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A randomized, controlled study of a healthy corner store initiative on the purchases of urban, low-income youth

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Conflicts of Interest

GDF served as a consultant to ConAgra Foods, United Health Group and Tate & Lyle during the time of this study. GDF and SSV are currently full-time employees of Weight Watchers International. All other authors report no conflict of interest or financial disclosures.

Contributions:

SSV, BS, SS and GDF designed the study and developed the overall research plan. SSV, GDF, ACW SS and TAM conducted the research and collected data. EK analyzed data. MRL conducted the literature search, analyzed data and wrote the manuscript. GDF had primary responsibility for final content. All authors edited the manuscript, and read and approved the final manuscript.

Abstract

Objective—Although many initiatives exist to improve the availability of healthy foods in corner stores, few randomized trials have assessed their effects. This study evaluated, in a randomized, controlled trial, the effects of a first-generation healthy corner store intervention on students' food and beverage purchases over a two-year period.

Design and Methods—Participants (n=767) were 4th-6th grade students. Ten schools and their nearby corner stores (n=24) were randomly assigned to the healthy corner store intervention or an assessment-only control. Intercept surveys directly assessed the nutritional characteristics of students' corner store purchases at baseline, 1 and 2 years. Students' weight and heights were measured at baseline, 1 and 2 years.

Results—There were no differences in energy content per intercept purchased from control or intervention schools at year 1 (p=0.12) or 2 (p=0.58). There were no differences between control and intervention students in BMI-z score (year 1, p=0.83; year 2, p=0. 98) or obesity prevalence (year 1, p=0.96; year 2, p=0.58).

Conclusions—A healthy corner store initiative did not result in significant changes in the energy content of corner store purchases or in continuous or categorical measures of obesity. These data will help to inform future interventions.

Keywords

Public health; obesity; nutrition; children

Introduction

Almost 17% of children and adolescents in the United States are obese[1]. The prevalence of childhood obesity in minorities is particularly high, especially among non-Hispanic black 6-11 year-olds (23.8%)[1], as well as among children from low-income families (≥130% below the poverty level, 19.3%-21.1%)[2,3]. Childhood obesity is associated with numerous medical and psychosocial consequences, including dyslipidemia, diabetes, sleep apnea, and poor self-esteem[4-8].

Unhealthy food environments may contribute to higher rates of obesity among low-income and minority children. In urban areas, many students have access to snack and beverage offerings from corner stores, which are often located near schools[9,10]. Corner stores primarily stock pre-packaged foods and sugar-sweetened beverages that are high in energy and low in nutritive value[11,12]. Almost 60% of 4th-6th grade students attending school in a low-income, urban area have reported shopping in corner stores before or after school[13]. Another study found that elementary school students spent $1.07 per corner store visit for items that contained 356 kcal (1497.7 kJ)[9]. Items commonly purchased were unhealthy, such as sugar-sweetened beverages, chips, and candy[9].

Community-based approaches aimed at improving unhealthy food environments offer one potential pathway to help prevent and treat obesity. Gittelsohn et al.,[14] identified 16 trials of healthy food and beverage programs in small grocery stores or corner stores located

primarily in minority and low-income neighborhoods. These multifaceted intervention programs aimed to increase the availability of and demand for healthy items. However, most of these intervention studies sampled only adults[15] or assessed consumer purchasing behavior through storeowner and/or consumer self-report surveys[14,16] or sales estimates[17] instead of direct consumer observations. Only one study[18] of children directly observed beverage purchases before (n=142) and 6 months after (n=176) a healthy beverage corner store intervention (with no control group) and found no significant change in the rates of sugar-sweetened beverages purchased by children. Moreover, while select corner store intervention trials used comparison groups in pre-post or quasi-experimental designs[16,17,19-21], only one trial to date has used a randomized, controlled design to examine the impact of interventions on adult purchases and used consumer self-report[22]. This four-month trial[22] followed primarily Latino customers and did not find significant increases in fruit and vegetable intake in the intervention group. As Gittelsohn et al.[14] noted in a recent review of corner store interventions, “the ability to influence health outcomes will require a more systematic evidenced-based approach to modifying the food environment, greater use of randomized controlled trials to evaluate program effectiveness, and publication in peer-reviewed literature to communicate findings” (p. 5).

To the best of our knowledge, the current study is the first randomized controlled trial to use direct observations of corner store purchases and the first randomized controlled trial to evaluate corner store purchases in children. Additionally, the current study includes objective measures of height and weight in children. This two-year study assessed the impact of a healthy food and beverage intervention on 4th-6th grade urban students’ purchases in corner stores located near their schools. Given that energy intake[23] is a principal contributing factor in the development of childhood overweight and obesity, our primary outcome was the energy content (calories) of students’ corner store purchases. We hypothesized that students in the healthy corner store intervention group would purchase significantly fewer calories (200 kcal; i.e., replacing one sugar-sweetened beverage and snack of candy/chips [approximately 360 kcal] with water and fruit salad [approximately 160 kcal]) at corner stores than control students at two years. Our secondary aims were to: 1) examine differences between groups in other nutritional characteristics of food and beverage purchases (i.e., fat content, fiber, carbohydrates, sugar and sodium); 2) assess differences between groups in students’ BMI, BMI percentile and BMI z-score; and 3) examine differences between groups in the prevalence of obesity (≥95th BMI percentile) at 1 and 2 years.

Methods

Participants

Schools and students—All 4th-6th grade students from 10 schools in low-income neighborhoods in Philadelphia were eligible to participate (n=1802). Of the eligible students, 43.8% consented (n=790) and 42.6% (n=767) completed height and weight assessments. Eligible schools had: 1) >50% of students qualifying for free/reduced meals (income ≤185% of the poverty level adjusted for household size); 2) ≥ 2 corner stores within a 4-block radius; and 3) no existing programs to target obesity. Schools were matched on size (±70

students) and corner store density (2-4 stores per school). Staff approached principals in a pre-determined random order. Of the 20 eligible schools, 13 were approached, 3 declined and 10 were randomized. The seven schools not approached were in close proximity to other schools or had limited nearby corner stores. The principal of each school sent a letter home describing the study and inviting parents to consent and children to assent for assessments of the child's height and weight, as well as to assessments (intercepts) of corner store purchases made by the children. All children were encouraged to return the consent/assent form regardless of whether or not they agreed to participate.

Corner stores—Corner stores were businesses that primarily sold food and beverages, had 1-4 aisles, and had only 1 cash register. Study staff approached the owners of all corner stores within a 4-block radius of each school. Owners signed a letter specifying that if randomized to a treatment cluster, they would: 1) display marketing materials provided by the study; 2) stock a minimum number of products targeted by the intervention; and 3) group healthier items for easy identification. Storeowners were paid $200 per year for their participation and were introduced to study staff, who wore identifiable clothing (shirts and/or jackets) and stood outside of corner stores to collect intercepts.

Randomization

A “school-store” cluster was defined as one school and its surrounding corner stores within a 4-block radius. From the pool of 10 enrolled schools, 5 schools and their proximal corner stores (n=12) were randomized to the intervention and 5 schools and their proximal corner stores (n=12) were randomized to an assessment-only control. Students were not blind to their status as an intervention school.

Measurement

Baseline assessments of height, weight and corner store intercepts were collected from January-June 2008. Assessments were taken again 1 and 2 years following intervention initiation, which began in September 2008.

Nutrition information—The primary outcome, the energy content (calories) of corner store purchases made by students, was based on directly intercepting students outside of the 24 corner stores.

Staff approached students outside of the 24 participating corner stores and asked if they attended the corner store's cluster school, and if they consented to participate in this study. If students said yes or were unsure, their consent status was verified later using a list of consented students. Staff collected intercepts anonymously on students not consented to participate in this study if they provided verbal assent and were in the 4^{th}-6^{th} grades at the participating school. Staff then conducted the intercept interview, which lasted approximately 1-2 minutes. Interviewers asked how much they spent and then looked in students’ bags at each of the purchased items. Interviewers did not ask for receipts because most corner stores were all cash businesses and did not provide receipts. Staff recorded the students’ responses, noting each purchased item's product category, name, size and quantity.

One intercept was equal to one corner store visit by one student and may have included more than one food and beverage item.

Staff obtained the energy content and other nutritive characteristics of items purchased at corner stores by inventorying all of the purchased food and beverage items in the selected corner stores. Staff developed a database of the nutrient content of these items. For packaged items, the package's nutrition label was the primary source of nutrient content. When the item did not have a printed nutrition label, staff contacted the manufacturer or distributor directly for nutrition information. If the manufacturer could not be contacted, online food databases such as CalorieKing.com were utilized. In the case of prepared items (e.g., sandwiches), staff purchased identical sandwiches, with the condiments on the side, from the corner store, and asked the store owner what brands of products were used. Staff then de-composed the sandwiches in the office to weigh each component (bread, deli meat) and calculated the nutrition information using similar methods as noted above.

BMI, BMI z-score and BMI percentile—Trained research staff used a standardized protocol to collect weight and height data in schools on consented students. Students' weight and height were measured in light indoor clothing without shoes. Weight was measured with a digital scale (SECA Alpha 882 and HD SECA 634, Hamburg, Germany) to the nearest 0.1 kg. Height was measured with a portable stadiometer (PE-AIM-101) to the nearest 0.1 cm. BMI (weight [kg]/height^2 [m^2]), BMI z-scores and BMI percentiles (a comparison of the student's BMI with children of the same sex and age) were calculated for each student[23,24].

Weight Categories—Obesity was defined as a BMI percentile ≥95th based on age- and gender-specific norms[24], overweight as ≥85th–94.9th BMI percentile, healthy weight as 5th< 85th BMI percentile, and underweight as <5th BMI percentile.

Healthy Corner Store Intervention

The Snackin' Fresh intervention, developed by The Food Trust (http://thefoodtrust.org), was based on social cognitive theory and was designed to promote healthier snack and beverage purchases in students shopping in corner stores. This study followed 4-6th graders for two years through the 6-8th grades and included an emphasis on bottled water and prepared fruit salad for sale in the corner stores.

There were three main intervention components. First, the intervention included classroom-based nutrition education lessons on identifying healthy snacks (i.e., fruit, single-serving packages and water), energy intake, tracking consumption, goal-setting and label reading taught by project staff (7 45-minute lessons). Second, a branded social marketing campaign communicated messaging regarding healthy eating and well-being. The Snackin' Fresh logo was imprinted on small giveaways and banners, and was displayed in corner stores. A branded Web site, comic book and video were also developed. Third, corner store-level initiatives included storeowner trainings, adding healthier items, and signage identifying healthy items.

All storeowners received training on buying, handling and selling fresh produce to reduce food costs, promote proper display and maintain produce quality. Whole produce, which

was usually sold by weight, was sold per unit to students so they could more easily purchase them as snacks. Whole fruit was priced competitively with retail prices in comparable stores. Owners were encouraged to group healthy snacks together. Fruit salads were sold in two sizes ($1.00 for 8 oz., $2.00 for 16 oz.). Bottled water (20 oz.) was sold for 60¢ to match the price of other commercially available waters. Intervention staff provided 11 Snackin' Fresh branded refrigerated barrels and one branded countertop refrigerator to intervention stores to stock fruit and water, respectively. Youth leaders provided feedback on which healthy items to introduce and on marketing messaging.

Statistical Analyses

Regression analyses were done with generalized linear mixed models (PROC GLIMMIX in SAS, v9.2, SAS Institute Inc., Cary, NC) with schools and corner stores as separate random effects to accommodate for the clustering of children who attended the same schools and/or shopped at the same stores. An additional adjustment for serial dependence was achieved with a repeated statement that applied to only consented participants, since non-consented children were not uniquely identifiable over time. Therefore, the regressions utilized a hybrid approach with both repeated and cross-sectional measures collected over time. Because the default starting values for the covariance parameters failed, the following dependent variables were dichotomized at their baseline medians: calories, fat, sodium, carbohydrates, sugars, protein, fiber and calories. Analyses consisted of differences in proportions falling above or below the median in each treatment group based on a binomial distribution with a logit link function. There were no problems for starting values for age adjusted BMI, BMI percentile scores, and BMI z-scores, therefore these analyses were based on comparison of means between treatment conditions assuming a normal distribution with an identity link. Because the model failed to converge with the repeated statement, a random effect for participants was used to accommodate for clustering of measurements over time within subjects. A similar strategy was utilized for BMI categories except multinomial and a cumulative logit link were used to compare groups. The p-values for nutrition content and BMI were based on two group post-hoc comparisons with alpha<0.025 to account for two time points. Chi-square and ANOVA examined differences in demographics.

The Office of Research and Evaluation at the School District of Philadelphia and the Institutional Review Board at Temple University approved the study protocol.

Results

Participants

Schools and students—The 10 schools had 82.1±7.4% of students that qualified for free or reduced-price meals. At baseline, 790 students provided consent and 767 students completed assessments. Characteristics of the student sample are in Table 1. Participating students reflected the racial/ethnic composition of the schools, which were 54.0% Black, 11.6% White, 22.9% Hispanic and 10.8% Asian. Participant flow through the study is in Figure 1.

There were no baseline differences in age (p=0.72), gender (p=0.50) or weight category (p=0.66) between students from control or intervention schools. When comparing race/ethnicity between groups, there were significantly more Asian students in the control group and significantly more Hispanic/Latino students in the intervention group (Table 1), which reflects the predominant races/ethnicities of the 10 neighborhoods.

Corner stores—Stores were on average 172.9±70.4 square feet, had 2.1±0.5 aisles and 2.4±1.0 employees on site. Among the 24 corner stores (n=12 control, n=12 intervention) who began the study, 21 (n=11 intervention, n=10 control) and 20 (n=10 intervention, n=10 control) remained at years 1 and 2, respectively. The four stores (n=2 intervention, n=2 control) that discontinued their participation did so because of a change in store ownership.

Intercepts—Items were analyzed by intercepts. The mean number of intercepts per store was 34.7±31.3 at baseline, 32.1±29.1 at year 1 and 35.4±32.2 at year 2. Staff collected 833 intercepts at the initial assessment (484 intercepts from consented students, 349 intercepts from non-consented students). At 1 year, staff collected 674 student intercepts (n=250 consented, n=424 unconsented) and at year 2, staff collected 708 intercepts (n=237 consented, n=471 unconsented) (Table 2). Average items per intercept at year 1 were 2.8±2.8 and 2.7±2.8 at year 2.

Nutrition Information of Corner Store Purchases

There was no difference in energy content per intercept in control or intervention purchases at baseline. Similarly, there were no significant differences in energy per intercept between control and intervention store purchases at years 1 or 2 , Table 2). There were also no significant differences between control and intervention corner store purchases in fat, sodium, carbohydrate, sugar, protein or fiber at baseline, year 1 or year 2 (Table 2). Typical items purchased by students were beverages, chips and candy. Means for nutritional information are - in Table 3.

BMI, BMI Z-score and BMI Percentile

Weight measurements were available only for consented students (see Figure 1). There were no differences between groups in BMI, BMI z-score or BMI percentile at baseline, year 1 or year 2 (Table 4).

Weight categories—There were no differences in the prevalence of obesity between control and intervention students at years 1 or 2 (Table 4).

Discussion

There were three principal findings from this study. First, a first-generation corner store intervention did not result in significant differences in the energy content purchased at corner stores by urban, low-income 4^{th}-6^{th} graders compared to control stores. It is unclear why the intervention did not impact the energy content of purchases. One potential reason may be the challenge of stocking fresh items in a corner store environment with limited space and equipment. It is also possible that students saw less value in the items targeted by

the intervention (i.e., fruit salad was $1.00) given their high cost relative to popular alternatives (0.75-1.0 oz. chips for $0.25-$0.50). Additionally, students may have been reluctant to purchase water given that water is widely available at no cost. It is possible that 4th-6th graders were not the primary demographic purchasing fruit salad, as students typically bought beverages, chips and candy. Some shoppers in intervention stores may have been from non-participating schools, potentially diluting the intervention. Finally, it is possible that students were not motivated to make healthier decisions when less expensive, highly palatable items were still readily available. Finally, due to the challenges in working with national snack distributors, space that was allocated specifically for healthier items was difficult to maintain. A recent commentary[25] on healthy food access programs in corner stores highlighted the importance of establishing strong relationships with customers and storeowners, encouraging change at the infrastructure and systems-level in stores, and tailoring interventions to meet the specific store needs to maximize healthy corner store initiative efficacy and sustainability.

There has only been one other evaluation of corner store interventions among children, and it was not randomized. Similar to our findings, The Boston Middle School Corner Store Initiative[18], a joint effort of middle schools (n=6) and nearby corner stores (n=8) to promote healthier beverage choices via in-class lessons and social marketing, found no significant change in the frequency of sugar-sweetened beverage purchases made by students from pre- to post- intervention using direct observation of corner store purchases.

Second, there were no differences in the fat, carbohydrate, sugar, fiber, or sodium content of corner store purchases of control or intervention students. At year 2, intervention corner store purchases remained high in sugar (35.2 g) and sodium (448 mg) and low in fiber (1.2 g).- The sugar content of purchases almost doubled the maximum intake of 12-20 g/d of added sugar recommended by the American Heart Association (AHA) based on a 1400-1800 kcal/day diet[26]. At baseline, more than 88% of beverages purchased were sugar-sweetened beverages (SSB)[9]. SSBs were not specifically targeted in our intervention, and future corner store interventions may benefit from focusing on reducing SSB consumption.

Third, there were no differences in relative weight or obesity prevalence between students in the control and intervention school-corner store clusters. Obesity prevalence in the overall sample also did not change significantly over the two years. Obesity nationally appears to be plateauing or declining[1,27] and recent epidemiological data from Philadelphia also show this trend[28]. Future school-corner store interventions may benefit from focusing on physical activity in addition to targeting intake to effect meaningful changes in weight.

Our study has several strengths. It is the first randomized, controlled study of a healthy corner store initiative that utilized direct observation of corner store purchases, included assessment of height and weight, and evaluated children. Previous trials utilized non-randomized control groups [19,20] or relied on self-report and store sales data rather than direct observation to measure consumer purchasing behaviors in corner stores[22]. Our study also had several limitations. Students changed schools or were absent on days study staff conducted height and weight measurements, leading to 22% attrition in year 1 and 33% in year 2. Additionally, it is possible that students changed their purchasing behaviors knowing

that their items would be recorded by evaluation staff; however, this would have occurred across control and intervention groups and be unlikely to influence between-group findings. Only 43.8% of eligible students consented to participate, though our sample was similar to the overall racial and ethnic composition of students in these schools. We did not record whether students shopped in corner stores alone or with others. Detecting differences in corner store purchasing patterns between individual students versus students shopping with parents or in groups may help identify future intervention targets. Finally, our study examined only urban and predominately minority 4 6th grade students in a small number of schools (n=10) and may not represent the behaviors of children of other ages, geographic locals or races/ethnicities.

Future studies may benefit from developing more robust interventions that work with corner storeowners to make more substantive changes in stocking healthier snacks and beverages, and in marketing these items[14]. Findings from this first-generation study will inform subsequent programs[28] and future studies. There is already work underway in Philadelphia to improve and strengthen corner store initiatives to effect meaningful change (i.e., additional store-owner training, refrigeration capabilities and infrastructure changes)[29]. Future studies are needed to assess their efficacy. Larger studies with a wider age span may also help provide insights on how to promote more healthful eating behaviors in urban children. It is also possible that corner store efforts need to be part of larger comprehensive efforts to impact healthy eating in schools and communities.

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What is already known on this subject:

- Corner stores sell foods and beverages that are high in energy content and low in nutritive value.
- A previous study found that approximately 60% of students from an urban, low-income area shopped in corner stores before or after school.
- Initiatives exist to improve the availability of healthy foods in corner stores but few studies have assessed their effects on individual purchasing behaviors.

What this study adds:

- This randomized controlled trial found no effects of a healthy corner store intervention on 4^{th}-6^{th} grade students' food and beverage purchases over two years, or on weight.
- Intercept surveys directly assessed the nutritional characteristics of individual corner store food and beverage purchases. Students' heights and weights were assessed in schools.
- Findings from this first-generation study will inform subsequent corner store programs, which may benefit from more robust interventions.

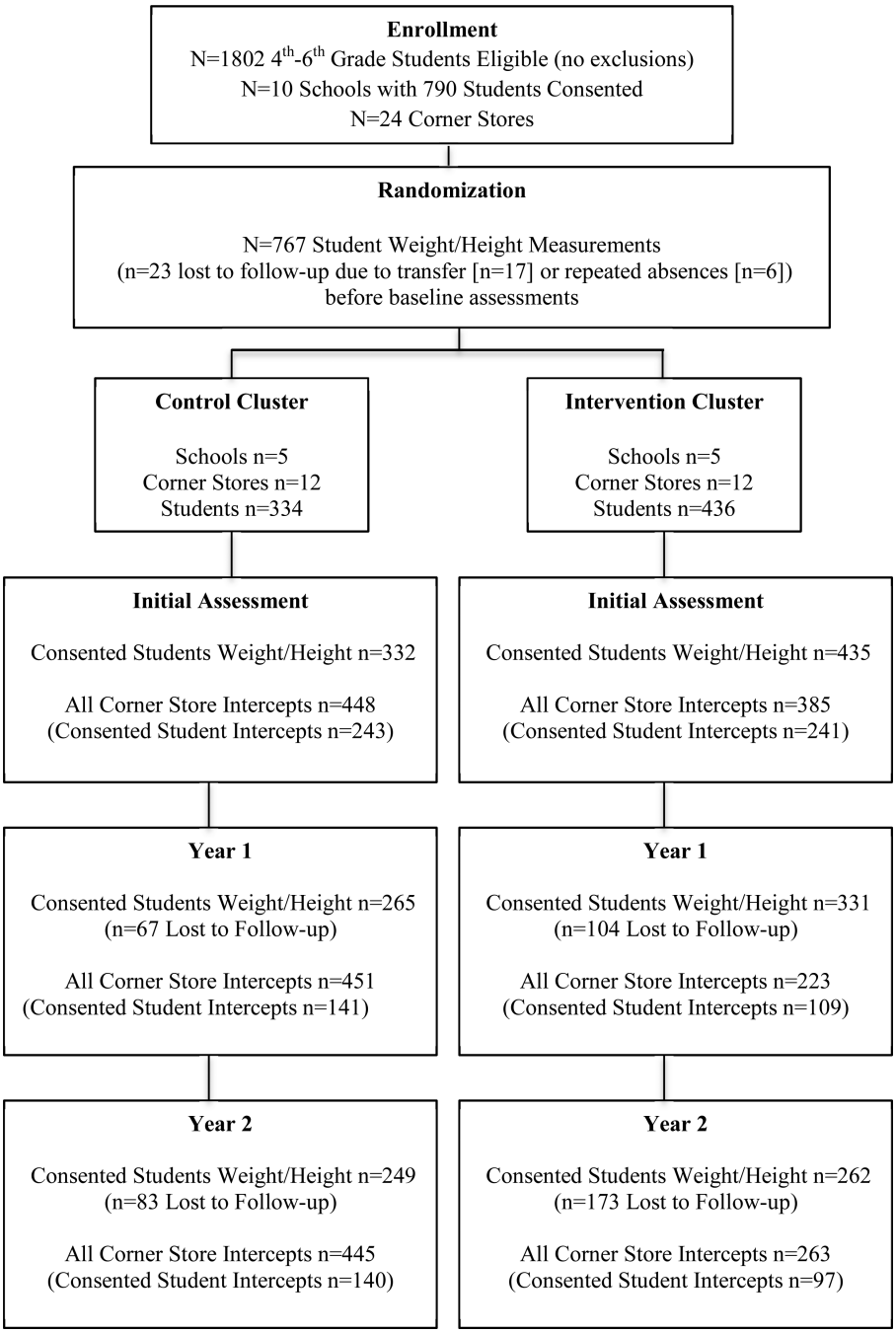

Figure 1.
Participant flow

Table 1

Characteristics of consented and measured 4th-6th grade students in control and intervention school-corner store clusters at baseline

Student characteristics	Control cluster (n=332)	Intervention cluster (n=435)
Age (M±SD, years)	10.99±0.92	10.97±1.02
Gender (% female)	57.8%	55.4%
Race/Ethnicity (%)		
Black/African American	38.3%	46.2%
White	13.2%	0.5%
Hispanic/Latino	16.2%	43.2%*
Asian	15.9%	0.5%*
Native American/Alaskan Native	1.5%	0.2%
Other/Mixed/Unknown	15.0%	9.4%

*Control versus intervention groups, significant at p<0.01. Of all consented students (N=790), 23 students did not attend school when baseline measures were collected.

Table 2

A comparison of student corner store intercept characteristics in control and intervention school-store clusters at 1 and 2 years after intervention initiation

	Baseline		Year 1				Year 2			
	N intercepts	Median	N intercepts	% Above Median [a]	OR (95% CI) [a]	p year 1 [a]	N intercepts	% Above Median [a]	OR (95% CI) [a]	p year 2 [a]
Intercepts										
Energy (kcal)		280.0			0.69 (0.4-1.1)	0.12			0.88 (0.5-1.5)	0.58
Intervention	385		223	62.6%			263	56.0%		
Control	448		451	53.4%			445	52.8%		
Fat (g)		10.0			0.78 (0.5-1.3)	0.33			0.77 (0.5-1.3)	0.32
Intervention	385		223	57.0%			263	55.5%		
Control	448		451	50.7%			445	49.1%		
Sodium (mg)		300.0			1.27 (0.7-2.3)	0.43			1.21 (0.7-2.2)	0.53
Intervention	385		223	53.2%			263	50.7%		
Control	448		451	59.0%			445	55.4%		
Carbohydrates (g)		44.0				0.54			1.21 (0.7-2.1)	0.50
Intervention	385		223	59.2%	0.84 (0.5-1.5)		263	54.5%		
Control	448		451	55.0%			445	59.2%		
Sugar (g)		18.0			0.86 (0.4-1.6)	0.64			0.84 (0.4-1.6)	0.61
Intervention	385		223	58.7%			263	56.8%		
Control	448		451	54.9%			445	52.6%		
Protein (g)		2.4			1.0 (0.6-1.7)	0.98			1.17 (0.7-2.1)	0.60
Intervention	385		223	66.2%			263	61.8%		
Control	448		451	66.1%			445	65.4%		
Fiber (g)		0.9			0.87 (0.45-1.7)	0.67			0.78 (0.5-1.5)	0.45
Intervention	385		223	41.6%			263	40.8%		
Control	448		451	38.2%			445	34.9%		

[a] Regression analyses were generalized linear mixed models with schools and corner stores as separate random effects to accommodate for the clustering of children who attended the same schools and/or shopped at the same stores. Because the default starting values for the covariance parameters failed, variables were dichotomized at their baseline medians. Between-group comparisons (control versus intervention) were based on differences in proportions falling above or below the median.

Table 3

Means±SD* of student corner store intercept characteristics in control and intervention school-store clusters at baseline enrollment, and 1 and 2 years after intervention initiation

	Baseline		Year 1		Year 2	
	N intercepts	Mean±SD	N intercepts	Mean±SD	N intercepts	Mean±SD
Intercepts						
Energy (kcal)						
Intervention	385	354.0±314.7	223	417.8±373.1	263	381.1±361.8
Control	448	358.9±267.9	451	413.0±359.0	445	406.1±311.6
Fat (g)						
Intervention	385	14.6±17.6	223	15.3±16.5	263	14.5±16.6
Control	448	12.5±13.3	451	14.1±14.7	445	14.6±16.1
Sodium (mg)						
Intervention	385	457.9±682.4	223	486.7±594.9	263	448.2±671.8
Control	448	602.7±845.4	451	644.0±756.7	445	721.6±899.5
Carbohydrates (g)						
Intervention	385	50.7±46.8	223	63.8±66.8	263	58.4±62.8
Control	448	58.0±43.4	451	66.8±65.6	445	63.9±44.9
Sugar (g)						
Intervention	385	28.0±36.9	223	37.9±48.4	263	35.2±51.9
Control	448	35.0±34.5	451	38.7±51.4	445	34.0±34.0
Protein (g)**						
Intervention	385	5.1±9.1	223	5.4±9.1	263	4.3±6.8
Control	447	5.7±9.5	450	6.6±10.3	444	6.8±9.5
Fiber (g)**						
Intervention	385	1.2±1.7	223	1.3±2.7	262	1.2±1.7
Control	448	1.2±1.6	451	1.2±1.6	445	1.2±1.6

* For ease of interpretation, mean values are presented. Means were reported but not compared between groups.

** Outliers (>2 SD) were excluded for protein (n=1 at baseline, year 1 and year 2) and fiber (n=1, year 2).

Table 4

Body mass index (BMI) of consented 4th-6th grade students in control and intervention school-corner store clusters

	Baseline			Year 1				Year 2			
	N	%	Mean±SD	n	%	Mean±SD	p [a] Year 1	n	%	Mean±SD	p [b] Year 2
BMI (kg/m^2)											
Intervention	435		21.4±6.0	331		22.3±6.5	0.73	262		23.5±6.8	0.64
Control	332		21.3±5.1	265		22.3±5.6		249		23.3±5.7	
BMI z-score											
Intervention	435		0.8±1.2	331		0.8±1.2	0.83	262		0.8±1.2	0. 98
Control	332		0.8±1.1	265		0.8±1.1		249		0.9±1.1	
BMI percentile (%ile)[c]											
Intervention	435		69.3±29.7	331		69.1±29.9	0. 80	262		71.3±28.7	0.99
Control	332		70.8±28.3	265		70.3±29.2		249		72.6±27.0	
Weight Category											
Intervention							0.96				0.58
Underweight (<5th%ile)	10	2.3%		10	3.0%			4	1.5%		
Heathy(5<85%ile)	224	51.5%		172	52.0%			134	51.1%		
Overweight (85<95%ile)	81	18.6%		59	17.8%			44	16.8%		
Obese (≥95th %ile)	120	27.6%		90	27.2%			80	30.5%		
Control											
Underweight	4	1.2%		5	1.9%			2	0.8%		
Healthy(5<85%ile)	179	53.9%		135	50.9%			129	51.8%		
Overweight (85<95%ile)	58	17.5%		49	18.5%			48	19.3%		
Obese (≥95th %ile)	91	27.4%		76	28.7%			70	28.1%		

[a] p = Control v. Intervention comparison of means, Yr 1

[b] p = Control v. Intervention comparison of means, Yr 2

[c] Based on gender and age-specific norms [24]