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Eating school meals daily is associated with healthier dietary intakes: The Healthy Communities Study

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Abstract

Background—Research on the association between school meal consumption and overall dietary intake post-Healthy Hunger-Free Kids Act implementation is limited.

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Author contributions: LR and LA developed study question. KG conducted data analysis. LA wrote first draft with contributions from KG and WG. All authors reviewed and commented on subsequent drafts of the manuscript.

Conflict of Interest: None to report.

Objective—This study examines the association between frequency of participating in the National School Lunch and School Breakfast Programs and children's dietary intakes.

Design—The Healthy Communities Study was a cross-sectional observational study conducted between 2013–2015.

Participants/setting—U.S. children ages 4–15 years (n=5,106).

Main outcome measures—Dietary measures were assessed using the National Health and Nutrition Examination Survey Dietary Screener Questionnaire. Dietary intake included fruit/vegetables, fiber, whole grains, dairy, calcium., total added sugar, sugar-sweetened beverages, and energy-dense foods of minimal nutritional value.

Statistical analysis—Multivariate statistical models assessed associations between frequency of eating school breakfast or lunch (every day vs. not every day) and dietary intake, adjusting for child and community-level covariates.

Results—Children who ate school breakfast every day compared to children who ate 0–4 days/week, reported consuming more fruits/vegetables (0.1 cup/day, 95% CI: 0.01, 0.1), dietary fiber (0.4 g/day, 95% CI: 0.2, 0.7), whole grains (0.1 oz/day, 95% CI: 0.05, 0.1), dairy (0.1 cup/day, 95% CI: 0.05, 0.1), and calcium (34.5 mg/day, 95% CI: 19.1, 49.9). Children who ate school lunch every day compared to those who ate less frequently, consumed more dairy (0.1 cup/day, 95% CI: 0.1, 0.2) and calcium (32.4 mg/day, 95% CI: 18.1, 46.6). No significant associations were observed between school meal consumption and energy-dense nutrient poor foods or added sugars.

Conclusions—Eating school breakfast and school lunch every day by U.S. schoolchildren was associated with modestly healthier dietary intakes. These findings suggest potential nutritional benefits of regularly consuming school meals.

Keywords

school breakfast; school lunch; dietary intake; fruits and vegetables; dairy; fiber; dietary guidelines

Introduction

The U.S. National School Lunch Program (NSLP) and the School Breakfast Program (SBP) provide the opportunity for students to receive nutritious meals every school day. In 2016, the NSLP served more than 30 million children per day and the SBP served over 14 million children.[1–3] Although meals are available to all students, most (85% of school breakfasts[4] and 73% of school lunches in 2016) are served to low-income students for free or a reduced-price.[3] Because of this broad reach, the new standards have the potential to significantly and consistently affect the nutritional health of many children, especially those from low-income households.[5] School meals can contribute over half of a child's daily caloric intake with 22% of calories coming from school breakfast and close to 31% of calories coming from school lunch.[6] In 2010, the Healthy Hunger-Free Kids Act (HHFKA)[7] made significant nutritional improvements to school meals by aligning them with the 2010 Dietary Guidelines for Americans (DGA).[8] While the revised standards were implemented gradually beginning during the 2012–2013 school year, most changes were instituted by 2013 when data collection for this study began. These updated school meal guidelines included minimum

and maximum calorie allowances, increased fruit and vegetable and whole grain servings, and the elimination of high-fat milk.[7]

Despite improvements to school meals over the past decade, research on the consumption of school meals and dietary intake has been limited since the HHKFA was instituted. In studies conducted before the HHFKA improvements, eating school meals has been found to have mixed results. Some studies found school meal consumption to be associated with higher diet quality,[9] higher nutrient density,[10,11] higher consumption of whole grains[12] and/or fruits and vegetables.[13] Other studies found that NSLP participants versus non-participants were less likely to consume energy-dense foods of low nutritional value, such as soda,[14] and consume less added sugars.[15] However, other studies found no clear direction between school meal participation and dietary intake, with NSLP participants having similar diet quality to non-participants.[16,17] The few studies that have been conducted after HHFKA have shown promising results. For example, in a study comparing pre- and post-HHFKA standards, vegetable and fruit consumption increased.[18] In another study comparing food consumption and waste in schools from 2012 to 2014, students consumed more fruit, threw away less vegetables, and consumed the same amount of milk.[19]

To our knowledge there have been no studies that have assessed the nutritional benefits associated with daily school meal consumption in a diverse national sample of U.S. schoolchildren after the implementation of the HHFKA. A diverse national sample is critical to examine this question since children from low-income or minority families are more likely to be overweight and receive free or reduced-price school meals than children from higher-income non-Hispanic white families who are less likely to eat school meals.[20,21] The hypothesis of this study is that students who consume school meals (lunch or breakfast) every day will have a significantly more nutritious diet, regardless of their eligibility status for free or reduced price school meals. The objective of this study is to examine the dietary intakes of students who consumed school breakfast or school lunch every day compared to those who ate the school meals less frequently or not at all.

Methods

Data on student-level participation in NSLP and SBP and dietary intakes were collected between 2013–2015 from a national cross-sectional sample of participants in the Healthy Communities Study (HCS). A full description of the research protocol for the HCS is described in John et al.[22] The Battelle Memorial Institute Institutional Review Board approved the study protocol. Written informed consent for participating students was obtained from parents and guardians.

Sample and Setting

The HCS included a total of 5,138 students ages 4–15 years old from 423 elementary and middle schools in 130 communities (defined as high school catchment areas) across the U.S. A hybrid sampling approach was used to select communities. Most communities were selected from a national probability-based sample that was stratified by region of the U.S. and community urbanicity, race/ethnicity, and income (n=102 communities).[23] These communities were sampled using weights proportional to the number of children aged 4–15

years in each Census Tract, and randomly selected with weights proportional to size. Other communities were chosen because they were known to be actively engaged in implementing programs and policies to address childhood obesity (n=28 communities).[23] Two elementary and two middle schools were randomly selected for recruiting households within each community. Between 1 and 44 students were sampled from each school with an average of 12 students per school. Children who met the study's recruitment goals related to sex, age, and race/ethnicity were selected from participating households.[22] During an in-home visit, trained research staff administered survey questions. The respondent (either parent or child) was determined by the child's age.[24] A more detailed description of the sampling approach for communities, schools, and households can be found in Strauss et al.[23]

Measures

Independent variables: School meal participation—SBP and NSLP participation was assessed during an in-home interview. The following school meal participation questions were from the third Student Nutrition Dietary Assessment Study (SNDA-III),[25] "How many days a week (does your child/do you) usually eat the school breakfast?" and "How many days a week (does your child/do you) usually eat the school lunch?" From these questions, two binary variables were created for eating school breakfast/lunch 0–4 days vs. every day (5 days). In addition to examining a binary school meal participation variable, categorical differences also were examined (0 days, 1–4 days, and 5 days for school breakfast and school lunch). Results were similar when predictor variables were expressed as binary or using the three categories (Supplementary Table 1 and Supplementary Table 2). For ease of interpretation, results are focused on the binary comparisons.

Dependent Variables: Dietary Intakes—The National Health and Nutrition Examination Survey (NHANES) Dietary Screener Questionnaire (DSQ) created by the National Cancer Institute (NCI) was used to estimate dietary intakes for the past 30 days.[26] This 26-item food frequency questionnaire was included in the NHANES 2009–2010.[24] Each of the 26 items in the screener were selected because of their relationship to one or more dietary factors of interest in dietary guidance.[26] Of the 9 dietary factors available from this screener, the following 7 were selected to be consistent with the main study's focus on obesity: fruits/vegetables/legumes without fried potatoes (cups/day), dairy (cups/day), total added sugar (tsp/day), sugar from sugar-sweetened beverages (tsp/day), whole grains (oz/day), dietary fiber (g/day), and calcium (mg/day).[24] NCI-generated scoring algorithms, based on age- and sex-specific 24-hour dietary recall intake data from NHANES, were used to calculate intakes. Additionally, the frequency of intake (times/day) of energy-dense foods of minimal nutritional value, including cookies, cakes, pies, donuts, sweets, fried potatoes, and chips/crackers, was computed.

Covariates—The individual-level covariates included in the models included: age, sex, maximum parental employment status and education, race/ethnicity, and annual household income. Community-level covariates, calculated from the 2009–2013 American Community Survey,[23] included: U.S. region, minority population tract status (30% or more African American or Hispanic), urbanicity, proportion of African American and Hispanic

populations, and proportion of population below the federal poverty level and unemployed. Seasonality of interview was also controlled.

Statistical Analyses

Multi-level statistical models were generated to relate school meal participation with selected dietary outcomes, adjusting for child and community-level covariates, and for clustering among children in the same school and same community. The analytical sample size included 5,106 students; 32 students were excluded because their school could not be identified. Sociodemographic covariates selected for the models were based on the least absolute shrinkage and selection operator techniques (LASSO)[27] due to the large number of sociodemographic covariates available in the data set and the highly correlated nature of those covariates.

To account for missing answers due to non-response, multiple imputation was computed 20 times using chained equations for the outcome variables and covariates, but not the predictor variable. Sensitivity analyses were compared using a partial sample of participants with complete data on all model variables to that using the complete sample based on imputed dietary outcomes when missing. There were no differences in significant outcomes between the two samples. To be consistent with previous Healthy Communities Study publications, [24,28] the analysis including the imputed outcome variables is presented.

For the analysis reported in the supplementary tables which compared the three school meal groups (0 days, 1–4 days, and 5 days), a Bonferroni approach was used. At a 5% procedure-wise error rate, statistical significance for each individual test was defined to be $P<0.0167$ ($0.05/3=0.0167$). Data were analyzed using SAS version 9.4 (SAS Institute Inc. Cary, NC, 2013).[29] A P-value of <0.05 was considered statistically significant.

Results

The sample was evenly distributed by sex (51% female) and the average age was 9 years old (Table 1). Close to 45% of children were Hispanic, 30% were non-Hispanic White, and 18% were non-Hispanic Black. Most children (73%) had at least one parent working full-time and at least one parent with a high school diploma (77%). More than half of the children lived in a household with an annual income less than $35,000. More than two-thirds of children (69%) qualified for free or reduced-price lunch, which is higher than the national average (62%).[30] Twenty-seven percent of households had a family annual income below $20,000, which is higher than the 2014 national average (18%).[31] At the community level, a large proportion of the sample was from southern states (41%) and from suburban areas (40%). Forty percent of children were overweight or obese based on measured BMI at or above the age and sex-specific 85th percentiles.[32] On average, children ate 2.5 cups/day of fruit/vegetables/legumes and consumed 19 tsp/day of added sugar, of which approximately 7 tsp/day came from sugar-sweetened beverages.

Students who consumed school breakfast every day reported higher daily fruit, vegetable and legume intake (0.1 cup/day, 95% CI: 0.01, 0.1), higher daily dietary fiber intake (0.42 g/day, 95% CI: 0.2, 0.7) as well as higher whole grain intake (0.1 oz/day, 95% CI: 0.05, 0.1)

than students who did not eat school breakfast every day in adjusted analysis (Table 2). Daily dairy (0.1 cup/day, 95% CI: 0.05, 0.1) and calcium intake (34.5 mg/day, 95% CI: 19.1, 49.9) also were higher for children who reported eating school breakfast every day compared to students who reported less frequent school breakfast consumption. No significant relationships were found between eating school breakfast every day and intake of added sugar, energy-dense foods, or sugar from sugar sweetened beverages.

Students who ate school lunch every day reported higher daily dairy (0.1 cup/day, 95% CI: 0.1, 0.2) and calcium (32.4 mg/day, 95% CI: 18.1, 46.6) intake than students who ate school lunch less frequently, after adjusting for covariates (Table 3). The frequency of eating school lunch was not significantly related to daily intake of fruit/vegetables/legumes, dietary fiber, added sugar, whole grains, or sugar from sugar sweetened beverages.

Discussion

In this study involving over 5,000 U.S. elementary and middle school students, children who consumed school breakfast every day reported higher intakes of healthy foods, including fruits and vegetables, whole grains, and dairy, as well as higher intakes of dietary fiber and calcium. Higher intakes of dairy and calcium were also seen among students consuming school lunch every day. While the observed differences generally were small, such small differences in dietary intakes over a large population persisting for a relatively long period of time may result in substantial differences in health outcomes. In addition, these higher nutrient intakes were seen in children at nutritional risk – low income children enrolled in meal programs. While recent data suggest that economic disparities in dietary quality are increasing in the U.S.[33], our findings suggest that school meal programs can potentially stabilize and begin to reverse these changes in disparities. By increasing participation in these meal programs, especially the School Breakfast Program, these programs may effectively counteract the forces leading to poorer diet among lower-income students who are able to eat both breakfast and lunch at school daily. If so, this would highlight the powerful force school meals can play in helping limit dietary disparities among children in the U.S.

Unfortunately, while daily school breakfast and lunch intake was associated with a higher intake of healthy foods (fruits and vegetables, whole grains, and dairy), there was no association with intake of unhealthy foods and beverages, such as energy-dense and nutrient poor foods (like chips, cookies, etc.), sugar sweetened beverages, or added sugar. In this study, with a high proportion of minorities and low-income children, there was higher reported intake of added sugar (19 tsp/day) compared to the national average (16 tsp/day) based on NHANES 2009–2010.[34] Some have suggested that school meals contribute excess sugar to children's diets,[35] but our study did not find that eating more school meals was associated with higher added sugar intake. While overall the present study suggests that the school meal programs may be important for increasing healthy food intake, further reductions in energy rich foods in school meals and outside of school may be needed to reduce obesity.[36] Obesity prevention requires reduction of calories from foods of limited nutritional value while replacing with healthy foods.[37,38] This study was not able to examine the degree to which unhealthy foods were consumed during the school day or at other times

of the day, nor was it able to examine whether students in schools with limited access to unhealthy food items consumed less of these types of foods. Further, this study was not able to assess if students who participated in school meals every day had different total energy intakes compared to those who participate in it less frequently. Future studies should examine such questions.

While students who ate school breakfast and lunch every day generally had better diets than those who did not, overall, the students in this study were not unlike most children who fail to meet the recommendations of the 2010 Dietary Guidelines for fruits and vegetables, dietary fiber, total added sugar, and whole grains. For example, children in this study consumed an average of 2.5 cups/day of fruits and vegetables whereas recommendations for youth in this age range are 2–4.5 cups/day for fruit and vegetables depending on sex and activity levels, and national averages are close to 2.1 cups/day.[34] This suggests that more work is needed to improve food environments and dietary behaviors for all students – including outside of schools.

Daily school breakfast consumption was associated with higher intakes of fruits and vegetables, dietary fiber, whole grains, dairy, and calcium compared to students who ate school breakfast less frequently. These findings are consistent with a study conducted in 2011–2012 of over 3,000 4th and 5th grade children which suggested that school breakfast eaters had higher total daily fruit, whole fruit, and dairy intakes compared to students who brought their meals from home.[9] A similar finding was observed in a nationally representative sample of 6–17 year old children that showed that participation in both school breakfast and lunch was associated with higher overall diet quality as measured by Healthy Eating Index scores among low-income children.[11] These findings show that there could be an additional nutritional benefit of consuming school breakfast. In this study, most of the students who consumed school breakfast also consumed school lunch. This shows that the relationship between school meal participation and dietary quality could be greater among low-income children because they are more likely to consume both school meals on a given day.

It is noteworthy that data were collected for this study directly after the start of the 2010 HHFKA policy implementation, which mandated school meal improvements. Because the guidelines were intended to be implemented gradually over time, and because this study is cross-sectional, it was not possible to assess whether students in schools that more closely adhered to HHFKA saw greater improvements in dietary intakes. Efforts to help limit students' preferences for and selection of energy-dense, nutrient poor foods and beverages is important for improving their diets and health.

This study has limitations. Because of the observational design, causality cannot be inferred. All nutrition measures were based on self-report which is subject to recall error and reporting bias. Previous studies have found that self-reported participation in the NSLP and SBP is consistently higher than participation rates estimated from administrative data.[39] Further, parents report higher school meal participation than children.[40] This could be because students tell their parents that they take the school lunch or breakfast more often than they actually do. Furthermore, because dietary intake was assessed using the NHANES

screener, this study was unable to separate out the difference in intake from fresh versus canned fruits, which may contribute to some added sugar intake. Additionally, it is possible that students who eat school breakfast regularly are different from those who do not due to variables not included in our study. In many schools, eating breakfast daily requires getting to school early, which may indicate some level of family organization. Also, in some schools, eating breakfast in the cafeteria is stigmatized; thus, students who eat breakfast may prioritize healthy breakfast over stigma associated with school breakfast. In this case, it is possible that their diets are healthier not because of their school meal participation, but because of their or their families' priorities or other unobserved factors. While this study included a diverse sample of U.S. elementary and middle schools, results may not be generalizable to other schools or children. For example, because this study oversampled minorities and low-income households, there were a higher number of children who qualified for free or reduced-price lunch and more low-income households in our study compared to the national average.

Conclusions

In this study, eating school meals every day, particularly school breakfast, was related to a higher intake of healthier foods. Findings from this study showed that students who consistently ate school breakfast reported consuming diets modestly higher in fruits and vegetables, whole grains, dairy, calcium, and dietary fiber. School meal consumption was not associated with intakes of energy-dense, nutrient poor foods or added sugars. Thus, school meals may be important for increasing consumption of foods that promote health, but may not be effective in limiting foods and beverages which, when consumed in excess, can lead to overweight and obesity. Further studies after full HHFKA implementation in schools are needed to confirm this study's findings that healthier dietary intakes are associated with school meal participation.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Research Snapshot

Research Question

Is the frequency of participating in the National School Lunch Program and School Breakfast Program associated with children's dietary intake?

Key Findings

In this cross-sectional observational study that included 5,106 U.S. schoolchildren ages 4–15 years old from the Healthy Communities Study, children who ate school breakfast every day consumed more fruits/vegetables, dietary fiber, whole grains, dairy, and calcium compared to children who did not eat school breakfast every day and children who ate school lunch every day consumed more dairy and calcium compared to children who did not each school lunch every day.

Table 1

Characteristics of students and communities in the Healthy Communities Study (N=5,106)

Child level characteristics	**Mean (SD)**
Body mass index (BMI)[a]	20.01 (5.41)
Body mass index z-score (BMIz)[a]	0.68 (1.20)
Age, years	9.28 (2.65)
	n (%)[g]
Overweight/obese[a,b]	2,065 (40.44)
Female	2,598 (50.90)
Race/ethnicity[c]	
Hispanic or Latino	2,279 (44.63)
Non-Hispanic White	1,512 (29.61)
Non-Hispanic Black	920 (18.02)
Non-Hispanic multi-racial	190 (3.72)
Non-Hispanic other	287 (5.62)
Receives free or reduced priced-lunch	3,460 (69.31)
Family annual income	
Less than $20,000	1,371 (26.85)
$20,000 – 35,000	1,251 (24.50)
$35,000 – 50,000	641 (12.55)
$50,000 – 75,000	559 (10.95)
$75,000 – 100,000	394 (7.72)
Greater than $100,000	890 (17.43)
Maximum parental education from both biological mother/father[d]	
Less than high school	1,155 (22.62)
High school diploma or equivalent	1,031 (20.19)
Some college or associate degree	1,272 (24.91)
Bachelor degree	782 (15.32)
Graduate degree	866 (16.97)
Maximum current employment status of biological mother/father[e]	
Working full-time for pay	3,726 (72.97)
Working part-time for pay	514 (10.07)
Unemployed	313 (6.13)
Other	553 (10.83)
Dietary intake	**Mean (SD)**
Fruits/vegetables/legumes (cup/day)	2.49 (0.93)

Child level characteristics	**Mean (SD)**
Whole grains (oz/day)	0.71 (0.44)
Dairy (cups/day)	2.50 (0.76)
Dietary fiber (g/day)	15.49 (3.91)
Calcium (mg/day)	1,108.39 (253.96)
Total added sugar (tsp/day)	19.03 (7.86)
Sugar from sugar-sweetened beverages (tsp/day)	6.99 (4.77)
Energy-dense foods of minimal nutritional value (times/day)	1.95 (1.84)
Eating school breakfast	
0 day	2,154 (42.19)
1 day	273 (5.35)
2 days	279 (5.46)
3 days	380 (7.44)
4 days	229 (4.48)
5 days	1,791 (35.08)
Eating school lunch	
0 day	808 (15.82)
1 day	343 (6.72)
2 days	293 (5.74)
3 days	372 (7.29)
4 days	309 (6.05)
5 days	2,981 (58.38)
Community level characteristics	**Participants living in communities with various characteristics, n (%)**[g]
U.S. region	
Midwest	977 (19.13)
Northeast	788 (15.43)
South	2,130 (41.72)
West	1,211 (23.72)
Minority classification[f]	
Black	1,053 (20.62)
Hispanic	2,026 (39.68)
Other[c]	2,027 (39.70)
Urbanicity	
Rural	1,160 (22.72)
Suburban	2,022 (39.60)
Urban	1,924 (37.68)

Child level characteristics	**Mean (SD)**
Catchment area[h]	**Mean % (SD)**
Percent of population aged 5 to 14 that is Black	19.70 (23.40)
Percent of population aged 5 to 14 that is Hispanic	34.58 (29.57)
Unemployment rate for population in labor force 16 years and over	20.62 (10.62)
Percent of population living below the federal poverty level	8.74 (3.41)

[a]Mean BMI and waist circumference are calculated by excluding observations with measurement issues.

[b]Overweight/obese includes 85th percentile or greater.

[c]Race and origin: Other includes American Indian/Alaska Native, Native Hawaiian/Pacific Islander, Asian.

[d]Maximum for biological parents; graduate includes masters, professional, doctorate degree.

[e]Maximum for biological parent employment: unemployed includes only temporarily laid off, on sick leave or maternity leave, looking for work, unemployed; other includes disabled, keeping house, retired, student, other.

[f]Minority tracts defined as having at least 30% of the community population being African American or Hispanic

[g]Percents may not add up to 100% because of rounding.

[h]Community catchment area represents the approximate catchment area of the high school.

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Table 2

Associations of eating school breakfast every day with dietary outcomes in the Healthy Communities Study (N=5,106)[a]

	Coefficient	Standard Error	95% Confidence Interval		P-value
Fruits/Vegetables/Legumes (cup/day)					
0–4 days (n=3,315)[b]	Ref	-	-	-	-
Every day (n=1,791)[b]	0.07	0.03	0.01	0.13	**0.03**
Whole Grain (oz/day)					
0–4 days	Ref	-	-	-	-
Every day	0.08	0.01	0.05	0.11	**<0.0001**
Dairy (cup/day)					
0–4 days	Ref	-	-	-	-
Every day	0.09	0.02	0.05	0.14	**0.0001**
Dietary Fiber (g/day)					
0–4 days	Ref	-	-	-	-
Every day	0.42	0.12	0.17	0.66	**0.0009**
Calcium (mg/day)					
0–4 days	Ref	-	-	-	-
Every day	34.46	7.85	19.07	49.85	**<0.0001**
Added Sugar (tsp/day)					
0–4 days	Ref	-	-	-	-
Every day	0.21	0.24	−0.26	0.69	0.38
Sugar from Sugar-Sweetened Beverages (tsp/day)					
0–4 days	Ref	-	-	-	-
Every day	−0.14	0.14	−0.42	0.13	0.31
Energy-dense Foods of Minimal Nutritional Value (times/day)					
0–4 days	Ref	-	-	-	-
Every day	0.04	0.06	−0.07	0.16	0.45

[a]Multilevel model adjusted for:

Child-level variables: age (as polynomial with degrees as follows: 1 for fruit and vegetables and calcium; 2 for dairy, whole grains, dietary fiber, 3 for sugar from sugar-sweetened beverages; 4 for total added sugar, energy-dense foods of minimal nutritional value), gender, race/ethnicity, annual household income, maximum parental education, maximum parental employment, seasonality of interview (based on sinusoidal curve over time), Community-level variables: U.S. region, minority classification, urbanicity, proportion of population below the federal poverty level, percent of population unemployed, and percent catchment area with children that are African American, Hispanic.

Standard errors are clustered at community and school level.

[b] N's are the same for all outcomes variables.

Table 3

Associations of eating school lunch every day with dietary outcomes in the Healthy Communities Study (N=5,106)[a]

	Coefficient	Standard Error	95% Confidence Interval		P-value
Fruits/Vegetables/Legumes (cup/day)					
0–4 days (n=2,125)[b]	Ref	-	-	-	-
Every day (n=2,981)[b]	0.05	0.03	−0.01	0.11	0.08
Whole Grains (oz/day)					
0–4 days	Ref	-	-	-	-
Every day	0.02	0.01	−0.01	0.05	0.15
Dairy (cup/day)					
0–4 days	Ref	-	-	-	-
Every day	0.12	0.02	0.07	0.16	**<0.0001**
Dietary fiber (g/day)					
0–4 days	Ref	-	-	-	-
Every day	0.22	0.12	−0.01	0.46	0.06
Calcium (mg/day)					
0–4 days	Ref	-	-	-	-
Every day	32.36	7.26	18.14	46.59	**<0.0001**
Added Sugar (tsp/day)					
0–4 days	Ref	-	-	-	-
Every day	0.07	0.22	−0.36	0.51	0.74
Sugar from Sugar-Sweetened Beverages (tsp/day)					
0–4 days	Ref	-	-	-	-
Every day	−0.07	0.13	−0.33	0.19	0.61
Energy-dense Foods of Minimal Nutritional Value (times/day)					
0–4 days	Ref	-	-	-	-
Every day	0.02	0.06	−0.1	0.13	0.79

[a]Multilevel model adjusted for:

Child-level variables: age (as polynomial with degrees as follows: 1 for fruit and vegetables and calcium; 2 for dairy, whole grains, dietary fiber, 3 for sugar from sugar-sweetened beverages; 4 for total added sugar, energy-dense foods of minimal nutritional value), gender, race/ethnicity, annual household income, maximum parental education, maximum parental employment, seasonality of interview (based on sinusoidal curve over time) Community-level variables: U.S. region, minority, urbanicity, proportion of population below the federal poverty level, percent of population unemployed, and percent catchment area with children that are African American, Hispanic. Standard errors are clustered at community and school level.

[b] N's are the same for all outcomes variables.