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Disparities in food access: Does aggregate availability of key foods from other stores offset the relative lack of supermarkets in African-American neighborhoods?

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Abstract

Objective—Recent work demonstrates the importance of in-store contents, yet most food access disparity research has focused on differences in store access, rather than the foods they carry. This study examined in-store shelf space of key foods to test whether other types of stores might offset the relative lack of supermarkets in African-American neighborhoods.

Methods—New Orleans census tract data were combined with health department information on food stores open in 2004-2005. Shelf space of fruits, vegetables, and energy-dense snacks was assessed using a measuring wheel and established protocols in a sample of stores. Neighborhood availability of foods was calculated by summing shelf space in all stores within two kilometers of tract centers. Regression analyses assessed associations between tract racial composition and aggregate food availability.

Results—African-American neighborhoods had fewer supermarkets and the aggregate availability of fresh fruits and vegetables was lower than in other neighborhoods. There were no differences in snack food availability.

Conclusions—Other store types did not offset the relative lack of supermarkets in African-American neighborhoods in the provision of fresh produce, though they did for snack foods. Altering the mix of foods offered in such stores might mitigate these inequities.

Keywords

Food stores; Fruits and vegetables; Snack foods; African-American; Obesity

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Introduction

Obesity remains a pressing public health concern in the U.S. with nearly two-thirds of Americans categorized as either overweight or obese (Ogden, et al., 2006). Inadequate consumption of low energy-dense foods, such as fruits and vegetables, and high intakes of energy-dense snack foods may be partially to blame. The low energy density and the high fiber content of fruits and vegetables make them well suited for the prevention of obesity (Ledikwe, et al., 2006, Rolls, et al., 2005). Conversely, the high energy density and poor micronutrient content of most snack foods and sweetened carbonated beverages make them a promoter of poor diet quality, higher overall energy intake (Ovaskainen, et al., 2006, Vartanian, et al., 2007), and unhealthy body weight (Schulze, et al., 2004).

While obesity rates are high in all U.S. populations, low income individuals and African-Americans tend to have the highest rates (Ogden, et al., 2006). This pattern has spurred researchers to examine racial disparities in neighborhood access to food. Having limited access to food outlets that sell healthy foods and greater access to stores that sell energy-dense foods may make it difficult to consume diets that promote healthy bodyweight. Recent studies have found correlations between food store access, diet, and obesity suggesting that such a mechanism is plausible (Laraia, et al., 2004, Larson, et al., 2009, Moore, et al., 2008, Morland, et al., 2002, Morland and Evenson, 2009, Rose and Richards, 2004).

Much of the literature on U.S. food access disparities has described African-American or low-income areas as having little to no access to supermarkets and greater access to other store types, like small corner groceries (Alwitt and Donley, 1997, Moore and Diez Roux, 2006, Morland, et al., 2002, Powell, et al., 2007). This is likely to be problematic since supermarkets tend to stock a wide variety of foods, including fresh fruits and vegetables, while most other food retailers types do not.

Most of the previous research on food access disparities has focused on differences in access to specific types of stores. However, recent research on the food environment has documented the importance of going beyond store type to measuring in-store contents. Rose et al. found that aggregate neighborhood availability of energy-dense snack foods was associated with Body Mass Index of area residents (Rose, et al., 2009). This research built on earlier experimental work in the marketing field that demonstrated that increases in shelf space of specific foods could affect overall sales of those foods (Curhan, 1972, Curhan, 1974).

While most alternative store types may not offer the same variety or selection of foods as a supermarket, many such stores do stock positive amounts of fruits and vegetables (Block and Kouba, 2006, Bustillos, et al., 2009, Connell, et al., 2007, Farley, et al., 2009). Moreover, many African-American and other low-income neighborhoods have a higher concentration of such retailers, like small groceries and discount general merchandise stores (Moore and Diez Roux, 2006, Sharkey and Horel, 2008). Might these stores offset the relative lack of supermarkets and provide equitable access to specific foods for local residents? Could it be that previous disparities research, relying mainly on food store typology, has provided an overly simplified depiction of access?

To address these questions, we hypothesized that there was no difference in overall availability of specific foods between African-American and other neighborhoods in New Orleans. We combined data on census tract racial composition, geo-mapping of health department lists of food stores, and our own in-store surveys conducted in 2004-05, to test this hypothesis. Separate analyses were conducted for availability of fresh, frozen, and canned fruits and vegetables, as well as for four categories of energy-dense snacks.

Methods

Study sample

This study was conducted throughout the entire city of New Orleans and used the neighborhood food environment as the unit of analysis. These environments, described in greater detail below, are based on residential census tracts. Demographic data on all 181 census tracts from Orleans Parish, which defines the city of New Orleans, were obtained for the year 2000 from the U.S. Census Bureau. Six non-residential census tracts containing fewer than 500 people were excluded. Thus, our final sample size was 175. The racial makeup of each census tract was described using the percentage of African-American residents. Census tracts with greater than 80% African-American residents were coded as predominately *African-American neighborhoods*. All other tracts were classified as *mixed racial neighborhoods*. We selected this eighty percent threshold based on previous research in this field (Morland, et al., 2002). Information on the population density of each tract was also obtained due to its potential to confound any associations found between neighborhood racial characteristics and food access.

Food store database

A database of food retailers open in New Orleans during the years 2004-2005 was obtained from the Louisiana Office of Public Health (N=760), which included each store's street address and data on the amount of sales for each store per year. The database also designated each store as a full-time or part-time grocery based upon the percentage of sales in food: stores with greater than sixty percent food sales were labeled as full-time groceries while stores with less than this percentage were coded as part-time.

We classified all food retailers into one of five store types. Among stores with a full-time grocery designation, *small food stores* (n=451) had less than 1 million dollars in annual sales, *medium food stores* (n=30) had sales between 1 million and 5 million dollars, and *supermarkets* (n=31) had sales that exceeded 5 million dollars. The supermarket category included supercenters, like Wal-Mart. Stores with a part-time grocery designation were coded as either *convenience stores* (n=228) or *general merchandise stores* (n=20) based upon key descriptive terms in their store name. Convenience stores included the chain convenience stores, gas stations that sold food, and drug stores. General merchandise stores were primarily discount “dollar” stores.

In-store food availability measures

This study was part of a larger project examining neighborhood availability and consumption of alcohol and foods in Southeastern Louisiana (Bluthenthal, et al., 2008, Rose, et al., 2009). During the 2004-2005 time period, all stores (N=307) in 103 randomly selected urban census tracts in the Southeastern Louisiana region were surveyed. The amount of total linear shelf space dedicated to specific food products was measured in these stores. Fresh, frozen, and canned fruits and vegetables were each measured separately. The amounts of shelf space allocated to energy-dense foods in the form of salty snacks, cookies, crackers, pastries, candies, and carbonated beverages were also assessed. Data were collected, not only from shelves found in the aisles of stores, but also from the customer accessible sides of stand-alone circular displays and near cash registers. Measurements were taken using a measuring wheel (Measure Master, Rolatape Corporation) by two trained store enumerators. Interobserver reliability of the shelf space measures was high with Kappa values of 0.99 for fruit and 0.96 for vegetable measurements (Cohen, et al., 2007).

Data from this sample of Southeastern Louisiana stores were used to impute values for non-surveyed food stores listed in the New Orleans food store database. Thirty-seven of the original 103 selected urban census tracts were located in New Orleans, thus the 84 stores found in these tracts did not require imputation. A probability-based "hot deck" imputation technique was utilized to randomly assign in-store availability data to the remaining non-surveyed stores, based on store type.

Neighborhood food environment

Neighborhood food environments were defined by a buffer, made with a two-kilometer "radius" going in all directions from the center point of each of the 175 census tracts, creating 175 unique food environments. The two-kilometer "radius" was measured as people actually travel, i.e. along a network of streets, rather than a straight-line, and is referred to as a network distance. A number of researchers have used zip code or census tract boundaries as proxies for the neighborhood food environment to examine access disparities in their study settings (Alwitt and Donley, 1997, Moore and Diez Roux, 2006, Morland, et al., 2002, Powell, et al., 2007, Powell, et al., 2007). Considering that urban census tracts tend to be smaller and residents' exposure to food stores is likely to extend beyond the geographic area covered by a census tract, a distance of two kilometers (1.2 miles) was chosen as a reasonable buffer.

Food stores were geocoded and network distances were generated from each tract center to all food stores using ArcGIS 9.2 (ESRI, Redlands, CA). Count variables representing geographic food store access were created by summing the number of each food store type within the neighborhood. Measures of aggregate food availability were created by summing the amount of shelf space dedicated to each food item within this same area.

Statistical analysis

Poisson regression models were generated to study the relationship between the number of food stores in an environment (dependent variable) and neighborhood racial composition. Poisson regression was necessary because of the count nature of the dependent variable. Preliminary bivariate models included only tract racial composition, with final models additionally adjusting for census tract population density (pop/km^2). To correct for over-dispersion in the small food store and convenience store counts, their standard errors were scaled using the square root of the Pearson chi-square dispersion estimate. Ordinary least squares regression (OLS) was used for the models predicting aggregate availability of foods, with all outcomes square root transformed to normalize the distributions. With the square root transformed OLS models, regression coefficients varied by census tract population density. A mean tract population density of 3,820 pop/km^2 was used when simulating differences in aggregate food availability based on estimated beta-coefficients (Table 4). All multivariable analyses were performed using Stata/SE 9.0 (StataCorp, College Station, TX).

Results

Table 1 describes the characteristics of the study tracts by neighborhood race categories. A total of 175 census tracts were included in our analysis, of which, eighty-three were classified as predominately African-American tracts and ninety-two were coded as mixed racial tracts. African-American tracts, on average, had greater population density and lower mean household incomes. More households lived in poverty in African-American tracts and fewer owned cars. Table 2 provides basic descriptive statistics on the food access variables. On average, food environments had far more small food stores and convenience stores than supermarkets. In addition, food environments had a much greater aggregate amount of snack food shelf space than space dedicated to fruits and vegetables. African-American tracts, on average, had a higher number of stores for all store types except supermarkets; these bivariate differences with mixed-racial tracts were statistically significant for small food stores and general merchandise stores (results not shown).

Table 3 presents results from the Poisson models that assessed the count of each food store type in the food environment by neighborhood racial composition, and controlled for population density. Supermarkets were less likely to be located in the food environments of predominately African-American tracts as compared to the environments of mixed racial tracts, with an Incident Rate Ratio (IRR) of 0.64, and a 95% Confidence Interval ranging from 0.49 to 0.83. Conversely, 1.6 times as many general merchandise stores (IRR 1.58, 95% CI 1.10 – 2.26) were found in African-American food environments. The finding of a higher number of small stores in African-American tracts, seen in bivariate results, was no longer significant when controlling for population density.

African-American food environments had significantly less aggregate shelf space dedicated to fresh fruits and fresh vegetables (Table 4). These areas had 19.7 meters less fresh fruit and 27.3 meters less fresh vegetable aggregate shelf space as compared to mixed racial areas. African-American environments also had significantly less frozen fruits and vegetables. These areas had nearly one meter less of frozen fruits and 12.4 meters less of frozen vegetables. Canned fruits and canned vegetables did not vary significantly by racial composition, nor did the aggregate availability of energy-dense snacks foods.

Subsequent analyses were conducted to test how sensitive our results were to our definition of African-American neighborhoods, based on 80% or more of the tract population. We also tested different thresholds, such as 50%, 60%, and 70%, and these produced similar findings as above (results not shown).

Discussion

Census tract-based neighborhoods in New Orleans that were predominately African-American had less access to supermarkets and greater access to small food stores and general merchandise stores than other neighborhoods, though the small food store difference was no longer significant after controlling for population density. These findings are comparable with previous studies on disparities in other cities (Moore and Diez Roux, 2006, Morland, et al., 2002, Powell, et al., 2007, Zenk, et al., 2005). Even though other store types often carry fruits or vegetables and there is a greater concentration of these stores in African-American neighborhoods, their presence did not compensate for the relative lack of nearby supermarkets. Aggregate availability of fresh and frozen fruits and vegetables was significantly lower in African-American neighborhoods. However, this was not the case for energy-dense snack foods. Even with fewer supermarkets, which are known to carry large quantities of these foods, availability of salty snacks, cookies, crackers, pastries, candies, or carbonated beverages was not significantly lower in African-American food environments.

The limited availability of fresh fruits and vegetables in African-American food environments coupled with the large supply of energy-dense snack foods, is a potential public health concern, especially if one considers the potential of the local food environment to influence dietary patterns. Experimental studies in the marketing literature have shown that altering the shelf space allocated to certain food products in a store has a direct effect on the sales of those items (Curhan, 1974). Research on food environments has suggested associations between the availability of foods in local groceries and the reported diet of nearby residents (Bodor, et al., 2008, Franco, et al., 2009). Such studies underscore the possibility that a disparity in the aggregate amount of different foods available between neighborhoods of different racial composition may partially explain the variation seen in diets and subsequent health. While disparities were found for fresh and frozen produce, availability of canned products did not vary by neighborhood racial characteristics. Much attention has been given to improving fresh produce access in underserved areas, yet the findings from this study suggest that African-American areas may have an equitable provision of canned fruits and vegetables. Future research and intervention work should consider the merits of healthy canned products in areas facing difficulty in stocking fresh produce.

Study limitations and strengths

This research has some limitations. First, the database of food stores was provided by a state-level government office charged with permitting retailers that sell food. It is possible that some stores did not file for the required permit and subsequently they would be missing from the database, though there is no reason to suspect that such errors would systematically vary by neighborhood racial composition. Second, sales data criteria to distinguish store types may have resulted in some misclassifications, particularly between medium stores and supermarkets. Some have used a threshold of $2 million/year to distinguish these store types, but this cut-off fell in mid-range of categorical data available in this study. Misclassification error was likely minimal, though. Our data show that stores classified as medium and as supermarkets had mean square footage of 2,825 and 28,174, respectively, whereas median store size for supermarkets nationally in 2008 was 46,755 (Food Marketing Institute, 2008). Third, this study did not directly survey the contents of all food stores in New Orleans, and instead used a probability-based method to assign in-store data to non-surveyed stores (89% of store database) using data from surveyed stores of the same type. The high concentration of food retailers found in New Orleans, plus the time-consuming nature of our surveys, made it impossible to survey all stores. However, previous work has indicated that a great deal more variability in food shelf space exists between store types than within types. For example, we have shown that 86% of the total variance in shelf length of fresh vegetables was accounted for by store type (Farley, et al., 2009). Moreover, similar disparity results were seen with analysis using just the observed stores in Southeastern Louisiana (Rose, et al., 2007).

A strength of this study was that in-store availability data were incorporated into an assessment of food access, which provided a more nuanced portrait of the existing disparities in access, by taking into account the aggregate contributions of foods from all stores in a neighborhood. Additionally, the in-store survey collected data on the shelf space amounts of foods in stores, rather than using a simple “yes/no” availability measure, which is important for distinguishing stores that have just a couple pieces of produce versus those that have larger offerings.

Conclusions

This study found that African-American neighborhoods had significantly fewer supermarkets and even with the higher concentration of other food stores, the overall availability of fresh fruits and vegetables in these areas was significantly lower. Poor access to stores that shelve fresh produce may significantly limit residents' opportunities to purchase and consume fruits and vegetables. While policy interventions encouraging the opening of new supermarkets in minority communities is a possible solution, policies that promote the altering of the in-store availability of fruits and vegetables relative to energy-dense foods in existing food stores may also be an effective way in addressing race related inequities in food access.

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Table 1

Characteristics of census tracts by racial composition, New Orleans, LA, 2004-2005

	African-American Tracts n = 83			Mixed Racial Tracts n = 92		
Characteristic	**Min.**	**Mean (SD)**	**Max.**	**Min.**	**Mean (SD)**	**Max.**
Population size	660	2946 (1683)	9931	510	2591 (1596)	8988
Population density, pop/km^2	41	4544 (2535)	15546	13	3167 (1626)*	6768
Household income, $	4621	19255 (8042)	40227	6875	37502 (21447)*	146158
Poverty rate, %	7.8	39.7 (17.6)	88.2	1.3	21.4 (13.1)*	54.0
Car ownership rate, %	15.4	58.7 (18.9)	95.8	33.5	78.9 (14.2)*	98.4
African-American, % [a]	80.0	92.3 (5.6)	99.3	0.2	38.1 (26.3)	79.9

* $p < 0.01$

[a] Statistical test not performed because differences based on the definition used to construct tract categories.

Table 2

Descriptive statistics on food access variables, New Orleans, LA, 2004-2005

Food Access Variable	Mean (SD)
Number of Stores [a]	
Supermarkets	1.5 (1.3)
Medium Groceries	2.0 (2.3)
Small Food Stores	30.3 (27.0)
Convenience Stores	11.8 (7.2)
General Merchandise Stores	0.8 (0.9)
Fruit and Vegetable Shelf Space [b]	
Fresh Fruits	71.2 (61.4)
Canned Fruits	38.7 (30.0)
Frozen Fruits	2.6 (3.8)
Fresh Vegetables	107.7 (84.4)
Canned Vegetables	89.0 (70.4)
Frozen Vegetables	32.8 (27.5)
Snack Food Shelf Space [b]	
Salty Snacks	489.7 (332.6)
Cookies, Crackers, and Pastries	460.5 (328.0)
Candy	401.1 (265.3)
Carbonated Beverages	616.5 (453.5)

[a] Number within 2 km of census tract

[b] Aggregate shelf space (meters) within 2 km of census tract

Table 3

Incidence rate ratios of food stores for African-American census tracts, New Orleans, LA, 2004-2005 [a]

Store Type [b]	IRR	95% CI [c]	p-value
Supermarkets	0.64	0.49 to 0.83	0.00
Medium Groceries	0.96	0.77 to 1.21	0.74
Small Food Stores	1.19	0.90 to 1.56	0.22
Convenience Stores	0.92	0.77 to 1.11	0.39
General Merchandise Stores	1.58	1.10 to 2.26	0.01

[a] Incidence rate ratios are based on Poisson regression models. Values less than 1 indicate that there are fewer stores than the reference group. Reference category is mixed racial tracts, i.e. less than 80% African-American residents.

[b] Each row represents a separate model that adjusted for tract population density.

[c] Confidence intervals for small food store and convenience store IRRs were adjusted for over-dispersion by scaling standard errors using the square root of the Pearson chi-square dispersion estimate.

Table 4

Regression results on the differences in aggregate shelf space of foods between African-American and mixed racial census tracts, New Orleans, LA, 2004-2005

Food Shelf Space [a]	β [b]	SE	p-value	Mean difference [c]
Fruits				
Fresh	-1.34	0.61	0.03	-19.7
Canned	-0.09	0.35	0.79	-1.1
Frozen	-0.38	0.14	0.01	-1.0
Total	-1.17	0.65	0.08	-22.4
Vegetables				
Fresh	-1.47	0.67	0.03	-27.3
Canned	-0.10	0.54	0.85	-1.8
Frozen	-1.23	0.38	0.00	-12.4
Total	-1.54	0.89	0.09	-42.3
Energy-dense Snacks				
Salty Snacks	-0.29	1.10	0.79	-12.1
Cookies/Crackers/Pastries	-0.84	1.13	0.46	-33.5
Candy	-0.25	1.00	0.80	-9.4
Carbonated Beverages	0.04	1.31	0.98	1.6

[a]Each row represents a separate OLS square root transformed model in which the dependent variable is the amount of shelf space of a given food. Reference category is mixed racial tracts, i.e. less than 80% African-American residents. All models are adjusted for tract population density.

[b]Beta-coefficients from the regression models are not readily interpretable since the dependent variables were square root transformed. A negative sign on the coefficient indicates a lower amount of aggregate shelf space for African-American tracts.

[c]Mean difference in aggregate shelf space (meters) of specific foods between African-American and mixed racial tracts. Differences are calculated after back-transforming raw regression results to the original units, i.e. meters of shelf space. A mean tract population density of 3,820 pop/km^2 was used in these calculations.