Associations between neighborhood sociodemographics and prevalence of beverage marketing among food retail stores in Seattle, WA.

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Abstract

Associations between neighborhood characteristics and presence of food store beverage marketing in Seattle, WA.

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Objective: To assess the prevalence of in-store and exterior SSB and non-SSB advertisements in Seattle, WA by neighborhood income and racial/ethnic composition.

Methods: We conducted in-store audits of food retail stores to collect information about SSBs and non-SSBs, including assessment of the presence of in-store and exterior beverage marketing in Seattle, Washington. We employed four separate multivariable Poisson regression models to examine in-store marketing of both SSB and non-SSB as a function of 1) neighborhood income and 2) racial/ethnic composition. We then employed two separate multivariable logistic regression models to examine the association between exterior SSB marketing neighborhood sociodemographics.

Results: A total of 147 food retail stores were included in the analysis. Neighborhoods in the middle tertile for percentage of non-Hispanic Black or Hispanic residents had a significantly higher prevalence of in-store SSB (PR=1.62; 95% CI: 1.03, 2.55) and non-SSB (PR=1.68; 95% CI: 1.02, 2.76) advertisements, compared to neighborhoods with the lowest percentage of non-Hispanic Black or Hispanic residents. In-store non-SSB advertisements were significantly more prevalent (PR=1.44; 95% CI: 1.08, 1.93) in middle-income neighborhoods compared to low-income neighborhoods. Racial/ethnic composition and median household income were not statistically significantly associated with odds of having any exterior SSB advertisements.
Conclusions: Marketing of in-store and exterior SSBs and non-SSBs may not be strongly targeted towards lower income neighborhoods, but racial/ethnic composition may be associated with the prevalence of in-store SSB and non-SSB advertisements. Continued monitoring is warranted given the dynamic nature of beverage marketing in the food environment and its impact on public health.

Introduction

Obesity continues to pose a major threat to public health, particularly among people of color and people with lower incomes.[1–5] Food and beverage marketing has gained interest in recent years as a potential contributor to the obesity epidemic and obesity disparities[6,7] as repeated exposure to food and beverage marketing is thought to influence preference for and consumption of nutrient-poor, energy-dense products.[6,8–11]In turn, studies have reported associations between advertising of nutrient-poor food and beverages with increased consumption of those products and higher BMIs.[12,13] Prior studies have also observed that a disproportionate burden of food and beverage advertising occurs in low-income communities and communities of color[14–16], with the majority of the advertisements promoting unhealthy products (i.e. soda, energy drinks, fast food). Despite the fact that low-income communities and communities of color are targets of unhealthy food advertising, prior studies have not yet examined sugar-sweetened beverages (SSBs) and non-SSB marketing patterns in relation to neighborhood-level sociodemographics.

Marketing of sugar-sweetened beverages (SSBs) is of particular public health interest, given that SSBs are the largest source of added sugars and calories for children and adults in the US[17] and have been linked to obesity.[18,19] In addition, consumption of SSBs, like obesity prevalence, has been found to vary by race/ethnicity and income. Studies suggest that the highest intake of SSBs is among low-income individuals and non-Hispanic Black, Mexican American, and non-Mexican Hispanic children, adolescents, and young adults.[20] Although considered an alternative for SSB consumers, some non-SSBs (e.g. diet soda, and low-calorie or diet sports and energy drinks) provide no nutritional value and may pose their own health risks.[21,22] Consumption of non-SSBs has also been found to differ by race/ethnicity and income, with non-

Hispanic whites and high-income individuals consuming more non-SSBs compared to non-Hispanic Black, Hispanic, and low-income individuals.[23]

Food and beverage companies pursue various marketing platforms, such as television, social media, and internet.[24,25] Retail food and beverage marketing through in-store (i.e end-aisle, special floor displays) and exterior displays (i.e. advertisements on billboards, wall signs, storefronts, etc) have become more commonly utilized by food and beverage companies. In particular, budgets for in-store marketing have increased by 40% between 1968 and 2009.[26] In turn, a recent study found that use of end-aisle displays increased sales volume of carbonated beverages by 51.7% compared to within aisle shelf displays.[27]

Relatedly, limited evidence suggests that in-store and exterior marketing of unhealthy food and beverages vary by race/ethnicity and income. Exterior food and beverage marketing, which often advertises unhealthy products, is more prevalent in low-income communities and communities of color.[14–16] In-store marketing of unhealthy foods and beverages may also target vulnerable communities. For example, a recent study found that in-store SSB beverage marketing increases during days when Supplemental Nutrition Assistance Program (SNAP) benefits are distributed, compared to other days during the month, and that this increase is greater for neighborhoods with high (vs. low) SNAP enrollment.[28]

We build on this small body of literature by examining SSB and non-SSB marketing patterns in relation to neighborhood-level socio-demographic characteristics. Specifically, the primary objective of this study is to assess whether neighborhood-level race/ethnicity and income was associated with the prevalence of in-store and exterior SSB and non-SSB advertisements in a large US city. A better understanding of this relationship is needed as in-

store and exterior beverage marketing may contribute to socio-demographic disparities in obesity rates.

Methods

Overview

We performed multivariable regressions to examine the association between marketing outcomes and neighborhood-level race/ethnicity (percent non-Hispanic Black or Hispanic) and income.

Study Setting and Sample

Data for this analysis had been collected as part of a larger evaluation of Seattle's Sweetened Beverage Tax. We conducted in-store audits of food retail stores to collect information about SSBs and non-SSBs, including assessment of the presence of in-store and exterior beverage marketing in Seattle, Washington. To sample stores, first, we divided our study area into 16 equal-sized areas to ensure a geographically balanced sample of stores in Seattle, Washington (WA). Second, we used business addresses to geocode all food retail stores in each of the 16 areas (see Figure 1) using the 2015 Public Health Food Permit records, a list of all permitted food establishments within King County, WA. Third, we selected a sample of each of the following store types from the 16 areas: superstores, supermarkets, grocery stores, drug stores, and small stores (N =147 stores total). The University of Washington Urban Form Lab (UFL) classified stores into the aforementioned categories from the 2015 Public Health Food Permit records. Finally, as detailed below, we recorded in-store and exterior beverage advertisements within these retail stores. For this sub-study, we excluded all food retail stores outside of the city's limits. We then divided all census tracts in the city of Seattle according to

tertile of neighborhood racial/ethnic and socioeconomic composition. To ensure that our sample of stores reflected the proportion of store types in each tertile of neighborhood racial/ethnic and socioeconomic composition, we developed and applied post-estimation weights to make the sample representative of the mix of stores in each of the tertiles.

Data Sources

Primary data collection. In each of the 147 stores, research staff recorded the presence or absence of in-store advertisements and the number of exterior advertisements. To capture in-store advertisements, data collectors surveyed the aisles and perimeter of a given store and recorded whether an end-aisle display or special-floor display were present for each beverage type (SSB vs non-SSB). SSBs included soda, sports drinks, energy drinks, juice drinks, and flavored milk. Non-SSBs consisted of diet soda, diet sports drinks, diet energy drinks, 100% juice drinks, milk, and water. Research staff documented the number of beverage advertisements for each beverage type on the building exterior. Exterior advertisements included signs on the door, exterior walls, signs in parking lot, on a post, sandwich board, or billboard. All ads had to be on the exterior of the building or part of the building's property.

Neighborhood Characteristics. Census tract boundaries and sociodemographics were obtained from the 2016 American Community Survey (ACS) 5-year estimates (2012-2016) for the city of Seattle. We divided all census tracts in the city of Seattle according to tertile of neighborhood racial/ethnic and socioeconomic composition.

Dependent variables

The dependent variables of interest were in-store and exterior marketing of SSBs or non-SSBs. The in-store marketing variable was the sum of the number of 1) end-aisle displays and 2)

special-floor displays for each beverage category (i.e. diet soda, soda, energy drinks, diet energy drinks, etc). Specifically, for each beverage category, we recorded whether an end-aisle display and or special-floor display were present for each beverage category (i.e. soda, diet soda), as a dichotomous variable (present vs not present). We then summed the number of end-aisle displays and special floor displays (a count variable) for each store to derive the total number of in-store end-aisle and special floor displays for SSB and 2) non-SSB in each store. The possible range of 0 to 10 for SSB advertisements and 0 to 12 for non-SSB advertisements, based on the number of different beverage categories within each.

The exterior marketing variable was the sum of the number of all posters, fliers, or signs on the outside of a retail location that promote the sale of either an SSB or non-SSB in each store. We counted the number of advertisements attached or adhered to the outside of the retail building or on the retail property, such as sandwich boards in the parking lot, or overhead signs. For SSB and non-SSB (separately), exterior marketing was dichotomized into any marketing present versus none because few stores had more than 1 exterior SSB or non-SSB advertisement. Additionally, very few stores had any exterior marketing of non-SSBs, creating cells with zero exterior non-SSB marketing for whole tertiles of neighborhood characteristics. For this reason, we could not pursue models of exterior non-SSB advertising and instead we included only the models of exterior SSB advertising.

Independent variables

Our independent variables included tertiles of neighborhood-level race/ethnic composition and income. Racial/ethnic composition was represented by combining the percent of non-Hispanic Black and Hispanic residents in each census tract. We focused on the proportion of

the population that was either non-Hispanic Black or Hispanic, given that previous literature has documented a higher prevalence of nutrient-poor, energy dense marketing in non-Hispanic Black and Hispanic communities, as compared to non-Hispanic white communities.[15,16] Neighborhood income status was defined using median household income in 2016 inflation-adjusted dollars. We then generated tertiles (low, middle, high), of both median household income and proportion of non-Hispanic Black or Hispanic based on the sample distribution.

Covariates

We used a directed acyclic graph to identify factors that were associated with both the exposures (neighborhood racial/ethnic composition and median household income) and the outcomes (in-store and exterior marketing) and not on the causal pathway. In these analyses, we controlled for the following confounders: median age of census tract residents, population density, and number of food retail stores per census tract. The aforementioned covariates were included in the models as continuous variables. We also controlled for store type, dichotomized as larger stores (superstores and supermarkets) and smaller stores (grocery stores, small stores, drug stores).

Statistical Analysis

We first calculated weighted means and frequency distributions of in-store and exterior SSB and non-SSB advertisements and key covariates according to neighborhood-level tertiles of income and race/ethnicity. To compare differences in SSB and non-SSB advertising prevalence across tertiles of income and racial/ethnic composition, we present P values from adjusted Wald tests.

We employed four separate multivariable Poisson regression models to examine in-store marketing of both SSB and non-SSB as a function of 1) neighborhood income and 2) racial/ethnic composition. We then employed two separate multivariable logistic regression models to examine the association between exterior SSB marketing and 1) neighborhood income and 2) racial/ethnic composition.

Regression models are weighted using the poststratification weights and implemented with the survey package in Stata to reflect the actual distribution of stores in each tertile of neighborhood-level race/ethnicity and income. We weighted the models as store type is correlated with the prevalence and type of beverage marketing.[29–31] and because we had a quota-based sample of stores, rather than a random sample. We used Taylor series linearized standard errors.

Secondary Analysis

We conducted a secondary analysis – for both in-store and exterior advertisements – of a subset of beverage types. We included soda, energy drinks, and sport drink advertisements and their low- or zero-sugar alternatives in regression models, as beverage companies spend a large portion of their marketing budget on these drink types (Rudd Report). Similar to above, we employed four separate multivariable Poisson models for in-store advertisements as function of neighborhood-level income and racial/ethnic composition stratified by beverage. We carried out separate multivariable logistic regression models for exterior advertisements. All analyses were carried out using Stata version 15 (StataCorp, LP, College Station, Tx).

Results

Descriptive Results

Table 1 describes weighted key characteristics of stores and neighborhoods by tertiles of income level and race/ethnic composition. A total of 147 food retail stores were included in the analysis. The results show that 45% (n=70) of the stores were located in lower-income census tracts, 38% (n=48) in middle-income census tracts, and 17% (n=29) in the highest-income census tracts. Despite a greater number of food stores in lower-income census tracts, there is a similar distribution of store types across the three income categories. For example, in the lowest-income census tracts, drug stores/pharmacies make up 8% (n=9) of all stores, 10% (n=2) in middle-income census tracts, and 8% (n=2) in the highest-income census tracts. By neighborhood-level race/ethnicity, 49% (n=76) of stores were found in neighborhoods with the highest percentage of residents who were Black or Hispanics, 34% (n=43) in the intermediate group for Black or Hispanic residents, and 16% (n=28) in neighborhoods with the lowest percentage of residents who were Black or Hispanic.

Also provided in Table 1 are weighted sample descriptive statistics regarding control variables used in the regression analyses. Mean (SEM) median household income in census tracts with highest percentage of Black or Hispanic residents was $55,137 ($1,417). In the census tracts with lowest percentage of Black or Hispanic residents, median household income was $102,896 ($2,976). Mean employment, median age, and mean population density were similar across tertiles of neighborhood race/ethnicity and income, but education varied. By race/ethnicity, 73% of residents in census tracts with the lowest percentage of Black or Hispanic residents had a college or advanced degree compared to 39% in census tracts with the highest percentage of Black or Hispanic residents. By income, in the lowest-income census tracts, 39% of residents had a college or advanced degree compared to 58% in middle-income and 74% in high-income census tracts.

Table 2 presents mean number of SSB and non-SSB beverage in-store advertisements and proportion of stores with at least 1 SSB exterior advertisement by neighborhood-level race/ethnicity and income with P values from adjusted Wald tests.

Exterior advertisements. Exterior SSB advertisements were infrequently found in the sample of stores studied. In high-income census tracts, 28% (n=7) of stores had an exterior SSB advertisement present. In low- and middle-income census tracts, 20% (n=10) and 19% (n=7) of stores had at least one exterior SSB advertisement, respectively. No SSB ads were found on the exterior of superstores, supermarkets, or drug stores/pharmacies across all income levels. Grocery stores did not have SSB advertisements in low- and high-income census tracts, whereas 11% (n=1) of grocery stores in middle-income census tracts had an SSB advertisement. Out of all store types, small stores had a higher prevalence SSB advertisement across all income levels.

By race/ethnicity, overall, 21% (n=3) of stores displayed exterior SSB marketing in neighborhoods with a low proportion of Black and Hispanic residents (Table 2). In the middle tertile, overall, 30% (n=13) of stores had exterior SSB marketing present while only 16% (n=8) of all stores in neighborhoods with the highest percentage of Black or Hispanic residents exhibited exterior SSB marketing. Superstores, supermarkets, and drug stores/pharmacies had no exterior SSB marketing present across all subgroups. Among small stores, exterior SSB marketing was present on 38% (n=3) of small stores in census tracts with the lowest percentage of Black or Hispanic residents, 50% (n=12) of small stores in the intermediate group, and 24% (n=8) of small stores in census tracts with the highest percent of Black or Hispanic residents.

In-store advertisements. Mean (SE) number of in-store SSB advertisements in the sample of food stores was significantly different by income (P=0.027). Mean number of in-store SSB ads ranged

from 1.0 (0.19) in high-income census tracts to 1.7 (0.17) in middle-income census tracts. Similarly, the mean number of non-SSB advertisements was significantly different by income in the sample of food stores ($p<0.001$). Superstores had a similar number of in-store SSB advertisements in low- and middle-income census tracts. However, there were no in-store SSB or non-SSB advertisements in high-income census tracts. Supermarkets averaged 3.11 (0.49) in-store SSB advertisements and 3.2 (0.51) in-store non-SSB advertisements in lower-income census tracts. Mean number of in-store SSB and non-SSB advertisements were similar in grocery stores across all income tertiles. Small stores in middle-income census tracts had roughly twice the number of in-store SSB ads (1.6 [0.19]) compared to small stores in low- (0.8 [0.15]) and high-income census tracts (0.8 [SE=0.26). Drug stores/pharmacies advertised a similar mean number of in-store non-SSB ads across all income levels ($2.0_{lowincome}$ [0.19]; $2.0_{middleincome}$ [SE=0.44]; $2.0_{highincome}$ [SE=0.60]).

The mean number of in-store SSB advertisements in the sample of food stores ranged from 1.1 (0.2) in census tracts with the lowest percent of non-Hispanic Black or Hispanic residents and to 1.5 (0.18) in the middle tertile for percent non-Hispanic Black or Hispanic. There were no in-store SSB or non-SSB advertisements in superstores or supermarkets in census tracts with the lowest percent of non-Hispanic Black or Hispanic residents. In contrast, supermarkets located in census tracts with the highest percentage of non-Hispanic Black or Hispanic residents displayed 3.1 (0.55) in-store SSB advertisements, on average, and 3.1 (0.57) non-SSB ads, respectively. A similar amount of in-store SSB and non-SSB ads were found in grocery stores in census tracts with the lowest (1.1[0.41]) and the highest percent of non-Hispanic Black or Hispanic residents (1.1 [0.22]). The mean number of in-store SSB was not statistically significantly different across tertiles of % non-Hispanic Black or Hispanic in small

stores and drug/stores pharmacies. However, significant differences were observed for in-store non-SSB marketing among small stores ($p = 0.035$).

Regression Results

Results for the association between neighborhood-level income and race/ethnicity and in-store and exterior SSB and non-SSB advertisements are displayed in Table 3.

In-store SSB advertising. Racial/ethnic composition and median household income were generally not significantly associated with prevalence of in-store SSB or non-SSB advertisements. However, neighborhoods in the middle tertile for percentage of non-Hispanic Black or Hispanic residents had a significantly higher prevalence of in-store SSB (PR=1.62; 95% CI: 1.03, 2.55) and non-SSB (PR=1.68; 95% CI: 1.02, 2.76) advertisements, compared to neighborhoods with the lowest percentage of non-Hispanic Black or Hispanic residents. However, we did not observe differences in the prevalence of advertisements when comparing neighborhoods with the highest percent of non-Hispanic Black or Hispanic residents to those with the lowest.

In-store non-SSB advertising. In-store non-SSB advertisements were significantly more prevalent (PR=1.44; 95% CI: 1.08, 1.93) in middle-income neighborhoods compared to low-income neighborhoods. Again, there was no difference in prevalence of non-SSB ads when comparing high-income to low-income neighborhoods.

Table 3 also shows results from logistic regressions for odds of having any exterior marketing of SSBs by neighborhood characteristics.

Exterior SSB advertising. Racial/ethnic composition and median household income were not statistically significantly associated with odds of having any exterior SSB advertisements. The odds of having exterior SSB advertising was different according to tertile of percentage of non-Hispanic Black or Hispanic residents ($OR_{middle\ tertile}$=1.97; 95% CI: 0.58,6.65; $OR_{highest\ tertile}$=0.69; 95% CI: 0.19, 2.49), compared to neighborhoods with the lowest prevalence of non-Hispanic Black or Hispanic. However, the direction of these non-significant associations did differ. Similarly, middle-income neighborhoods (OR=0.81; 95% CI: 0.26, 2.54) and higher-income neighborhoods (OR=1.88; 95% CI 0.69, 5.08) had similar odds of having exterior SSB advertisements, compared to lower-income neighborhoods, but the direction of the association again varying.

Secondary Analysis: When we included soda, energy drinks, and sport drink advertisements and their low- or zero-sugar alternatives in separate, stratified regression models we did not find any statistically significant associations between racial/ethnic composition and median household income and prevalence of beverage marketing (Table 4).

Discussion

This study assesses both in-store and exterior SSB and non-SSB beverage marketing in relation to neighborhood-level race/ethnicity and income. We found that neighborhoods in the middle tertile for percent non-Hispanic Black or Hispanic had a significantly higher prevalence of in-store SSB (PR=1.62; 95% CI: 1.03, 2.55) and non-SSB (PR=1.68; 95% CI: 1.02, 2.76) advertisements, compared to neighborhoods with the lowest percentage of non-Hispanic Black or Hispanic residents. By income, middle income neighborhoods had a significantly higher prevalence of in-store non-SSB advertisements (PR=1.44; 95% CI: 1.08, 1.93) compared to low

income neighborhoods. Contrary to our hypothesis, we generally did not find evidence that either SSB or non-SSB in-store or exterior SSB marketing systematically differed according to neighborhood income but did find signs of an association between in-store SSB and non-SSB marketing and racial/ethnic composition.

Contrary to our findings, many studies have noted differences in prevalence of unhealthy advertising by neighborhood racial/ethnic composition in major US cities[15,16,32,33] and documented forms of racially targeted beverage marketing.[34,35] In their multivariate generalized regression models, Hillier et al. found census blocks with a higher percent of Black residents to contain significantly more unhealthy outdoor ad (i.e. billboards, bus bench and shelter ads, and store window posters) clustering around schools in Philadelphia. In Los Angeles, census blocks with high percentages of white residents had significantly less unhealthy outdoor ad clustering around schools.[36] In a study of 7 identically zoned communities in Los Angeles, Lowery and Sloane found that communities of color, compared to other communities, contained more outdoor advertising portraying harmful content, including SSBs.[15] Differences between our findings may be attributed to type of ads studied and or geographic location. We focused solely SSBs and non-SSBs advertisements while other studies have examined unhealthy ads, which included – in addition to beverage ads – fast food, alcohol, and tobacco.[15,36] Additionally, some of the previous studies were limited to areas surrounding schools[14,36], whereas we examined neighborhoods citywide. Similar to our findings, one prior related study by Isgor and colleagues also report that regular soda ads were not significantly more prevalent in supermarkets/grocery stores located in majority non-Hispanic Black and Hispanic communities, in models that adjusted for median household income, degree of urbanization and other covariates.[14]

We did not find consistent associations between median household income and prevalence of interior or exterior SSB or non-SSB beverage marketing, with the exception that middle-income census tracts had a higher prevalence of in-store non-SSB ads relative to low-income census tracts. Unlike our findings, Isgor and colleagues found that in supermarkets/grocery stores and limited service stores, regular soda ads were significantly more prevalent in low income communities as compared to high income communities.[14] Similarly, a previous study found that higher income areas may have lower exposure to nutrient-poor food and beverage advertisements.[16] Beverage marketers may also target SNAP customers by increasing the quantity of SSB ads during SNAP issuance.[28] Despite these contrary findings, our results are consistent to those by Kwate and Lee who focused on predominantly African American neighborhoods in New York City and found no significant association between median household income and overall advertisement density.[37]

It is possible that our findings are influenced by the SSB consumption patterns of Seattle residents. On average, 23% of adults aged 18 – 64 in Seattle consumed at least one SSB daily[38], as compared to 50% of adults, who consumed SSBs on a given day nationally.[20] Consumption patterns in Seattle vary by race/ethnicity and education, with highest consumption among non-Hispanic Black adults and adults with a high school education or less.[38] Beverage companies may elect to concentrate their advertisements in areas where consumption rates are higher rather than demographic factors.[12] Further, high levels of education and high income are common in Seattle and may limit exposure to beverage marketing.

Our study has several limitations that should be noted. Since we had few exterior SSB advertisements, we dichotomized the exterior variable to assess presence of an exterior SSB advertisement. Therefore, we were unable to examine the number of exterior advertisements. We

did not capture information related to the manufacturer or retailer of the advertisements, which may contribute to the distribution patterns of ads and dictate consumers' exposure to a type of beverage ad.[25,29] Given prevalence and distribution of in-store and exterior advertisements, we did not have large enough variation by store type to support stratification by store type in our models, we did, however, control for a dichotomous measure of store type (large versus small). Further, unmeasured personal preference may influence selection into neighborhoods with a certain food environment and, as a result, the type and magnitude of marketing in that environment.[39] Despite some limitations, our study is unique in several ways. We focused both on in-store (i.e. end-aisle displays, special floor displays) and exterior (i.e. ads on building properties and ads adhered to the building) beverage advertisements. The attention on in-store advertisements allows us to focus on point-of-sale marketing, where decisions around consumption are often made.[40,41] We also assessed advertising of SSBs and non-SSBs, allowing us to assess for marketing patterns across two beverage types.

Conclusion

We found evidence that disparities of in-store SSB and non-SSB marketing may exist by racial/ethnic composition in Seattle, WA. However, in-store SSB and non-SSB was largely not associated with neighborhood income. We did not find significant difference by income and racial/ethnic composition for exterior SSB advertisements. These findings suggest that, in this context, marketing of in-store and exterior SSBs and non-SSBs may not be strongly targeted towards lower income neighborhoods, but racial/ethnic composition may be associated with the prevalence of in-store beverage marketing. Continued monitoring is warranted given the dynamic nature of beverage marketing in the food environment and its impact on public health.

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Figure 1. Sixteen Sample areas in Seattle, WA

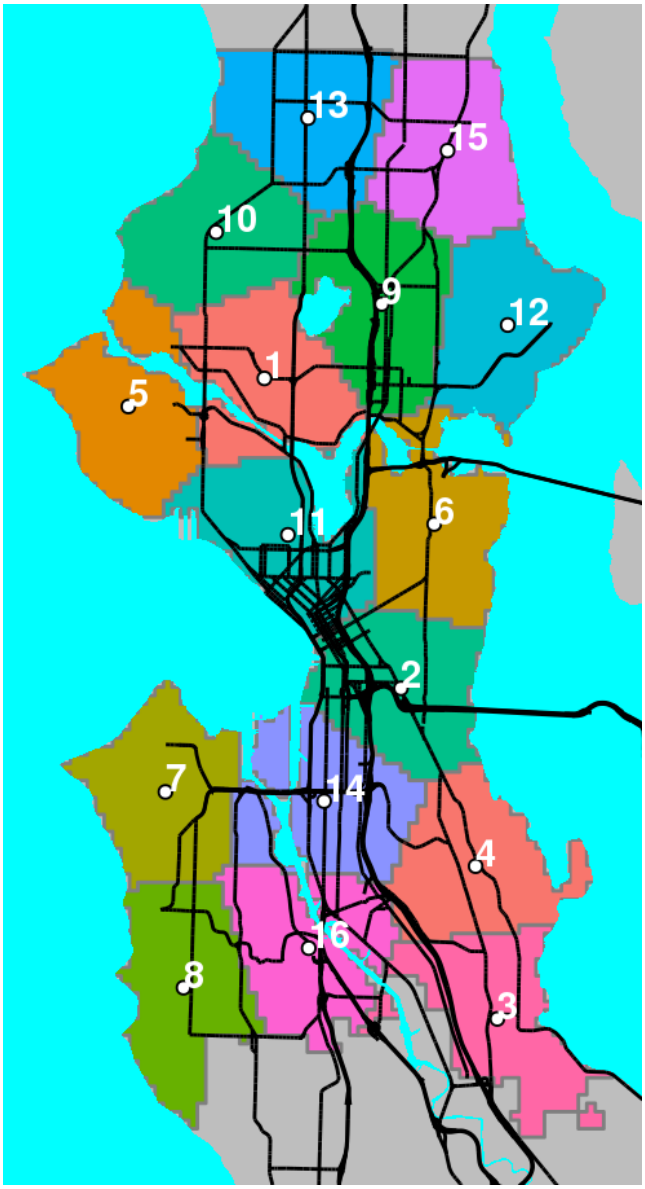

Table 1. Descriptive statistics of sampled census tracts from Seattle, WA by tertiles of income and tertile of percent Black or Hispanic residents

	Overall (N=147) (**unweighted**)	Income (**weighted**)			Non-Hispanic Black or Hispanic, % (**weighted**)		
		Low income (N = 70)	Middle income (N= 48)	High income (N = 29)	First tertile (N = 28)	Second tertile (N= 43)	Third tertile (N = 76)
Average Median Age, (SE[a])	36.5 (0.35)	36.2 (0.40)	36.1 (0.41)	37.8 (0.61)	37.8 (0.73)	34.6 (0.67)	36.7 (0.27)
Race/Ethnicity, %							
Non-Hispanic White	57%	43%	65%	78%	84%	71%	39%
Non-Hispanic Black	11%	17%	7%	2%	1%	3%	19%
Non-Hispanic Asian	16%	21%	13%	9%	6%	11%	22%
Hispanic	8%	11%	8%	4%	4%	7%	11%
Average median household income, $ (SE)	68,818 (2,225)	49,431 (1,116)	73,558 (776)	109,846 (2,976)	102,891 (4,302)	73,801 (3,256)	55,137 (1,417)
Mean Employment, %	94%	92 %	95%	97%	97%	95%	92%
Education %							
Less than high school	9%	14%	7%	2%	2%	3%	15%
HS degree	13%	18%	11%	6%	7%	9%	18%
College degree or beyond	53%	39%	58%	74%	73%	64%	39%
Mean Population Density per Sq Mi, (SE)	10,907 (578)	9,927 (750)	10,159 (811)	12,876 (1,144)	10,714 (920)	13,676 (1,275)	9,403 (508)
Food Environment, %							
Food Stores (overall)	**100%**	**45%**	**38%**	**17%**	**16%**	**34%**	**49%**
Food Stores, by type % (n)[b]							
Superstore	8% (12)	9% (5)	15% (6)	13% (1)	19% (1)	14% (3)	8% (8)
Supermarket	13% (19)	1% (9)	2% (7)	0% (3)	0% (5)	1% (6)	2% (8)
Grocery	22% (32)	15% (14)	16% (9)	26% (9)	19% (9)	19% (6)	16% (17)
Small Store	46% (67)	67% (33)	57% (20)	52% (14)	55% (9)	54% (24)	67% (34)
Drug Store/ Pharmacy	12% (17)	8% (9)	10% (2)	8% (2)	8% (4)	12% (4)	7% (9)

Weighted to be representative of all stores within either income tertiles or percent Black or Hispanic tertiles

[a] SE = standard error of mean for unweighted data; Taylor series linearized standard errors for weighted data

[b] Unweighted values

Table 2. SSB and non-SSB advertisements by tertiles of income and tertile of percent Black or Hispanic residents[a]

	Income				Non-Hispanic Black or Hispanic, %			
	Low Income	Middle Income	High income	p value	Lowest tertile	Middle tertile	Highest tertile	p value
Proportion of stores with ≥ 1 exterior[b] SSB[c] advertisement, % (n)[d]								
Food stores (total)	20% (10)	19% (7)	28% (7)	0.465	21% (3)	30% (13)	16% (8)	0.102
Superstore	0% (0)	0% (0)	0% (0)		0% (0)	0% (0)	0% (0)	
Supermarket	0% (0)	0% (0)	0% (0)		0% (0)	0% (0)	0% (0)	
Grocery	0% (0)	11% (1)	0% (0)	0.213	0% (0)	17% (1)	0% (0)	0.200
Small Store	30% (10)	30% (6)	54% (7)	0.191	38% (3)	50% (12)	24% (8)	0.048
Drug Store/Pharmacy	0% (0)	0% (0)	0% (0)		0% (0)	0% (0)	0% (0)	
Mean number of SSB interior[d] advertisements, SE[e]								
Food Stores (total)	1.3 (0.13)	1.7 (0.17)	1.0 (0.19)	0.027	1.1 (0.20)	1.5 (0.18)	1.3 (0.14)	0.307
Superstore	2.0 (0.24)	2.0 (0.53)	0	< 0.001	0	2.0 (0.69)	2.0 (0.33)	< 0.001
Supermarket	3.1 (0.49)	2.0 (0.30)	0	0.053	0	2.0 (0.40)	3.1 (0.55)	0.100
Grocery	1.1 (0.29)	0.8 (0.35)	1.1 (0.36)	0.70	1.1 (0.36)	0.7 (0.38)	1.1 (0.27)	0.598
Small Store	1.1 (0.18)	1.9 (0.25)	1.2 (0.31)	0.027	1.4 (0.33)	1.7 (0.24)	1.1 (0.19)	0.191
Drug Store/Pharmacy	1.9 (0.15)	1.5 (0.39)	1.0 (0)	< 0.001	1.3 (0.46)	1.5 (0.37)	1.9 (0.16)	0.312
Mean number of non-SSB interior advertisements, SE								
Food Stores (total)	1.1 (0.11)	1.7 (0.16)	0.9 (0.18)	< 0.001	1.0 (0.21)	1.5 (0.17)	1.1 (0.16)	0.080
Superstore	2.0 (0.24)	3.0 (0.66)	0	< 0.001	0	3.0 (0.80)	2.4 (0.45)	< 0.001
Supermarket	3.2 (0.51)	2.1 (0.32)	0	0.074	0	2.2 (0.37)	3.1 (0.57)	0.160
Grocery	1.0 (0.24)	0.8 (0.32)	1.1 (0.40)	0.784	1.1 (0.41)	0.5 (0.39)	1.1 (0.22)	0.420
Small Store	0.8 (0.15)	1.6 (0.19)	0.8 (0.26)	0.004	1.2 (0.35)	1.4 (0.20)	0.8 (0.14)	0.035
Drug Store/Pharmacy	2.0 (0.19)	2.0 (0.44)	2.0 (0.60)	1.000	2.0 (0.67)	2.0 (0.30)	2.0 (0.19)	1.000

SE = standard error; SSB = Sugar-sweetened beverage

[a] Weighted to be representative of all stores within income tertiles or percent Black or Hispanic tertiles

[b] Includes posters, fliers, or signs on the outside of a retail location that promote the sale of a beverage

[c] SSB = sugar sweetened beverage; regular soda, regular energy, sports drinks, juice, and flavored milk

[d] Counts of end-aisle displays and special for displays promoting the sale of a beverage

[e] SE = linearized standard error

[f] Non-SSB = Diet soda, diet energy, diet or zero sugar sports drinks, 100% juice, milk, and water

Table 3. Adjusted associations between neighborhood-level socio-demographics and prevalence of in-store[a] and exterior[b] beverage marketing [c,d]

Variable	In-store SSB ads PR (95% CI)	In-store non-SSB ads PR (95% CI)	Exterior SSB ads OR (95% CI)
Non-Hispanic black or Hispanic, %			
Lowest tertile	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Middle tertile	1.62 (1.03, 2.55) *	1.68 (1.02, 2.76) *	1.97 (0.58, 6.65)
Highest tertile	1.40 (0.91, 2.16)	1.28 (0.79, 2.08)	0.69 (0.19, 2.49)
Income			
Low income	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Middle income	1.20 (0.88, 1.64)	1.44 (1.08, 1.93) *	0.81 (0.26, 2.54)
High income	0.67 (0.41, 1.09)	0.68 (0.42, 1.13)	1.88 (0.69, 5.08)

Ads= advertisements; CI = confidence interval; OR = odds ratio; PR = prevalence ratio
[a] In-store results from Poisson regression
[b] Exterior results from logistic regression; excluded exterior non-SSB models as few stores contained exterior non-SSB ads
[c] Weighted to be representative of all stores within income tertiles or percent Black or Hispanic tertiles
[d] Controlled for median age, population density, store type, and number of stores per census tract
* $P < .05$

Table 4. Adjusted associations between neighborhood socio-demographics and prevalence of in-store[a] and exterior[b] beverage marketing excluding milk, flavored milk, juice drinks, 100% juice drinks, and water[c,d]

Variable	In-store SSB ads PR (95% CI)	In-store non-SSB ads PR (95% CI)	Exterior SSB ads OR (95% CI)
Non-Hispanic Black or Hispanic, %			
Lowest tertile	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Middle tertile	1.50 (0.94, 2.40)	1.62 (0.97, 2.71)	1.91 (0.56, 6.55)
Highest tertile	1.19 (0.74, 1.90)	1.21 (0.71, 2.07)	0.74 (0.21, 2.63)
Income			
Low income	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Middle income	1.24 (0.89, 1.72)	1.27 (0.89, 1.82)	0.85 (0.29, 2.50)
High income	0.74 (0.42, 1.29)	0.67 (0.36, 1.24)	1.81 (0.59, 5.55)

Ads= advertisements; CI = confidence interval; OR = odds ratio; PR = prevalence ratio
[a] In-store results from Poisson regression
[b] Exterior results from logistic regression; excluded exterior non-SSB models as few stores contained exterior non-SSB ads
[c] Weighted to be representative of all stores within income tertiles or percent Black or Hispanic tertiles
[d] Controlled for median age, population density, store type, and number of stores per census tract
* $P < .05$