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Community food environment moderates association between health care provider advice to lose weight and eating behaviors

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ABSTRACT

Patients who receive weight loss advice from a health care provider (HCP) are more likely to eat healthy. The food environment affects eating behaviors. This study explored how the community food environment may moderate the relationship between HCP advice to lose weight and eating behaviors. Data were obtained from a household telephone survey in 4 New Jersey cities from two cross-sectional panels (2009–10 and 2014). Analyses were limited to 1427 overweight and obese participants. Self-reports assessed frequency of consumption of fruits, vegetables, sugar sweetened beverages, and fast food. Community food data were purchased from InfoUSA and Nielsen and classified according to previously established protocol. Stratified gamma regression analysis determined the differences in the association between receiving weight loss advice and eating behaviors stratified by community food environment. Stratified analyses revealed that receiving advice to lose weight from a HCP was associated with lower reported consumption of total sugar-sweetened beverages, soda, and sweetened fruit drinks when participants lived near a small grocery store, or far from a supermarket, limited service restaurant, or convenience store. There were no associations between receiving weight loss advice and sugar sweetened beverage consumption when participants lived near supermarkets, limited service restaurants, or convenience stores. There were no associations with fruit, vegetable, salad or fast-food consumption, regardless of the community food environment. Food environment may play a critical role in moderating the association between HCP advice and eating behaviors. Interventions that enhance the community food environment may help convert HCP advice into improved eating behaviors.

1. Introduction

Overweight and obesity (OW/OB) continues to be a public health concern in adults, especially among low-income and minority populations. From 2011 to 2014, 68.5% of white adults were OW/OB compared to 76.3% of non-Hispanic blacks and 78.4% of Hispanics (National Center for Health Statistics, 2016). Given the high prevalence of obesity, the U.S. Preventive Services Task Force recommends that health care providers (HCP) screen all adult patients for obesity and offer the appropriate treatment as needed (LeBlanc et al., 2011).

Despite these national guidelines, only 47% of obese patients receive weight loss advice from their HCP (Loprinzi and Davis, 2016). Patients who receive weight loss advice from their HCP are more likely to eat less fat and calories (Bish et al., 2005; Loureiro and Nayga, 2006), and eat more salad and fruit (Lorts and Ohri-Vachaspati, 2016). However, not all who receive advice from their HCP change their eating behavior (Rodondi et al., 2006), suggesting that knowledge alone may not lead to behavior change. Research on the factors influencing the effectiveness of HCP weight loss advice have focused on the quality of counseling (Alexander et al., 2011), but have not included patient-centered factors.

The community food environment may be a potential moderator in the association between HCP weight loss advice and eating behaviors. The food environment has been shown to be associated with eating behaviors. Those who live near a supermarket or grocery store eat more fruit and vegetables (Dunn et al., 2015; Robinson et al., 2013), while those who live near fast-food restaurants and convenience stores drink more sugar sweetened beverages (SSB) (Laska et al., 2010). The confluence of exposure to environmental factors that promote healthy eating, alongside obtaining HCP advice, may result in healthier food

Abbreviations: HCP, health care provider; SSB, sugar sweetened beverages; OW/OB, overweight and obesity; LSR, limited service restaurant

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consumption behaviors among OW/OB individuals.

Using data from a low-income, high minority OW/OB sample, this study explores how the community food environment may moderate the relationship between receiving HCP advice to lose weight and eating behaviors, potentially explaining why some patients improve their eating behaviors after receipt of weight loss advice while others do not. There are two hypotheses. First, the association between receiving HCP advice to lose weight and participants' frequency of fruit and vegetable consumption will be stronger among those who live closer to small grocery stores and supermarkets, compared to those who do not live close to these outlets. Second, the association between HCP advice to lose weight and sugar sweetened beverage and fast-food consumption will be weaker among those who live closer to convenience stores and limited service restaurants, compared to those who do not live near these food outlets.

2. Methods

2.1. Participant data

Participant data were obtained from the New Jersey Child Health study conducted in four New Jersey cities: Newark, New Brunswick, Trenton, and Camden. A household telephone survey of 2211 adults was completed with the adult who made most of the food shopping decisions for their household and had at least one child between the ages of 3–18 years. Survey data were collected in two cross-sectional waves: 1408 adults from 2009 to 10 (panel 1) and 803 adults in 2014 (panel 2). The phone survey took on an average 30–36 min to compete and was conducted in both English and Spanish, and included questions on demographics, food and physical activity behaviors, health status, and employment status. The response rate for panel 1 and 2 were 49% and 36%, respectively. The Arizona State University and Rutgers University institutional review boards approved this study.

2.2. Study sample

Analyses were limited to 1427 OW/OB adults from the two panels with non-missing outcome or explanatory variables. Participants who were normal weight, underweight, or pregnant (n = 518) and those with one or more missing outcome or explanatory variables (n = 266) were omitted from the analysis. Using standard definitions (US National Heart, 2000), overweight was categorized as a body mass index (BMI) of 25–29.9 kg/m^2, obesity was categorized as a BMI of 30–39.9 kg/m^2, and extreme obesity was a BMI of $\geq 40\ kg/m^2$.

2.3. Outcome variables

Four food categories were chosen as outcome variables based on their nutrient and energy density as well as their relationship with weight status (Khan et al., 2009; Parker et al., 2009): fruits, vegetables, SSB, and fast food. Consumption was determined by frequency-based questions adapted from the Behavior Risk Factor Surveillance Survey and 2009–10 National Health and Nutrition Examination Survey (Centers for Disease Control and Prevention, 2011a, 2011b), asking participants to recall foods they ate or drank during the past month. Response options included number of times per day, per week, or per month. Frequency of fruit consumption was obtained by asking, “Not counting juice, how often did you eat fruit? Count fresh, frozen, or canned fruit.” Using similar format for questions, total frequency of vegetable consumption was obtained by asking participants to report on “a green leafy or lettuce salad, with or without other vegetables”, “potatoes such as baked, boiled, mashed potatoes, or potato salad, but not including french fries or other fried potatoes”, “cooked or canned dried beans, such as refried beans, baked beans, bean soup, tofu, or lentils”, and “other vegetables such as tomatoes, green beans, carrots, corn, cooked greens, sweet potatoes, broccoli, or any other kinds of vegetables”. Salad was also analyzed separately from total vegetable consumption. Fast-food consumption was gathered by the question, “How often did you eat at a fast-food restaurant, deli, pizza, burger, taco or chicken place where you pay before you eat?”. Two questions captured SSB consumption, “How often did you drink fruit flavored drinks such as lemonade, Sunny Delight, Kool-Aid, Gatorade, or sweet iced teas? Do not include 100% fruit juice,” and “How often did you drink regular carbonated soda or soft drinks such as coke, Pepsi, or 7-up? Do not include diet drinks.” Sweetened fruit drinks and regular soda were also included in analyses separately due to the variation in consumption patterns among sub-populations of the sample and by food outlet (Han and Powell, 2013; Powell and Nguyen, 2013). Consumption of fruits, vegetables, and SSB were calculated as frequency (number of times) per day while fast-food consumption was calculated as frequency per week.

2.4. Explanatory variables

Demographic variables, including age group, sex, race/ethnicity, educational attainment, height, and weight, were self-reported by participants in response to survey questions. Race/ethnicity was categorized into, “Non-Hispanic White,” “Non-Hispanic Black,” “Hispanic,” and other races were categorized into “Other.” The participant's education level was categorized into, “less than high school”, “high school or equivalent,” “some college,” or “college graduate.” General health status was determined by the question “Would you say your health is…,” with response options “excellent”, “very good”, “good”, “fair”, or “poor”. Responses of “excellent” and “very good” were collapsed into one category and responses of “fair” and “poor” into another.

Receiving HCP's advice to lose weight was determined by the question, “In the past 12 months, has a doctor, nurse, or other health professional given you advice about your weight?” Responses included “yes, lose weight”, “yes, gain weight”, “yes, maintain weight”, “no advice given about weight”, “don't know/not sure”, or refusal to answer. Participants who responded, “yes, lose weight” were coded as 1 for HCP's advice to lose weight while those who received no advice were coded as 0. Participants who responded, “yes, gain weight” (n = 7) or “yes, maintain weight” (n = 43) were excluded from analysis.

Community food data were purchased from both InfoUSA (InfoUSA) and Nielsen (Nielsen) in 2008, for panel 1, and in 2014, for panel 2. Food outlets were classified as supermarket, small grocery store, convenience store, fruit and vegetable market, meat market, meat market with small grocery, full service restaurant, or limited service restaurant (LSR) according to previously established protocol based on the store sales volume, North American Industry Classification System (NAICS) code, and follow-up phone calls to assess availability of healthy options (Ohri-Vachaspati et al., 2011). The following outlet categories were used in the analysis: supermarket, small grocery store (including fruit and vegetable markets and meat markets with small grocery stores), convenience store, and LSR.

Proximity of food outlets to participant's homes was determined by GIS mapping using Esri ArcMap with Network Analyst (version 10.3.1) calculating roadway network distance between each respondent's home and food outlet. Preliminary analysis revealed that the distribution of food outlets within the community varied by type of outlet; unhealthy food outlets were closer to participants' homes while healthy food outlets were farther from participants' homes. A ¼ mile distance was used for LSR and convenience stores, as there was limited variability in distribution of these food outlets beyond a ¼ mile, with 95% of households having a LSR and 97% having a convenience store within a ½ mile of home. Conversely, a ½ mile distance was used for small grocery stores and supermarkets, as there was limited variability in the distribution of these outlets within ¼ mile, with only 7% having a small grocery store and 13% having a supermarket in the ¼ mile. Previous studies have shown that presence of convenience stores and LSR within

a ¼ mile of an individual's home (Ohri-Vachaspati et al., 2014; Ohri-Vachaspati et al., 2013) and presence of a supermarket within a ½ mile is associated with health behaviors and status (Ploeg et al., 2017).

2.5. Statistical analysis

Descriptive analyses were conducted using Chi-squared tests for categorical variables and *t*-tests for continuous variables.

2.5.1. Multivariable analysis

Model fit testing based on examination of Akaike's information criterion (AIC) revealed that gamma regression with logarithmic link function had the best fit due to the dietary variables' positively skewed distribution. The antilogarithm of the regression coefficient, e^b, for gamma regression represents the proportional differences in the outcome associated with a 1-unit increase in the independent variable. In this analysis, e^b represents the proportional difference in frequency of food or beverage consumption with the receipt of HCP weight loss advice, compared to not receiving weight loss advice. For example, an e^b value of 1.25 for a food category would mean a 25% higher frequency of consumption for that food category for those who received HCP advice to lose weight compared to those who did not receive weight loss advice. Inclusion of variables in the multivariable model were determined by bivariate associations of $p < 0.10$, but demographic variables and year of data collection (panel) were included in all models.

2.5.2. Interaction and stratified analyses

To test for interaction, an interaction term (HCP advice*presence of food outlet) was included in the multivariable regression models. Separate stratified models were also run by presence or absence of specific outlets to determine differences in the association between HCP's advice and eating behaviors by community food environment. Similar results were obtained when using presence/absence or count of food outlets, so presence/absence was used to be consistent with previous research (Ohri-Vachaspati et al., 2013). All analyses were conducted in Stata (version 13.1). Individual associations were considered significant at $p < 0.05$ and interactions were considered significant at $p < 0.10$.

3. Results

A vast majority of respondents were female (82%), 59% were non-Hispanic black, and 56% were between the ages of 35 to 54 years (Table 1). There were significant differences in who received HCP's advice by age, race/ethnicity, BMI, health status, and year of data collection. Of participants ages ≥55 years, 45% received advice compared to 30% of participants ages 18–34 years. A higher percentage of black and Hispanic participants (39% for both) received HCP advice compared to white participants (25%). A greater percentage of participants who were obese (BMI = 30–39.9 kg/m^2) or extremely obese (BMI ≥ 40 kg/m^2) received HCP advice to lose weight compared to those who were overweight (44% and 67% vs. 23%). More participants from Panel 2 received advice compared to participants from Panel 1 (44% vs 34%).

Table 2 shows associations between key independent variables and outcomes adjusting for age, gender, race/ethnicity, education, general health status, city of residence, BMI, and panel. Receiving HCP advice to lose weight was associated with a 24% lower reported frequency of consuming soda ($p = 0.02$) and 16% lower frequency of consuming SSB ($p = 0.03$). There was a marginally significant association between HCP advice to lose weight and frequency of salad consumption ($e^b = 1.14$; 95% CI: 0.99, 1.30; $p = 0.06$). Similarly, marginally significant associations were observed between the presence of a LSR within ¼ mile and higher vegetable and salad consumption ($p = 0.07$) and presence of a small grocery store within ½ mile and lower SSB consumption ($p = 0.08$).

Stratified analyses (Fig. 1, complete data shown in Supplementary Tables A–D) reveal that the associations between HCP advice to lose weight and beverage consumption varied with the presence or absence of food outlets. For those who lived within ½ mile of a small grocery store, receiving HCP advice to lose weight was associated with a 33% lower frequency of fruit drink consumption ($e^b = 0.67$, 95% CI: 0.48, 0.93) and 29% lower frequency of total SSB consumption ($e^b = 0.71$, 95% CI: 0.55, 0.93). There was no association between HCP advice to lose weight and fruit drink ($e^b = 1.05$, 95% CI: 0.84, 1.32) and total SSB ($e^b = 0.91$, 95% CI: 0.75, 1.10) when a small grocery store was absent.

For those who did not have a supermarket within ½ mile distance of their home, receiving HCP advice to lose weight was associated with a 21% lower frequency of total SSB ($e^b = 0.79$, 95% CI: 0.66, 0.95) and 32% lower frequency of soda consumption ($e^b = 0.68$, 95% CI: 0.51, 0.90). There was no association between HCP advice and total SSB and soda consumption ($e^b = 0.96$, 95% CI: 0.73, 1.27, $e^b = 0.98$, 95% CI: 0.66, 1.48, respectively) when a supermarket was present within ½ mile distance.

Among participants who did not have a convenience store present within ¼ mile distance of their homes, receiving HCP advice to lose weight was associated with a 62% lower frequency of total SSB ($e^b = 0.48$, 95% CI: 0.32, 0.73), 72% lower frequency of soda ($e^b = 0.38$, 95% CI: 0.21, 0.69), and 42% lower frequency of fruit drink consumption ($e^b = 0.58$, 95% CI: 0.35, 0.96). There was no association between HCP advice and the consumption of total SSB ($e^b = 0.92$, 95% CI: 0.78, 1.10), soda ($e^b = 0.83$, 95% CI: 0.64, 1.07), or fruit drinks ($e^b = 1.00$, 95% CI: 0.82, 1.23) when a convenience store was nearby.

Lastly, among participants who did not have a LSR present within ¼ mile distance of their home, receiving HCP advice to lose weight was associated with a 24% lower total SSB consumption ($e^b = 0.76$, CI: 0.59, 0.97) and 31% lower frequency of soda consumption ($e^b = 0.69$, CI: 0.46, 1.05), although marginally significant. There was no significant association between HCP advice to lose weight and total SSB ($e^b = 0.87$, CI: 0.72, 1.06) or soda ($e^b = 0.81$, CI: 0.61, 1.07) consumption when an LSR was present within ¼ mile distance of their home. We found no association between HCP advice to lose weight and frequency of fruit, vegetable, salad or fast-food consumption in any of the models stratified by presence of food outlet.

4. Discussion

This study examined if the community food environment moderates the relationship between receiving weight loss advice from a HCP and consumption of food and beverages in an OW/OB population. Interaction and stratified analyses revealed that receiving HCP advice to lose weight was associated with a lower reported consumption of total SSB, soda, and sweetened fruit drinks when participants lived near a small grocery store, or far from a supermarket, LSR, or convenience store. However, when participants lived near supermarkets, LSR, or convenience stores, there was no association between HCP advice and reported SSB consumption. We found no association with respect to fruit, vegetable, salad or fast-food consumption. These results elucidate the complex role of context (i.e., community food environment) on the effect of HCP weight loss advice.

Most studies analyzing the influence of the community food environment have focused on fruit and vegetable consumption (Dunn et al., 2015; Morland et al., 2002; Robinson et al., 2013; Zenk et al., 2005), with only three examining SSB (Duran et al., 2016; Gustafson et al., 2013; Laska et al., 2010). Laska et al. found similar results to our findings in their sample of adolescents; those having a fast-food restaurant or convenience store within 1600 m of home consumed 25% and 24% more SSB, respectively (Laska et al., 2010). Our result of lower reported SSB consumption in the absence of a supermarket also align with findings from Gustafson et al. who found that those who shopped

Table 1
Demographic characteristics and eating behaviors by receipt of advice from a health care provider to lose weight. Cross-sectional data from overweight and obese individuals collected from four New Jersey cities in 2009–10 and 2014 (n = 1427).

	All OW/OB respondents (n = 1427)	No HCP's advice (n = 892)	HCP's advice (n = 535)	p-Value for difference by receipt of advice
	n (%)	n (%)	n (%)	
Age group (years)				< 0.001
18–34	437 (30.6%)	308 (70.5%)	129 (29.5%)	
35–54	800 (56.1%)	480 (60%)	320 (40%)	
55+	190 (13.3%)	104 (54.7%)	86 (45.3%)	
Sex				< 0.001
Male	262 (18.4%)	193 (73.7%)	69 (26.3%)	
Female	1165 (81.6%)	699 (60%)	466 (40%)	
Race/ethnicity				0.01
Non-Hispanic white	72 (5.1%)	54 (75%)	18 (25%)	
Non-Hispanic black	848 (59.4%)	520 (61.3%)	328 (38.7%)	
Hispanic	480 (33.6%)	295 (61.5%)	185 (38.5%)	
Other	27 (1.9%)	23 (85.2%)	4 (14.8%)	
BMI category (kg/m^2)				< 0.001
25–29.9	617 (43.2%)	474 (76.8%)	143 (23.2%)	
30–39.9	649 (45.5%)	364 (56.1%)	285 (43.9%)	
≥40	161 (11.3%)	54 (33.5%)	107 (66.5%)	
Educational attainment				0.62
Less than high school	243 (17%)	153 (63%)	90 (37%)	
High school or equivalent	591 (41.4%)	369 (62.4%)	222 (37.6%)	
Some college	398 (27.9%)	241 (60.6%)	157 (39.5%)	
College graduate	195 (13.7%)	129 (66.2%)	66 (33.9%)	
Poverty status				0.61
≤100% poverty level	503 (35.2%)	308 (61.2%)	195 (38.8%)	
100–199% poverty level	472 (33.1%)	292 (61.9%)	180 (38.1%)	
200–399% poverty level	318 (22.3%)	202 (63.5%)	116 (36.5%)	
≥400% poverty level	134 (9.4%)	90 (67.2%)	44 (32.8%)	
General health status				< 0.001
Excellent/very good	556 (39%)	401 (72.1%)	155 (27.9%)	
Good	526 (36.9%)	313 (59.5%)	213 (40.5%)	
Fair/poor	345 (24.2%)	178 (51.6%)	167 (48.4%)	
Food outlet environment				
Small healthy outlet				0.89
Absence – ½ mile	878 (61.5%)	550 (62.6%)	328 (37.4%)	
Presence – ½ mile	549 (38.5%)	342 (62.3%)	207 (37.7%)	
Supermarket				0.70
Absence – ½ mile	985 (69%)	619 (62.8%)	366 (37.2%)	
Presence – ½ mile	442 (31%)	273 (61.8%)	169 (38.2%)	
Convenience Store				0.48
Absence – ¼ mile	306 (21.4%)	186 (60.8%)	120 (39.2%)	
Presence – ¼ mile	1121 (78.6%)	706 (63%)	415 (37%)	
Limited service restaurant				0.07
Absence – ¼ mile	469 (32.9%)	309 (65.9%)	160 (34.1%)	
Presence – ¼ mile	958 (67.1%)	583 (60.9%)	375 (39.1%)	
Panel				< 0.001
1 (2009–10)	895 (62.7%)	593 (66.3%)	302 (33.7%)	
2 (2014)	532 (37.3%)	299 (56.2%)	233 (43.8%)	
City of residence				0.70
Camden	421 (29.5%)	272 (64.6%)	149 (35.4%)	
Newark	498 (34.9%)	303 (60.8%)	195 (39.2%)	
New Brunswick	162 (11.4%)	100 (61.7%)	62 (38.3%)	
Trenton	346 (24.3%)	217 (62.7%)	129 (37.3%)	
Consumption frequency	Mean (SD)	Mean (SD)	Mean (SD)	p-Value
Fruit – all (daily)	1.03 (1.21)	1.00 (1.2)	1.07 (1.23)	0.26
Vegetables - all (daily)	2.19 (1.57)	2.14 (1.55)	2.27 (1.59)	0.12
Salad (daily)	0.73 (0.88)	0.68 (0.79)	0.81 (1.00)	0.01
Fast food (weekly)	1.00 (1.49)	1.05 (1.64)	0.92 (1.19)	0.12
Sugar sweetened beverages – all (daily)	1.12 (1.58)	1.16 (1.56)	1.03 (1.61)	0.13
Soda (daily)	0.51 (1.07)	0.55 (1.06)	0.45 (1.07)	0.09
Fruit drinks (daily)	0.60 (1.00)	0.62 (0.96)	0.58 (1.08)	0.56

HCP = Health care provider; OW/OB = overweight and obese.
Note: Chi-squared analysis used to determine p-value of difference among groups for categorical variables and t-test used to determine difference in eating behaviors by HCP's advice to lose weight.
Note: Numbers/percentages for receipt of HCP's advice sum across row to see differences of variables by receipt of advice. Percentages may sum over 100% due to rounding.

Table 2
Associations of frequency of consumption of selected food and beverage categories with receipt of advice to lose weight from a health care provider (yes/no), and with presence of various food outlets. Cross-sectional data from overweight and obese individuals collected from four New Jersey cities in 2009–10 and 2014 (n = 1427).[a,c]

Food and beverage category(frequency consumption)	Association with receiving HCP advice (vs. no advice)		Presence of small grocery within ½ mile		Presence of supermarket within ½ mile		Presence of convenience store within ¼ mile		Presence of LSR within ¼ mile	
	e^b (95% CI)	p-Value	e^b (95% CI)	p-Value	e^b (95% CI)	p-Value	e^b (95% CI)	p-Value	e^b (95% CI)	p-Value
Fruit – all (daily)	1.07 (0.94, 1.22)	0.33	1.04 (0.92, 1.18)	0.56	1.06 (0.92, 1.22)	0.40	0.98 (0.84, 1.13)	0.76	1.02 (0.89, 1.16)	0.81
Vegetables – all (daily)	1.05 (0.97, 1.14)	0.22	0.98 (0.92, 1.08)	0.95	0.95 (0.87, 1.04)	0.25	1.03 (0.93, 1.13)	0.60	1.08 (0.99, 1.17)	0.07
Salad (daily)	1.14 (0.99, 1.30)	0.06	0.98 (0.88, 1.14)	0.97	1.01 (0.87, 1.17)	0.91	1.05 (0.89, 1.23)	0.58	1.14 (0.99, 1.30)	0.07
Fast food (weekly)	0.96 (0.82, 1.13)	0.65	0.98 (0.85, 1.14)	0.80	1.08 (0.92, 1.27)	0.32	1.09 (0.91, 1.30)	0.34	1.02 (0.88, 1.19)	0.80
Sugar sweetened beverages – all (daily)	0.84 (0.72, 0.99)	0.03	0.88 (0.76, 1.01)	0.08	0.99 (0.84, 1.16)	0.89	0.97 (0.81, 1.15)	0.71	1.01 (0.87, 1.17)	0.91
Soda (daily)	0.76 (0.60, 0.96)	0.02	0.89 (0.71, 1.11)	0.31	0.94 (0.75, 1.19)	0.63	1.04 (0.80, 1.35)	0.77	1.04 (0.83, 1.30)	0.76
Fruit drinks (daily)	0.93 (0.77, 1.12)	0.43	0.87 (0.73, 1.04)	0.13	1.02 (0.84, 1.24)	0.81	0.90 (0.73, 1.11)	0.33	0.99 (0.83, 1.19)	0.95

HCP = Health care provider; LSR = Limited Service Restaurant; e^b = antilogarithm of regression coefficient and represents the proportional difference in frequency of food or beverage consumption with the receipt of weight loss advice vs no advice.

[a] Separate models were run for each food category and each food outlet.

[c] Each model used gamma regression and was adjusted for age group, gender, race/ethnicity, education, general health status, city of residence, BMI category, and panel (year of data collection).

frequently at a supermarket had a higher odds of consuming SSB (Gustafson et al., 2013). The positive association between supermarkets and SSB consumption may be due to the variety of beverages found within supermarkets. A study in Sao Paulo, Brazil found that adults who lived in a census tract with a greater variety of SSB were more likely to consume SSB (Duran et al., 2016). Further, supermarkets have been shown to have lower SSB prices compared to convenience stores (Vilaro and Barnett, 2013).

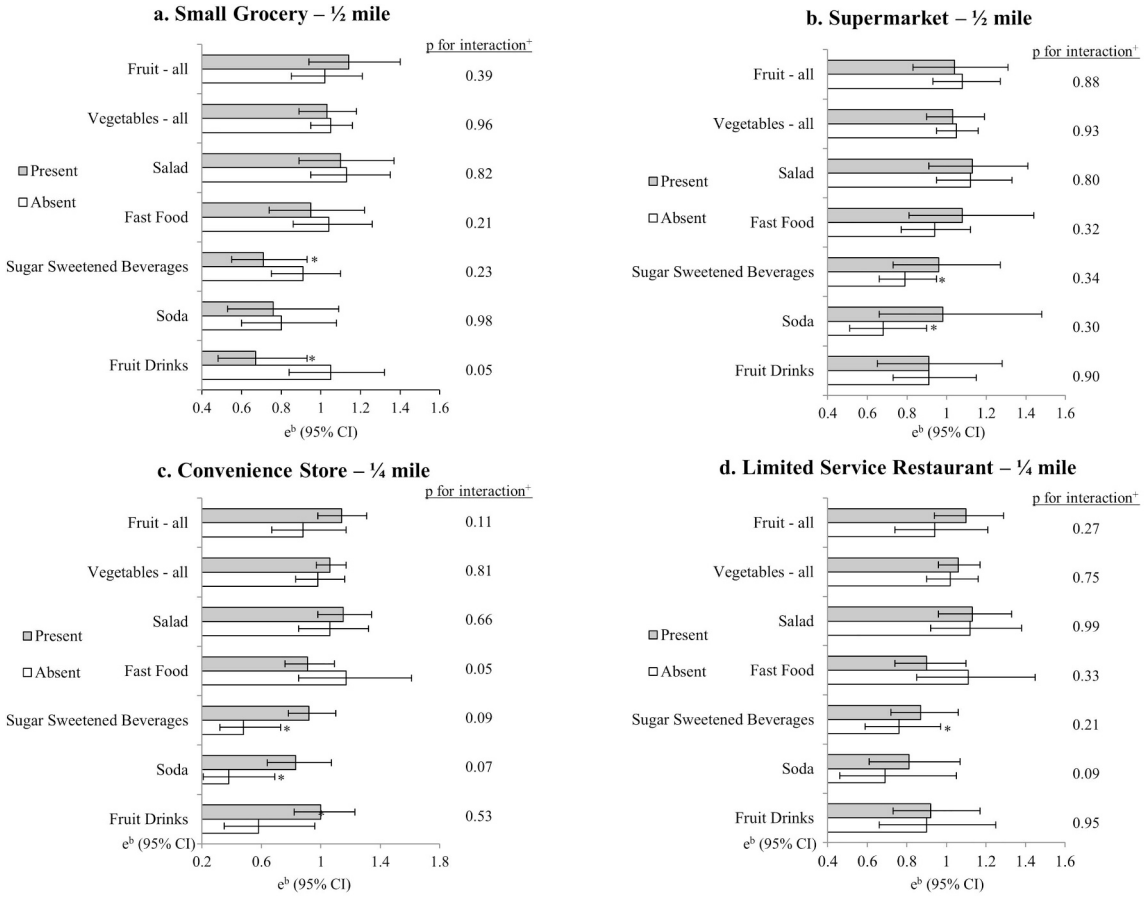
The lack of association between HCP advice and SSB consumption when participants lived near supermarkets, LSR, or convenience stores suggests that receiving HCP advice to lose weight may not be powerful enough to overcome environmental cues such as ease of access, in-store marketing, and price discounts. However, modifications to the food environment could theoretically enhance the association between HCP advice and healthy eating behaviors. Recommended strategies for reducing SSB consumption at the population level include limiting access to SSB, creating a cost differential so healthy beverages are less expensive than SSB, limiting the marketing of SSB, and including SSB-related counseling in routine medical care (Center for Disease Control and Prevention, 2010). A study examining the effect of a soda tax in Berkeley, California noted that consumption decreased 21% after the tax was enacted (Falbe et al., 2016). An intervention that increased the price of soda in a worksite cafeteria resulted in a 26% decrease in soda purchases. When an educational campaign was added, purchases declined another 18% (Block et al., 2010). Using soda taxes or price differentials to render SSB more expensive than healthy beverages and in-store education may help enhance the effects of HCP advice. Further, more attention to the food environment in the HCP's advice, in terms of directing patients to healthier food sources or providing incentives or coupons for healthy food purchases during consultation, may lead to improvements in patient behaviors.

While 37% of this study's OW/OB population received advice to lose weight, the majority of participants did not receive advice. Past research has found some health care practitioners have bias against those who are overweight or obese and fail to provide adequate care (Flint, 2015). Huizinga et al. found that as patient BMI increased, physician respect towards the patient decreased (Huizinga et al., 2009). Interestingly, there may also be a difference in quality of care by gender. Overweight men are more likely to report substandard quality of care compared to overweight women (Hebl et al., 2003). Educational interventions targeting medical students on weight bias and the causes of obesity combined with facilitated discussions with OW/OB patients have proven to be successful in creating short-term improvements in care (Flint, 2015). However, interventions that create long-lasting changes to health care practitioner-delivered care are still needed.

4.1. Study limitations and strengths

There are several strengths to the current study. Participants were mostly low-income and from racial/ethnic minority groups, populations which have a greater risk of obesity and obesity-related illnesses. In addition, GIS-mapping was used to determine outlet proximity to each participant's home rather than grouping participants by census tract, allowing for more precise measurements of presence and absence of food outlets.

This study does have some limitations. The four cities included in the sample are urban, low-income, and with high minority populations. The results therefore, are likely generalizable to similar communities. Because data on advice to lose weight and eating behaviors were self-reported and only collected once, there is possibility for same source bias and underreporting of unhealthy eating behaviors (Goris et al., 2000). To minimize such biases, these items were dispersed through the survey and not included in the same section. The specific weight loss advice given by the HCP is also unknown. The observed significant differences in consumption behaviors between those obtaining HCP's advice and those not getting similar advice were modest. In addition,



eb = antilogarithm of regression coefficient and represents the proportional difference in frequency of food or beverage consumption with the receipt of weight loss advice vs no advice.*p<0.05 for association between health care provider advice and eating behavior, based on specific presence or absence of food outlet. + p-value from an independent model including interaction between health care provider advice and food outlet presence, fully adjusting for age (categorical), sex, race/ethnicity, education, general health status, body mass index category, city of residence, and panel (year of collection).

Fig. 1. Stratified analysis of the association between health care provider advice to lose weight and eating behaviors, based on presence or absence of a food outlet, and the significance of the interaction between health care provider advice and food outlet presence.

while the classification process for food outlets was robust, it was based on purchased data and there is a possibility that some food outlets were missing from the databases or the information was outdated (Powell et al., 2011). Analyses of the food environment only accounted for one type of food outlet at a time. Lastly, the data were cross-sectional and, therefore, the depicted associations should not be construed as cause-effect relationships.

5. Conclusion

This study highlights the moderating role of the community food environment on the association between eating behaviors and receiving weight loss advice from a HCP. Receiving HCP weight loss advice was associated with fewer reported unhealthy eating behaviors, but these beneficial associations were not found when participants lived near supermarkets, LSR, or convenience stores. Additional studies are needed to understand moderating factors that influence HCP weight loss advice, and possible environmental strategies that assist in HCP weight loss advice being beneficial.

Declaration of Competing Interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2019.100926.

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