

Fruits, Vegetables, Milk, and Sweetened Beverages Consumption and Access to à la Carte/Snack Bar Meals at School

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American children, as a group, do not consume the recommended 5 daily servings of fruits, 100% juice, and vegetables.¹⁻⁶ Their calcium consumption is low, likely owing to low milk consumption, while their soft drink consumption has been increasing, raising concerns about increased risks for osteoporosis and obesity.^{7,8} National School Lunch Program (NSLP) meals offer 2 servings of fruits and vegetables and 8 ounces of milk to about 95% of US children on a daily basis during the school year.^{9,10} Students who participated in the NSLP were almost twice as likely to report eating vegetables at lunch and consuming more fruits compared with nonparticipants (73% vs 40% and 48% vs 32%, respectively).⁹ Students who did not eat NSLP meals were 3 times more likely to report sugar consumption (i.e., sweetened beverages, sweets) compared with NSLP participants (64% vs 21%).⁹ When students transition to middle schools, they often gain access to snack bar/à la carte meals and school stores not available in elementary schools.⁹ Descriptive studies have noted that the top-selling snack bar foods (e.g., pizza, chips, soda, french fries, candy, and ice cream) are high in fat and calories.¹¹ In middle schools, 88.5% of the foods sold in school stores are high in fat/sugar.¹² This environment does not foster healthy eating practices that are consistent with the Dietary Guidelines for Americans.¹³ A cross-sectional study identified a significantly lower consumption of fruits and vegetables by fifth-grade students who had access to snack bar foods compared with fourth grade students who received only NSLP meals.¹⁴ Fifth-grade students who selected only the NSLP lunch consumed 0.8 servings of fruits and vegetables compared with 0.4 servings for the fifth-grade students who chose only snack bar foods for lunch and 0.2 servings for the fifth grade students who brought their lunches from home. The fifth-grade students who selected the NSLP lunch

Objectives. We assessed the impact of access to school snack bars on middle school students' fruit, vegetable, milk, and sweetened beverage consumption.

Methods. Five hundred ninety-four fourth- and fifth-grade students completed lunch food records 4 times during a 2-year period.

Results. The fourth-grade cohort consumed fewer fruits, regular (not fried) vegetables, and less milk and consumed more sweetened beverages and high-fat vegetables during year 2.

Conclusions. Middle school students who gained access to school snack bars consumed fewer healthy foods compared with the previous school year, when they were in elementary schools and only had access to lunch meals served at school. Healthy food choices and school policies that require healthier foods at school snack bars should be promoted. (*Am J Public Health.* 2004;94:463-467)

had similar fruit and vegetable consumption totals as the fourth-grade students who selected the NSLP lunch (0.8 serving).¹⁴

Our study assessed longitudinal change in fruit, vegetable, milk, and sweetened beverage consumption for 2 cohorts of students over a 2-year period during the 1998-1999 and 1999-2000 school years. Cohort 1 students attended the fourth grade during Year 1 and ate only NSLP meals. During Year 2, Cohort 1 students transitioned to the fifth and sixth grade middle school and had access to a snack bar in addition to NSLP meals; Cohort 2 students were in the middle school for both years and acted as a control for secular events during the 2-year period. We hypothesized that there would be a significant decline in fruit, regular-vegetable, and milk consumption and that there would be an increase in high-fat-vegetable and sweetened beverage consumption among the Cohort 1 students during the 2-year period because of the change in cafeteria environment. We also hypothesized that the consumption of these foods among the Cohort 2 students would remain stable during the 2-year period.

METHODS

Participants

Students from a school district in southeast Texas were invited to participate in our study.

All potential Cohort 1 students (n=430) were in the fourth grade at 1 of 4 elementary schools where only NSLP meals were served. All potential Cohort 2 students (n=422) attended the fifth grade at 1 middle school where a snack bar/à la carte line was available in addition to NSLP meals. During the second year, Cohort 1 students advanced to the fifth grade and transitioned to the middle school, while the Cohort 2 students, who were already in the middle school, advanced to the sixth grade. The school district comprised 18% African American, 24% Mexican American, 57% European American, and 1% Asian/Other students. Approximately 24% of the students were eligible for free and reduced price meals, and the school district used the food-based menu planning option, which requires 2 servings of fruits/vegetables be offered with each lunch. Demographic information about the students was obtained from the signed informed consent forms provided by the parents. Students were aged 9 to 11 years at the beginning of the study.

Data Collection

For both years during the fall and the spring, students completed lunch food records for 5 consecutive days (4 data collection periods: Time 1 through Time 4). These records were completed in the classroom or in the cafeteria after each lunch period. Trained

data collectors instructed students on how to complete the food records. Each food item was listed on a separate line, and students indicated how many servings they ate and what the source of the food was (NSLP, snack bar, home, or combination). Data collectors checked the food records for missing data and ensured that all food items were described properly. This method of data collection via food records has been shown to be valid.¹⁵ The food records were coded for fruits, regular vegetables (not fried), high-fat vegetables (e.g., french fries and tater tots), milk, and sweetened beverages (water-based beverages that contain sugar)—in accordance with the Food Guide Pyramid serving sizes—by trained dietitians who used behavioral coding procedures.¹⁶

Data Analyses

The meal source for each lunch was categorized as NSLP, snack bar, home, or combination. Fruit, vegetable, milk, and sweetened beverage servings were summed for each day by meal source, and Year 1 and Year 2 means across 10 days were calculated for each student. Descriptive statistics and Wilcoxon signed rank tests were conducted between year 1 and year 2 means for the total group and were conducted separately for each co-

hort by sex and race/ethnicity. The change in fruit, vegetable, and milk consumption from NSLP meal consumption was compared within each cohort by year.

RESULTS

Approximately 80% of fourth-grade and 72% of fifth-grade students returned consent forms signed by their parents. About 75% (n=322) of fourth-grade and 68% (n=286) of fifth-grade students received parental permission to participate and provided written assent. Five percent of fourth-grade and 4% of fifth-grade students refused to participate. No data were available for the students who did not return signed consent forms. The percentage of meals by source is shown in Figure 1. Fewer NSLP and home meals were consumed in middle school compared with elementary school. In the middle school, 35% to 40% of meals were purchased exclusively from the snack bar.

Cohort 1: fourth to fifth grade. Significant differences between Year 1 and Year 2 means were found for Cohort 1 students (Table 1). Servings of fruits, regular vegetables, and milk decreased 33%, 42%, and 35%, respectively ($P<0.001$ for all), and servings of high-fat vegetables and sweetened beverages in-

creased 68% and 62%, respectively ($P<0.001$ for both) (Figure 2). Results by gender and by race/ethnicity were similar to results for the whole group. Servings of fruits (0.15–0.04), regular vegetables (0.22–0.06), high-fat vegetables (0.15–0.09), and milk (4.1–1.8 oz) from NSLP meals declined significantly from Year 1 to Year 2 ($P<0.001$ for all).

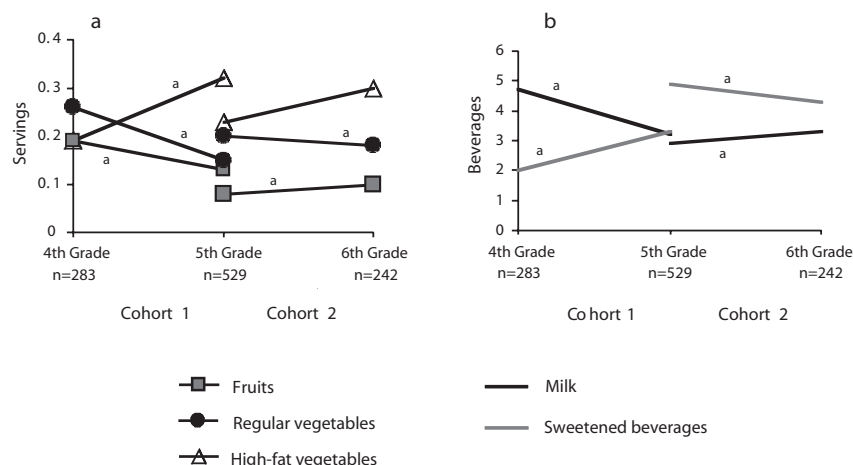
Cohort 2: fifth to sixth grade. There were significant differences in consumption between the 2 years. For Cohort 2 students, high-fat-vegetable ($P<0.001$) and milk ($P<0.05$) consumption increased 30% and 14%, respectively, while consumption of regular vegetables ($P<0.05$) and sweetened beverages ($P<0.05$) decreased 10% and 12%, respectively (Figure 2). Fruit consumption did not change. Similar patterns were observed by gender and for most racial/ethnic groups, and Asian American students reported higher regular-vegetable intake ($P<0.001$) (Table 1).

Servings of fruits, regular vegetables, high-fat vegetables, and milk from NSLP and snack bar meals did not change significantly from Year 1 to Year 2 (data not shown). During Year 2, Cohort 2 students reported significantly lower fruit ($P<0.05$) and significantly higher sweetened beverage ($P<0.05$) consumption compared with Cohort 1.

DISCUSSION

These data highlight the importance of NSLP meals to fruit, vegetable, and milk consumption among elementary and middle school children. Consistent with predictions, significant adverse declines in fruit, milk, and regular-vegetable consumption and significant adverse increases in sweetened beverage and high-fat-vegetable consumption, were noted between Year 1 and Year 2, when Cohort 1 students gained access to the snack bar in fifth grade. Consumption of fruits, vegetables, and milk from NSLP meals for Cohort 1 was significantly lower during the second year. An examination of Year 2 data revealed only a significantly lower consumption of fruits and a greater consumption of sweetened beverages for the sixth grade students.

Age-related changes in children's daily fruit, vegetable, milk, and sweetened beverage consumption have been previously identified,¹⁷ but the impact of the source of the



^aSignificant difference between years 1 and 2.

FIGURE 1—Percentage of lunch meals by source during 2 periods each year for 2 consecutive school years in Southeast Texas, 1998–1999 and 1999–2000: (a) fruits and regular and high-fat vegetables and (b) milk and sweet beverages.

TABLE 1—Average Daily Lunch Servings of Fruits, Regular Vegetables, High-Fat Vegetables, Milk, and Sweetened Beverages for 2 Cohorts of Middle School Students Over 2 School Years: Southeast Texas, 1998–1999 and 1999–2000

	Cohort 1 (4th Grade)				Cohort 2 (5th Grade)			
	Year 1		Year 2		Year 1		Year 2	
	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)	n	Mean (SD)
Fruit, serving								
Total	283	0.18 (0.18)	272	0.12 (0.18)**	257	0.08 (0.12)	242	0.10 (0.17)
Boy	122	0.20 (0.18)	120	0.14 (0.19)***	106	0.09 (0.13)	100	0.12 (0.19)
Girl	161	0.17 (0.17)	152	0.11 (0.16)***	151	0.08 (0.12)	142	0.09 (0.15)
AA	46	0.19 (0.19)	40	0.13 (0.19)	35	0.14 (0.19)	29	0.10 (0.15)
EA	147	0.17 (0.17)	144	0.13 (0.19)**	123	0.06 (0.09)	117	0.10 (0.16)*
MA	67	0.20 (0.18)	65	0.10 (0.13)**	72	0.08 (0.09)	69	0.11 (0.19)
AS	23	0.15 (0.15)	23	0.13 (0.17)	27	0.11 (0.18)	27	0.10 (0.17)
Regular vegetables, serving								
Total	283	0.26 (0.22)	272	0.15 (0.19)**	257	0.20 (0.20)	242	0.18 (0.20)**
Boy	122	0.26 (0.24)	120	0.14 (0.18)***	106	0.20 (0.22)	100	0.20 (0.24)
Girl	161	0.22 (0.20)	152	0.15 (0.18)***	151	0.20 (0.19)	142	0.16 (0.16)*
AA	46	0.26 (0.24)	40	0.15 (0.21)*	35	0.20 (0.18)	29	0.16 (0.17)
EA	147	0.27 (0.22)	144	0.15 (0.11)***	123	0.18 (0.20)	117	0.14 (0.17)**
MA	67	0.26 (0.22)	65	0.13 (0.14)***	72	0.24 (0.20)	69	0.18 (0.19)*
AS	23	0.28 (0.22)	23	0.14 (0.15)*	27	0.17 (0.20)	27	0.31 (0.29)***
High-fat vegetables, serving								
Total	283	0.19 (0.12)	272	0.32 (0.25)***	257	0.23 (0.18)	242	0.30 (0.23)***
Boy	122	0.20 (0.12)	120	0.36 (0.27)	106	0.24 (0.17)	100	0.27 (0.25)
Girl	161	0.19 (0.13)	152	0.29 (0.35)***	151	0.22 (0.19)	142	0.31 (0.21)***
AA	46	0.18 (0.12)	40	0.35 (0.31)**	35	0.32 (0.21)	29	0.35 (0.20)
EA	147	0.18 (0.12)	144	0.32 (0.23)***	123	0.23 (0.18)	117	0.31 (0.25)**
MA	67	0.24 (0.13)	65	0.32 (0.26)*	72	0.22 (0.17)	69	0.27 (0.21)*
AS	23	0.20 (0.11)	23	0.29 (0.26)	27	0.20 (0.15)	27	0.26 (0.21)
Milk, oz								
Total	283	4.6 (2.8)	272	3.0 (3.1)***	257	2.9 (2.8)	242	3.3 (3.6)*
Boy	122	5.1 (3.0)	120	3.5 (3.4)***	106	3.4 (2.9)	100	4.4 (4.0)
Girl	161	4.3 (2.7)	152	2.6 (2.9)***	151	2.5 (2.7)	142	2.6 (3.1)
AA	46	4.5 (2.9)	40	3.4 (3.2)*	35	3.1 (2.8)	29	3.1 (3.4)
EA	147	4.7 (2.9)	144	2.9 (3.1)***	123	2.6 (2.8)	117	3.1 (3.7)
MA	67	4.7 (2.8)	65	2.9 (3.2)***	72	3.3 (2.8)	69	3.7 (3.5)
AS	23	4.5 (3.1)	23	3.3 (3.4)	27	2.7 (2.9)	27	3.7 (4.0)
Sweetened beverages, oz								
Total	283	2.1 (2.2)	272	3.4 (3.4)***	257	4.9 (3.8)	242	4.3 (4.3)*
Boy	133	1.9 (2.2)	120	3.4 (3.6)***	106	4.7 (3.6)	100	4.4 (4.8)
Girl	161	2.2 (2.2)	152	3.2 (3.2)**	151	5.1 (4.1)	142	4.3 (4.0)
AA	46	1.4 (1.7)	40	2.7 (3.4)	35	3.8 (4.0)	29	4.5 (5.5)
EA	147	2.4 (2.4)	144	3.8 (3.6)***	123	5.7 (3.8)	117	4.8 (4.2)
MA	67	1.5 (1.9)	65	2.6 (3.0)*	72	3.9 (3.4)	69	3.0 (3.3)
AS	23	2.9 (2.3)	23	4.1 (3.5)	27	5.1 (4.3)	27	5.0 (5.5)

Note: AA = African American, EA = European-American, MA = Mexican American, and AS = Asian/Other.
P* < 0.05, *P* < 0.01, and ****P* < .001.

lunch has not been addressed. The changes we observed in lunch consumption may provide at least a partial explanation for the decline in daily fruit consumption between ages 5 and 19 years, the decline in daily milk consumption for girls between aged 6 and 19 years, and the increase in daily soft drink consumption during childhood and adolescence that has been reported in national survey data.¹⁷ National daily starchy-vegetable consumption increased across these ages and may be explained by the increase in high-fat-vegetable consumption during lunch that was documented in our study for both cohorts.¹⁷ National dietary survey data include fried vegetables in the total vegetable category.¹⁷ In Minnesota, significantly lower percentages of eighth-grade students reported consuming any fruit (37.1%), vegetable (41.6%), and milk (90.1%) over the entire day compared with third-grade (64.6%, 56.1%, and 98.6%, respectively) and fifth-grade students (55.9%, 49.5%, and 97.9%, respectively). During this time, the percentage of students who reported soft drink consumption significantly increased from 21.4% for third-grade students to 30.8% for fourth-grade students and 57.1% for eighth-grade students, although specific food intake was not reported.¹⁹ Our results suggest that the source of the lunch meal may in part be responsible for some of these changes. Approximately 35% to 40% of students reported eating snack bar meals exclusively over the 2 years. The long-term impact of access to high-fat and high-sugar foods in the school environment should be studied further.

Lunchtime dietary intakes for Cohort 2 were not stable over the 2 years, but the changes in consumption were lower than those for Cohort 1 students. The increase in high-fat-vegetable consumption is consistent with the national data previously reported.¹⁹ The slight increase in milk consumption and the decline in sweetened beverage consumption are inconsistent with the national data and are difficult to explain, because the amount of milk provided by NSLP meals did not change during the period. Bottled water did become available at the snack bar during the second year, and consumption increased from a daily lunch mean of 1.3 (± 3.6) ounces in the fall to 1.8 (± 4.4) ounces in the

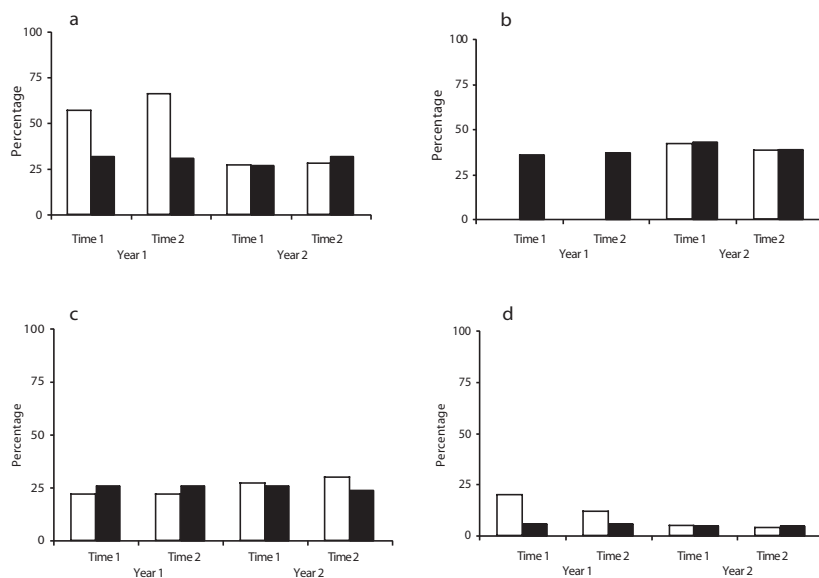


FIGURE 2—Average daily lunch servings of fruits, regular and high-fat vegetables, milk, and sweetened beverages: year 1 (white) and year 2 (black) means for fourth and fifth grade cohorts: (a), NSLP meals, (b), snack bar meals, (c) combo meals, (d) home meals.

spring. The increase in water consumption may have been responsible for the decrease in sweetened beverage consumption. There was a negative relationship between water and sweetened beverage consumption at the last data collection, which suggests that students were selecting water instead of sweetened beverages. Future research should investigate the relationship between water and sweetened beverages, because replacing sweetened beverages with water may reduce caloric intake.

Earlier studies documented that the availability of fruits and vegetables in school lunches was related to fruit and vegetable consumption, and students who were in schools that served more fruits and vegetables ate more fruits and vegetables.^{4,20} In our study, an average of 2.5 fruit and vegetable servings were offered daily in the NSLP meal. Only french fries and pickles were available on the snack bar until Year 2, when a new food service director allowed individual cafeteria managers more freedom in selecting fresh fruits for the snack bar. This change may be responsible for the slight increase in fruit consumption during Year 2.

There are several limitations to our study. All dietary-intake data were self-reported, which is subject to memory and recording errors.²¹ However, the method we employed has been previously validated,¹⁵ and the data were collected less than 1 hour after consumption and thereby maximized the likelihood of reporting accuracy.¹⁵ This was not a randomly assigned experiment, and there was no true control group (i.e., a cohort that received only NSLP meals during the fourth-grade to fifth-grade years). Secular events that could have influenced these results were not assessed. Therefore, factors not measured in this study may have influenced the changes in food consumption noted, such as modeling the food choices of older students, and other influences should be assessed in future research. All participants lived in 1 school district in southeast Texas, so our findings may not be generalizable to all elementary and middle school students.

The NSLP provides students with meals that meet dietary recommendations. However, 35% to 40% of meals consumed by middle school students were exclusively from snack bars, and those students consumed

fewer fruits, regular vegetables, and milk and consumed greater amounts of sweetened beverages and high-fat vegetables than what they reported in previous years, when they only received the NSLP meal. Low fruit, vegetable, and milk consumption patterns that continue into adulthood may contribute to an increased risk for the development of chronic diseases. For example, sweetened beverage consumption may be related to increased risk for obesity.²² Future research should identify ways to increase fruit and vegetable availability and should test possible interventions to promote fruits, vegetables, and milk in school cafeterias and snack bars. ■

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Contributors

K.W. Cullen conceptualized the study, oversaw implementation, and wrote the paper. I. Zakeri conducted the data analyses and participated in manuscript preparation.

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Human Participant Protection

The study was approved by the institutional review board of the University of Texas M.D. Anderson Cancer Center, and parental consent and student assent were obtained.

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