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RESEARCH ARTICLE

Schoolchildren's Consumption of Competitive Foods and Beverages, Excluding à la Carte*

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ABSTRACT

BACKGROUND: Competitive foods/beverages are those in school vending machines, school stores, snack bars, special sales, and items sold à la carte in the school cafeteria that compete with United States Department of Agriculture (USDA) meal program offerings. Grouping à la carte items with less nutritious items allowed in less regulated venues may obfuscate analysis of the school competitive food environment. Excluding à la carte items from competitive foods, the objectives were to: (1) assess competitive food use by gender, ethnicity, eligibility for free or reduced-price meals, and participation in school meals programs, (2) determine differences between grade levels in energy intakes obtained from food sources, (3) determine the nutrient intake derived from competitive foods for students who consumed them, and (4) determine energy-adjusted differences in 24-hour nutrient intakes of protein, calcium, iron, and other selected nutrients between competitive food consumer and nonconsumers.

METHODS: Competitive foods/beverages use, excluding à la carte items, was examined using the third School Nutrition Dietary Assessment Study (SNDA III), a nationally representative sample of 2309 schoolchildren in grades 1 to 12. Mean nutrient intakes were adjusted for energy intake and other covariates, and differences between consumers and nonconsumers of competitive items were determined using analysis of variance and SUDAAN.

RESULTS: Excluding à la carte items, 22% of schoolchildren consumed competitive items in a representative school day and use was highest in high school. Consumers of competitive items other than à la carte had significantly higher mean energy, sugar intakes, and lower sodium, dietary fiber, B vitamins, and iron intakes than nonconsumers.

CONCLUSIONS: Use of competitive foods/beverages, excluding à la carte, was detrimental to children's diet quality.

Keywords: nutrition and diet; school food services; risk behaviors.

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Childhood obesity, resulting in part from poor dietary choices and sedentary lifestyle, increases the childhood and adult risk for many chronic diseases, placing enormous burden on public health expenditures.[1] A healthy school food environment is the goal of national school wellness policies to reduce dietary risk for childhood obesity (Child Nutrition and Women, Infant, and Children (WIC) Reauthorization Act of 2004, Section 204 of Public Law 108-265, June 30, 2004). However, offering competitive food and beverages of poor nutritional value in schools would appear to undermine this goal. Data on the nutrient content of foods and beverages that compete with the national school lunch program for children's food money (termed competitive foods) suggest that most are of poor nutrient quality.[2-6] Energy-dense competitive foods, such as sweetened beverages, snack chips, and candy, are accessible to students in 97% of US schools.[7-9]

Competitive (or US Department of Agriculture [USDA] nonreimburseable) foods/beverages are those sold in schools that are not part of the National School Lunch Program (NSLP) or School Breakfast Program (SBP). Such foods and beverages include those sold separately in the school cafeteria, termed à la carte, plus those not permitted for sale in the school cafeteria due to low nutritional value. The USDA defines Foods of Minimal Nutritional Value (FMNV) as those that provide less than 5% of the Reference Daily Intake for 8 nutrients—protein, vitamin A, vitamin C, niacin, riboflavin, thiamin, calcium, and iron—per serving and per 100 calories (7 CFR 210 Section 210.11 and 7 CFR 220, Section 220.12). À la carte foods are not allowed to be FMNV,[9] but, to date, studies of competitive food consumption have included à la carte items.[2,8] À la carte foods and beverages include components of NSLP and SBP meals, such as French fries, milk, and cookies sold individually rather than as part of a meal. Grouping à la carte items that are part of the NSLP or SBP with FMNV allowed in less regulated venues, such as school stores and vending machines, may obfuscate analysis of the school food environment outside of the cafeteria. As defined in the present study, competitive foods excluded à la carte items to focus specifically on those foods and beverages in venues with the least regulatory guidance, because these food and beverage items are often of poor nutritional quality.

To help evaluate the nutritional quality of foods children eat, the USDA periodically contracts researchers to perform the School Nutrition Dietary Assessment Study (SNDA). The third collection of SNDA data on foods purchased in schools by children has recently been completed.[10] Thus, data are available to examine the most frequently consumed competitive foods, frequency of competitive food use, and contribution of such items to the nutrient intake of schoolchildren.[10] The analysis in this report is an examination of how use of competitive foods (excluding à la carte items) relates to students' daily nutrient intake, while adjusting for energy intake differences, and this has not been published to date. Mathematica Policy Research, Inc., conducted the initial analysis of SNDA III, but did not adjust for energy intake differences in their assessment of the relationship of competitive food/beverage consumption to the nutrient intakes of children.[10] Such an adjustment for differences in energy intake between competitive food consumers and nonconsumers is important, because it allows for a comparable assessment of the nutrient density of the diet, rather than assessing absolute nutrient intakes which vary with energy intake. Energy adjustment allows us to better understand diet quality rather than merely the quantity of nutrients.

The objectives of this study were to (1) assess competitive food/beverage use (excluding à la carte) by gender, ethnicity, eligibility for, and participation in NSLP/SBP; (2) determine differences between grade levels in energy intakes obtained from various food sources; (3) determine the nutrient intakes derived from competitive foods among students who consumed them; and (4) determine differences in energy-adjusted 24-hour nutrient intakes between competitive food consumers and nonconsumers.

METHODS

Sample and data set

The SNDA III data set includes data collected on a nationally representative sample of 2309 children in grades 1 to 12 from schools across the 48 contiguous states in the United States.[10] The sample was a multistage, stratified sample of districts, schools within sampled districts, and students within 397 of the schools designed to represent all students in grades 1 through 12 attending school on a typical school day. Students in kindergarten, prekindergarten, or reading readiness (pre-first grade) classes, as well as students enrolled in special education programs with self-contained classrooms, were excluded from the SNDA sample.[10]

Trained interviewers administered questionnaires to obtain 24-hour food recall data on a school day (from midnight to midnight). A second day of food intake was obtained from a subset of students to account for day-to-day variation when estimating usual intakes. Children in elementary schools were first interviewed while at school (usually after lunch) about foods eaten since awakening, and they were interviewed a second time (usually the next day) with parent assistance about foods eaten the rest of the day. All students of middle schools and high schools self-reported their dietary intakes.[10] All dietary interview data were collected using the AUTOMATED

MULTIPLE PASS METHOD software (version 2.3, 2003, USDA Agricultural Research Service, Food Surveys Research Group, Beltsville, MD), and the SURVEY NET coding system (version 3.14, 2004, USDA Agricultural Research Service) was used to link reported food items to food composition data via the Food and Nutrient Database for Dietary Studies (version 1.0, 2004, Agricultural Research Service, Food Surveys Research Group).[10] Data on food source (eg, vending machine, school store) were collected and identified by a 2-digit code in the public use file (USDA Food and Nutrition Service, Office of Research, Nutrition, and Analysis, Alexandria, VA). The original SNDA III analysis of competitive foods[11] included à la carte items along with items obtained from other competitive venues; however, in this analysis à la carte foods were specifically excluded, in order to focus the analysis on foods that were more likely to be FMNV.

Analysis

A computer disk containing the SNDA III public use data in the form of SAS data files was obtained from the USDA Food and Nutrition Service. Variables (and their categories) available in the public use data set used to classify students in these analyses included the following: gender (male, female), ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other), income eligibility for NSLP/SBP (eligible for free meals, eligible for reduce-price meals, not eligible), and participation in NSLP/SBP (yes/no). Eligibility for free or reduced-price meals had been determined by Mathematica if the student's family income was <135% or >135% but <185% of the poverty index, respectively. Mathematica had classified a student as a SBP participant if he/she consumed 2 out of 4 of the USDA-required meal components for breakfast, and NSLP participation had been defined as consumption of at least 3 of the 5 USDA required meal components for lunch.[12] For these analyses, students were classified as consumers of competitive (or USDA nonreimburseable) foods/beverages if their dietary recalls included any foods or beverages obtained from a school vending machine, school store, snack bar, or a nonreimbursable food source other than à la carte.

All statistical analyses were performed using SUDAAN (version 9.0.3, 2008, Research Triangle Institute, Research Triangle Park, NC). Nutrients selected for these analyses included energy, protein, total fat, saturated fat, carbohydrate, total sugars, dietary fiber, vitamins A, E, and C, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, calcium, phosphorus, magnesium, iron, zinc, sodium, and potassium. To compare mean nutrient intakes of competitive food consumers and nonconsumers, analysis of variance techniques were employed to test significance of differences between groups while controlling for covariates. Sample-weighted least square means and standard errors were estimated using PROC REGRESS of SUDAAN. Covariates included grade category, gender, ethnicity, income eligibility, NSLP/SBP participation, and age in years. Mean nutrient intakes were also adjusted for energy intake, but mean energy and percentages of energy contributed from macronutrient intakes were not.

RESULTS

Competitive foods/beverages, excluding à la carte, in the present analysis of the SNDA III data were consumed by 22.1 ± 1.7% of US schoolchildren. The percentage consuming competitive foods/beverages, excluding à la carte, was not significantly lower among students who were eligible for free (22.2 ± 2.7%) or reduced-price (18.5 ± 2.9%) school meals compared with students whose family's income made them ineligible for meal concessions (22.9 ± 2.1%) (Table 1).

The percentage of students who consumed competitive foods/beverages from sources other than à la carte was lower among participants when compared with nonparticipants of the USDA NSLP (17.2 ± 1.8% vs 30.0 ± 2.8%, $p < .01$) or SBP (14.5 ± 2.8% vs 23.8 ± 1.91%, $p < .01$), respectively. Differences between race and ethnic groups achieved statistical significance only in elementary grades where the percentage consuming competitive foods other than à la

Table 1. **Percentage* of US Schoolchildren in Grades 1 to 12 Who Consumed Competitive Foods† (Except à la Carte) by Gender, Ethnicity, NSLP/SBP‡ Eligibility, and Participation**

Gender, Ethnicity, Eligibility, and NSLP/SBP Participation	Sample Size (n)	Percent ± SE
All schoolchildren	2309	22.1 ± 1.7
Gender		
Male	1138	18.9 ± 1.8
Female	1171	25.3 ± 2.1**
Ethnicity		
White	1181	23.5 ± 2.2
Black	439	21.3 ± 3.5
Hispanic	529	18.8 ± 3.0
Other	160	23.8 ± 5.0
Eligibility		
For free meals	742	22.2 ± 2.7
For reduced-price meals	300	18.5 ± 2.9
Not eligible	1267	22.9 ± 2.1
National School Lunch Program		
Participation	1381	17.2 ± 1.8
Nonparticipation	928	30.0 ± 2.8**
School Breakfast Program		
Participation	381	14.5 ± 2.8
Nonparticipation	1928	23.8 ± 1.9**

**$p < .01$ significant difference between groups.
Source: School Nutrition and Dietary Assessment Study III.
*Sample-weighted percentage and standard error are estimated using SUDAAN.
†Competitive foods include those obtained from school vending machines, the school store, snack bar, and other nonreimbursable sources.
‡National School Lunch Program/ School Breakfast Program.

carte was lower among Hispanic than non-Hispanic white students in grades 1 to 5 (data not shown). However, neither of these 2 ethnic groups differed from non-Hispanic blacks (data not shown).

Table 2 shows the energy intake obtained from food sources at school and outside of school by grade category. Mean energy intake from competitive foods/beverages (excluding à la carte) contributed 1.6, 2.5, and 4.7% of the total energy intake obtained from all food sources for children in elementary, middle, and high school grades, respectively. Energy intake from competitive sources other than à la carte was highest (99.6 ± 19.4 kcal) for schoolchildren in high school grades, but the energy intake from these sources did not differ significantly from those in elementary grades (32.8 ± 8.9 kcal) and middle school grades (52.1 ± 10.1 kcal). Students in both middle school and high school grade categories had higher energy intakes from à la carte items than students in elementary grades. All together, sources of foods/beverages eaten or obtained at school contributed a range of 34% to 35% of total energy intake, depending on the grade category, and a range of 53% to 56% of energy intake was derived from food and beverage items not consumed at school but obtained from home, relatives, friends, or community feeding programs.

Less nutrient-dense foods/beverages such as soft drinks, bottled water, candy, snack chips, crackers, cookies, cakes, and ice cream, as well as more nutrient-dense foods/beverages such as low-fat milk, fruit, and fruit juice obtained from competitive food sources other than à la carte were frequently mentioned in the 24-hour recalls (data not shown). Competitive foods similar to à la carte items like pizza, French fries, hamburgers, chicken nuggets, and burritos were available in venues outside the cafeteria, but these items were less frequently mentioned than the snack foods and beverages easily distributed using nonrefrigerated vending machines (data not shown).

The mean daily intakes of food energy and energy-adjusted mean intakes of macro- and micronutrients from the diets of students consuming competitive foods/beverages (excluding à la carte items) versus those not consuming them are shown in Table 3. The average energy derived from competitive foods and beverages other than à la carte items (253.4 ± 16.6 kcal) was about 11% of the daily energy intake of the schoolchildren consuming them (2270 ± 45 kcal). Energy intake was higher for consumers compared with nonconsumers of competitive foods/beverage other than à la carte items (2270 ± 45 vs 2064 ± 24 kcal, $p < .01$). Total sugar intake was higher amongst competitive food/beverage consumers compared with nonconsumers (155.7 ± 2.8 vs 145.8 ± 1.4 g, $p < .01$), but sodium intake was lower (3287 ± 50 vs 3436 ± 29 mg, $p < .01$). Compared with nonconsumers, competitive food consumers had lower intakes of dietary fiber, B vitamins (eg, thiamine, riboflavin, niacin, folate), and iron.

DISCUSSION

In this analysis of a nationally representative sample of schoolchildren in a typical school day, about 2 in 10 students (20%) consumed competitive foods/beverages from school vending machines, the school store, snack bar, or sources other than à la carte, compared with 40% of children consuming competitive items when à la carte was included.[11] The public health ramifications for obesity, chronic diseases such as diabetes and dental caries of 20% children consuming an additional 250 kcal above their average needs and additional sugar chronically in competitive items are enormous. Twenty percent

Table 2. **Mean Energy Intake (Adjusted for Covariates*) Obtained From Food Source by Grade Level of US Schoolchildren**

Food Source	Elementary Grades 1 to 5 (n = 700)	Middle School Grades 6 to 8 (n = 802)	High School Grades 9 to 12 (n = 807)
Total diet	2147 ± 57.6	2013 ± 43.4	2125 ± 76.0
Food eaten or obtained at school	724.1 ± 27.9	706.4 ± 20.2	737.3 ± 38.3
Home/relative/friend/community	176.5 ± 26.8	174.8 ± 24.5	159.1 ± 34.4
Restaurant/store/other	9.3 ± 5.0	14.3 ± 3.6	31.8 ± 10.9
School food sources	538.3 ± 34.4	517.3 ± 24.6	546.4 ± 45.6
Reimbursable	512.1 ± 35.8	426.8 ± 25.2	375.6 ± 51.2
À la carte	6.7 ± 6.3[a]	38.3 ± 12.1[b]	71.3 ± 18.2[b]
Competitive† (except à la carte)	32.8 ± 8.9[a]	52.1 ± 10.1[a]	99.6 ± 19.4[b]
Food not eaten at school	1386 ± 27.9	1404 ± 20.2	1373 ± 38.3
Home/relative/friend/community	1125 ± 41.6	1190 ± 26.3	1112 ± 11.6
Restaurant/store/event/other	260.8 ± 39.0	213.4 ± 20.1	260.5 ± 47.1

[a,b]Means not sharing alphanumeric character are significantly different ($p < .05$).

Source: School Nutrition Dietary Assessment Study III.

*Sample-weighted least square mean and standard error are estimated using PROC REGRESS of SUDAAN. Covariates with grade category include gender, ethnicity, income eligibility, age (years), and total energy intake.

†Competitive food sources include school vending machines, the school store, snack bar, and other nonreimbursable sources.

Table 3. **Nutrient Intake From Competitive Foods Among Consumers and Total Diet Energy and Nutrient Intake (Adjusted for Covariates*) of Schoolchildren in Grades 1 to 12 by Consumption of Competitive† Foods and Beverages (Except à la Carte)**

Nutrient	Nutrient Intakes From Competitive Foods/Beverages in Consumers' Diets	Nutrient Intake From Total Diet in Students Consuming Competitive Foods (n = 537)	Nutrient Intake From Total Diet in Students Not Consuming Competitive Foods (n = 1772)
Energy, kcal	253.4 ± 16.6	2270 ± 45**	2064 ± 24
Protein, g	4.0 ± 0.5	74.4 ± 1.2	76.3 ± 0.6
Total fat, g	7.2 ± 0.6	75.8 ± 1.0	76.3 ± 0.6
Saturated fat, g	2.4 ± 0.4	26.5 ± 0.5	26.3 ± 0.3
Carbohydrate, g	44.4 ± 2.8	288.1 ± 2.9	285.5 ± 1.6
Total sugars, g	30.3 ± 2.5	155.7 ± 2.8**	145.8 ± 1.4
Dietary fiber, g	1.2 ± 0.1	13.3 ± 0.3**	14.3 ± 0.2
Vitamin A, μg RAE	41.8 ± 10.1	600 ± 17	628 ± 12
Vitamin E, mg ATE	0.7 ± 0.1	5.9 ± 0.2	6.3 ± 0.1
Vitamin C, mg	12.0 ± 2.4	90.1 ± 5.6	92.0 ± 3.2
Thiamin, mg	0.12 ± 0.02	1.55 ± 0.03**	1.69 ± 0.02
Riboflavin, mg	0.17 ± 0.03	2.23 ± 0.04*	2.33 ± 0.03
Niacin, mg	1.3 ± 0.2	20.7 ± 0.3**	22.2 ± 0.3
Vitamin B6, mg	0.11 ± 0.02	1.71 ± 0.04	1.80 ± 0.03
Folate, μg DFE	42.6 ± 8.1	538 ± 22*	601 ± 16
Vitamin B12, μg	0.27 ± 0.08	5.0 ± 0.2	5.3 ± 0.1
Calcium, mg	78.0 ± 13.9	1067 ± 23	1098 ± 15
Phosphorus, mg	101.0 ± 13.2	1355 ± 19	1371 ± 12
Magnesium, mg	22.6 ± 2.6	246 ± 4.0	254 ± 2
Iron, mg	1.2 ± 0.1	14.3 ± 0.3**	15.8 ± 0.3
Zinc, mg	0.7 ± 0.1	11.3 ± 0.3	11.6 ± 0.2
Sodium, mg	222 ± 16	3287 ± 50**	3436 ± 29
Potassium, mg	187 ± 26	2458 ± 37	2512 ± 22
Total fat, % energy		31.9 ± 0.4	31.9 ± 0.3
Saturated fat, % energy		11.1 ± 0.2	11.0 ± 0.1
Carbohydrate, % energy		55.1 ± 0.5	54.6 ± 0.3
Total sugars, % energy		29.7 ± 0.5**	27.9 ± 0.2

**$p < .01$, *$p < .05$ significant difference between consumers and nonconsumers of competitive foods/beverages.
Source: School Nutrition Dietary Assessment Study III.
*Sample-weighted least square mean and standard error are estimated using PROC REGRESS of SUDAAN. Covariates include grade category, gender, ethnicity, income eligibility, SBP/NSLP participation, and age (years). Nutrients were also adjusted for energy intake, but energy and percentages of energy from macronutrients were not.
†Competitive foods include those obtained from school vending machines, the school store, snack bar, and other nonreimbursable sources.

of children consuming an extra 250 kcal/day for 200 days amounts to an extra 14 pounds per year, considering that it takes on average 3500 kcal to contribute to 1 pound of body weight. For some students this might be a serious contributor to weight issues. Interestingly, competitive food use did not differ significantly between children who qualified for subsidized school meals and those who did not, suggesting that the cost of vended items was priced so that children of all incomes could purchase them.

The finding of significantly higher intakes of total energy and sugar, with lower intakes of iron, dietary fiber, and several B vitamins by consumers of competitive items versus nonconsumers, was similar to that of Clark and Fox[13] who did not exclude à la carte foods for a regional sample of students. The finding is likely due to the availability—through school stores, snack bars, and vending machines—of FMNV such as sweetened beverages, dessert items, and snack chips.[14] While this may seem to detract from the need to exclude à la carte when considering the school competitive food environment, we observed differences in sodium and total sugar intake by competitive food use were not seen in the Clark and Fox study.[13] It may seem surprising that sodium intake of competitive food consumers was lower than for nonconsumers. Research has indicated, however, that sodium intakes are inversely associated with increasing snack consumption by adolescents.[15] This might reflect the fact that snack foods frequently consumed between meals are less sodium dense than foods such as mixed dishes or à la carte items more often eaten at regular meals.[16]

The peak competitive food/beverage consumption in high school grades likely reflects both increased independence in food selection and access to discretionary funds. Middle and high school groups are the most appropriate target for educational efforts encouraging healthy competitive food/beverage selections and should be the focus of school health

administrators' efforts to improve the school food environment.[14,17] Using the information on grade category, gender, and ethnicity patterns in competitive food consumption by schoolchildren, school health educators can design guidelines restricting competitive foods and beverages to those that are nutrient dense and not energy dense. School foodservice personnel can also prepare point-of-service materials to promote selection of nutrient-dense foods. Such targeted nutrition education to publicize the importance of healthful snacks should be part of the Child Nutrition and Health Campaign's objective for good nutrition to decrease children's risks of developing obesity and chronic diseases.[11,13,18]

Thus far, school wellness policies have not adequately addressed the food and beverages of poor nutritional quality available in competitive food sources such as vending machines. Sixteen percent of elementary schools, 52% of middle schools, and 88% of high schools had vending machines in school.[10,14] Soft drinks constituted more than two-thirds of beverages offered in school vending machines and stores.[11] Desserts and snacks were the most commonly consumed competitive items among elementary schoolchildren, while beverages other than milk and 100% fruit juice were most commonly consumed among middle and high school competitive item consumers.[11] Only 1% of high schools (none of elementary or middle schools in the SNDA III sample) offered fresh fruit, and none offered yogurt through vending machines.[12,14] If healthful options are not available in competitive venues, children are at risk for poor nutrition by choosing competitive items over a USDA meal or a meal packed from home.[2,14,19,20]

The analysis reported here, as well as those by others,[14] indicates that although soft drinks, desserts, and snack foods such as candy, snack chips, crackers, cookies, cakes, and ice cream were popular selections, more healthful competitive options such as bottled water, low-fat milk, fruit, and fruit juice were frequently mentioned as well. French et al[2] suggested small price reductions in low-fat items, coupled with modest price increases for high-fat items, for a net revenue gain and a profit for vendors. A community-based survey of over 800 men and women in Minnesota found that requiring low-fat, healthful foods to be available in school cafeterias and eliminating high-fat foods from vending machines were the most favorably evaluated public health policies.[21] The findings reported here also support such recommendations.

Limitations

This study is a secondary data analysis of a nationally representative data set collected before 2005 and may not reflect changes in competitive food environment in the past few years. The sample sizes for competitive foods consumers were small and did not yield statistical power adequate to assess grade-level differences in nutrient intake by competitive food use. The SNDA III did not include data on use of nutrient supplements, so the mean nutrient intakes reported here are from the total diets and do not include nutrients from supplements.

IMPLICATIONS FOR SCHOOLS

Because competitive foods/beverages in the school food environment are detrimental to schoolchildren's diet quality, school administrators should include guidelines for the nutritional quality of foods and beverages offered in school vending machines and stores in wellness policies. As long as there are long lines for school meals, vending machines will not disappear, without changes to the current laws. It is appropriate, however, to restrict access to vending machines and stores during the school meal hours and snack times if the offerings are foods and beverages of poor nutritional quality. An alternative means of promoting good diet quality for schoolchildren while generating school revenue is to promote the sale of healthful foods and beverages, such as fresh fruit, yogurt, low-fat milk, juice, and sandwiches in school vending machines and stores. Health professionals and school personnel must work in concert to formulate and enforce comprehensive wellness policies regulating competitive foods, with and without à la carte items, to improve and protect the diet quality of schoolchildren as well as revenue streams.

Human Subjects Approval Statement

This study received exempted approval from Michigan State University's institutional review board.

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