables (76.8%).

For the 2011-2012 school year, elementary and intermediate school students in the participating schools purchasing a reimbursable NSLP lunch paid $1.80 and $2.05, respectively. The average cost for meals brought from home for elementary school students was $1.93 and $1.76 for intermediate school students (**Table 3**). Students who attended lower-income intermediate schools had significantly higher-cost lunches from home ($1.94) than their middle-income peers ($1.63). No other significant differences in demographic variables were found in cost of lunches from home.

Discussion

Quality of Lunches From Home

The results from this study revealed that lunches brought from home compared unfavorably with current NSLP nutrition guidelines for both elementary and intermediate school students. On average, lunches brought by elementary students exceeded the NSLP energy requirement range, although actual energy and saturated fat consumption were within guidelines for both age groups. Lunches from home contained more sodium and fewer servings of vegetables, fruits, whole grains, and fluid milk than school meal standards. National School Lunch Program guidelines restrict energy-dense foods such as sweetened beverages, snack chips, and desserts, but many students (90%) had these foods in their lunches from home.

Although the literature is sparse, prior studies of packed lunch quality have shown similar results. A 2001 comparison of lunch from home and school lunches for elementary school students found that lunches from home provided significantly more carbohydrates, total fat, and sugar than did school meals.[4] Students eating school meals were also more likely to meet recommended daily allowance nutrient guidelines. A 2012 comparison of packed and school lunches found that home lunches were significantly less likely to contain fruit, vegetables, and dairy products and significantly more likely to contain drinks with a juice content less than 100%, sugary snacks, and snacks with high fat content,[6] similar to the current findings. Of note, both studies assessed the quality of school meals as selected rather than comparing the meal selected with the NSLP guidelines. These studies were also conducted before the 2012 implementation of the new school meal guidelines. Similar findings have also been reported in the United Kingdom, where lunches from home compared unfavorably with school meals and standards.[7-9]

Cost of Lunches Brought From Home

The average cost of packed lunches was greater for elementary students ($1.93) than for intermediate students ($1.76) and ranged from $0.69 to $4.78 for elementary and $0.63 to $3.91 for intermediate school students (Table 3). As noted, the 2011-2012 student cost for full-priced lunch was $1.80 for elementary and $2.05 for intermediate school students; therefore, the average lunch from home for elementary school students cost more than the NSLP meal, whereas intermediate students' lunches from home were less expensive. However, 27 intermediate school students purchased additional food at school, and the least expensive item was $0.60.

No published article was found that assessed the reasons for children bringing home lunches; cost and preference are likely 2 reasons. The type of foods selected for their lunch, the extent to which children influence food selections, and reasons for purchasing a la carte foods are important areas for future research. There were no statistically significant sex differences in home lunch cost; however, lunches brought by students in the low-income intermediate schools cost significantly more than lunches from students in middle-income schools ($P = .03$). Given the small sample and paucity of literature on cost of lunches from home, this is a new finding that warrants more investigation. The only published study on food cost assessed lunch in 4 North Texas elementary schools using similar methods; the cost of lunches from home ranged between $1.52 and $1.80.[5] The study did not analyze potential differences in cost by sex or socioeconomic status.

This study had several limitations. A small sample size in 1 Texas school district limits broad applicability of the data. There could be sampling design/selection bias because the selection process was not random and was not necessarily representative of the student body. Also, the data may have limited precision due to the nature of the observational study design. For example, the observers could not accurately ascertain whether all beverages were consumed except for those

containers that the students crumbled or when it was obvious that the student drained the container. In addition, this study was conducted before the implementation of the Healthy Hunger-Free Kids Act. It is unclear whether more rigorous NSLP guidelines could have any effect on the cost or quality of lunches brought from home. In terms of lunch cost, the large standard deviations in the data set could indicate variability in the cost of lunches from home. In addition, data collectors collected prices only for brand-name items that were not on sale. Including generic and sale items in the price analysis could impact average cost.

Implications for Future Research

Due to the paucity of published research on the quality of lunches brought from home in the United States, more investigation is needed across several demographics and geographic regions. Future research should compare home lunches as brought and consumed with school meals as selected and consumed. Parent or guardian knowledge and attitudes surrounding packed lunch components should also be investigated to determine parameters for potential intervention.

The results from this study suggest that interventions should focus on nutrition guidance for parents and students who regularly bring lunch from home. Such an intervention was effective for 3- to 5-year-old children in a child-care setting where the intervention group was provided with lunches that contained significantly more vegetables and whole grains than in the lunches provided by the control-group parents.[10] A companion study investigating psychosocial outcomes found significant increases in parental knowledge, outcome expectations, and subjective norms for the healthy target food groups when compared with the control group.[11]

There has been very little investigation into the cost of lunches brought from home. Our findings indicate packed lunch cost to be an area for more thorough investigation, especially due to the significant finding for low-income intermediate school students. Future research should explore this finding, as well as compare lunch quality and cost, to determine if higher-cost lunches are of higher nutritional quality. In addition, parent and student attitudes about the cost of packed lunches should be assessed.

Conclusions

Because of the problem of childhood obesity, much attention has been given to the school food environment and the NSLP. However, it is apparent that a large component of the school food environment—foods brought from home—has not been thoroughly investigated and could be a contributing factor to child overweight status. Results from this study and previous studies indicate that, on average, lunches brought from home compare unfavorably with reimbursable school meals. In addition, the cost of lunches brought from home is a subject that warrants more thorough investigation, especially due to the significant association between low-income intermediate school students and higher-cost lunches brought from home. Although more study is needed, results to date could indicate foods brought from home are an important area in need of budget-friendly nutrition interventions and guidance.

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