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Store and Restaurant Advertising and Health of Public Housing Residents

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Abstract

Objectives—To determine relationships between food and beverage signs and health.

Methods—In 12 public housing neighborhoods, food and alcohol signs were counted for stores and restaurants. Health and demographic data were from 373 adults.

Results—Multilevel modeling showed higher BMI was related to more store and restaurant alcohol signs, higher blood pressure, nonsmokers, and females. Higher dietary fat consumption was related to more store and restaurant alcohol and fewer low-calorie healthy signs, lower fruit consumption, fewer minutes walked, and white and Hispanic/Latino ethnicity.

Conclusions—Signs in stores and restaurants are related to BMI and dietary fat consumption among residents.

Keywords

advertising; body mass index; diet; public housing; walking

Advertising has the capacity to impact health through its influence on the selection and consumption of food and beverages.^{1,2} For example, exposure to food advertising on television (especially fast food or convenience foods) influences consumer choices toward higher-fat or higher-energy foods,³ contributing to the growing obesity epidemic.⁴

Television, radio, print, billboard, and Internet advertisements represent approximately 20% of the \$6 billion spent on food, beverages, and candy marketing; most advertising is in more nontraditional media such as point-of-purchase advertising and promotions, corporate event sponsorship, and other promotions.^{5,6} The balance of advertising toward nontraditional media suggests that it is an important medium for persuasion, yet its health effects have not been well described in the scientific literature.

Health-related behaviors, such as purchasing foods high in dietary fat, are best understood within the context of environmental settings.⁷ The bodily sense primarily used to negotiate the retail environment is vision, and marketers know visual in-store advertising is essential to the marketing mix with the ability to reinforce messages of the more traditional television, print, or radio advertisements. Point-of-purchase advertising can provide up to an 181% return-on-investment.⁸ Signage is a large part of point-of-purchase advertising, especially for convenience stores where outdoor signs are used to entice customers inside; indoor signage further entices customers to purchase specific brands.⁶ For example, convenience store beverage sales have shown a 9.2% increase from such signage.⁹ Both exterior and interior store advertisements increase alcohol sales and consumption.⁸ For healthful foods, a strong positive relationship also exists between store displays and healthful food consumption, when available.¹⁰

Differential exposure to a greater number of billboard advertisements for unhealthy food and beverage items, including alcohol, has been found in urban areas with greater proportions of ethnic minority and lower socioeconomic status (SES) residents.^{11–14} Often, public housing developments are located in impoverished urban areas that lack access to healthy food resources, such as fresh fruits.^{15,16} Some research suggests that residents prefer fast food and convenience foods because they are low cost and provide high satiety.¹⁵ Other health behaviors, such as smoking, have been linked to lower body mass index¹⁷ but greater consumption of dietary fat.¹⁸ In addition, heavy alcohol use has also been linked to obesity.¹⁹

Despite links between advertising and consumption, few studies have examined the relationships between food and beverage advertisements and health-related behavior and outcomes for adults, especially those from low-SES, high ethnic minority areas. There is a clear need for specific and reliable objective assessments of store advertisements.²⁰ Therefore, the purpose of this study was to assess the relationship between food and alcohol advertisements in stores and restaurants and the dietary fat intake and body mass index (BMI, a proxy for obesity) of public housing residents. It was hypothesized that more advertisements for high-calorie (ie, high-fat and high-sugar content) foods and alcohol and fewer advertisements for healthful foods would be related to higher BMI and higher dietary fat intake.

METHODS

Design

This cross-sectional study combined data from 2 studies in the greater-Kansas City metropolitan area. Individual-level data were from the Pathways to Health (PATH) study²¹

and environmental data from the Understanding Neighborhood Determinants of Obesity in Kansas City (UNDO-KC) study.^{15,16,22–24} PATH was a 6-month cluster-randomized trial that randomly assigned 20 public housing (and section 8) developments to a smoking-cessation²¹ or fruit-and-vegetable²⁵ condition. Baseline data for residents included self-reported dietary fat intake and measured BMI. The UNDO-KC project focused on the neighborhoods surrounding the center of the 12 “nonelderly” housing developments from the PATH trial and assessed advertising in restaurants and stores that sold food.

Participants

Individual-level data were collected during recruitment health fairs at each housing development during the PATH trial.²⁶ Housing development residents met poverty guidelines (ie, \$18,850 annual household income for a family of 4;²⁷ and all residents (smokers and nonsmokers) were eligible to attend the health fairs. Despite efforts to maximize attendance (eg, training “peer” residents as recruiters, announcements, flyers), participation rates ranged from 9% to 47% (or 470 of 2523 residents; mean = 18%).²⁴ Complete data for the current study were available for 373 participants.

Participants were primarily African American (79.6%), female (74.0%), and had a high school education or more (59.6%). The average age for participants was 42.6 years (sd=16.1), and 32.7% had never smoked. All participants gave informed consent, and study procedures were approved by the university’s institutional review board.

Neighborhoods

Neighborhood environments were defined as the area captured by an 800-meter radius circle around the center of each housing development in order to capture residents’ area of daily exposure by foot, public transportation, and automobile travel.^{22,28} Within each neighborhood, all restaurants and stores that sold food were identified using a 3-step process of Internet and phone book searches, verification by phone, and mapping or physical confirmation where additional restaurants and stores not included in existing databases were identified.^{16,22}

Measures

Individual-level—Surveys were interviewer administered to reduce any literacy barriers. Dietary fat intake was based on the question “On average, is your dietary fat intake high, medium, or low?” from the National Cancer Institute’s Percentage Energy from Fat Screener instrument.³⁰ The question has been positively correlated with percent energy from fat.³⁰ The screener has been validated in comparison to 24-hour dietary recalls.³³ Participant heights and weights were measured using a portable stadiometer and Tanita scale.²² Individual BMI was calculated to indicate participant weight status, where a BMI of 25–29.9 indicated overweight and a BMI of 30 or higher indicated obesity.³³ Participants were also asked to indicate the average minutes they walked each day and their number of daily ½ cup servings of fruit and vegetables.

Environmental—To assess food and alcohol advertisements (as well as the overall nutrition environment, see¹⁶) in stores and restaurants, separate assessment forms for

restaurants and stores that sold food were developed over a 9-month period, pilot tested, and revised. Field data were collected by trained research assistants in teams of 2 following standardized safety protocols. Observations were made of the inside and outside of each food store or restaurant within the defined neighborhoods. Store types included *grocery* (small grocery store), *supermarket* (large franchise or chain grocery store), *convenience* (store selling convenience foods, drinks, and other items and may have gasoline pumps), *liquor* (store that predominately sold liquor, but also carried some convenience food items), *pharmacy* (drugstore that sold food in at least one aisle or section), *ethnic* (store that sold foods targeted for a specific ethnic group), and *other* (any other type of store that sold food), similar to Cohen et al.¹⁸ Restaurant types included *fast food* (orders were taken at the counter or from a car; no table service), *buffet* (food was already out in a central location for customers to serve themselves), *table service* (orders were taken by a server who came to the table), and *other* (any other type of restaurant).

Assessment teams counted and coded all interior and exterior food and alcohol advertisements of preprinted signs or posters for a specific brand of food or drink. Signs created by the retailer or without a brand (eg, deli sandwiches) were not included. Coded signs were placed in one of 3 categories:

1. alcohol – signs for specific alcohol brands (eg, Budweiser), including neon signs;
2. high-calorie – signs for foods and beverages with a low amount of nutritional value and high amounts of sugar, fat, and calories (eg, Oreos, Coca-Cola); and
3. low-calorie healthy – signs for foods and beverages that had a healthy nutritional content (eg, fruits, vegetables, low-fat or nonfat dairy items).

Statistical Analysis

Interrater reliability was assessed on advertisement counts by collecting a 10% overlap sample within 1 to 90 days of the first observation. Repeat observations were conducted an average of 56.0 (sd = 41.7) days after the initial observation for stores and 51.5 (sd = 43.7) days for restaurants. Intraclass correlations (ICCs) were computed between the 2 sets of ratings for the alcohol, high-calorie, and low-calorie healthy sign counts. ICCs were chosen to evaluate the interrater reliability for 2 or more raters as data were considered at least interval level and were conceptualized as the ratio of between-group variance to total variance.^{33,34} One-way random effects models were examined as the primary analysis, but we also computed Pearson's *r* correlations for comparison.

Complete health fair data were available for 373 cases (88% of the sample). A multilevel model taking into account the data structure of individuals nested in 12 neighborhoods was used to examine the risk factors for BMI. The multilevel model was fitted using the Proc Mixed procedure in SAS 9.1.3 with a random statement (random intercept) to account for the nested structure within each neighborhood. The Aikake information criterion (AIC) was used to assess the model fit (ie, 1942 for BMI), where smaller AIC values were better.³⁵ A stepwise model building procedure was used to first select factors independently related to BMI in univariate analysis with the criteria of $P < 0.15$ for entering the model. Correlation coefficients were checked among potential confounding variables, and highly correlated

covariates were excluded to avoid the multicollinearity problem. Then, significant covariates with $P = 0.05$ in the multivariate multilevel model were retained. No significant 2-way interactions were found. Three-way interactions were not examined due to sample size constraints. As the dietary fat consumption variable was discrete (ie, had 3 levels) and nested within each neighborhood, Generalized estimating equations (GEEs) modeling based on multinomial distribution³⁶ was used to fit the data to account for the nested structure. The GEEs model was fitted using the Proc Genmod procedure in SAS 9.1.3 with repeated statement to account for the nested structure within each neighborhood. The criterion used for evaluating potential confounding variable was a P-value less than 0.15 in the univariate analysis, and the criterion for retention of variables was $P = 0.05$ in the multivariate model. Deviance (ie, the difference in log-likelihoods between the current model and the saturated model) was used to assess the model fit.³⁷ The deviance of the GEE model for fitting the dietary fat was 175.03 (with degrees of freedom = 320). The likelihood ratio test for the goodness of fit gave a P-value of 1, indicating our model had a good fit to the data. The likelihood ratio test was also used to examine the fit of the model by comparing the current GEE model to the GEE model with only the intercept term. The P-value for this comparison was <0.0001 (test statistic = 378.9, degrees of freedom = 7), which also indicated a good fit for the model. No significant 2-way interactions were found. Three-way interactions were not examined due to sample size.

RESULTS

For all participants, the mean BMI was 30.3 (sd = 8.3). Almost 27% of the participants were overweight, and 42.4% were obese. Significantly more females (73.6%, $n = 204$) than males (56.2%, $n = 54$) were overweight or obese, $\chi^2 = 10.12$, $P = 0.001$. By ethnicity, 79.4% ($n = 27$) of whites, 67.4% ($n = 203$) of blacks, 81.8% ($n = 9$) of Hispanics or Latinos, and 73.9% ($n = 17$) of participants of other ethnicities were overweight or obese; these differences were nonsignificant.

Thirty percent of participants ($n = 112$) reported eating a high amount of dietary fat, with similar percentages for males (28.4%, $n = 27$) and females (30.8%, $n = 85$). By ethnicity, 26.5% ($n = 9$) of whites, 31.8% ($n = 95$) of blacks, 27.3% ($n = 3$) of Hispanics or Latinos, and 17.4% ($n = 4$) of participants of other ethnicities reported eating a high amount of dietary fat. High dietary fat intake was positively correlated with BMI, $r = 0.141$, $P < 0.01$.

Sixty-six restaurants and 50 food stores were found for all neighborhoods with a range of 0–16 restaurants ($m = 5.33$, $sd = 4.72$) and 2–8 stores per neighborhood ($m = 4.17$, $sd = 1.64$). Table service restaurants ($n = 34$) and convenience stores ($n = 16$) were the most prevalent types. As shown in Table 1, many of the intraclass correlations (ICCs) were modest to high and statistically significant, despite variance in the average days between ratings.

There were 842 signs in the 66 restaurants and 50 stores surveyed. Overall, 60% of the signs were for alcohol ($n = 514$), 33.1% ($n = 279$) were for high-calorie items, and 5.8% ($n = 49$) were for low-calorie healthy items. In restaurants there were 149 alcohol signs, 86 highcalorie, and 36 low-calorie healthy signs; in stores there were 365 alcohol signs, 193

high-calorie, and 13 low-calorie healthy signs. Table 2 summarizes the distribution of signs by housing development neighborhood.

As shown in Table 3, statistically significant positive associations with BMI included alcohol signs in food stores ($P=0.04$) and restaurants ($P=0.02$), after adjusting for the significant effects of diastolic blood pressure, glucose level, age, gender, and smoking status. For every additional alcohol sign in food stores, BMI increased 0.10, holding all other variables in the model constant. For every additional alcohol sign in restaurants, BMI increased 1.26, holding all other variables constant in the model.

Table 4 shows that higher dietary fat consumption was significantly associated with more alcohol signs in stores ($OR = 1.01$, 95%CI = 1.00 to 1.02) and restaurants ($OR = 1.20$, 95%CI = 1.12 to 1.28), fewer low-calorie healthy signs in stores ($OR = 0.65$, 95%CI = 0.54 to 0.78) and restaurants ($OR = 0.74$, 95%CI = 0.55 to 1.00), lower fruit consumption ($OR = 0.87$, 95%CI = 0.77 to 0.99), and fewer minutes walked ($OR = 0.99$, 95%CI = 0.98 to 0.99). Higher dietary fat consumption was also significantly associated with white ($OR = 3.96$, 95%CI = 1.16 to 13.52) and Hispanic or Latino ($OR = 2.77$, 95%CI = 1.02 to 7.55) ethnicity compared to those of other ethnicities.

DISCUSSION

This study assessed the relationship of food and alcohol advertisement signs in food stores and restaurants with the BMI and dietary fat intake of public housing residents. As hypothesized, more signs for alcohol in stores and restaurants were associated with higher BMI levels among neighborhood residents after adjusting the effect of diastolic blood pressure, glucose level, age, gender, and smoking status of individual residents. However, we found no significant relationships between BMI and high-calorie or low-calorie healthy food signs. We found higher BMIs for those with higher diastolic blood pressure, females, and those who had never smoked.

As hypothesized, higher dietary fat consumption was associated with more alcohol signs and fewer low-calorie healthy signs in stores and restaurants, after adjusting for the residents' age, gender, education level, and ethnicity. We also found that individuals reporting higher dietary fat consumption reported lower fruit consumption and fewer minutes of walking. Whites had the highest dietary fat consumption, followed by Hispanics or Latinos, African Americans, and those of other ethnicities.

In this study, we found that neighborhoods around public housing developments exposed residents to high numbers of signs for unhealthy foods and alcohol and few signs for healthier foods in stores and restaurants. Less than one fifth of the signs were for low-calorie healthy items, with stores averaging fewer of those types of signs than restaurants. Previous research has shown similar advertising trends for these food categories.³ This distribution of signs could contribute to the deprivation amplification of environments in impoverished urban areas, effectively promoting unhealthy food and beverage choices above healthier ones.³⁸ As an alternative, the distribution of signs may reflect product availability because low-SES neighborhoods have poorer access to healthy foods.^{15,39} Thus, the environmental

stimuli of signs may be one of the factors contributing to social disparities in BMI.⁴⁰ It also appears that signs for healthier foods may be protective for dietary fat consumption as a lower prevalence of these signs was associated with a lower frequency of the behavior. Future research could examine the interplay between signage, food availability, and health outcomes.⁴³

Almost one third of participants reported eating a high amount of dietary fat. Although the types of fats that were consumed were not measured, this is a clear area of concern for this low-income population. Previous research has shown that blacks and Hispanics have higher fat intakes than whites.⁴¹ Additional measures of dietary intake such as food diaries or 24-hour dietary recalls would be useful to provide quantifiable measurements of dietary fat.

Over 69% of the housing development residents were overweight or obese, which was higher than the national average of 66%.⁴² In fact, the mean BMI for study participants was at the obese level.³² Other than the 2 participants of Asian ethnicity, participants in all ethnic groups had high rates of overweight and obesity. It is possible that, in this sample, low neighborhood income or other environmental factors (eg, lack of physical activity or healthful food resources) were more important forces driving overweight and obesity than ethnicity although the lack of variability in ethnicity across the sample makes this impossible to determine. As well, no direct measure of income level was used. Although participants had to meet low-income criteria guidelines to qualify for public housing, it is unclear what the actual income was for each participant.

Signage has the potential to influence consumer food selection and consumption, but these participant behaviors were not measured.^{1,2} The association between alcohol signs in stores and restaurants and higher dietary fat consumption may be illuminated by studies linking alcohol consumption to greater energy intake from fat.⁴⁴ Future studies could investigate whether the presence and type of alcohol signs prompt the purchase of alcohol and/or high-fat foods. In addition, only printed signage in stores was examined in this study. Multiple types of media influence, including television, radio, Internet, and billboard advertisements as well as social-cultural practices, should be studied for their effects on food-related behaviors.³⁻⁶ Strengths of this study included detailed and reliable, objective assessments of neighborhood store and restaurant signage, a sizeable sample of lower-SES participants, measured BMI, and appropriate analytic techniques. Because both stores and restaurants tend to change signs on a monthly basis, the fact that our ratings demonstrated consistency across raters over a range of time periods (eg, range of 127 days for the total sample and 71 days for stores and 66 days for restaurants when we limited the sample to those with 90 days or less between ratings) is impressive. Future studies evaluating signs in store and restaurant should minimize the amount of time between observations to 30 days or less in order to maximally evaluate interrater reliability.

Study limitations included a small sample size for neighborhoods (although the multilevel models accounted for the participants nested within the 12 neighborhoods). Although several strategies were employed to increase response rate in the PATH study (eg, peer residents, newsletter announcements), as detailed in Heinrich et al,²⁴ the overall participation rate of 18.6% was low. This may have led to underrepresentation by certain

groups of individuals, but data were not gathered to describe nonresponders. Causal inferences cannot be drawn from these cross-sectional data. In addition, the directionality of the relationships found is unclear.

CONCLUSIONS

Over half of the public housing residents in this low-SES sample were overweight or obese and almost one-third reported high dietary fat consumption. The majority of store and restaurant signs were for alcohol products and high-calorie foods, with few for low-calorie healthy foods. Higher BMI was associated with more signs for alcohol in neighborhood stores and restaurants, as well as found in females and participants who had never smoked. Higher dietary fat consumption was associated with more alcohol signs in restaurants and stores and fewer low-calorie healthy signs in restaurants, as well as a lower reported fruit consumption and fewer minutes walked. These results remained significant after accounting for differences by gender or ethnicity. Future studies are needed to examine the relationship between signs and food selection and consumption as well as include comparisons between neighborhoods of varying SES levels.

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Table 1Intraclass Correlations (ICC) and Pearson's *r* for Sign Count Interrater Reliability

	Alcohol Signs (P value)	HC ^a Signs (P value)	LCH ^b Signs (P value)
Store Ratings (N = 8)			
One-Way Random Effects ICC	0.000 (0.493)	0.668 (0.019)	0.422 (0.115)
Pearson's <i>r</i>	<i>c</i>	0.749 (0.032)	0.472 (0.238)
Store Ratings Subgroup^d (N = 6)			
One-Way Random Effects ICC	0.000 (0.489)	1.000 (<0.001)	1.000 (<0.001)
Pearson's <i>r</i>	<i>c</i>	1.000 (<0.001)	1.000 (<0.001)
Restaurant Ratings (N = 15)			
One-Way Random Effects ICC	0.939 (<0.001)	0.310 (0.115)	0.596 (0.006)
Pearson's <i>r</i>	0.976 (<0.001)	0.711 (0.003)	0.577 (0.024)
Restaurant Ratings Subgroup^d (N = 11)			
One-Way Random Effects ICC	0.969 (<0.001)	0.318 (0.147)	0.579 (0.020)
Pearson's <i>r</i>	1.000 (<0.001)	0.887 (<0.001)	0.551 (0.079)

Note.

^aHigh-Calorie^bLow-Calorie Healthy^cValues not computed because at least one of the variables was a constant.^dComputed for those with ≤ 90 days between ratings.

Table 2

Advertising Distribution by Housing Development Neighborhood

	Neighborhood												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
Restaurants (n)	6	0	16	7	0	3	5	2	4	3	7	13	66
Mean alcohol signs	1.8	0	2.05	0	0	0	3.8	0	0	7	0.14	4	2.33
Mean HC signs	3.6	0	1.25	1.71	0	0	0.2	2	5.5	0.33	0.42	1.17	1.34
Mean LCH signs	0	0	0.75	0	0	0	0	0	0.25	0	0.14	0	0.56
Stores (n)	4	3	8	4	4	6	3	2	5	3	5	3	50
Mean alcohol signs	0	0	4.38	20.25	0.25	24.17	0	39	0	2.33	2.8	1.33	7.45
Mean HC ^a signs	5.5	3.33	0.5	6.3	2.25	7	0	3.5	2.75	9.33	5.8	1.67	3.94
Mean LCH ^b signs	0.25	0	0	0.25	0.5	0	0	0	0.25	2	0.4	0	0.27

Note.

^aHigh-calorie^bLow-calorie healthy

Table 3

Multilevel Model Predicting Individual Body Mass Index

Effect	Type 3 Tests of Mixed Effects			
	Estimate	Standard Error	<i>t</i> Value	Pr > <i>t</i>
Intercept	5.2864	4.7878	1.10	0.2705
Store Alcohol Signs	0.1007	0.04802	2.10	0.0369
Store HC ^a Signs	0.5347	0.3762	1.42	0.1564
Store LCH ^b Signs	-2.9292	2.3375	-1.25	0.2112
Restaurant Alcohol Signs	1.2587	0.5259	2.39	0.0174
Restaurant HC ^a Signs	0.3984	0.4066	0.98	0.3280
Restaurant LCH ^b Signs	-0.8035	0.9336	-0.86	0.3902
Diastolic Blood Pressure	0.2162	0.04157	5.20	< .0001
Glucose	0.01310	0.007178	1.82	0.0692
Age	-0.05597	0.03441	-1.63	0.1050
Gender (Female)	4.1355	1.0950	3.78	0.0002
Never Smoked	3.5039	1.0605	3.30	0.0011
Former Smoker	2.5702	1.4749	1.74	0.0825
Smoked on Some Days	-0.7796	1.6409	-0.48	0.6351
Smoked Every Day	0			

Note.

^a High-calorie^b Low-calorie healthy

Table 4

Multilevel Model Predicting Individual Dietary Fat Intake

Parameter	Analysis of GEE Parameter Estimates		
	Odds Ratio Estimates	95% Confidence Limits for Odds Ratio	
Store Alcohol Signs	1.0109	1.0013	1.0206
Store LCH^a Signs	0.6501	0.5440	0.7769
Restaurant Alcohol Signs	1.1994	1.1249	1.2788
Restaurant LCH^a Signs	0.7400	0.5450	1.0048
Fruit Consumption	0.8730	0.7681	0.9924
Minutes Walked	0.9851	0.9771	0.9933
Gender	0.7999	0.4538	1.4099
Age	0.9811	0.9588	1.0038
Education	0.9834	0.8366	1.1559
Race			
White	3.9602	1.1601	13.5177
African American/Black	2.0947	0.7459	5.8832
Hispanic/Latino	2.7688	1.0155	7.5489
Others	1.0000	1.0000	1.0000

Note.

^aLow-calorie healthy