



Nutritional Comparison of Packed and School Lunches in Pre-Kindergarten and Kindergarten Children Following the Implementation of the 2012–2013 National School Lunch Program Standards

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ABSTRACT

Objective: Approximately 40% of children bring a packed lunch to school. Little is known about the quality of these lunches. This study examined the nutritional quality of packed lunches compared with school lunches for pre-kindergarten and kindergarten children after the implementation of 2012–2013 National School Lunch Program standards.

Methods: The researchers collected observational data for packed and school lunches from 3 schools in rural Virginia for 5 consecutive school days and analyzed them for macro and micro nutrients.

Results: Of the 1,314 observations collected; 42.8% were packed lunches (n = 562) and 57.2% were school lunches (n = 752). Energy, fat, saturated fat, sugar, vitamin C, and iron were significantly higher whereas protein, sodium, fiber, vitamin A, and calcium were significantly lower for packed lunches than school lunches.

Conclusions and Implications: Packed lunches were of less nutritional quality than school lunches. Additional research is needed to explore factors related to choosing packed over school lunches.

Key Words: packed lunch, school lunch, children, NSLP, nutrition (*J Nutr Educ Behav.* 2014;46:621–626.)

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INTRODUCTION

Over 50 million children attend elementary and secondary public schools in the US each day.¹ These children spend a substantial portion of their waking hours and consume a substantial portion of their daily calories at school.^{2,3} For approximately 60% of children, these calories are derived from the National School Lunch Program (NSLP); the remaining 40% are from packed lunches.⁴ During the past few years, there have been significant shifts in NSLP participation,

with decreases from 31.8 million average daily meals in 2011 to 31.6 million in 2012,⁵ which translates into more children consuming packed lunches. Whereas the NSLP is mandated to meet nutrition standards aligned with the 2010 Healthy and Hunger-Free Kids Act,^{6,7} packed lunches are not required to meet nutrition standards.

To date, relatively few studies have been published on the nutritional quality of packed lunches.^{2,4,8–13} Existing studies used a variety of data collection methods and timeframes

such as 24-hour recalls and 1- to 3-day food observations and were conducted with a variety of ages ranging from kindergarten (K) to 12th grade.^{2,4,8–13} No studies reported data over a full school week (5 days) with pre-K classes attending public school and compared with the new NSLP standards. The purpose of this study was to examine the nutritional quality of packed lunches compared with school lunches served to pre-K and K children attending public school over 5 consecutive school days after implementation of the 2012 NSLP standards.

METHODS

Recruitment of Schools

The researchers contacted 8 elementary schools in a rural area in Virginia via e-mail and telephone. Of the 8 schools contacted, 3 (37.5%) agreed to participate. The County Public School Research Office and each individual school administrator granted permission to enter each elementary school. The Institutional Review Board

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for Virginia Tech approved the study and did not require child or parental consent.

Setting and Participants

The 3 elementary schools spanned 2 counties: Montgomery, with a population of 95,194 composed of white (87.9%), black (4.1%), and Hispanic/Latino (2.9%) individuals; and Giles, with a population of 16,928 composed of white (97%), black (1.5%), and Hispanic/Latino (1.3%) individuals.¹⁴ The 3 schools had free and reduced price school lunch participation rates of 33.3%, 46.6%, and 52.7%, respectively. No identifying information for any student was collected. The authors selected pre-K and K students because young ages represent a malleable time to promote food acceptance.¹⁵⁻¹⁸

Observational Protocol

National School Lunch Program menus need to meet nutritional requirements over the course of 1 week; therefore, observational data were collected in each elementary school for 5 consecutive school days.⁷ All pre-K and K students in each school were served NSLP meals consisting of similar portion sizes. An observational checklist reflecting the meal components of the day's specific menu and commonly consumed items from packed lunches were used to record data on the presence of all food and drinks served as part of the NSLP and brought from home, with write-in sections for additional foods that may have not been part of the observational checklist. Each researcher was assigned a specific grouping of students to observe for a lunch period, approximately 10 students/researcher.

Observer Training and Reliability

Undergraduate and graduate nutrition students were recruited and trained as observers in direct observation to assess lunch contents, specifically visual item identification and portion size estimation. The training was conducted by a doctoral-level registered dietitian. For checklist reliability testing, the researchers conducted observations of 5 premeasured sample packed lunches,

for a total of 24 items. Food and beverage items selected represented commonly found items in elementary packed lunches. School lunches were not chosen because of their uniformity and ease of recording. Accuracy was determined by dividing the number of items accurately recorded by the total number of items (item identification = 93.8%; portion estimation = 92.1%). Interobserver reliability was assessed with average pairwise percent agreement tests (JMP, version 11, SAS Institute, Inc, Cary, NC, 2013). Observers demonstrated 90.7% agreement for item identification and 86.8% agreement for portion estimation. This was consistent with previous research showing that trained observers with prior nutrition knowledge can accurately and reliably assess packed lunch contents and intake by direct observation in an elementary school setting.¹⁹

Data Analysis

The school foodservice director for the region or the cafeteria manager for the elementary schools provided nutrient analyses for school lunches per food item. Packed lunch items were analyzed (Nutritionist Pro Diet Analysis software, version 5.1, Axxya Systems, Stafford, TX, 2009) based on serving sizes recorded at the time of observation. If an item was unavailable in the Nutritionist Pro database, the nutrition facts label per product brand and type were used for analysis. US Department of Agriculture reference items were recorded when available. Students who brought a packed lunch and purchased milk from the cafeteria were classified as a packed lunch observation. Students who participated in the NSLP but also brought food from home ($n = 5$; 0.007% of total observations) were excluded.

Descriptive statistics were used to describe the nutritional quality of packed vs school lunches. Shapiro-Wilk test was used to determine whether the data were parametric. The researchers carried out comparisons of mean quantities of macronutrients and micronutrients (calories, protein, fat, saturated fat, carbohydrates, sugar, fiber, vitamin A, vitamin C, calcium, and iron) using the Mann-Whitney-Wilcoxon test. Multiple comparison and *post hoc* comparison

tests were carried out with Bonferroni adjustment of $P < .004$. Tukey's Honest Significant Difference test was used to detect differences between groups.

RESULTS

Nutritional Profile of Packed and School Lunches

A total of 1,314 lunches were observed, 42.8% of which were from packed lunches ($n = 562$) and 57.2% from NSLP ($n = 752$). Energy, carbohydrate, fat, saturated fat, sugar, vitamin C, and iron were significantly higher for packed lunches compared with school lunches whereas protein, sodium, fiber, vitamin A, and calcium were significantly lower for packed lunches compared with school lunches (Table 1). The nutrient availability for children in both packed and school lunch groups almost entirely met the nutrition standards of the NSLP except that school lunches being 38 calories below energy and 0.4 mg below iron recommendations whereas packed lunches were 1.5 g higher than fat and 0.3 g higher than saturated fat recommendations.

Nutritional Profile of Packed Lunches by School

Differences among schools for the nutritional profile of packed lunches for protein, fat, saturated fat, sodium, vitamin A, and calcium were not statistically significant (Table 2). Energy was significantly higher for packed lunches of students at the moderate (46.6%) free and reduced eligibility level compared with both other schools. Packed lunches of students at the school with the low (33.3%) free and reduced eligibility level were significantly lower for carbohydrate, sugar, and vitamin C and significantly higher for iron and fiber than packed lunches at both other schools.

Food Categories in Packed and School Lunches

Packed lunches were less likely to contain fruits (54% vs 67%), vegetables (17% vs 61%), juice with no sugar (10% vs 22%), and milk (20% vs 96%) than NSLP meals. They also contained

Table 1. Comparisons of Nutrients Between School and Packed Lunches Among Pre-Kindergarten and Kindergarten Students in 3 Schools

	School Meals (n = 752)			Packed Meals (n = 562)			P (Bonferroni Adjusted Significance = .004) ^a	US Department of Agriculture Nutrient Goals: K Through Fifth Grade and Pre-K
	Mean	Median	Interquartile Range	Mean	Median	Interquartile Range		
Energy, kcal	512	520	106	608	588	240	< .001	550–650 kcal (K through fifth grade) 517 kcal (pre-K) ^b
Carbohydrate, g	66	67	25	88	85	38	< .001	–
Protein, g	26	27	8	18	17	9	< .001	9 g (K through fifth grade) ^c 7 g (pre-K) ^c
Fat, g	13	13	5	21	20	14	< .001	< 19.5 g (K through fifth grade) ^d < 17 g (pre-K) ^d
Saturated fat, g	3.6	3	4	6.8	6.5	6	< .001	< 6.5 g ^e < 5.7 g (pre-K) ^e
Sodium, mg	1,021	1,038	364	883	818	482	< .001	< 1,230 mg ^f
Fiber, g	7.2	7	4.5	4.8	4.5	4	< .001	–
Sugar, g	35	35	12	45	43	37	< .001	–
Vitamin A, IU	3,856	1,350	4,800	1,375	502	715	< .001	1,000 IU ^c
Vitamin C, mg	24	17	22	43	29	59	< .001	15 mg ^c
Calcium, mg	503	460	209	305	297	285	< .001	267 mg ^c
Iron, mg	2.9	2.5	1.5	3.4	3	2	< .001	3.3 mg ^c

K indicates kindergarten.

^aBased on Mann-Whitney-Wilcoxon test; ^bMinimum requirement for pre-K children served meals as part of the National School Lunch Program; ^cOne third of the Recommended Daily Allowance for age/grade group; ^dTotal fat not to exceed 30% of total calories over a school week (calculation based on mean calorie range); ^eSaturated fat not to exceed 10% of total calories over a school week (calculation based on meal calorie range); ^fSodium guidelines not required until 2014–2015 school year.

more savory snacks such as chips and crackers (57% vs 5%) and sugar-sweetened beverages (40% vs 0%). Some of the most commonly brought food items in packed lunches were peanut butter sandwiches (n = 155), single-serving chips (n = 145), single-serving yogurt items, including yogurt cups and yogurt tubes (n = 117), Capri Sun drink pouches (n = 112), and Lunchables (prepackaged food and drink combinations) (n = 102). Dessert items were classified as grain-based desserts, chocolate bars, dairy-based desserts, gummies, and candy. Of the packed lunches, 61% contained a dessert item and 17% contained > 1 dessert item. The NSLP did not provide dessert items to students (Table 3).

DISCUSSION

To the authors' knowledge, this is the first study to compare packed lunches to NSLP lunches over a 5-day period among pre-K and K, and after the implementation of new NSLP nutrition standards. Like previous studies, the

nutritional profile for packed lunches was of less nutritional quality than NSLP lunches.^{2,10} School lunches were more likely to meet nutrition standards than packed lunches, especially for fat and saturated fat, which exceeded recommended levels in packed lunches. The authors expected to find more differences in the nutrition profile of packed lunches among schools because the various free and reduced lunch eligibility levels potentially indicated various socioeconomic levels. The elementary school with the lowest free and reduced lunch eligibility level (33.3%) had the best nutrition profile compared with both other schools. This potentially indicates that the nutritional value of packed lunches differs significantly among schools based on eligibility for free and reduced school lunch. A wider variation in eligibility may be warranted to observe greater differences by level.

The findings also suggest that packed lunches may contribute to higher solid fat and added sugar

intake among young children because of the higher prevalence of dessert items, savory snack items, and sugar-sweetened beverages. These findings mirror previous studies in which NSLP participants consumed fewer sugar-sweetened beverages and energy-dense, solid foods than nonparticipants.^{8,20} This trend may lead to increased caloric intake and ultimately higher body mass and childhood obesity.^{21,22} While consumption of energy-dense, low-nutrient foods continues to rise, fruit and vegetable intakes in children are below recommended levels and tend to decrease with age.^{23,24} In this study the NSLP provided increased exposure to fruits and vegetables compared with packed lunches, which is critical for acceptance, especially in young children.^{15,18}

Sodium content was higher in school lunch than packed lunch even though packed lunches provided many processed foods in the form of prepackaged ready-to-eat items, primarily owing to the use of processed food items in preparing NSLP lunches,

Table 2. Nutritional Profile of Packed Lunches of Pre-Kindergarten and Kindergarten Students From 3 Separate Elementary Schools by Free and Reduced School Lunch Eligibility

	School 1: 33.3% Eligibility (n = 210, 37%)			School 2: 46.6% Eligibility (n = 94; 17%)			School 3: 52.7% Eligibility (n = 258; 46%)			P (Bonferroni Adjusted Significance = .004) ^a
	Mean	Median	Interquartile Range	Mean	Median	Interquartile Range	Mean	Median	Interquartile Range	
Energy, kcal	570 ^b	559	235	676 ^c	649	276	614 ^b	590	244	< .001
Carbohydrates, g	80 ^b	76	36	100 ^c	99	47	91 ^c	72	37	< .001
Protein, g	19	17	10	18	18	7	17	17	8.5	.121
Fat, g	20	19	20	24	22	11	21	20	19	.028
Saturated fat, g	6.5	6	6	7.6	7	5	6.8	6.5	5.5	.043
Sodium, mg	861	782	513	887	847	372	899	838	497	.203
Fiber, g	5.6 ^c	5	4.5	3.7 ^b	4	3	4.4 ^b	4	3.5	< .001
Sugar, g	38 ^c	36	22	54 ^c	54	28	47 ^b	48	23	< .001
Vitamin A, IU	1,499	515	710	1,080	500	603	1,382	502	679	.249
Vitamin C, mg	34 ^b	15	57	52 ^c	59	64	46 ^c	47	58	< .001
Calcium, mg	330	327	309	295	285	309	288	258	260	.033
Iron, mg	4.0 ^c	3.5	2	3.0 ^b	2.5	2	3.1 ^b	3	2	< .001

^aBased on Mann-Whitney-Wilcoxon test; ^{b,c}Means followed by the same letter are not significantly different at the .004 level (Bonferroni corrected significance), using Tukey's Honest Significant Difference.

specifically in entrée items. To allow food manufacturers time to reformulate products and schools more time to build student acceptance of lower-sodium meals, the US Department of Agriculture are expected to transition new sodium standards in the NSLP in 2014–2015.⁷ Although school lunch sodium levels are higher than they are in packed lunches in this study, the NSLP was meeting 2014–2015 school year recommended levels.

Unlike in previous studies, NSLP school lunches were lower than the recommended level for iron and calories, which could be the result of food selection by pre-K and K students.^{1,11} Many schools offer 2-3 fruit and vegetable choices per meal along with multiple options for a main entrée; under the new guidelines students are only required to take a minimum of 3 meal components (food groups) at lunch, and only 1 of those food groups must be a fruit or vegetable. This study compares the NSLP foods selected by students, not all food items on a lunch menu. Therefore, this finding does not reflect poor adherence of schools in meeting the nutritional guidelines, but rather which food groups or items are chosen (or not chosen) by NSLP participants.

This study was consistent with previous studies that found vitamin C to be higher in packed lunches.^{11,13} Both packed and NSLP lunches met recommended levels; however, the higher amount of vitamin C in packed lunches most likely results from fortified sugar-sweetened beverages.

Several factors may limit the generalizability of this study. The sample was restricted to young elementary students in a rural area in Virginia and may not be applicable to urban, ethnically diverse, or older students. This study examined only foods and beverages served and/or offered to children over the school lunch period. Lunches were analyzed using observation techniques and not weighted samples. Possibly the largest limitation of this study was that actual consumption of food items was not measured. Future studies should also consider gathering food waste data to compare food consumption across various schools and between packed and school lunches.²⁵ To protect the

Table 3. Comparison of Food Items Included in School Meals and Packed Lunches of Pre-Kindergarten and Kindergarten Students

Food Item	School Meals (n = 752) (% of students)	Packed Meals (n = 562) (% of students)
≥ 1 fruit item (not juice)	67	54*
≥ 1 vegetable/bean item (not juice)	61	17*
≥ 1 dessert item (ie, grain-based desserts, chocolate bars, dairy based desserts, gummies, candy)	0	61**
> 1 dessert item	0	17**
≥ 1 savory snack item (ie, chips, crackers)	5	57*
No sugar-added juice	22	10*
Sugar-added juice/soda	0	40**
Milk (flavored and unflavored)	96	20*

*Statistically significant at < .001 level with chi-square test; **Unable to determine statistical significance owing to 0% in school meal category.

privacy of elementary students, the research team collected no identifying information to track students over the 5-day study period, which would have allowed for student-level analyses. In previous studies, the longest observation period was 3 days. Five days is a more appropriate timeframe because the new nutrition standards provide guidance over a 5-day period, and there may be day-to-day variations in the nutritional quality of school and packed lunches that may not be detected during a 3-day observation period.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Habits develop in early childhood and continue into adolescence and adulthood.^{16,17} Therefore, this is a critical time to promote healthy eating. Determining the many factors that influence the decision to participate in the NSLP or bring a packed lunch from home is vital to addressing the poor quality of packed lunches. Recently, Ohri-Vachaspati²⁶ reported that participation in schools meals was independently associated with whether parents perceived the meals to be healthy. Additional research is needed to explore additional factors related to choosing packed over school lunches and/or decision making regarding what is offered in packed lunches. Furthermore, nutrition education programs targeting

children, parents, and perhaps even school policy regarding packed lunches should be encouraged to promote healthier options within packed lunches and/or encourage participation and increase enrollment in NSLP.

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