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Placement and promotion strategies to increase sales of healthier products in supermarkets in low-income, ethnically diverse neighborhoods: a randomized controlled trial[1–3]

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ABSTRACT

Background: The greater presence of supermarkets in low-income, high-minority neighborhoods has the potential to positively affect diet quality among those at greatest risk of obesity. In-store marketing strategies that draw attention to healthier products may be effective, sustainable, and scalable for improving diet quality and health. Few controlled studies of in-store marketing strategies to promote sales of healthier items in low-income, high-minority neighborhoods have been conducted.

Objective: The objective of this study was to evaluate the effects of in-store marketing strategies to promote the purchase of specific healthier items in 5 product categories: milk, ready-to-eat cereal, frozen meals, in-aisle beverages, and checkout cooler beverages.

Design: The design was a cluster-randomized controlled trial conducted from 2011 to 2012. Eight urban supermarkets in low-income, high-minority neighborhoods were the unit of randomization, intervention, and analysis. Stores were matched on the percentage of sales from government food-assistance programs and store size and randomly assigned to an intervention or control group. The 4 intervention stores received a 6-mo, in-store marketing intervention that promoted the sales of healthier products through placement, signage, and product availability strategies. The 4 control stores received no intervention and were assessment-only controls. The main outcome measure was weekly sales of the targeted products, which was assessed on the basis of the stores' sales data.

Results: Intervention stores showed significantly greater sales of skim and 1% milk, water (in aisle and at checkout), and 2 of 3 types of frozen meals compared with control store sales during the same time period. No differences were found between the stores in sales of cereal, whole or 2% milk, beverages, or diet beverages.

Conclusions: These data indicate that straightforward placement strategies can significantly enhance the sales of healthier items in several food and beverage categories. Such strategies show promise for significant public health effects in communities with the greatest risk of obesity. *Am J Clin Nutr* doi: 10.3945/ajcn.113.075572.

INTRODUCTION

Efforts to increase access to supermarkets in disadvantaged urban and rural communities hold promise for promoting healthier diets (1–3). Whereas there are positive economic benefits of supermarkets in underserved areas (4), it is less clear what effect greater access to both healthy and unhealthy products will have on diet generally or obesity specifically. Several studies have found that simply having access to a neighborhood supermarket did not affect residents' diet quality or risk of obesity (5–8), whereas others found positive effects (9). These data suggest that access alone may be necessary, but not sufficient, to drive healthier choices. Cummins et al recently suggested that complementary interventions, such as in-store stocking policies, are needed to help shoppers move from perceptions of their increased accessibility to actions leading to healthier food and beverage purchasing (8).

The recent increased presence of supermarkets in low-income, ethnically diverse neighborhoods provides a unique opportunity to develop and evaluate various strategies to promote the purchase of healthier products (10). A greater availability of healthier foods, if translated to purchases, may positively affect diet quality among those at greatest risk of obesity—low-income, racial, and ethnic minorities.

The framework of the "4 Ps" of marketing—price, promotion, product, and placement—suggests opportunities for adapting commercial food store environments to encourage healthier and less energy-dense food purchasing (10, 11). Lessons from past research can be informative within this framework. One approach to increase the sales of healthier products has been to provide price discounts (eg, coupons, rebates). Whereas some studies have found positive effects (12–14), others have not (15, 16), and some studies have shown that price reductions often promote higher energy intake (11). It is notable that lower socioeconomic groups may respond differently to price reductions (17, 18) than other socioeconomic groups, and some fiscal modeling studies have found that variable taxes and subsidies targeting nutrient categories affect the largest changes in low-income groups (19, 20). However, price discounts require substantial

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and sustained investment. Previous supermarket interventions on healthier items have primarily used point-of-purchase approaches (nutrition education posters, shelf-tags, and pop-out flyers) to promote the nutritional value of selected healthier products (21). Point-of-purchase interventions have had mixed results on the sale of healthier products (21); some studies have reported increased sales (22–26), whereas others found no change (15, 27–30). Whereas such interventions can be applied store-wide, they are geared toward educated consumers.

Overall, the existing literature on promoting healthier purchases in supermarkets has been conducted in middle-class areas among educated consumers and leveraged the health attributes of products or used price discounts (10, 21, 31). Such interventions may be costly to sustain and ineffective in low-income, high-minority areas where economic concerns trump nutritional ones (11, 32). Little research has focused on enhanced placement strategies of healthier foods in low-income areas. Such methods, if effective, require negligible incremental cost to implement and are not based on shoppers placing high value on nutritional attributes.

The purpose of this study was to evaluate, in a cluster-randomized, controlled trial design, the effects of in-store marketing strategies to promote the purchase of specific healthier items. The strategies focused on placement and product availability and targeted 5 food and beverage categories (milk, ready-to-eat cereal, frozen meals, in-aisle beverages, and checkout cooler beverages).

SUBJECTS AND METHODS

Study setting and dates

This study was conducted in 8 urban supermarkets located in low-income, high-minority neighborhoods in Philadelphia, PA, and Wilmington, DE (which is adjacent to the Philadelphia metropolitan area). The baseline period was from September 2011 to November 2011, and the intervention period was from November 2011 to May 2012.

Stores

Supermarkets were the unit of randomization, intervention, and analysis. Two chains were approached about the study: Brown's Super Stores Inc (Shoprite) (n = 11 stores) and The Fresh Grocer (n = 8 stores). On the basis of statistics from Policy Map (33) and the US Census (34), 8 stores (4 in each chain) met the following eligibility criteria: located in a low- to moderate-income census tract, located in an area of below-average supermarket density, or located in an area having a supermarket customer base with >50% living in a low-income census tract (35). All stores were located in urban, high-minority, low-income neighborhoods. Characteristics of the 8 enrolled supermarkets are described in **Table 1**. This study was approved by the institutional review boards at Temple University and the University of Pennsylvania.

Category and product selection

Categories

To determine which product categories would be selected for the study, we reviewed the preceding year's sales data for the top 15 selling products in 11 common food and beverage categories from the 8 participating stores. The categories were selected with input from the grocers based on feasibility of making placement changes, existence of healthier (lower calorie) items in the category, and high sales volume. The 11 categories included ready-to-eat cereal, milk, frozen meals, beverages, canned pasta, ice cream, ground meat, salty snacks, frozen pizza, prepacked child lunches, and sliced bread.

Products

The research team developed 5 criteria for identifying healthier products within each category that would be targeted for in-store marketing interventions. Recommended products had to *1*) have fewer calories per fixed amount [ie, 1 cup of cereal

TABLE 1
Store characteristics[1]

	Store size[2]	Sales EBT (WIC and SNAP)	Household income <$25,000[3,4]	Minority[3,4]	Hispanic[3,4]
	square feet	%	%	%	%
Chain A stores					
Intervention 1	60,000	25.5	47	99	4.5
Control 1	57,000	18.2	27	85	2
Intervention 2	40,000	17.2	39.5	91	2
Control 2	55,000	19.2	36	49	4
Chain B stores					
Intervention 3	52,000	45	47	96	2
Control 3	50,000	37	44	92	2
Intervention 4	46,000	29	56	71	9
Control 4	44,000	58	40	58	19
Average					
Intervention stores	49,500	29.2	47	89	5
Control stores	51,500	33.1	37	71	7

[1] EBT, electronic benefit transfer; SNAP, Supplemental Nutrition Assistance Program; WIC, Women, Infants, and Children benefits.
[2] Conversion factor: 1 square foot = 0.09 square meters.
[3] Within a 1-mile (~1.6-km) radius of store (28).
[4] From reference 29.

(125 g), 8-fluid-ounce beverage (236.6 mL)] than other high-volume products in the category (calories); *2*) be a popular, high-volume product (typically a top-10 seller in the product category) (sales); *3*) be made by a national manufacturer to facilitate scalability and accessibility nationally after the study (manufacturer); *4*) be cost neutral or cost less for the consumer and profit-neutral or more profitable for grocers compared with other top-selling products in the category (cost/profit); and *5*) be commonly consumed by families with children (family focus). All product information regarding the 5 criteria was obtained from the product packages or discussions with the grocers (ie, senior management of the participating chains). Caloric information was sourced from the nutritional labels on packages, and the manufacturer's names were found on the fronts of the packages. Sales data for the preceding year, profit margin data, and nonsale prices of products were obtained from the grocers. Discussions with the grocers helped to identify family-friendly products.

On the basis of above criteria and further review of the sales data, 4 of the 11 product categories had top-selling, price-equivalent, lower-calorie, family friendly products that could be targeted and recommended: *1*) milk, *2*) ready-to-eat cereal, *3*) beverages (split into in-aisle beverages and checkout cooler beverages for the intervention), and *4*) single-serving frozen meals. The other 7 categories did not have a top-selling lower-calorie product, the caloric difference among products was negligible, or the lower-calorie products were substantially more expensive. The specific recommended products for the targeted product categories are listed in **Table 2**.

Focus groups ($n = 6$ groups, 57 participants; 82% female, 95% African American) were conducted with primary shoppers of households with at least one child younger than 18 y. Questions addressed purchase decision making, brand loyalty, food and beverage preferences, nutritional knowledge, and acceptance or reluctance to change food and beverage purchases. The focus group discussions confirmed our initial impressions about shoppers' habits and the information provided by store managers about their customers. The focus groups also confirmed the acceptability and feasibility of promoting the recommended products in the targeted categories. Many participants reported being receptive to trying the targeted healthier options, and preferred the healthier cereals and frozen dinners. Price, taste, and children's preferences were noted as top motivators for their shopping habits. In addition, we had discussions with the national manufacturers of the targeted products (eg, ConAgra Foods, Post, Mid-Atlantic Dairy, General Mills) to obtain their input and insights about in-store marketing techniques that would be low-cost and sustainable.

Randomization

Eight supermarkets (4 from each chain) were divided into 4 matched pairs (with each store in a pair from the same chain) based on the stores' square footage and the percentage of subsidized sales (electronic benefit transfer; Supplemental Nutrition Assistance Program, and Women Infants and Children benefits) (Table 1). The randomization allocation sequence was created by a statistician and implemented by a research coordinator. Within each pair, the stores were randomly assigned to intervention or control.

Intervention

Intervention stores

Intervention stores ($n = 4$) received a 6-mo intervention to increase the purchase of recommended healthier items in 5 food and beverage categories. The intervention consisted of 4 major marketing strategies used across all categories, with placement as the dominant strategy and promotion as the secondary strategy. Strategies included *1*) multiple facings: increased the number of facings of the recommended products; *2*) prime placement: placed recommended products at arm/eye level and in the middle of the category aisle and reordered types of milk so that 2% milk was located on the left-hand side of the dairy case followed by 1%, skim and then whole milk; *3*) signage: placed call-out signs with the recommended product's name and price, and shelf runners below recommended products; and *4*) secondary placement: mimicked shelf strategies (1 and 2) in all secondary placements (end caps, dead space stacks, etc). In addition, other strategies were used as appropriate to the category, including *5*) cross promotion (cereal and beverages only): displayed recommended products in 2 product categories together, through dead space stacks and end caps (eg, cereal and bananas, soda and water); and *6*) taste-testing (milk only): offered free samples of recommended products to increase

TABLE 2
Targeted products

Category	Recommended products
Milk[1]	2%, 1%, skim
Cereal[2]	Cheerios (plain) and Honeycomb
Frozen meals[3]	Banquet individual dinners (Salisbury steak, turkey dinner, chicken nugget meal)
In-aisle beverages[4]	Diet Pepsi, Aquafina water
Checkout cooler beverages[5]	Zero-calorie soft drinks and water

[1] The brand of milk sold at The Fresh Grocer was LeHigh Valley. The brand of milk sold at Brown's Super Stores Inc was ShopRite.

[2] Cheerios cereal was manufactured by General Mills. Honeycomb cereal was manufactured by Post.

[3] Banquet individual dinners were manufactured by ConAgra Foods.

[4] Diet Pepsi and Aquafina water were manufactured by PepsiCo Inc.

[5] Checkout coolers contained a variety of beverages from national manufacturers, including PepsiCo, Canada Dry, Dr Pepper Snapple Group, The Coca-Cola Company, Red Bull, Arizona Beverages Company, and Minute Maid.

TABLE 3
Intervention strategies

Category	Marketing strategy					
	Multiple facings[1]	Prime placement	Signage[2,3]	Taste-testing	Secondary placements[4]	Cross-promotion
Milk	Reduce the number of whole-milk facings by 30% and re-appropriate equally between skim, 1%, and 2% milk (eg, in the gallon section, if whole milk has 9 facings, take 3 facings away and give 1 to 2%, 1 to 1%, and 1 to skim)	Change the order of the milk presentation in the dairy case, resulting in whole milk to the far right and 2% milk in the prime placement (eg, left to right, from whole, 2%, 1%, and skim to 2%, 1%, skim, whole)	Display call-out signs for 1 targeted milk each month, rotating products	Provide free tastings of 2%, 1%, and skim milk on 1 d each month	Secondary placements (grab n' go entrance cases) should follow facing and placement strategies	NA[5]
			Place shelf runners on back of shelves			
Frozen meals	Give the targeted products double the number of facings (eg, if most frozen meals have 1 facing each, give the recommended products 2 facings)	Place the targeted products at eye level, on the middle 2 shelves, with one facing of each product on each shelf, facings vertically in line (eg, 1 facing on shelf 2 and 1 facing directly below on shelf 3)	Display call-out signs for all of the targeted products each month	NA	In end caps, targeted products should follow the facing and placement strategies	NA
	Have the targeted products front-facing (full front of package facing outward); place all other products lying down		Place shelf runners on front of shelves			
Ready-to-eat cereal	The number of facings for the targeted products should be ≥ the current dominating (most popular in sales, most facings) cereal within brand (eg, Cocoa Pebbles dominates sales for Post and has 3 facings, Honeycomb should have 3–4 facings)	If the targeted products' brands are side by side, place the targeted products at the end of their brand's section, so that the targeted products are side by side	Display call-out signs for all of the targeted products each month	NA	Targeted products should compose one-third of their brand's end cap presence	Cross promotion with produce and milk (eg, a stack of Cheerios by the bananas and milk)
		Place the recommended products at adult eye level, on the second shelf down	Place shelf runners on front of shelves			

(Continued)

TABLE 3 (*Continued*)

Category	Marketing strategy					
	Multiple facings[1]	Prime placement	Signage[2,3]	Taste-testing	Secondary placements[4]	Cross-promotion
In-aisle beverages	Reduce the number of full-calorie facings by 30% and re-appropriate the facings to the diet version (eg, if there are 32 facings of Pepsi 2 L, replace 14 of those facings with Diet Pepsi)	Place the targeted product in the middle of the full calorie product, at eye level (eg, divide the Pepsi facings with the Diet Pepsi facings: left to right, shelf should be 5 facings of Pepsi, 7 facings of Diet Pepsi, and 5 facings of Pepsi)	Display call-out signs for all targeted products each month Place shelf runners on front of shelves	NA	End caps and dead-space stacks should have 50% of the facings devoted to the targeted products	Place dead-space stacks of water in beverage aisle by the soda section
Checkout coolers	Have an equal number of full-calorie and reduced-calorie facings	Place water on the top shelf and diet beverages on the middle 2 shelves	NA	NA	NA	NA

[1] Facings refers to how many fronts of packages are visible on the shelf.

[2] Signs used the template the store used and highlighted product name and price.

[3] Shelf runners are channel molding, which should match the color of the product label (eg, yellow tape below the Cheerios) and be below the targeted products only. Molding tape serves to highlight the products (cereal, frozen meals, and beverages) and guide stocking (milk).

[4] End caps are built-in displays of products at the end of the aisles; dead-space stacks are free-standing displays of products that can be anywhere in the store.

[5] NA, not applicable.

shoppers' exposure to healthier options (1 d/mo for 2–3 h). It is important to note that the strategies were "stealth" with regard to health or nutrition claims, there were no prompts to buy one product instead of another, and there were no reductions in the price of the targeted products. The overall approach was to simply increase the visibility of, and access to, healthier options through increased number and optimal placement of the recommended products, signage, and taste-testing. The specific strategies used for each product category in the intervention stores are described in **Table 3**.

The intervention strategies were developed in consultation with supermarket operators and managers and were implemented by store staff, rather than the research team. Planograms, which are visual representations of where specific products are placed on the supermarket shelves, were created for each category and store to promote consistency through the intervention period.

Control stores

Control stores (n = 4) received no intervention and served as assessment-only controls. These stores controlled for both the presence/absence of intervention and seasonal fluctuations in sales (36).

Main outcome measures

Sales data

Grocers provided weekly sales data for each of the targeted products. The data included units sold of all targeted products. All sizes of the targeted products were included.

Implementation assessment

The degree to which the intervention was implemented as intended over the 6-mo period in the 4 intervention stores was assessed by unannounced weekly visits to the store by research staff. During each visit, trained research staff completed standard monitoring forms that assessed compliance with each marketing strategy across targeted product categories. This included recording placement, number of facings, and signage for each of the recommended products. A composite score for compliance across all components was calculated for each targeted product from each weekly assessment, with a possible range of 0% to 100%.

Statistical analysis

Our primary outcome measure was weekly sales per store in each targeted product category. We compared the mean weekly sales of the preintervention period with the mean weekly sales of the during-intervention period for the intervention stores and separately for the control stores. In addition, we tested whether the changes in sales from before to during the intervention differed by treatment group. For milk, in-aisle beverages, checkout cooler beverages, and cereals, the outcome was the total volume sold of each product (in ounces), whereas for frozen meals the measure was total units sold. The distribution of each of the outcomes was right-skewed, so a log transformation was used to approximate normality. Linear mixed-effects models were fit by using SAS Proc Mixed (SAS Institute) to assess for differences in weekly sales. Each model included fixed effects for intervention group (intervention compared with control), time period (preintervention compared with during intervention), and the interaction between these 2 main effects (ie, time-by-treatment interaction). The interaction allowed us to test whether the difference between the sales during intervention compared with during preintervention differed for intervention stores and control stores. In addition, a random effect for store was included by using an unstructured covariance structure, which accounted for the repeated weekly sales measurements.

To determine at what point during the intervention a significant change in sales was identifiable between treatment and control stores, descriptive graphs were created examining the weekly differences in mean sales between intervention and control stores, with 95% CIs for the difference plotted. If a CI excluded 0, it indicated a significant difference between stores at that week. We used a P value <0.05 to assess statistical significance. All analyses were performed by using SAS version 9.3 (SAS Institute).

RESULTS

Intervention implementation

All 8 stores completed the intervention and the follow-up assessments. During the intervention, the mean compliance score was 73% (**Table 4**). Interventions for the milk, cereal, and frozen meal categories had scores of ~90% compliance, whereas compliance scores for in-aisle beverages and checkout cooler beverages were ~50%. The overall compliance scores across stores were relatively consistent (64–85%).

Weekly sales data

The sales data for each of the recommended products in the 5 targeted product categories are shown in **Table 5**.

TABLE 4
Percentage intervention implementation compliance scores by product category at intervention stores (n = 4 stores, 24 weekly measures/store)

	Milk	Cereal	Frozen meals	In-aisle beverages	Checkout cooler beverages	Overall
	%	%	%	%	%	%
Store 1	90.1 ± 14.5[1]	90.5 ± 6.9	93.6 ± 11.2	19.4 ± 13.4	38.8 ± 10.5	66.5 ± 34.8
Store 2	86.9 ± 15.3	92.6 ± 12.2	72.8 ± 21.3	26.7 ± 11.0	41.3 ± 14.9	63.7 ± 28.8
Store 3	96.7 ± 6.3	95.3 ± 4.9	88.3 ± 13.2	84.5 ± 7.8	60.1 ± 10.6	85.0 ± 14.8
Store 4	92.3 ± 12.2	85.0 ± 10.9	91.7 ± 11.5	82.7 ± 10.7	26.8 ± 7.0	75.3 ± 27.7
Average	91.5 ± 4.1	90.4 ± 4.4	86.6 ± 9.5	53.3 ± 35.0	41.8 ± 13.8	72.6

[1] Mean ± SD (all such values).

TABLE 5
Change in sales of targeted products

Product and store type	Preintervention[1]	During intervention[1]	Change[1]	Statistics[2]		
				t	*P* (within group)	*P*-interaction
Milk (total oz)[3]						
Whole milk						
Intervention stores	121,398.5 ± 23,915.2	109,492.3 ± 21,516.7	−11,906.2 ± 3767.0	−4.10	<0.0001	
Control stores	113,458.6 ± 22,351.1	105,463.0 ± 20,724.9	−7995.6 ± 3200.0	−2.90	0.0039	
Intervention vs control			−3910.6 ± 4942.7	−0.85		0.6658
2% Milk						
Intervention stores	111,706.2 ± 21,242.6	103,703.0 ± 19,688.5	−8003.2 ± 2640.4	−3.75	0.0002	
Control stores	96,806.5 ± 18,409.2	91,221.2 ± 17,318.8	−5585.3 ± 2159.3	−3.00	0.0029	
Intervention vs control			−2417.9 ± 3410.9	−0.53		0.5505
1% Milk						
Intervention stores	27,346.2 ± 10,212.9	28,449.7 ± 10,614.6	1103.5 ± 933.1	1.31	0.1909	
Control stores	21,135.1 ± 7893.2	18,855.4 ± 7034.9	−2279.7 ± 1048.8	−3.78	0.0002	
Intervention vs control			3383.2 ± 1403.8	3.60		0.0014
Skim milk						
Intervention stores	15,957.6 ± 7076.5	15603.6 ± 6912.9	−354.0 ± 580.0	−0.64	0.5251	
Control stores	11,596.8 ± 5142.7	9733.7 ± 4312.4	−1863.1 ± 910.9	−4.97	<0.0001	
Intervention vs control			1509.1 ± 1079.9	3.06		0.0078
Cereal (total oz)[4]						
Cheerios						
Intervention stores	1608.6 ± 319.2	1393.9 ± 269.2	−214.7 ± 134.6	−1.71	0.0873	
Control stores	1433.4 ± 284.5	1056.1 ± 203.9	−377.2 ± 130.4	−3.65	0.0003	
Intervention vs control			162.6 ± 187.4	1.37		0.3905
Honeycomb						
Intervention stores	290.8 ± 100.0	293.0 ± 97.6	2.2 ± 45.8	0.05	0.9609	
Control stores	201.7 ± 69.4	162.9 ± 54.2	−38.8 ± 32.2	−1.36	0.1744	
Intervention vs control			41.0 ± 55.9	1.00		0.2271
Single-serve frozen meals (total units)						
Banquet Salisbury steak						
Intervention stores	89.5 ± 12.5	97.4 ± 12.3	7.9 ± 10.1	0.78	0.4367	
Control stores	61.6 ± 8.6	59.0 ± 7.4	−2.6 ± 6.6	−0.39	0.6960	
Intervention vs control			10.5 ± 12.1	0.83		0.6503
Banquet chicken nuggets						
Intervention stores	51.5 ± 14.0	66.9 ± 17.4	15.4 ± 9.1	1.81	0.0714	
Control stores	34.8 ± 9.5	29.7 ± 7.7	−5.1 ± 5.0	−1.09	0.2756	
Intervention vs control			20.5 ± 10.4	2.05		0.0074
Banquet turkey dinner						
Intervention stores	41.0 ± 8.3	45.3 ± 8.7	4.3 ± 5.0	0.85	0.3977	
Control stores	30.6 ± 6.2	24.1 ± 4.6	−6.5 ± 3.5	−2.03	0.0427	
Intervention vs control			10.8 ± 6.2	2.04		0.0326
In-aisle beverages (total oz)[3]						
Pepsi						
Intervention stores	33,864.0 ± 7690.7	39,845.3 ± 8693.7	5981.3 ± 4331.6	1.41	0.1582	
Control stores	32,620.3 ± 7408.2	41,308.1 ± 9012.8	8687.8 ± 4506.4	2.05	0.0408	
Intervention vs control			−2706.5 ± 6250.6	−0.45		0.8793
Diet Pepsi						
Intervention stores	5542.5 ± 1923.7	6187.5 ± 2112.8	645.0 ± 690.3	0.97	0.3327	
Control stores	4524.4 ± 1570.3	5676.4 ± 1938.3	1152.0 ± 682.2	2.00	0.0463	
Intervention vs control			−507.0 ± 970.5	−0.73		0.2905
Aquafina						
Intervention stores	7675.9 ± 9793.5	5250.9 ± 6617.9	−2425.0 ± 3920.6	−1.05	0.2955	
Control stores	5554.4 ± 7086.7	1439.4 ± 1814.1	−4115.0 ± 5371.1	−3.73	0.0002	
Intervention vs control			1690.0 ± 6649.8	1.89		0.0109
Checkout cooler beverages (total units)						
Regular						
Intervention stores	184.7 ± 27.9	154.6 ± 23.1	−30.1 ± 7.7	−4.90	<0.0001	
Control stores	132.6 ± 20.0	116.0 ± 17.4	−16.5 ± 5.2	−3.68	0.0003	
Intervention vs control			−13.5 ± 9.3	−0.87		0.6173
Low calorie						
Intervention stores	73.2 ± 20.4	67.4 ± 18.7	−5.8 ± 3.3	−2.05	0.0411	

(Continued)

TABLE 5 (*Continued*)

Product and store type	Preintervention[1]	During intervention[1]	Change[1]	Statistics[2]		
				t	*P* (within group)	*P*-interaction
Control stores	55.2 ± 15.4	47.9 ± 13.3	−7.3 ± 2.9	−3.53	0.0005	
Intervention vs control			1.5 ± 4.4	1.05		0.2219
Water						
Intervention stores	80.0 ± 18.5	87.9 ± 20.1	7.9 ± 4.6	1.86	0.0637	
Control stores	63.1 ± 14.6	52.5 ± 12.0	−10.6 ± 3.9	−3.63	0.0003	
Intervention vs control			18.5 ± 6.0	3.88		0.0002

[1] Mean ± SE (all such values).

[2] Statistical testing: Linear mixed effects models were used to assess for differences in weekly sales. Each model included fixed effects for the intervention group (intervention vs control), time period (preintervention vs during intervention), and interaction between these 2 main effects (ie, time-by-treatment interaction). The interaction tested whether the difference between the sales during intervention vs preintervention differed for intervention stores vs control stores. A random effect for store was included by using an unstructured covariance structure, which accounted for the repeated weekly sales measurements.

[3] Conversion factor: 1 oz = 29.6 mL.

[4] Conversion factor: 1 oz = 28.5 g.

Milk

Milk sales generally declined over the 6-mo intervention period. In the intervention stores, however, skim milk sales remained relatively stable, whereas sales declined significantly ($P = 0.0078$ for time-by-treatment interaction) in control stores, and sales of 1% milk improved significantly in intervention stores as compared with control stores ($P = 0.0014$ for time-by-treatment interaction). No significant differences were found between intervention and control stores in the amount of whole or 2% milk purchased.

Cereal

Overall, the sales of the 2 targeted cereals were relatively stable over the intervention period, and no significant differences were found between intervention and control stores.

Frozen meals

Intervention stores had increased sales compared with decreases in the control stores for 2 of the 3 targeted frozen meals, turkey dinner and chicken nugget ($P = 0.0326$ and 0.0074, respectively). For turkey dinner frozen meals, there was a significant decrease in the number of units sold in the control stores and no significant change in the intervention stores. For the frozen chicken nugget dinner, there was a nonsignificant decrease in sales in control stores, a nonsignificant increase in intervention stores, and a significant time-by-treatment interaction favoring the intervention stores. No differences were found between the intervention and control stores in sales over time for the third targeted meal, Salisbury steak.

In-aisle beverages

No differences were found between the intervention and control stores in the sales of in-aisle regular or diet versions of the targeted Pepsi product (PepsiCo). Sales of water in the aisle decreased in both the control and intervention stores; however, the decrease was less in the intervention stores ($P = 0.0109$).

Checkout cooler beverages

Of the 3 types of beverage cooler products analyzed (regular products, diet or low-calorie products, and water), the only difference between groups was in water sales. Water sales increased in the intervention stores and were significantly different from control stores ($P = 0.0002$), which showed declines over time.

DISCUSSION

There were several principal findings from this study. The first is that simple placement and product availability strategies were able to significantly influence the purchase of healthier items in the milk categories. Specifically, intervention stores had greater sales of 1% milk than did control stores and a smaller decrease in sales of skim milk than control stores. This was achieved with an intervention strategy that decreased the availability of whole milk by 30% and increased the remaining categories by 10%. The size of the effect per week in the milk category was ~24 gallons for skim and 53 gallons for 1%. These differences, when compared with the most frequently consumed milk in these stores (whole), would result in an energy deficit of 11,520 kcal/store per week (skim) and 21,200 kcal/store per week (1%), respectively. Whereas the results may appear modest per store, the public health effect, if implemented broadly over time, is quite significant and, in this example, totaled >785,000 calories in 6 mo.

Second, the intervention had a significant effect on the purchase of lower-calorie frozen meals. Similarly, intervention stores showed increased sales of 2 of the 3 targeted lower-calorie frozen meals. This result was achieved by a simple change in stacking from horizontal to vertical for the desired products and by increased prime placement at eye level. The absolute effect was quite modest, however, which resulted in 2 more frozen meals per week per store in intervention than in control stores. Nonetheless, the purchase of such items may increase consumers' exposure and eventual adoption of lower-calorie, already top-selling items in this product line that is competitively priced for low-income populations. Of note, the third targeted lower-calorie frozen meal was the highest selling type of frozen meal

in all sales, which may explain why no relative change was seen in the intervention stores.

Third, no differences were found between the intervention and control stores in the sales of regular or diet versions of the targeted products, either in the soda aisle or at the checkout coolers. However, in both locations, the sales of the targeted water product declined significantly less in the intervention stores than in the control stores. Part of the difficulty in changing the consumption of diet compared with regular versions of the targeted product may have been attributable to the lower implementation levels for the beverage category (~50%). Observations suggested that this resulted from the products being stocked by product employees rather than store employees, which made store-level implementation more difficult to manage. It is also possible that, even in the context of 100% implementation of the strategies, low-income, high-minority samples may be hesitant to consume diet beverages. Our data suggest that it may be easier to target water rather than diet products as a substitution for higher-calorie beverages.

Fourth, the intervention had no effect on increasing the sales of the desired cereal items. The reasons for this are unclear but may have resulted from a greater brand loyalty in the cereal group and fewer impulse purchases, which might have been affected by our interventions (37).

This study had several strengths. It was the first randomized controlled trial, to our knowledge, to focus on in-store placement and promotion strategies intended to affect sales of healthier products in supermarkets in low-income, high-minority neighborhoods. Given the considerable state and federal funding dedicated to increasing supermarket access in low-income neighborhoods (38), we believe that such data are useful for assessing strategies that may influence the purchase of healthier items among those at greatest risk of obesity and its comorbidities. In addition, this study used methods developed in collaboration with grocers to facilitate scalability and sustainability. The methods used in this study did not require any additional staff or price-discount subsidies. The intervention changes were accomplished by asking store staff to make slight alterations to the stocking patterns of the desired products. Finally, the study used objective and direct measures of sales rather than relying on self-reported purchases.

The study also had several limitations, including a relatively small sample size (8 stores), the inability to evaluate the effect of the interventions on subsidized sales to shoppers receiving food assistance, and lower than ideal implementation within the 2 beverage product categories. Another limitation to the intervention was that marketing approaches that were chain-wide, such as newspaper advertising and store circulars, could not be manipulated because stores were the unit of randomization. It is also possible that there was heterogeneity in marketing execution across stores; this is a risk of field experiments, but can be controlled by randomization and offset by the advantage of potential generalizability and scalability. Whereas randomization controlled for factors that are identical between conditions (eg, seasonality) (36), it is possible that the between-group differences may not be generalizable to another season. Lastly, price reductions, which might have increased the magnitude of intervention effects (19, 20), were not tested in this study.

In summary, these data indicate that low-cost scalable strategies focused on increased product availability, and optimal placement can enhance the purchase of healthier items in low-income, high-minority supermarkets. They also suggest that some categories (milk, water, frozen meals) may be more amenable to change than others (regular soda, diet soda, and cereal). This first of its kind study awaits replication in larger and longer-term studies. More intensive ways to implement the interventions should also be explored.

The authors' responsibilities were as follows—GDF, AK, ACW, ED, SW, JB, CS, and KG: designed the research; ACW, ED, and SW: conducted the research; GDF, AK, JB, CS, DL, PJB, and KG: provided the essential materials; CB, AT, and WG: analyzed the data; GDF, AK, ACW, ED, SW, and KG: wrote the manuscript; and GDF: had primary responsibility for the final content. All authors read and approved the final manuscript. During the time of the study, GDF served on the scientific advisory boards of the United Health Group, ConAgra Food, and Tate & Lyle. GDF is currently the Chief Scientific Officer at Weight Watchers International. JB is an owner of Brown's Super Stores Inc. PJB is an owner of The Fresh Grocer. None of the other authors declared any conflicts of interest.

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