Nutrition; Health Promoting Community Design

Environmental Intervention in Carryout Restaurants Increases Sales of Healthy Menu Items in a Low-Income Urban Setting

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Abstract

Purpose. *To investigate how a pilot environmental intervention changed food sales patterns in carryout restaurants.*

Design. *Quasi-experimental.*

Setting. *Low-income neighborhoods of Baltimore, Maryland.*

Subjects. *Seven carryouts (three intervention, four comparison).*

Intervention. *Phase 1, menu board revision and healthy menu labeling; phase 2, increase of healthy sides and beverages; and phase 3, promotion of cheaper and healthier combination meals.*

Measures. *Weekly handwritten menu orders collected to assess changes in the proportion of units sold and revenue of healthy items (entrée, sides and beverages, and combined).*

Analysis. *Logistic and Poisson regression models with generalized estimating equations.*

Results. *In the intervention group, odds for healthy entrée units and odds for healthy side and beverage units sold significantly increased in phases 2 and 3; odds for healthy entrée revenue significantly increased in phase 1 (odds ratio [OR] 1.16, 95% confidence interval [CI] 1.08–1.26), phase 2 (OR 1.32, 95% CI 1.25–1.41), and phase 3 (OR 1.39, 95% CI 1.14–1.70); and odds for healthy side and beverage revenues increased significantly in phase 2 (OR 1.62, 95% CI 1.33–1.97) and phase 3 (OR 2.73, 95% CI 2.15–3.47) compared to baseline. Total revenue in the intervention group was significantly higher in all phases than in the comparison group ($p < .05$).*

Conclusion. *Environmental intervention changes such as menu revision, menu labeling, improved healthy food selection, and competitive pricing can increase availability and sales of healthy items in carryouts. (Am J Health Promot 2015;29[6]:357–364.)*

Key Words: Menu Labeling, Restaurants, Intervention, Prepared Food Sources, Low-Income, Urban, Environmental Approaches to Obesity, Point of Purchase, Prevention Research. Manuscript format: research; Research purpose: intervention testing/evaluation, Study design: quasi-experimental; Outcome measure: behavioral, financial; Setting: community; Health focus: nutrition; Strategy: multiphased environmental intervention; Target population age: adults; Target population circumstances: low-income African-Americans in Baltimore, Maryland

INTRODUCTION

Americans consume approximately one-third of their total calories from foods obtained away from home.[1,2] A large proportion of foods eaten away from home (76.8%) consists of prepared foods purchased at fast-food restaurants and carryouts (nonfranchised food establishments that sell ready-to-eat food and beverages for off-premises consumption).[3] Prepared foods are typically more calorically dense and higher in fat[4] and have been associated with increased body mass index and weight gain.[5–7] Low-income urban populations are disproportionately exposed to prepared food sources.[8–11] Low-income individuals spend a greater percentage of their food dollars at fast-food restaurants and carryouts than high-income individuals (54% vs. 37%).[11] Although a growing body of research has examined consumer behavior at franchised fast-food restaurants,[12,13] little attention has focused on nonfranchised fast-food restaurants such as carryouts.

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This study focuses on the city of Baltimore, where more than three-quarters of prepared food sources in low-income areas are carryout restaurants,[3] and one-third of the population has an annual household income of less than $25,000.[14] Moreover, 20% of residents live in food deserts (defined as "the distance to a supermarket is more than one-quarter mile; the median household income is at or below 185% of the Federal Poverty Level; over 40% of households have no vehicle available; and the average Healthy Food Availability Index score for stores is low, measured using the Nutrition Environment Measurement Survey"[15]) and African-Americans in Baltimore are 3.7 times more likely to live in a food desert than whites (26% vs. 7%).[16] Palmer et al.[17] suggest that residents of Southwest Baltimore spent $280 per month at supermarkets and $153 at carryouts ($288 at all prepared food sources) per person.

Although some environmental trials focusing on point-of-purchase promotion (e.g., menu labeling, price reduction) have shown some impact on increasing sales of healthy options at prepared food sources,[18–22] only a few have focused on low-income urban settings.[23,24] The goal of this study was to investigate how a pilot environmental intervention—Baltimore Healthy Carryouts (BHC)—impacted healthy food sales and total revenue at carryouts. Based on earlier studies that found increased purchasing of healthful options[25] without negative impact on revenues or transactions,[26–28] we hypothesized that (1) the intervention would increase the proportion of healthy to unhealthy food items sold and total revenue from healthy items; and (2) the intervention would not affect total sales revenue.

METHODS

Baltimore Healthy Carryouts

Carryout Sampling. BHC was an 8-month trial conducted in eight carryouts (four intervention, four comparison) in Baltimore using a quasi-experimental study design. Intervention carryouts were selected based on three main criteria: owners' race/ethnicity, region of the city, and physical environment of carryouts. The study utilized a previously conducted environmental assessment[4] of prepared food source locations in low-income (i.e., <$30,000 annual household income) neighborhoods of Baltimore. We stratified this assessment by race/ethnicity of storeowners and region of the city (East vs. West Baltimore). Four intervention carryouts were randomly selected per stratum: one Korean-American and one African-American carryout in East and West Baltimore. Next, four comparison carryouts were matched for physical environment (e.g., presence of Plexiglas, lack of tables, etc.), principal types of food offered (e.g., fried chicken, sandwiches), healthy food availability,[4] and neighborhood characteristics (e.g., median income, percentage of African-American ethnicity). In order to avoid potentially contaminating the intervention effect, we selected matching control carryouts located at least 1 mile away from any intervention carryout.

Recruiting eight carryouts took approximately 6 months (August 2010–February 2011) that occurred concurrently with the formative research period. Recruitment teams (one program coordinator and one or two data collectors) visited selected carryouts and explained research objective to the owners using frequently asked questions (FAQ) sheets. When recruiting Korean-American carryouts, a Korean-speaking researcher performed the recruitment. Only one out of four carryouts decided to participate in the study on our initial attempt. The recruitment team focused on building rapport with the owners prior to discussing research participation. In these discussions, we emphasized positive aspects of the carryout such as some of the menu offerings, the interior/design, or their reputation as reported by community members. In a subsequent visit, we provided a FAQ sheet and asked carryout owners to review the information at their leisure and to contact the study staff if they had any questions. We made a third visit to discuss in-depth expectations for participation in the research project. The recruitment team reassured the carryout owners that participation was completely voluntary. Upon implementation of the new recruitment strategy, all newly attempted carryouts (n = 3) agreed to participate. Only one comparison carryout refused to participate. Including intervention and comparison carryouts, 66% (8 out of 12) of carryouts approached agreed to participate.

This study was conducted according to the Declaration of Helsinki and all procedures involving human subjects were approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board. Written informed consent was obtained from all carryout owners who participated in this study.

Intervention Strategies. Formative research from focus groups, customer and owner interviews, and conjoint analyses led to the development of intervention strategies.[24] The multiphase intervention included three intervention strategies (Table 1). Each phase lasted for 2 months. Each successive phase built on the previous phase.

Phase 1: Menu Revision and Labeling. In mid-February 2011, we focused on providing carryouts new menu boards that contained labeling placed next to the selected healthier menu items to encourage purchases of the item. Two dietitians conducted a menu analysis at each participating carryout to determine healthier versus less-healthy dishes. A healthy entrée was less than 600 kcal and 20 g fat and a healthy side was less than 200 kcal and 7 g fat.[24] On the menu boards, digital photos were taken of selected healthy food items and placed on the menu board to help promote them. Paper menus that were replications of the menu board were provided to carryouts for distribution. Point-of-purchase posters, indicating menu changes, were displayed alongside the new menu boards.

Phase 2: Healthy Sides and Healthy Beverages. In late April 2011, we focused on promoting already-existing healthy sides and beverages such as collards, corn, salads, broth-based soups, bottled water, and diet soda, as well as introducing new healthy sides such as yogurt, fruit cups, fresh fruits, and baked chips. Initial stocks of healthy sides were provided to carryouts to encourage future stocking. We projected that the initial stocks of healthy

Table 1
Description of Baltimore Healthy Carryouts Intervention Phases*

Phase	Phase Name	Description of Each Phase
1	Menu revision and labeling	• Replaced existing menu boards with new boards that emphasized healthy foods† with full-color photographs and menu labeling that indicated more-healthy items using leaf logo • Provided carryout with paper menus (replicating new board) for distribution • POP‡ posters indicated menu changes
2	Healthy sides and healthy beverages	• Promoted already-existing healthy sides using posters next to menu boards§ • Introduced cost-neutral, culturally appropriate healthy sides and beverages‖ • Provided initial stocks of healthy sides to encourage future stocking • POP‡ posters indicated healthy sides and beverages
3	Affordable healthy combination meals	• Promoted healthy combination meals¶ of equal or lesser price than original combination meals# • Added menu entrées using healthy food preparations (ex. grilled chicken instead of fried chicken) • POP‡ posters indicated affordable healthy combo meals

* Each phase lasted for 8 weeks.
† Definition of a healthy entrée, <600 kcal and <20 g of fat; a healthy side, <200 kcal and <7 g of fat; and a healthy beverage, water or diet soda.
‡ POP indicates point-of-purchase, referring to area surrounding the counter where customer makes payment.
§ Existing healthy sides and beverages included collard greens, corn, salad, soup, bottled water, and diet soda.
‖ Newly introduced healthy sides included baked chips, yogurt, fruit cup, bananas, and watermelon. These were defined by community members at formative research stage.
¶ Example of a healthy combination meal: a grilled chicken sandwich, a bag of baked chips, and a bottle of water. Example of a less-healthy combination meal: fried chicken wings (four count), a large order of French fries, and a jumbo soda.
# Carryout owners determined amount of price reduction, ranging from $0.35 to $2.50.

sides would last for no more than a week.

Phase 3: Affordable Healthy Combination Meals. In early July 2011, we focused on promoting healthy combo meals with price reduction and introducing healthy food preparation methods, for example, grilled chicken instead of fried chicken. A healthy combo meal included a healthy entrée, a healthy side, and a healthy beverage; for example, a grilled chicken sandwich, baked chips, and water would be grouped as a "grilled chicken sandwich combination meal." Carryout owners determined the amount of price reduction on the combination meals. The amount ranged from providing free baked chips ($.35 value) to discounting a combination meal up to $2.50 ($9.00 to $6.50). More detailed information on the development and implementation of the BHC intervention can be found elsewhere.[24]

Food Item Categories. Based on the foods offered for sale in the study carryouts, BHC developed a list that included a total of 47 healthy items and 119 less-healthy items.[24] Classification of entrées, sides, and beverages was easily determined through the menu analysis and communications with carryout owners. For example, all healthy sides and beverages (e.g., collards, fresh fruit, bottled water) and healthy entrées (e.g., grilled chicken sandwich, turkey sandwich) were aggregated. As for the unit sales, each order was counted as one. For example, one grilled chicken sandwich with one banana was counted as one healthy entrée and one healthy side, therefore two total healthy items sold. As for revenue, the dollar amount for healthy items were recorded and summed.

Data Collection and Management. All sales receipts were collected weekly, and total sales were tracked for all carryouts from February to September 2011. Sales receipts contained detailed information about food items purchased such as entrées, sides, and beverages, both in-person and over-the-phone orders, and cost of each item. Trained data collectors visited carryouts to retrieve sales receipts every week for 32 consecutive weeks, including baseline (4 weeks) and the intervention period (28 weeks). Carryout owners received a $25 gift card each week for collecting the receipts. One intervention carryout did not follow the sales receipt collection protocol and was excluded from the analysis. Sales receipts were entered into Excel (Microsoft, Redmond, Washington) by four research assistants. Ten percent of receipts were randomly selected each week and cross-checked by a fifth research assistant.

Statistical Analysis

To answer the first hypothesis, the statistical analysis focused on sales of (1) healthy entrées, (2) healthy sides and beverages, and (3) total healthy items (combination of health entrées, sides, and beverages). For each category of items, sales were measured by the number of items sold and the revenue from those items. For the number of items sold, the data were assumed to follow a binomial distribution: for instance, for a given carryout and phase, the count was the number of healthy entrées sold and the binomial total was the total number of entrées sold. Therefore, the mean for the number of items sold was the proportion of healthy entrées sold.

To answer the second hypothesis, the statistical analysis focused on sales of total items (healthy and otherwise) and sales were measured by the number of items sold and the revenue from total sales. The total revenues were rounded to the nearest dollar so that the values were integers. For the total sales, the data were assumed to

follow a Poisson distribution: for instance, for a given carryout and phase, the count was the revenue from total sales, and, to account for the fact that the carryouts differed in total revenue, the revenue from total sales from that carryout and phase of the intervention would be included in the analysis. Therefore, the exponentiated Poisson regression coefficient for the total revenue was the relative mean generated by sale of total items sold.

Descriptive statistics were calculated, including the mean and SE of the proportion of healthy food sales in units and revenue as well as the total units and revenue. Differences in the baseline monthly sales information between the intervention and comparison carryouts were analyzed using Wilcoxon rank sum test because of the skewness of the data.

To assess the impact of the intervention, logistic regression models using generalized estimates equations (GEEs) were used to estimate the relative change in the odds of healthy items sold or relative change in the proportion of revenue attributed to healthy item sales, comparing the intervention phases to baseline separately for the intervention and comparison carryouts. Specifically, the models included an indicator variable for the intervention group, indicator variables for the three intervention phases, and the interaction of these two sets of variables (intervention group × intervention phases).

Poisson models using GEEs were used to estimate the relative ratio (RR) of total items sold and RR of total revenue comparing the intervention phases to baseline separately for the intervention and comparison carryouts. All models accounted for repeated sales data within carryouts over time by assuming an exchangeable working correlation structure and including a robust variance estimate to account for deviations from this working correlation model. Sensitivity analysis was conducted without an outlier intervention carryout. Data were analyzed using STATA 12.0 (StataCorp LP, College Station, Texas). Statistical significance was set at a value of $p < .05$.

Table 2
Estimated Relative Odds and 95% CI of Healthy Entrées, Healthy Sides and Beverages, and Total Healthy Items Sold Comparing the Intervention Phases to Baseline Within Each of the Comparison and Intervention Groups*

	OR† (95% CI)		*p* for Intervention × Phase‡
	Comparison (n = 4)	Intervention (n = 3)	
Healthy entrées			
Baseline	Reference	Reference	
Phase 1	0.97 (0.71, 1.32)	1.07 (0.99, 1.17)	0.52
Phase 2	1.14 (0.85, 1.53)	1.20 (1.04, 1.38)	0.76
Phase 3	1.07 (0.67, 1.70)	1.20 (1.01, 1.43)	0.65
Healthy sides and beverages			
Baseline	Reference	Reference	
Phase 1	1.20 (1.14, 1.28)	1.01 (0.56, 1.83)	0.56
Phase 2	1.06 (0.90, 1.14)	1.94 (1.67, 2.24)	<0.0001
Phase 3	1.35 (1.27, 1.43)	3.96 (2.99, 5.24)	<0.0001
Total healthy items			
Baseline	Reference	Reference	
Phase 1	1.03 (0.82, 1.29)	1.08 (0.99, 1.16)	0.72
Phase 2	1.13 (0.91, 1.39)	1.23 (1.09, 1.39)	0.47
Phase 3	1.15 (0.81, 1.62)	1.29 (1.04, 1.62)	0.56

* CI indicates confidence interval; and OR, odds ratio.

† OR estimated using logistic regression models based on generalized estimating equations where the data for each carryout and phase is specified as a binomial distribution to account for the varying amount of sales within each carryout. For instance, for healthy entrées, the number of healthy entrées sold for a carryout in that phase is the response and the total number of entrées sold for that same carryout in that phase is the total number of trials. This provides a logistic model for the proportion of healthy entrées sold, and we compare the odds of healthy entrées sold for the baseline period and intervention phases. The logistic models include main effects for intervention phase, intervention, and the interactions.

‡ *p* values compare whether the estimated ORs are the same across the comparison and intervention group at each intervention phase. The overall tests for interaction in the healthy entrées, healthy sides and beverages, and total healthy items sold were 0.81, <0.0001, and 0.73, respectively.

RESULTS

Baseline

A total of 186,654 unit sales were collected over the study period. Total units sold were not statistically different between the intervention (958.9 ± 173.9) and comparison carryouts (939.5 ± 117.6) at baseline. However, the intervention carryouts had statistically greater proportion of revenue for healthy entrées (.38 ± .11) than the comparison carryouts (.10 ± .08) ($p < .02$). This was due to one intervention carryout that had a very large volume of healthy entrée sales. Proportion of units sales for healthy sides and beverages were less than 2% in both intervention and comparison groups ($p = .2$).

Change in Units Sold From Baseline

In the intervention group, the odds of healthy entrée units sold in phase 2 were significantly greater (odds ratio [OR] 1.20, 95% confidence interval [CI] 1.04–1.38), and the odds of healthy side and beverage units sold were 1.94 times greater in phase 2 (OR 1.94, 95% CI 1.67–2.24) and 3.96 times greater in phase 3 (OR 3.96, 95% CI 2.99–5.24) compared to baseline. In the comparison group, the odds of healthy side and beverage units sold were greater at phase 1 (OR 1.20, 95% CI 1.14–1.28) and phase 3 (OR 1.35, 95% CI 1.27–1.43), respectively, compared to baseline. In the intervention group, the odds of total healthy items sold at phase 2 and phase 3 were significantly greater than baseline, whereas no changes were found in the comparison group (Table 2).

The overall test for interaction was significant in the healthy side and beverage units sold ($p < .0001$) but not in the healthy entrées and total healthy

Table 3
Sensitivity Analysis Results for the Estimated Relative Odds And 95% CI of Healthy Entrées, Healthy Sides and Beverages, and Total Healthy Items Sold Comparing the Intervention Phases to Baseline Within Each of the Comparison and Intervention Groups*

	Comparison (n = 4) OR† (95% CI)	Intervention (n = 2) OR (95% CI)	*p* for Intervention × Phase‡
Healthy entrées			
Baseline	Reference	Reference	
Phase 1	0.97 (0.75, 1.26)	1.01 (0.93, 1.09)	0.75
Phase 2	1.15 (0.90, 1.46)	1.41 (1.02, 1.96)	0.32
Phase 3	1.09 (0.73, 1.64)	1.45 (1.19, 1.78)	0.22
Healthy sides and beverages			
Baseline	Reference	Reference	
Phase 1	1.20 (1.15, 1.26)	0.99 (0.67, 1.48)	0.35
Phase 2	1.06 (0.99, 1.14)	1.80 (1.79, 1.82)	<0.0001
Phase 3	1.35 (1.27, 1.43)	3.48 (3.04, 3.99)	<0.0001
Total healthy items			
Baseline	Reference	Reference	
Phase 1	1.03 (0.83, 1.27)	1.01 (0.97, 1.04)	0.86
Phase 2	1.13 (0.92, 1.39)	1.54 (1.16, 2.06)	0.09
Phase 3	1.15 (0.82, 1.62)	1.98 (1.86, 2.09)	0.002

* CI indicates confidence interval; and OR, odds ratio.
† OR estimated using generalized equation estimate regression model accounting for carryout clustering effect and repeated measure of sales data.
‡ *p* values compare whether the estimated ORs are the same across the comparison and intervention group at each intervention phase. The overall tests for interaction in the healthy entrées, healthy sides and beverages, and total healthy items were all <0.0001.

items sold (Table 2). Sensitivity analysis showed significant differences in the overall test for interactions in all three outcomes on units sold (healthy entrée, healthy sides and beverages, and total healthy items; all $p < .0001$) (Table 3).

There was no significant difference in the total units sold in each phase from baseline in the intervention group (RR_{phase1} 1.14, 95% CI .95–1.36; RR_{phase2} 1.14, 95% CI .97–1.33; and RR_{phase3} 1.12, 95% CI .93–1.36, respectively), whereas there was a significant decrease in the comparison group (RR_{phase1} 1.00, 95% CI .86–1.18; RR_{phase2} .84, 95% CI .79–.89; and RR_{phase3} .78, 95% CI .72–.85, respectively).

Change in Revenue From Baseline

In the intervention group, the odds of revenue from healthy entrées were significantly greater in all phases compared to baseline (OR_{phase1} 1.16, 95% CI 1.08–1.26; OR_{phase2} 1.32, 95% CI 1.25–1.41; and OR_{phase3} 1.39, 95% CI 1.14–1.70, respectively). The odds of revenue from healthy sides and beverages were 1.62 times greater in phase 2 (OR 1.62, 95% CI 1.33–1.97) and 2.73 times greater in phase 3 (OR 2.73, 95% CI 2.15–3.47). In the comparison group, the odds of revenue from healthy entrée sales were 1.31 times greater in phase 2 compared to baseline (OR 1.31, 95% CI 1.07–1.62) and significantly greater odds of revenue from healthy sides and beverages were found in phase 1 (OR 1.31, 95% CI 1.17–1.47) and phase 3 (OR 1.46, 95% CI 1.39–1.54), respectively. In the intervention group, combined revenue of healthy items at all phases was significantly greater, whereas only phase 2 was significant in the comparison group compared to baseline (Table 4).

The overall test for interaction was significant in the healthy sides and beverages revenue ($p < .0001$) but not in the healthy entrées and total healthy items revenue (Table 4). Sensitivity analysis showed significant differences in the overall test for interactions in all three outcomes for revenue (i.e., healthy entrées, healthy sides and beverages, and total healthy items; all $p \leq .001$) (Table 5).

The total revenue was significantly greater in the intervention group in all phases relative to baseline (RR_{phase1} 1.24, 95% CI 1.10–1.40; RR_{phase2} 1.25, 95% CI 1.09–1.44; RR_{phase3} 1.22, 95% CI 1.03–1.46, respectively). However, in the comparison group, total revenue significantly decreased relative to baseline (RR_{phase1} .97, 95% CI .83–1.15; RR_{phase2} .82, 95% CI .73–.91, RR_{phase3} .73, 95% CI .67–.79, respectively).

DISCUSSION

To our knowledge, this is the first pilot study to assess the impact of an environmental intervention at a prepared food source, carryout restaurants, in a low-income urban setting. Significant increases in units sold and revenue of healthy items in the intervention group suggest that structural changes in carryouts using menu revision and labeling, improved selection, and competitive pricing were effective. Moreover, the total revenues for the intervention group were significantly higher in all phases whereas comparison group revenues decreased over time. This suggests that the intervention was protective against overall revenue loss. Improvements in revenue were mainly due to increases in healthy item sales in the intervention group. Therefore, we were able to demonstrate that an environmental intervention was able to increase demand and sales of healthy food and beverage items. In other studies, an increase in sales was crucial to ensure a sustained supply of healthier foods.[29,30]

When the price reduction was introduced in phase 3, the odds of units sold and revenue of healthy entrées and sides and beverages were greater compared to baseline. These findings are consistent with other studies demonstrating the effectiveness of pricing interventions.[21,29] Horgen and Brownell[21] found that sales of promoted items were highest during a combined price reduction and healthy message intervention, but sales were higher

Table 4
Estimated Relative Odds and 95% CI of Healthy Entrées, Healthy Sides and Beverages, and Total Healthy Items Revenue Comparing the Intervention Phases to Baseline Within Each of the Comparison and Intervention Groups

	OR (95% CI)†		*p* for Intervention × Phase‡
	Comparison (n = 4)	Intervention (n = 3)	
Healthy entrées			
Baseline	Reference	Reference	
Phase 1	1.04 (0.88, 1.23)	1.16 (1.08, 1.26)	0.23
Phase 2	1.31 (1.07, 1.62)	1.32 (1.25, 1.41)	0.93
Phase 3	1.33 (0.91, 1.94)	1.39 (1.14, 1.70)	0.83
Healthy sides and beverages			
Baseline	Reference	Reference	
Phase 1	1.31 (1.17, 1.47)	0.87 (0.72, 1.05)	<0.0001
Phase 2	1.03 (0.92, 1.15)	1.62 (1.33, 1.97)	<0.0001
Phase 3	1.46 (1.39, 1.54)	2.73 (2.15, 3.47)	<0.0001
Total healthy items			
Baseline	Reference	Reference	
Phase 1	1.07 (0.92, 1.26)	1.16 (1.07, 1.26)	0.37
Phase 2	1.28 (1.07, 1.56)	1.34 (1.25, 1.44)	0.69
Phase 3	1.36 (0.97, 1.92)	1.44 (1.13, 1.83)	0.79

* CI indicates confidence interval; and OR, odds ratio.

† OR estimated using logistic regression models based on generalized estimating equations where the data for each carryout and phase are specified as a binomial distribution to account for the varying amount of sales within each carryout. For instance, for healthy entrées, the number of healthy entrées sold for a carryout in that phase is the response and the total number of entrées sold for that same carryout in that phase is the total number of trials. This provides a logistic model for the proportion of healthy entrées sold and we compare the odds of healthy entrées sold for the baseline period and intervention phases. The logistic models include main effects for intervention phase, intervention and the interactions.

‡ *p* values compare whether the estimated ORs are the same across the comparison and intervention group at each intervention phase. The overall tests for interaction in the healthy entrées, healthy sides and beverages, and total healthy item revenues are 0.41, <0.0001, and 0.83, respectively.

during the price reduction phase alone compared to the healthy message intervention alone. Michels et al.[29] reduced the price of healthy foods by 20% and observed a 6% increase in the consumption of healthy food items. However, both studies were conducted in a single location without comparison groups.

Contrary to the hypotheses, BHC found a significant increase in revenue from healthy sides and beverages in phases 1 and 3 in the comparison group. This may be due to seasonality, as the weather became warm and the demand for fresh fruits and beverages increased.[31,32] However, the magnitudes of the OR in the intervention group were far greater than those in the comparison group and the significant interaction term indicated that the change was associated with intervention rather than existing trends observed in comparison. Having a comparison group allowed the opportunity to control for secular and seasonal changes in customers' food purchasing behaviors independent of the intervention effect.

One of the intervention carryouts located alongside a major highway had larger business volume. To minimize bias, we compared proportion of healthy item sales that were adjusted for the total sales volume for each carryout. Moreover, we performed sensitivity analyses excluding the outlier carryout and found that the significant relationships became stronger. It is possible that the intervention was more effective at improving healthy item sales at carryouts where healthy item sales were rare. However, the overall effect consistently showed that the intervention group sold significantly more healthy items relative to baseline.

There are several limitations to this study. The study design applied new intervention strategies on top of preexisting ones; thus, we cannot tease out the effectiveness of each intervention phase alone. Therefore, the ORs for phases 2 and 3 should be considered with caution because we cannot differentiate whether or not impact is due to the introduction of phases 2 and 3, carryover effect of phase 1, or some combination of phases. BHC strategically used the most cost-effective and rapport-building strategy for the first phase and gradually implemented more resource-intensive phases. Second, the significant difference of dependent variables between the carryouts at baseline indicates nonequivalent comparison group assignment.[33] However, to minimize bias, we compared the proportion of healthy item sales relative to total sales volume to account for the variability between carryouts within group assignments. This study also used generalized estimate equations to account for the study design. Third, small sample size limits generalizability of our findings. However, as a pilot study, BHC demonstrated promising effects that warrant larger-scale investigation. Fourth, BHC provided more healthy food items to intervention carryouts, which provided greater chance to impact sales. Lastly, the definition of a healthy item was limited to calories and fat. This study simplified the menu analysis by focusing only on calories and fat using the free U.S. Department of Agriculture National Nutrient Database, which minimized the overall burden in analyzing nutrient contents of foods.[34]

The study has several strengths. First, BHC studied purchasing behavior in a real-world community setting, which maximizes the internal and external validity of our results. Second, calculation of sales was based on actual receipts rather than self-report. Third, BHC used a quasi-experimental study design with comparison groups and collected sales data longitudinally. Fourth, this is one of the first studies to look at sales patterns of nonfranchised fast-food restaurants, which are a key

Table 5
Sensitivity Analysis Results for the Estimated Relative Odds and 95% CI of Healthy Entrées, Healthy Sides and Beverages, and Total Healthy Items Revenue Comparing the Intervention Phases to Baseline Within Each of the Comparison and Intervention Groups

	Comparison (n = 4) OR† (95% CI)	Intervention (n = 2) OR (95% CI)	*p* for Intervention × Phase‡
Healthy entrées			
Baseline	Reference	Reference	
Phase 1	1.04 (0.88, 1.23)	0.99 (0.93, 1.06)	0.62
Phase 2	1.31 (1.06, 1.62)	1.33 (1.15, 1.53)	0.92
Phase 3	1.33 (0.91, 1.94)	1.38 (1.36, 1.40)	0.85
Healthy sides and beverages			
Baseline	Reference	Reference	
Phase 1	1.31 (1.17, 1.47)	0.98 (0.85, 1.13)	0.002
Phase 2	1.03 (0.92, 1.16)	1.97 (1.96, 1.98)	<0.0001
Phase 3	1.46 (1.39, 1.54)	3.44 (2.66, 4.46)	<0.0001
Total healthy items			
Baseline	Reference	Reference	
Phase 1	1.07 (0.92, 1.26)	0.99 (0.94, 1.05)	0.34
Phase 2	1.28 (1.06, 1.56)	1.40 (1.26, 1.55)	0.46
Phase 3	1.36 (0.97, 1.92)	1.58 (1.44, 1.75)	0.46

* CI indicates confidence interval; and OR, odds ratio.
† OR estimated using generalized equation estimate regression model accounting for carryout clustering effect and repeated measure of sales data.
‡ *p* values compare whether the estimated ORs are the same across the comparison and intervention group at each intervention phase. The overall tests for interaction in the healthy entrées, healthy sides and beverages, and total healthy items are 0.001, <0.0001, and <0.0001, respectively.

SO WHAT? Implications for Health Promotion Practitioners and Researchers

What is already known on this topic?

Low-income urban populations are disproportionately exposed to locally owned carryout restaurants that offer few healthy options. The limited research in this area suggests that changes to the food environment can impact purchases of prepared foods.

What does this article add?

To our knowledge, this is the first paper to track the impact of an environmental intervention at locally owned carryout restaurants. Also, the study design and statistical analysis approach allowed us to tease out, to some degree, the impact of different components of the intervention on sales. Assessing such outcomes is necessary for ensuring small businesses enroll in and sustain such public health interventions. Assessing sales helps store owners understand the incentive they may gain from environmental changes to their retail venue.

What are the implications for health promotion practice or research?

Environmental interventions are effective ways to improve healthy food availability in low-income settings. Increases in sales of healthy food items can be used as an incentive to encourage store owners to participate in future similar interventions.

source of food consumed away from home in urban areas.[7] Most importantly, this study was able to generate evidence that an environmental intervention at carryout restaurants in a low-income setting is feasible and led to increased total revenue at participating food outlets. Such findings may be crucial for future studies when recruiting owners who are concerned about their profits.

The results have important implications for future studies. The increase in sales of healthy foods in the intervention groups suggested that carryouts are a feasible venue for improving dietary habits and could potentially reduce obesity risk among low-income African-American adults. Moreover, increases in sales of healthy foods can be used as evidence when recruiting carryout restaurant owners who may be uncertain about adopting intervention strategies. Further studies should consider larger sample sizes, longer duration per phase, washout periods between phases, and longer study duration to take into account seasonal variability.

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