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# Beyond Food Deserts

## Measuring and Mapping Racial Disparities in Neighborhood Food Environments

*Samina Raja, Changxing Ma, & Pavan Yadav*

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The metaphor of “food deserts,” used to describe neighborhoods with limited food retail, has captured the public and academic imagination in recent years (Cummins and Macintyre 2002). Yet the metaphor has been used rather loosely, in some instances referring to areas marked by an absence of supermarkets (Short, Guthman, and Raskin 2007), in others to areas characterized by limited retail outlets that sell healthful foods (Wrigley et al. 2002). These shifting definitions arise, in part, from limited empirical research on the precise nature, extent, and location of food destinations and disparities in access to these destinations. Without developing a nuanced and empirically substantiated understanding of inadequacies and disparities in the neighborhood food environments, it is difficult to fulfill the charge of devising comprehensive planning solutions to tackle neighborhood food insecurity (Kaufman 2004), improve public health (Boarnet 2006), and create more equitable access to healthful foods.

This article contributes to the emerging community and regional food planning literature by asking the question: how do food environments in neighborhoods of color differ from those in other neighborhoods? Specifically, we test the hypothesis that access to different types of food retail destinations, located within a five-minute travel time, in predominantly black and mixed-race neighborhoods differs from that in predominantly white neighborhoods, while controlling for factors such as income, population, and area of the neighborhood.

Similar to some studies (Moore and Diez Roux 2006; Zenk et al. 2005) we find an absence of certain healthful food sources, namely supermarkets, in minority neighborhoods when compared to predominantly white neighborhoods. However, contrary to reports in the popular press and studies from elsewhere in the country (Mari Gallagher Research and Consulting Group 2006), our study reveals an extensive network of small grocery stores available within a five-minute travel time of minority neighborhoods that offers a tremendous opportunity for creating healthful food environments within neighborhoods of color. The use of the metaphor “food deserts,” which conjures the image of the absence of food retail outlets, is not an adequate description of the food environments in minority neighborhoods in Erie County. Our findings suggest that rather than soliciting supermarkets, creative planning and policy support for

### Abstract

Given the emerging focus on improving food environments and food systems through planning, this article investigates racial disparities in neighborhood food environments. An empirical case of Erie County, New York tests the hypothesis that people belonging to different racial groups have access to different neighborhood food destinations. Using multiple methods—Gini coefficients and Poisson regression—we show that contrary to studies elsewhere in the country there are no food deserts in Erie County. However, like other studies, we find an absence of supermarkets in neighborhoods of color when compared to white neighborhoods. Nonetheless, our study reveals an extensive network of small grocery stores in neighborhoods of color. Rather than soliciting supermarkets, supporting small, high-quality grocery stores may be a more efficient strategy for ensuring access to healthful foods in minority neighborhoods.

**Keywords:** *food environments; food deserts; food security; racial food disparities; healthy eating*

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networks of existing small grocery stores may be a more efficient strategy for ensuring access to healthful foods within minority neighborhoods. We present a Neighborhood Healthful Foods Vulnerability Index (NHFVI) to identify at-risk neighborhoods that would benefit most from such support.

### ► Are There Racial Disparities in Neighborhood Food Environments?

While a number of studies are emerging, there is little empirical work, particularly within planning, on the types of neighborhood food environments people live in and even less on the racial disparities in neighborhood food environments. Some of what we know about racial disparities in food access is based on what we know about urban neighborhoods, since these neighborhoods are often home to racial minorities. In cities across the country, for example, the number of supermarkets—an important food retail destination—is declining. The Institute for Food and Development Policy reports that since 1970, thirty-four out of fifty supermarkets in Boston have closed, while in Chicago the number of supermarkets reduced from over one thousand to fewer than five hundred (IFDP, undated). Half of all black neighborhoods in the United States are reported to be without full-service grocery stores and supermarkets (NBEJN, undated).

One could argue that these closures of city supermarkets in and of themselves has little to do with racial composition of the areas they serve, as the decline may reflect the nationwide trend of consolidation in the grocery retail sector as stores become larger in size and fewer in number (Dunkley, Helling, and Sawicki 2004). However, at least one study (Chung and Myers 1999) has found that large stores, such as supermarkets, are far more likely than smaller, independent stores to locate outside the inner city in higher income areas. As a result many urban neighborhoods are predominantly served by small stores.

This redlining of urban neighborhoods by large supermarkets limits the food choices available to residents. Indeed, community food assessment reports from around the country (Buffalo: SUNY-Buffalo 2003; Milwaukee: Johnson, Percy, and Wagner 1996; Los Angeles: Ashman et al. 1993) note that the smaller stores dominating the urban neighborhoods sell food that is poorer in quality. In the case of Milwaukee, Johnson (1996) notes that the quality of produce is generally high in medium and large stores, while wilted, damaged, or spoiled produce is not uncommon in smaller stores. Food reportedly costs more in urban areas as well, possibly because smaller grocery stores are unable to sell food at prices comparable to larger supermarkets (Chung and Myers 1999; Johnson, Percy, and Wagner 1996). Urban residents, this would suggest, pay more for food that is poorer in quality.

Findings from the emerging public health literature support the idea that disparities in the food environment exist across

racial lines. Moore and Diez Roux (2006), for example, find that minority census tracts in North Carolina, Maryland, and New York have twice as many grocery stores as white neighborhoods, while white census tracts have a greater number of supermarkets, adjusted for population density and census tract size. More recently, a study commissioned by LaSalle Bank of Chicago shows the presence of food deserts, measured as the absence of grocery stores, in African American neighborhoods and correlates the presence with a higher incidence of negative health outcomes (Mari Gallagher Research and Consulting 2006).

Racial disparities in the food retail environment have been previously documented in the planning literature as well. Helling and Sawicki (2003) report that affluent black neighborhoods in Atlanta have poorer access—measured in terms of travel time—to retail, including food retail, than comparably affluent white households, suggesting that even after controlling for income racial disparities persist.

The findings of these studies notwithstanding, some minority neighborhoods are reported to be food “oases” rather than “deserts.” A study of three neighborhoods in the San Francisco Bay area, for example, ably demonstrated that small, full-service food retailers provide culturally affordable foods at low-income prices in minority neighborhoods (Short, Guthman, and Raskin 2007).

The contradictory findings in the literature warrant a closer examination of the quantitative relationship between residential racial composition and access to food destinations. Before pursuing this examination, as we do in our empirical section, a number of issues from the existing literature are important to note.

The first pertains to the issue of the *quality* of food available within the neighborhood food environment. Most quantitative studies of the food environment typically do not directly measure the quality of foods in available destinations. Instead many of these studies (Moore and Diez Roux 2006; Morland, Dietz Roux, and Wing 2006; Morland et al. 2002; Zenk et al. 2005) use the presence of a conventional supermarket as an indicator of quality, citing evidence (Sallis, Nader, and Atkins 1986) that supermarkets carry fresher produce and a greater variety of food products than smaller grocery stores and convenience stores. However, gauging the quality of food requires a broader concept, best encapsulated by Community Food Security Coalition’s (CFSC) definition of food security. According to CFSC, a community cannot be considered food secure unless the food environment provides *nutritionally adequate, affordable, and culturally appropriate* food. Thus, in judging the quality of food within the environment, researchers and planners would do well to consider a comprehensive definition of quality. The few quantitative studies that go beyond the presence of supermarkets as an indicator of quality focus mostly on nutritional quality (Saelens et al. 2007), a few on affordability (Chung and Myers

1999), and even fewer on cultural appropriateness (Short et al. 2007) of available food. Short et al. (2007) refreshingly consider all three aspects of quality of the food environment. However, their results are based on surveys of only three strategically selected neighborhoods in San Francisco. The narrow geographic focus of this study is not surprising given that there is limited quantitative data available on quality of food in stores, and researchers must often gather data on quality through time-consuming and expensive store surveys.

Second, many quantitative studies of disparities in the food environment, especially those in the public health literature, examine food access at the geographic *scale* of a census tract, which is too large a scale to examine urban residents' neighborhood food shopping experience especially of those residents who do not own a car. Those that offer a closer view of neighborhood food environments—such as the Short et al. (2007) study—tend to focus on a few strategically chosen neighborhoods within a larger community.

Third, most studies of disparities in the food environment do not take into account the fact that the urban form, especially the design of its street network, of a neighborhood is likely to affect how far people need to travel to reach a store. Thus, a more precise definition of access should take into account the *opportunity cost* of time required to travel to an available food destination from each neighborhood (Helling and Sawicki 2003).

Finally, there is a great degree of diversity in food destinations within a food environment: supermarkets, farmers' markets, grocery stores, convenience stores, restaurants, to name a few. Yet a significant proportion of the food environment literature tends to focus on the absence or presence of supermarkets as a healthful food source within a neighborhood, potentially ignoring the key role played by other destinations in the food environment—such as ethnic grocery stores in San Francisco (Short et al. 2007)—in providing healthful, affordable, and culturally appropriate food. Thus, in judging the adequacy and disparities in the food environment, planning practitioners and researchers must consider the presence of and role played by all possible food retail outlets within a food environment.

### ► Empirical Study of Racial Disparities in the Neighborhood Food Environment in Erie County, New York

This case study measures racial disparities in the neighborhood food environments in Erie County, an urban county in Upstate New York. Specifically, it asks the question: how does the food environment in neighborhoods of color differ from that in predominantly white neighborhoods? This case study contributes to the food planning literature in a number of ways. To our knowledge, this is the first planning study that

offers a large-scale, countywide, quantitative assessment of neighborhood food disparities. Second, unlike previous studies, which examine food access at a census tract level, this study analyzes the neighborhood food environment at the relatively fine scale of census block group, thus combining geographic range with geographic specificity. Third, the case study demonstrates use of multiple methods in measuring disparities within the neighborhood food environments, especially the use of Gini coefficients in describing the spatial concentration of food destinations and the application of Poisson regression of GIS-based variables to test racial disparities in the neighborhood food environment.

### Method

*Research design.* We use a cross-sectional research design to compare the access to food destinations in neighborhoods of color versus predominantly white neighborhoods in 897 census block groups in Erie County, NY. We offer two analyses. The first is a descriptive analysis that describes the spatial distribution of food destinations across Erie County neighborhoods using Gini coefficients. The second analysis uses Poisson regression to test whether access to food outlets in neighborhoods of color is significantly different than in predominantly white neighborhoods.

*Definition and selection of neighborhood.* Existing quantitative studies of neighborhood food environments define neighborhoods as census tracts (Moore and Diez Roux 2006; Morland, Diez Roux, and Wing 2006; Morland et al. 2002; Block, Scribner, and DeSalvo 2004) or zip codes (Lewis et al. 2005; Chung and Myers 1999), which owing to their large size—particularly in suburban and rural municipalities—serve as a poor proxy for neighborhoods. Therefore, it is important to examine disparities in the food environment at as fine a geographic scale as feasible. As such, in this study, we use the census block group as a proxy for a neighborhood and as our unit of spatial analysis. Furthermore, most studies focus on selected neighborhoods—often nonrandomly selected—within a community. These studies, many of which are from the public health literature (e.g., Morland, Diez Roux, and Wing 2006), select neighborhoods based on ongoing health studies. The results, while useful for a public health analysis, do not offer a comprehensive spatial picture of neighborhood food environments that would be useful from a planning perspective. To the authors' knowledge, this study is the most comprehensive. Of the 912 census block groups in Erie County, we include 897 census block groups in the study. The remaining 15 (1.64 percent) block groups were not included because the U.S. census does not report population for these. Of the 897 block groups in the study, 16 percent (141) of the neighborhoods were predominantly

black, 9 percent (79) were mixed-race, and 75 percent (677) were predominantly white.

*Analytical method.*

- a. *Spatial distribution of food stores (Gini coefficients and Lorenz curves).* In a novel application of a tool typically used in planning to study resource distribution, which has recently found favor among epidemiologists, we use Gini coefficients (and their graphical equivalent, Lorenz curves) to measure the concentration of food destinations across Erie County. Gini coefficients offer an easy-to-replicate metric for planners. They are typically used to describe distribution of resources among various units of a population. We use the same tool to describe distribution of different types of food destinations among neighborhoods (census block groups) in a community. Briefly, a Gini coefficient close to 0 (and a Lorenz curve closer to the diagonal line of equality) suggests that a resource—in this case a type of food destination—is equitably distributed across all receiving units—in this case neighborhoods (census block groups)—in the study area. A Gini coefficient closer to 1 (and a Lorenz curve sagging away from the diagonal) indicates that the resource is concentrated among a few neighborhoods in the study area (Coulter 1989).
- b. *Racial disparity in distribution of food stores (Poisson regression analysis).* Finally, going beyond the spatial description of the food environment, to answer the key empirical question—is there an association between the prevalence of food destinations and the racial composition of neighborhoods?—the study uses regression analysis. To do so, we model the association between the number of food destinations accessible to a neighborhood (the dependent variable) and the racial composition of a neighborhood, adjusting for area, population, and median income of the neighborhood (independent variables). Since the dependent variable in the regression model—the number of food destinations accessible in a neighborhood—is a count variable, we use Poisson distribution to test the association between food access and racial composition of neighborhoods, controlling for other variables.<sup>1</sup> Poisson regression models the number of occurrences of a dependent variable as a function of independent variables. In the resulting estimated regression equation, the exponentiated ratios of the coefficients of a nominal independent variable (type of neighborhood: predominantly black, mixed, or predominantly white) can be interpreted as prevalence ratios (per 1,000 persons) of the dependent variable (in our model, the number of food destinations) in a certain type of neighborhood (in our model, a neighborhood of color) in comparison to the reference neighborhood (in our model, predominantly white).

Our regression model is based on Moore and Diez Roux (2006), with some variations, as outlined below. In Moore and Diez Roux (2006), the dependent variable, food access, is measured as the number of food destinations available within a census tract. Drawing on Helling and Sawicki (2003), we refine the dependent variable by incorporating the idea of opportunity cost of travel time. Specifically, we use the number of food destinations available within a five-minute travel time of the centroid of each census block group as a measure of food access. We used the five-minute travel time norm not as an absolute

standard for how far people are willing to travel to a food destination, but to allow us to compare access to food (using the same travel time) in different types of neighborhoods.

In the regression model, racial composition of the neighborhoods is our key independent variable of interest. Similar to Moore and Diez Roux (2006), we define racial composition of a neighborhood as follows. Census block groups where more than 60 percent of the households identify themselves as white are classified as “predominantly white,” while those where more than 60 percent of the households identify themselves as black are defined as “predominantly black,” and the remaining are classified as “racially mixed” neighborhoods.

Because the variation in land area and population of neighborhoods (census block groups) may influence the number of food destinations in a neighborhood, we include these as control variables in the regression model. Furthermore, to account for the fact that food businesses may be more likely to locate in higher income neighborhoods, we include the household median income of neighborhoods as a control variable in the model.

Finally, because travel time to food destinations varies by mode of transportation and because there are a variety of food destinations in Erie County neighborhoods, we build separate regression models for six different types of food destinations (supermarkets, grocery stores, fruit and vegetable markets, meat and fish markets, convenience stores, and restaurants) and three modes of travel (walking, biking, and driving). In addition to these eighteen regression models, for the sake of comparison, we also include six models that replicate Moore and Diez Roux’s (2006) model for six types of food destinations. The Moore and Diez Roux (2006) model uses the number of food destinations within a neighborhood (irrespective of how long it takes to reach these destinations) as a dependent variable. In our table 5, the results from these models are labeled as “within the census block group” model. Overall, we present results from twenty-four different regression models in the findings section (summarized in table 5).

## Data sources

*Food destinations.* In this analysis, food destinations refer to all destinations in Erie County where food can be obtained through purchase. Data on food destinations was obtained from the Reference USA database, which is created and maintained by a private vendor. The Reference USA database reports results from a telephone survey conducted by the vendor and includes records for individual businesses nationwide. Each record provides a number of variables for individual businesses, including its primary Standard Industrial Classification (SIC) code and, most importantly, for Geographic Information Systems (GIS) analysis, the precise location of each business.



**Table 1.**  
**Food destination classification, Erie County, New York.**

<i>Food Destination</i>	<i>SIC codes and Reference USA Codes</i>	<i>Definition</i>	<i>Example</i>
Supermarket	5411: 01, 04 to 06	Grocery stores and food markets with more than fifty employees	Wegmans
Grocery	5411: 01 to 06	All other grocers and food markets	Guercio & Sons
Convenience	5411: 03	Convenience stores	Wilson Farms
Meat and fish	5421: 01 to 19	Seafood, butchers, poultry	Federal Meats
Fruit and vegetable	5431: 01 to 05	Farmers markets, vegetable markets	Broadway Market
Candy and nut	5441: 01 to 06	Confectionary, popcorn, nuts	Fowler's
Dairy	5451: 01 to 03	Dairy, yogurt, cheese retail	Upstate Milk Corporation
Bakery	5461: 01 to 11	Doughnut, cookie, bagel stores, bakeries	Tim Hortons, Krispy Kreme
Natural food	5499: 01, 09, 35	Organic food stores, health food stores	Lexington Food Cooperative
Specialty	5499: 10,12,14,16-23, 26, 27, 28, 30, 37	Ethnic stores, kosher food stores, and other specialty stores	Asian Food Store, Spices of India
Restaurant	5812	Restaurants, cafes, and delis	Anchor Bar, McDonald's

Note: SIC = Standard Industrial Classification.

Food destination data for Erie County was classified according to the standard four-digit Standard Industrial Classification system and included the following categories: 5411, 5421, 5431, 5441, 5451, 5461, 5481, and 5499. SIC category 5411 was subclassified into two categories: (1) supermarkets and grocery stores, and (2) convenience stores on the basis of two-digit subcodes assigned by the Reference USA database. Following Moore and Diez Roux 2006, supermarkets were distinguished from grocery stores on the basis of payroll size; grocery stores with more than fifty employees were identified as supermarkets. SIC category 5499 was subclassified, on the basis of the Reference USA code, into natural food stores and specialty food stores. Natural food stores included organic food stores, health food stores, and local food cooperatives. Specialty food stores included stores that sell ethnic foods, kosher, halal, or other specialty foods.

The research team verified the accuracy of the database by cross-listing with the telephone directory as well as by conducting a short telephone survey of the businesses, to verify their address, four-digit SIC classification and two-digit Reference USA subclassification. The resulting food destinations were imported into the Erie County Food Environment Database, as described in the next section. The resulting database includes all food retail stores and restaurants as well as direct producer-to-consumer marketing venues such as farmers' markets and farm stands. The data does not, however, include community-supported agriculture drop-off sites, community gardens, emergency food locations, and institutional food venues. Table 1 shows the type, SIC, and Reference USA classification codes, and definition of food destinations in this study. A typical example of each food destination is also provided for each type of food destination.

*Demographic data.* Racial composition, population, and income data for neighborhoods (census block groups) was obtained from the 2000 US Census.

*Geographic Information Systems (GIS) Database.* To enable spatial analysis, food destination data from Reference USA and demographic data from the U.S. Census was geo-coded to countywide parcel and street network layers. The parcel layer was obtained from Erie County, and the street layer was purchased from Geographic Data Technologies (GDT) for network analysis. GIS analysis of the Erie County Food Destination Database was completed using ArcGIS and Network Analyst.

## ► Findings

With thirty-five food destinations available per ten thousand persons, Erie County's food environment offers a variety of conventional and niche food stores, and an even larger number of restaurants. The county's restaurants, including the famous Anchor Bar restaurant, legendary originator of buffalo wings, constitute a major share (71 percent) of all available food destinations in the county's food environment. There are about twenty-six restaurants available per ten thousand persons in Erie County neighborhoods, a higher incidence than any other type of food destination in the county (see table 2). It is not entirely surprising that restaurants dominate Erie County's food environment given that people are increasingly spending a bigger share of their food dollar in eating out. Between 2003 and 2004, for example, at-home food expenditures for urban households in the United States rose by 7.3 percent, while away-from-home food expenditures—63 cents of every food dollar

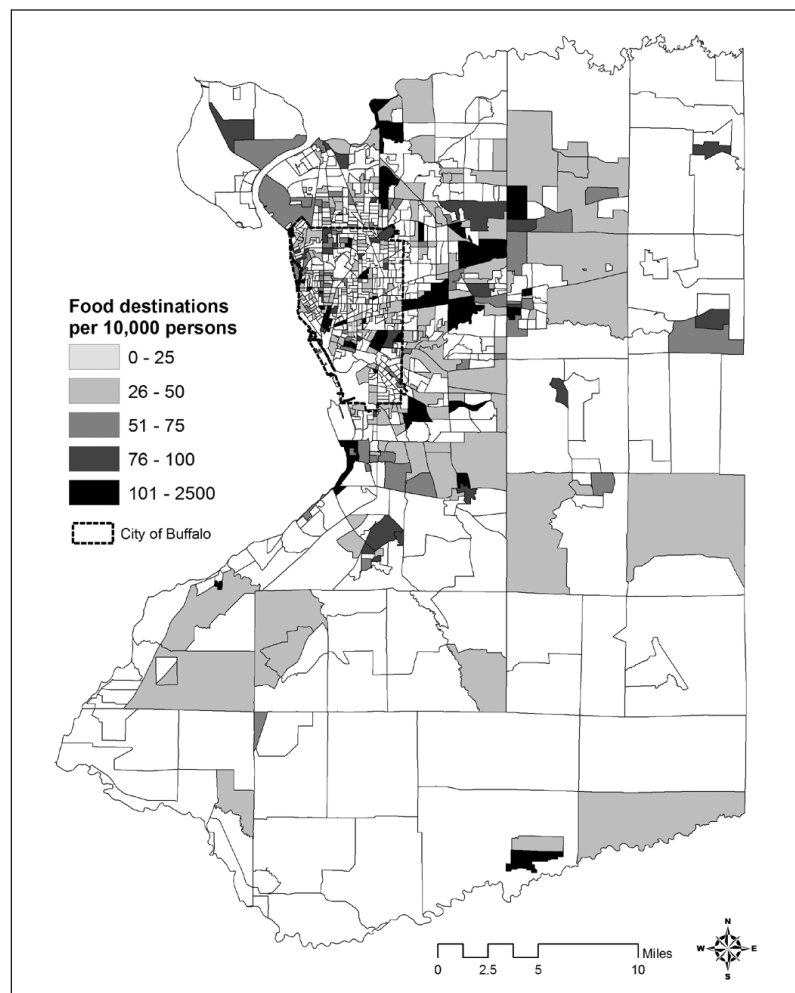


Figure 1. Food destinations in Erie County block groups.

**Table 2.**  
Available food destinations, Erie County, New York.

Food Destination	County Total	% of Total	Number per 10,000 Population
Restaurant	1,685	71.73	26.31
Convenience	152	6.47	2.29
Bakery	150	6.39	2.00
Grocery	146	6.22	2.24
Meat and fish	59	2.51	0.63
Supermarket	47	2.00	0.43
Candy and nut	43	1.83	0.50
Natural food	34	1.45	0.35
Fruit and vegetable	16	0.68	0.15
Specialty	13	0.55	0.12
Dairy	4	0.17	0.05
Total	2,349	100.00	35.08

spent—rose by 9.3 percent (Economic Information Bulletin 2007). While the large share of restaurants in the food environment may well be a result of the trend to dine out, the presence

of restaurants in the food environment also enables the choice to eat out.

Convenience stores, bakeries, and grocery stores constitute the next significant share of available food destinations in Erie County, at about 6 percent each, considerably smaller than that of restaurants. Convenience stores and grocery stores are the most dominant food destination where residents can purchase food to eat at home, around two per ten thousand persons. Meat and fish markets, supermarkets, candy and nut stores, and natural food stores each constitute between 1 and 2 percent of the share of available food destinations. The total number of supermarkets in the county, which are frequently reported to offer the most healthful food choices (Sallis, Nader, and Atkins 1986), number less than fifty, equivalent to 0.4 supermarkets per ten thousand persons, a shockingly low number when compared to the number of restaurants available. This relative dominance of restaurants over all other types of food destinations is likely to have public health implications, such as an impact on obesity. Twenty-nine percent of fast-food restaurants in Atlanta neighborhoods, for example, were found to encourage large portion sizes (Saelens et al. 2007). To be sure, to draw public health implications from an analysis of the food environment requires a careful consideration and measurement of the nutritional value of food available at food destinations, an issue that is beyond the scope of this analysis.

### Spatial Distribution of Food Destinations in Erie County

How are these different types of food destinations distributed across Erie County? Figure 1 shows the density of food destinations across the county. Lorenz curves, in figure 2, clearly show that different types of food destinations are not similarly distributed across Erie County.<sup>2</sup> In addition to being the most abundant, restaurants as indicated by the Lorenz curves are the most evenly distributed across Erie County neighborhoods. A startling finding is that about 60 percent of neighborhoods have no other food destinations located within their perimeter besides restaurants (see figure 2). In fact, the other types of food destinations are concentrated within a small proportion of neighborhoods.

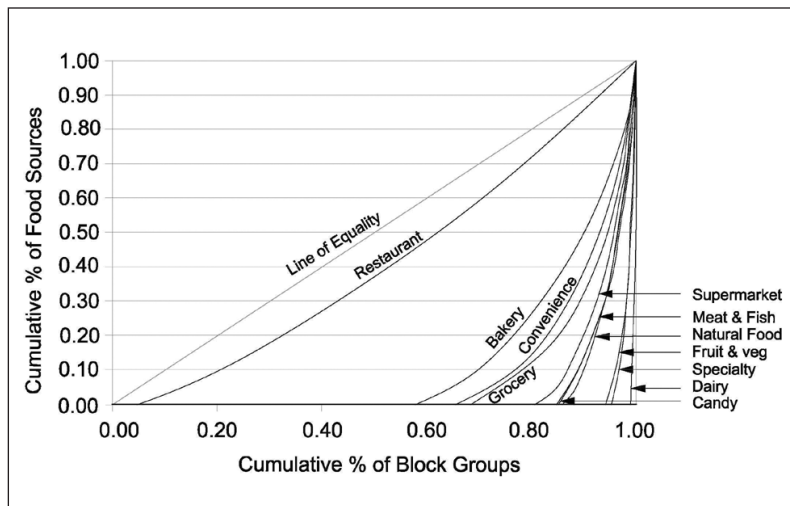


Figure 2. Lorenz curves of food destinations in Erie County.

The extreme case is that of fruit and vegetable markets: about 95 percent of Erie County neighborhoods lack a fruit and vegetable market. It is possible to overstate the problem of lack of access to healthful food since fruits and vegetables are sold at other venues besides fruit and vegetable markets, such as supermarkets and grocery stores.

Interestingly, both supermarkets and grocery stores have a similar distribution across Erie County neighborhoods. All the available grocery stores and supermarkets are concentrated within about 20 to 30 percent of the county’s neighborhoods, respectively. Of course, it is plausible that each is located in different types of neighborhoods, a possibility that we examine later on in this article.

Overlapping Lorenz curves, such as those for destinations other than bakeries and restaurants in figure 2, are difficult to compare (Coulter 1989). As such, we use a numerical equivalent of the Lorenz curve, the Gini coefficient, which ranges from 0 to 1, to judge concentration of food destinations across neighborhoods. As explained previously, the farther a Lorenz curve from the line of equality, the higher its Gini coefficient (Coulter 1989). Thus, a Gini coefficient closer to 0 signals an even distribution of food destinations across neighborhoods while a coefficient closer to 1 signals a concentration of food destinations in a few neighborhoods. Table 3 shows the Gini coefficients for each type of food destination in Erie County. Not surprisingly, compared to all food destinations, restaurants have the lowest Gini coefficient (0.18). All other food destinations are concentrated in a small proportion of neighborhoods, as indicated by high Gini coefficients ranging between 0.73, for bakeries, and 0.96, for fruits and vegetable markets (see table 3).

The Lorenz curves and Gini coefficients unequivocally demonstrate that, with the exception of restaurants, and, to some degree, bakeries, all other types of food destinations are unevenly distributed among Erie County neighborhoods. Destinations that are likely to offer more healthful food

choices—such as supermarkets, grocery stores, meat and fish markets, and fruits and vegetables markets—are concentrated in a relatively small proportion of the county’s neighborhoods.

### Racial Disparities in the Neighborhood Food Environment: Regression Results

One might argue that the relative absence of food destinations from a neighborhood (census block group)—as indicated by the Gini coefficients—is a less than useful indicator of food in access unless we take into account the opportunity cost of the time required to reach a food destination by walking, biking, or driving.<sup>3</sup> To account for this,

we compute, using GIS, the number of grocery stores within five-minute biking, driving, and walking distance of each census block group in Erie County. Table 4 shows the average number of food destinations accessible within five-minute travel, by mode of travel for all neighborhoods.

In Erie County neighborhoods, on average, residents can walk to 1.13 restaurants within five minutes, *less than one* grocery store, convenience store, and specialty store, and essentially *zero* supermarkets, fruit and vegetable markets, and fish and meat markets, reiterating the dominance of restaurants as a food destination within the neighborhoods. Not surprisingly, access increases within a five-minute bike ride and a five-minute driving distance, respectively (see figure 3).

The limited access to other food destinations within a five-minute travel time documented above, while sobering, may not be universally viewed as problematic. After all, the concentration of food retail may simply be a function of economies of

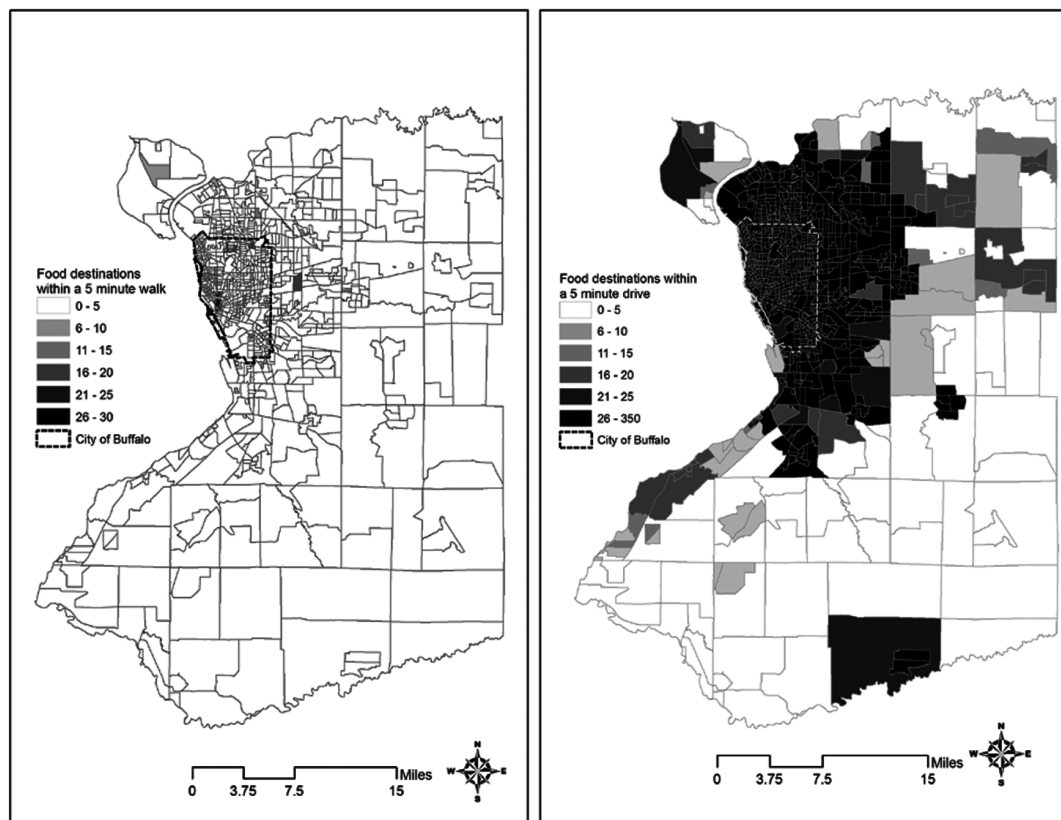
**Table 3.**  
**Gini coefficients of food destinations, Erie County, New York.**

Type of Food Destination	Gini Coefficient	
	0	Perfectly equal distribution
Restaurant	0.18	
Bakery	0.73	
Convenience	0.80	
Grocery	0.82	
Supermarket	0.89	
Meat and fish	0.90	
Fruit and vegetable	0.96	
	1	Perfectly unequal distribution



**Table 4.**  
Average number of food destinations within five-minute travel time, Erie County, New York.

Type of food destination	Average Number of Food Destinations Within. . .			
	a neighborhood <sup>1</sup>	a five-minute walk from the centroid of a neighborhood	a five-minute bike ride from the centroid of a neighborhood	a five-minute drive from the centroid of a neighborhood
Supermarket	0.05	0.01	0.20	1.79
Grocery	0.16	0.15	2.86	10.98
Convenience	0.16	0.11	1.16	8.51
Meat and fish	0.06	0.05	0.53	3.88
Fruit and vegetable	0.01	0.00	0.08	0.80
Restaurant	1.85	1.13	11.77	87.57
Specialty	0.01	0.15	1.52	10.98



**Figure 3.** Available food destinations within five-minute travel time of a neighborhood.

scale and of the economic necessity for some food retailers, such as supermarkets, to capture a larger market area. Furthermore, the limited opportunity to access food destinations with a five-minute travel time may simply be the result of an arbitrary measure that ignores the possibility that people may be willing to travel (by walking, bicycling, or driving) farther than five minutes for food shopping. If, however, the concentration of food destinations and limited opportunity to

access food destinations within a certain travel time varies by racial composition of the neighborhood, *controlling for income, population, and area of a neighborhood*, then the problem is one of inequity. We examine this possibility in the following section as we answer our key research question: how does the access to food destinations in predominantly black and mixed-race neighborhoods differ from that in predominantly white neighborhoods?

To answer this question, we use Poisson regression to model the number of available food destinations as a function of the racial composition of the neighborhood, while controlling for the land area, population, and median household income of the neighborhood. Since it is more meaningful to compare food access after considering the opportunity cost of travel time, we define available destinations as those present within an area accessible by a five-minute walk, bike ride, or drive (these results are shown as “within a five-minute walk, bike, and car” models for each type of food destination in table 5).

As explained previously, the exponentiated coefficients of Poisson regression models can be interpreted as prevalence ratios of food stores in minority neighborhoods, in comparison to reference (white) neighborhoods (see Moore and Diez Roux 2006). In table 5, we report the prevalence ratios of food destinations (within five-minute walking, bicycling, and driving distances) for six major types of food destinations. For the sake of comparison with previous findings by Moore and Diez Roux (2006), we also show the prevalence ratios of food stores located *within* a census block group *without* considering travel time. For brevity, only the prevalence ratios and not the full results of the regression models are shown in table 5.

Our results show that prevalence ratios of food destinations available within a five-minute travel time area—as opposed to food destinations available within the census block group—yield higher estimates of food access. When we compare availability within a five-minute *walking area*, black neighborhoods have about one-half (0.43 times) of the number of supermarkets as compared to the number available within a five-minute walk of white neighborhoods. This is a better outlook than indicated by the “within the neighborhood model” (which is modeled after Moore and Diez Roux [2006]) which estimates that predominantly black neighborhoods in Erie County have less than one-fourth (0.21 times) the number of supermarkets within their boundaries when compared to predominantly white neighborhoods, controlling for population and neighborhood area.

Is there a racial disparity in food access across Erie County neighborhoods? The answer is complex. Contrary to reports in the popular media and in a number of studies (Associated Press 2004; Mari Gallagher Research and Consulting 2006), our data does not show an overall paucity of food destinations in neighborhoods of color in comparison to predominantly white neighborhoods. Instead, different neighborhoods appear to “specialize” in different types of food destinations, and this “specialization” changes if one considers the mode of transportation used to access the food destinations.

Let us compare access—between neighborhoods of color and white neighborhoods—to food destinations within a five-minute *walking* distance. Within a five-minute walking distance, predominantly black neighborhoods have about half of the supermarkets (0.43 times) and 0.6 times the number of meat and fish markets, as compared to predominantly white neighborhoods, adjusting for area of neighborhood, population, and median household income (see table 5). At the

**Table 5.**  
Prevalence ratios of food destinations within  
five-minutes’ travel time.

<i>Model</i> <sup>5</sup>	<i>Prevalence ratios of food destinations in comparison to white</i>	
	<i>Predominantly black</i>	<i>Racially mixed neighborhoods</i>
<b>Supermarkets</b>		
Within a five-minute walk	0.43 <i>0.000</i>	0.69 <i>0.212</i>
Within a five-minute bike ride	0.39 <i>0.000</i>	0.95 <i>0.834</i>
Within a five-minute drive	0.93 <i>0.459</i>	0.98 <i>0.830</i>
Within the census block group	0.21 <i>0.133</i>	0.73 <i>0.667</i>
<b>Grocery Stores</b>		
Within a five-minute walk	1.15 <i>0.35</i>	1.59 <i>0.004</i>
Within a five-minute bike ride	0.92 <i>0.53</i>	1.25 <i>0.084</i>
Within a five-minute drive	2.27 <i>&lt;0.000</i>	1.68 <i>&lt;0.000</i>
Within the census block group	2.19 <i>0.000</i>	2.92 <i>&lt;0.000</i>
<b>Fruit and Vegetable Markets</b>		
Within a five-minute walk	5 <i>&lt;0.000</i>	1.6 <i>0.173</i>
Within a five-minute bike ride	2.1 <i>&lt;0.000</i>	2.18 <i>0.000</i>
Within a five-minute drive	2.2 <i>0.000</i>	1.56 <i>0.000</i>
Within the census block group	1.5 <i>0.703</i>	3.9 <i>0.072</i>
<b>Meat and Fish Markets</b>		
Within a five-minute walk	0.6 <i>0.031</i>	1.8 <i>0.003</i>
Within a five-minute bike ride	0.74 <i>0.036</i>	1.5 <i>0.001</i>
Within a five-minute drive	1.27 <i>0.000</i>	1.05 <i>0.558</i>
Within the census block group	0.37 <i>0.179</i>	3.19 <i>0.001</i>
<b>Convenience Stores</b>		
Within a five-minute walk	1.37 <i>0.056</i>	1.4 <i>0.083</i>
Within a five-minute bicycle ride	1.47 <i>&lt;0.000</i>	1.46 <i>0.000</i>
Within a five-minute drive	1.93 <i>&lt;0.000</i>	1.46 <i>&lt;0.000</i>
Within the census block group	1.61 <i>0.051</i>	1.68 <i>0.079</i>
<b>Restaurants</b>		
Within a five-minute walk	0.40 <i>&lt;0.000</i>	1.02 <i>0.843</i>
Within a five-minute bike ride	0.60 <i>&lt;0.000</i>	1.34 <i>0.000</i>
Within a five-minute drive	1.24 <i>&lt;0.000</i>	1.27 <i>0.000</i>
Within the census block group	0.36 <i>&lt;0.00</i>	1.04 <i>0.617</i>

Note: Models are adjusted for neighborhood area, population, and median household income; prevalence ratios (per 1,000 people) of stores in predominantly black and racially mixed neighborhoods are estimated in comparison to predominantly white neighborhoods; chi square values are shown in italics.

same time, black neighborhoods have 1.15 times the number of grocery stores and 1.59 times the number of convenience stores within walking distance as compared to predominantly white neighborhoods. Clearly, as far as supermarkets and meat and fish markets are concerned, black neighborhoods fare worse than white neighborhoods in Erie County. However, there is a relative abundance of grocery stores and convenience stores, which admittedly are reported (Sallis, Nader, and Atkins 1986) to provide less than healthful food options, within walking distance of predominantly black neighborhoods. The results also show that, within a five-minute walk, black neighborhoods in Erie County have five times the number of fruit and vegetable markets as compared to predominantly white neighborhoods. This finding must be interpreted with caution given that there are very few (only sixteen) fruit and vegetable markets in the entire study area and that other types of food destinations—such as supermarkets and grocery stores—also sell fruits and vegetables. A surprising result was a lack of restaurants—including full-service or limited service restaurants such as fast-food restaurants—within a five-minute walking distance of black neighborhoods. Predominantly black neighborhoods have less than half the number (0.4 times) of restaurants within a five-minute walking distance when compared to predominantly white neighborhoods (see table 5).

The conditions in racially mixed neighborhoods are slightly different. Except supermarkets, all types of food destinations are equally or more prevalent within a five-minute walking distance of racially mixed neighborhoods when compared with predominantly white neighborhoods. Specifically, racially mixed neighborhoods have about 0.69 times the number of supermarkets when compared to predominantly white neighborhoods, adjusting for neighborhood area, population size, and median household income (see table 5). On the other hand, racially mixed neighborhoods have 1.02 times the number of restaurants as white neighborhoods. The juxtaposition of lower prevalence of supermarkets with higher prevalence of restaurants creates a food environment wherein there is an imbalance in the types of foods available. This imbalance may place racially mixed neighborhoods at a higher risk of obesity than predominantly white neighborhoods, a possibility that needs to be tested through future research.<sup>6</sup>

While individuals may be willing to walk to shop for daily food needs, such as milk and bread, it is cumbersome to carry heavy grocery bags even over short distances, particularly during inclement weather or for people with disabilities. It is thus prudent to compare food access—between neighborhoods of color and white neighborhoods—within a five-minute *drive* of a neighborhood. These results for Erie County are interesting, though not surprising. For most food destinations, the *comparative* disadvantage of neighborhoods of color *decreases* when we consider the number of food destinations within a five-minute driving distance. In the case of supermarkets in black neighborhoods, for example, there is about 0.93

times the number of supermarkets within a five-minute drive—as opposed to 0.43 times the number available within a five-minute walk—of a black neighborhood than in a white neighborhood. All other types of food destinations within a five-minute driving distance are more prevalent in black neighborhoods than in white neighborhoods. In particular, the number of restaurants is 1.24 times that of white neighborhoods.

Similar trends are present in racially mixed neighborhoods. Thus, access to means of transportation—whether by automobile or public transit—is likely to reduce the comparative disadvantage of black neighborhoods in accessing food within their neighborhood food environment.

Overall, these findings suggest neighborhoods of color fare worse than predominantly white neighborhoods in terms of their share of supermarkets within the regional food environment, with predominantly black neighborhoods faring even worse than mixed-race neighborhoods. This racial disadvantage is greatest in terms of accessing food destinations within a five-minute walking distance. Nevertheless, minority neighborhoods are currently being served by an extensive network of small grocery stores and convenience stores, and to some extent by the few fruit and vegetable markets within the county. People's access to healthy food in these neighborhoods will, therefore, depend on the degree to which this current network of food destinations sells nutritious, culturally appropriate food at affordable prices.

## ► Discussion

This article answers the question whether food environments in neighborhoods of color differ from those in predominantly white neighborhoods. Using a cross-sectional Poisson regression model, we demonstrate that there is a significant racial disparity in neighborhood food environments. Similar to other studies (Moore and Diez Roux 2006; Mari Gallagher Research and Consulting 2006; Morland, Diez Roux, and Wing; Morland et al. 2002), we find limited access to supermarkets in neighborhoods of color. Yet we also find an abundance of small grocery stores, convenience stores, and fruit and vegetable markets that serve minority neighborhoods. Thus, it would be incorrect to conclude that neighborhoods of color in Erie County have no access to food destinations.

Admittedly, the presence of small grocery stores and convenience stores in these neighborhoods says little about the quality of food—its nutritional value, affordability, and cultural appropriateness—available at these destinations, yet it is important to place these findings in that context. To this end, we offer some supplementary evidence. Based on 2003 store survey data of twenty-five food stores in the city of Buffalo and adjacent suburban municipalities within Erie County, we estimate the weekly

**Table 6.**  
Weekly cost of purchasing food items for a household of four.

Food Groups	Items	Cost of USDA Thrifty Food Plan for a Household of Four Erie County, New York			National Average
		Supermarkets	Grocery Stores	Convenience Stores	
Grains	White bread, elbow macaroni, white enriched rice	13.12	12.60	16.31	
Vegetables	Green peas, potatoes, kidney beans	26.23	34.20	30.93	
Fruit	Apples, bananas, orange juice	18.28	15.44	15.11	
Dairy	2% milk, yogurt	44.41	39.77	56.94	
Meat	Tuna, bologna, peanut butter	30.61	31.37	43.18	
Total cost		132.64	133.39	162.47	108.90
Stores surveyed		9	5	6	

Note: USDA = United States Department of Agriculture.

cost of a market basket for a household of four, following the USDA's Thrifty Food Plan (TFP) guidelines, at each of the major food destinations discussed in this article.<sup>7</sup> These estimates, shown in table 6, are also compared with what such a market basket would cost nationally. Interestingly, the results reveal that in Erie County there is very little difference between the weekly costs of purchasing foods for a nutritious meal at supermarkets (\$132.64) versus a grocery store (\$133.39). However, purchasing the same items is significantly more expensive at a convenience store (\$162.47). This suggests that, in Erie County, small grocery stores may well be selling foods at competitive prices.

Nonetheless, there is a cautionary note to these findings. The market basket used to estimate these costs met the nutrition guidelines of the TFP but was limited to food items that were available at all three types of food destinations. Thus, the market basket did not include leafy vegetables or whole grains, since these were not available at many of the convenience stores and only some grocery stores. In fact, while all the supermarkets carried fresh produce, only 70 percent of grocery stores and 33 percent of convenience stores that were surveyed carried fresh produce. Availability of whole grains in grocery stores and convenience stores was even lower (see table 7). As another measure of quality, the survey also recorded the expiration dates on a list of food products (non-produce only). A number of smaller grocery stores and convenience stores did not post expiration dates on a number of items, so it was difficult to ascertain the freshness of food.<sup>8</sup> Thus, it is highly likely that, despite a greater number of grocery stores and convenience stores and competitive prices for many food items, the access to healthful food, namely fresh produce and whole grains, in neighborhoods of color may be rather limited in comparison to predominantly white neighborhoods. On a positive note though, anecdotal reports from field researchers who conducted the 2003 store survey suggest that in some minority neighborhoods—specifically Buffalo's West Side, which is home to a large immigrant community—grocery stores carry culturally appropriate

**Table 7.**  
Availability of healthful food.

	Percentage of Stores		
	Fresh Produce Available	Whole Grains Available	Number of Stores
Supermarkets	100.00	88.90	9
Grocery stores	70.00	50.00	10
Convenience stores	33.33	16.70	6

ethnic foods, such as a wide variety of Goya products popular in the Hispanic community, a finding similar to that reported by Short, Guthman, and Raskin (2007) in their recent study of immigrant neighborhoods in San Francisco.

Finally, as shown by the regression results, residents' ability to reach food destinations within neighborhoods improves in absolute and in relative terms if they have access to means of transportation, such as a car or a bicycle. However, in our study area, access to private vehicles varies greatly among neighborhoods. Forty-two percent of owner-occupied households in predominantly black neighborhoods and 38 percent in racially mixed neighborhoods do not own any vehicles (in comparison to 12 percent of owner-occupied households in predominantly white neighborhoods). Thus, for these households, the availability of an efficient public transit system is a critical factor in improving access to healthful food choices.

## ► Conclusion

As a profession, planning has the interdisciplinary skills to understand systemic connections in the "food shed" (Getz 1991), as well as the ability to facilitate changes in communities—through design and planning interventions—to lessen food insecurity in underserved neighborhoods. Nonetheless, thus

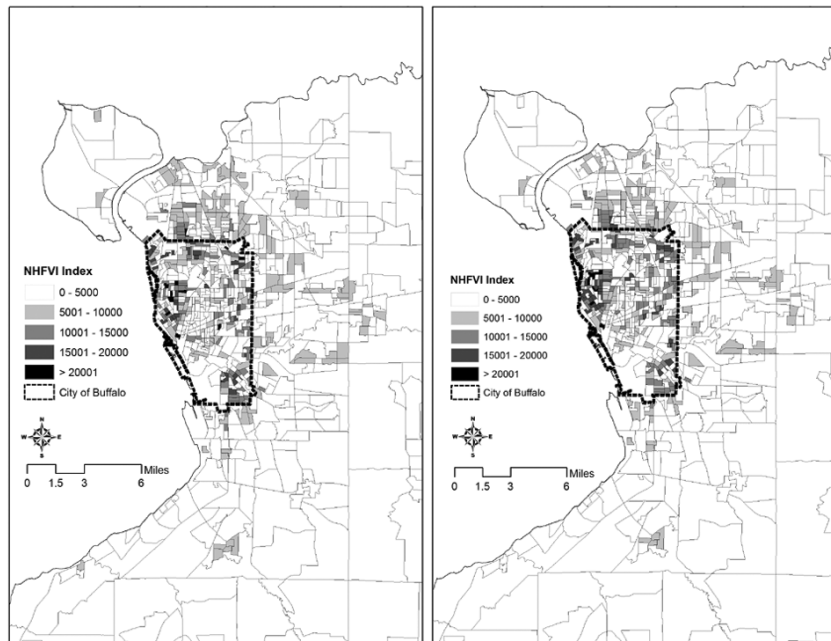
far, practicing planners have played a minimal role in this area. In a study of thirty-two cities, Pothukuchi (2005, 241) reports that “despite widespread acknowledgment of the absence of grocery stores in low-income neighborhoods, city planning agencies and development agencies tend to wait for proposals to be initiated by developers.” She suggests four key actions that planners can take to increase grocery retail in underserved areas: conduct systematic assessments of citywide and neighborhood-level demand of food; identify and recruit chain and independent stores; create, or support the creation of, a citywide supermarket program that identifies potential sites, provides development assistance, and simplifies the review process for grocery retail; and, finally, view grocery stores as important contributors to neighborhood quality of life rather than suboptimal economic development tools.

While we agree with these recommendations, in the light of our findings, we suggest that it would be a mistake to overlook the existing extensive network of small grocery stores and their potential role in providing healthful, affordable, and culturally appropriate foods in minority neighborhoods. Instead, similar to “third wave” strategies of economic development that focus on nurturing home-grown businesses and encourage networking among them (Blakely and Bradshaw 2002), we propose that local governments support existing food businesses (small grocery stores) and encourage networks between grocery stores and local food producers of healthful food (such as farms, community-supported agriculture operations, urban farms, and local bakers).

Support for existing grocery stores could come in many forms. During interviews conducted in 2003, grocery store owners reported lack of public safety as their biggest challenge for operating within the city of Buffalo (SUNY-Bufferalo 2003). Enhanced public safety efforts—improved lighting, improved police patrolling, among other measures—around grocery store sites can alleviate store owners’ and customers’ concerns around safety.

As outlined in the American Planning Association (APA)’s recent policy guide on food, planners can also “assemble and implement business-enhancement incentives to encourage partnerships between existing stores and local nonprofits that encourage stores to offer healthful foods on the one hand, and educate the community to adopt healthy diets, on the other” (APA 2007).

Local governments could also create incentive programs to retrofit small grocery stores with equipment that enables them to store and sell the healthful foods that these stores currently



The healthful category (h) includes a broad cross-section of food destinations including supermarkets, grocery stores, farmers markets, and meat and fish stores.

**Figure 4.** Neighborhood Healthful Food Vulnerability Index in Erie County.

lack. For example, using economic development monies, local governments can set up grants or loan programs directed to grocery stores for the purchase of refrigeration equipment to store fresh produce. This would enable businesses to increase inventory and, therefore, upscale their operation as well as supply healthy foods within the neighborhoods.

To avoid misuse of these publicly provided incentives, just as economic development incentives are targeted to areas that are most impoverished, local governments’ support to grocery stores should be offered in neighborhoods that have least access to healthful food destinations. Clearly, this will require that practitioners have access to indexes and measures that identify neighborhoods most in need of intervention. We outline one such index based on the concept of location quotient (LQ), a familiar tool for planners (see, e.g., Klosterman, Brail, and Bossard 1993).

The proposed Neighborhood Healthful Food Vulnerability Index (NHFVI) measures the vulnerability of a neighborhood relative to the vulnerability of a larger community.<sup>9</sup> We illustrate the use of NHFVI using Erie County as an example. Neighborhoods with higher values of NHFVI (indicated by darker areas on the two maps in figure 4) indicate a greater proportion of unhealthy to healthful food destinations in a neighborhood (adjusted by population size) compared to the proportion of unhealthy to healthful food destinations in a reference community (in our example, Erie County).

Figure 4 shows NHFVI distribution across Erie County neighborhoods. Darker areas on both maps, which represent



the neighborhoods with a higher imbalance in food destinations, are clustered in the City of Buffalo, particularly on the more economically challenged East and West sides.

The two maps differ slightly in how food destinations are classified. In the map on the left, the healthful destinations ( $h$ ) includes supermarkets, fruit and vegetable markets, meat and fish markets, specialty stores, dairy stores, natural food markets, and grocery stores, while unhealthful destinations ( $u$ ) include the remaining food destinations: restaurants, convenience stores, and candy and nut stores. In the map on the right, only supermarkets are included in  $h$  following the reports of studies that suggest that supermarkets offer healthful foods. Which of the two is a better classification of the quality of food is left to the readers and future researchers to decide. For our purposes, the maps show how NHFVI can serve as a useful tool for identifying the balance of healthful/unhealthful food destinations in a neighborhood relative to an entire county.

In summary, conducting a comprehensive assessment may result in identification of potential bottlenecks and opportunities within neighborhood food environments. In Erie County neighborhoods, for example, we learned there are few food deserts per se. Restaurants are abundant and uniformly spread across neighborhoods; and different neighborhoods specialize in different types of food stores. Supermarkets are concentrated in white neighborhoods; neighborhoods of color specialize in grocery stores. While these grocery stores do not offer fresh produce and whole grain foods with the same frequency as supermarkets, their presence, nonetheless, has significant potential for supplying healthful produce in minority neighborhoods. Planners can promote food security in minority neighborhoods by supporting and nurturing this network of small grocery stores.

Given limited public resources, we recommend that the strategy to chase after supermarkets (or, grocery stores) to bring them into minority neighborhoods, while important in some neighborhoods, be approached with caution. Akin to urban renewal strategies that resulted in the decimation of housing in minority neighborhoods, recruiting large stores may result in the closure of existing grocery stores within minority neighborhoods. Furthermore, quick turnover among new recruits—as is wont to happen in these neighborhoods (e.g., Latinas Foods, a supermarket in the city of Buffalo closed within a year of its opening)—may leave these neighborhoods worse off than before. We hope that this article offers planners a model for better understanding neighborhood food environments and developing creative solutions to combat food insecurity in underserved communities.

## ► Notes

1. The statistical analysis was completed with the SAS software, using the SAS GENMOD procedure to perform a Poisson regression (SAS Institute Inc. 2003).

2. The diagonal line of equality represents an even distribution of food destinations across Erie County neighborhoods (census block groups), since each cumulative percentage of block groups has an equivalent cumulative percentage of food destinations.

3. Gini's usefulness may also be limited by the fact that census block groups have varying sizes. In an extreme situation, a census block group with an extremely small area with a grocery store just outside its perimeter (such that a resident can walk to it within 5-mins) will be judged as being worse off than a census block group with an extremely large area and a grocery store located just inside its perimeter.

4. For most types of stores (except specialty), the number of stores available within a census block group (neighborhood) is higher than the number available within a 5-minute walk. This may be explained by the fact that the census block groups may span distances larger than a 5-minute walk along the street network, which is likely to be especially true in suburban municipalities where the continuity of street networks is interrupted by cul-de-sacs. In any event, the access to food destinations—in terms of opportunity measure of travel time—is likely influenced by the built form of the neighborhood.

5. "Within the census block group" models are similar to Moore and Diez Roux (2006), with the exception that ours uses the census block group as a unit of analysis, while they use a census tract. Also, our coefficients are estimated after controlling for population, neighborhood area, and median household income, while they control for the first two variables only.

6. Clearly this risk is likely to vary by the type of restaurant. For example, fast food restaurants may serve larger portion sizes (Saelens 2007) or foods with higher fat content than other restaurants. However, in our current food destination database it was not possible to disaggregate the restaurants by type.

7. The store survey was completed as part of a community food assessment in 2003; the data included the price of 22 individual food items from a sample of stores in Erie County. For this article, we applied the USDA guidelines for a Thrifty Meal Plan to the survey data to estimate the weekly cost of purchasing food for a household of four.

8. Interestingly though, in supermarket chains a number of food items were closer to expiration at store locations within neighborhoods of color than at store locations in predominantly white neighborhoods.

9. Building on the concept of a location quotient, the index can be written in equation form as:

$$NHFVI_i = \left\{ \frac{\frac{u_i}{(u_i + h_i)}}{\frac{u_s}{(u_s + h_s)}} \right\} * a_i$$

In the above equation,  $u$  is the number of unhealthful food destinations within a neighborhood;  $h$  is the number of healthful food destinations located within a neighborhood;  $i$  is the neighborhood of interest (e.g., block group, census tract, or other suitable definition);  $s$  is the entire reference area (such as a city); and  $a$  is an adjustment factor equal to population divided by area of the neighborhood. The term within the curlicue is essentially an  $LQ$ , which measures the proportion of unhealthful to healthful food destinations in a neighborhood relative to the reference area and can be interpreted in the same way as traditional  $LQ$ s. An  $LQ$  higher than 1 would indicate that a

neighborhood is more vulnerable in terms of the imbalance between unhealthful and healthful food destinations as compared to the reference area. Multiplied by the population density, the NHFVI identifies neighborhoods where most people are exposed to this imbalance. Using GIS, the resulting NHFVI for each neighborhood in a community can be mapped fairly quickly to identify areas that are out of “healthful” balance in comparison to all other neighborhoods in a community. See Mari Gallagher Research and Consulting 2006 for another example of a healthy neighborhoods index.

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