

## Food store availability and neighborhood characteristics in the United States

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### Abstract

**Objective.** This study provides a multivariate analysis of the availability of food store outlets in the US and associations with neighborhood characteristics on race, ethnicity and socioeconomic status (SES).

**Method.** Commercial food store outlet data are linked across 28,050 zip codes to Census 2000 data. Multivariate regression analyses are used to examine associations between the availability of chain supermarkets, non-chain supermarkets, grocery stores and convenience stores and neighborhood characteristics on race, ethnicity and SES including additional controls for population size, urbanization and region.

**Results.** Low-income neighborhoods have fewer chain supermarkets with only 75% ( $p < 0.01$ ) of that available in middle-income neighborhoods. Even after controlling for income and other covariates, the availability of chain supermarkets in African American neighborhoods is only 52% ( $p < 0.01$ ) of that in White neighborhoods with even less relative availability in urban areas. Hispanic neighborhoods have only 32% ( $p < 0.01$ ) as many chain supermarkets compared to non-Hispanic neighborhoods. Non-chain supermarkets and grocery stores are more prevalent in low-income and minority neighborhoods.

**Conclusion.** The study results highlight the importance of various potential public policy measures for improving access to supermarkets that may serve to reduce systematic local area barriers that are shown to exist by race, ethnicity and income.

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**Keywords:** Obesity; Environment; Food stores; Supermarkets; Socioeconomic factors; Race; Ethnicity

### Introduction

External environmental, social and economic factors are increasingly recognized as playing an important role in influencing people's lifestyles and risks for developing obesity (Egger and Swinburn, 1997; Hill and Peters, 1998; Swinburn et al., 1999; Allison et al., 2001; French et al., 2001). Examining factors that characterize individuals' local environments can help to provide evidence on the extent to which neighborhood factors are related to behavioral choices and obesity. One such factor relates to the availability of local area food stores.

Larger sized food stores such as supermarkets versus smaller stores and chain versus non-chain supermarkets have been shown to be more likely to stock healthful foods (Sallis et al., 1986; Horowitz et al., 2004) and to offer foods at a lower cost

(BLS, 1966; Morris et al., 1990; Kaufman et al., 1997; Mantovani et al., 1997; Chung and Myers, 1999). Food costs are found to be associated with diet quality (French et al., 2001; Drewnowski and Specter, 2004), and studies reveal significant correlations between diet quality and the availability of healthful foods in stores (Cheadle et al., 1991; Fisher and Strogatz, 1999).

Potential barriers to obtaining a variety of healthful foods due to a lack of local area food stores such as supermarkets are likely to adversely affect dietary patterns and contribute to the risk of obesity. The availability of supermarkets has been associated with more fruit and vegetable intake, more healthful diets, and lower rates of obesity (Morland et al., 2002a, 2006; Laraia et al., 2004). Shopping at supermarkets versus independent grocers has been associated with more frequent fruit and vegetable consumption (Zenk et al., 2005a). However, study results based on interventions in the UK aimed at improving local grocery store access have shown mixed results for associated improvements in diet quality (Wrigley et al., 2003; Cummins et al., 2005).

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The prevalence of obesity is shown to be significantly higher among Black and Hispanic populations compared to their White counterparts though these relationships differ by gender (Ogden et al., 2006). Evidence also shows higher obesity rates among low- versus high-income and education groups, with associations differing by gender and race (USDHHS, 2001; Paeratakul et al., 2002; Chang and Lauderdale, 2005). Differences in neighborhood socioeconomic (SES) indicators have been related to health outcomes controlling for individual-level social class indicators (Diez Roux et al., 1997; Robert, 1999). Differential rates of local area food store type availability by neighborhood characteristics may contribute to the fact that the problem of obesity does not affect all populations equally (Diez Roux et al., 1999; Cummins and Macintyre, 2006).

The extent to which food store availability differs by local area SES, racial and ethnic characteristics has been examined in several locations across the United States. Low- versus high-poverty, predominantly White versus Black and predominantly Latino versus non-Latino zip codes in LA county were found to have more supermarkets per household (Shaffer, 2002). In Chicago, poor versus non-poor neighborhoods were found to have significantly fewer supermarkets but more small grocery stores (Alwitt and Donley, 1997). Study results based on multi-state samples have found that low- versus high-income neighborhoods and predominantly Black versus White neighborhoods have fewer numbers of available supermarkets but significantly more grocery and convenience stores (Morland et al., 2002b; Moore and Diez Roux, 2006). National studies of metropolitan (Cotterill and Franklin, 1995) and urban (Morris et al., 1990) areas have found that low- versus high-SES neighborhoods have fewer available supermarkets.

Chain versus non-chain grocery stores have been found more likely to be located in non-poor zip code areas (Chung and Myers, 1999). Recent study results showed that, among the poorest tertile of neighborhoods, distance to the nearest chain supermarket increased with a higher proportion of African Americans, but remained similar across race in the least impoverished neighborhoods (Zenk et al., 2005b).

Due to the difficulty of gathering environmental data on a large scale, most studies that have examined food store availability and associations with neighborhood SES, racial and ethnic characteristics have been limited in their geographic coverage and all but one study (Zenk et al., 2005b) perform univariate analyses.

This study provides the first comprehensive multivariate national study of the availability of food stores by zip code across the United States and associations with neighborhood characteristics on race, ethnicity, SES, population size, urbanization and region. Commercial food store outlet data are linked by zip code to Census Bureau population and SES data. This study covers a population of 280,675,874 people living in 28,050 zip codes in the year 2000. For our full sample of zip codes and a sub-sample of zip codes in urban areas, we examine the availability of four types of food stores that include: (1) chain supermarkets, (2) non-chain supermarkets, (3) grocery stores and (3) convenience stores. This study provides evidence on the extent to which different types of food

stores are differentially available in low-income communities and in those neighborhoods with higher proportions of minority populations simultaneously accounting for both factors.

## Methods

### Data

#### *Food store outlet measures*

Data on food store outlets were obtained from a business list developed by Dun and Bradstreet (D&B) available through MarketPlace software (Dun and Bradstreet, 2005). MarketPlace contains information on more than 14 million businesses in the US that is compiled and updated quarterly through directories, government registries, websites, and interviews.

MarketPlace allows sorting by multiple criteria such as location and Standard Industry Classification (SIC) codes of business types. Facilities may be listed by both “primary” and “secondary” SIC codes. To eliminate such duplications, we draw on the primary SIC code listing in creating the list of outlets used for this analysis.

Information on the number of food store outlets by type (supermarkets, grocery and convenience stores) and by supermarket type (chain versus non-chain) was pulled by zip code for the year 2000 to allow us to examine the availability of four types food store outlets: (1) chain supermarkets, (2) non-chain supermarkets, (3) grocery stores and (4) convenience stores. Supermarkets are substantially larger food stores compared to grocery stores and are more likely to have on-site food preparation such as a butcher, baker and deli. For example, in the D&B sample of food stores in the year 2000, supermarkets averaged seven times the number of employees as grocery stores and forty six times the sales volume of grocery stores. Grocery stores in the D&B sample averaged two times the number of employees as convenience stores.

#### *Census bureau measures*

This study draws on Census 2000 (U.S. Census Bureau, 2002a,b) neighborhood racial and ethnic characteristics and SES data along with measures of population, urbanization and region matched to the outlet density data for a total of 28,050 zip codes. The zip code sample was restricted if the zip code reflected a post office box address or had a population of less than 300 people. The full sample of 28,050 zip codes represents a total population of 280,675,874 persons. A sub-sample of 4404 zip codes with all census block groups defined as urban areas covers a population of 107,509,876 persons.

The race variable is defined as the percentage of the population in the categories of White, African American, Asian and *other* race (including American Indian, Alaska Native, Native Hawaiian, Other Pacific Islander, some other race and two or more races). Ethnicity is defined separately to race by the percentage of Hispanic persons in the zip code. The income variable is defined by median household income. Separate income categories were created to represent low income (bottom quintile), middle income (middle three quintiles) and high income (top quintile).

For each zip code, we include total population size and a variable that described its degree of urbanization. In the Census 2000, urbanized areas are defined by an urban nucleus of 50,000 or more people with a population density of 1000 persons per square mile. Urban clusters consist of densely settled areas with a population of at least 2500 but less than 50,000 persons. Non-urban areas are defined as rural non-farm and rural farm according to the census farm definition. We use these definitions to create four urbanization categories: urban (urbanized area), suburban (urban cluster), rural (rural non-farm), and farm (rural farm). These variables are defined by the percentage of the zip code’s population that falls into each category based on aggregations of block groups and census blocks. Finally, we also control for region (South, West, Midwest, and Northeast).

### Analysis

This paper uses multivariate analyses to examine the association between the availability of food stores and neighborhood characteristics. Specifically, for chain supermarkets, non-chain supermarkets, grocery stores and convenience stores, we estimate multivariate count regression models to assess the

Table 1  
Summary statistics of census variables, United States, 2000

Variable	“Mean” or “percent”
Median household income*	\$44,833.00
Race*	
White	75%
African American	12%
Asian American	4%
Other race	9%
Ethnicity*—Hispanic	13%
Population	10,006
Urbanization	
Urban	30%
Suburban	10%
Rural	56%
Farm	4%
Region	
Northeast	18%
Midwest	31%
South	35%
West	16%
Number of zip codes (N)	28,050

Notes. The starred (\*) variables are population weighted. The region variable is a dummy indicator that reflects the distribution across zip codes, while all other variables reflect averages of continuous measures per zip code.

association between the number of available food store outlets and the racial, ethnic and SES composition of the zip code including additional control variables for population, urbanization and region. All of the racial, ethnic, SES and other control variables are included in the regression models simultaneously. We also estimate similar models for the sub-set of zip codes falling into urban areas. The Poisson count model is appropriate for the discrete count nature of our dependent variables, and we find that the data are not over-dispersed for our chain and non-chain supermarket outcomes. However, due to overdispersion of the data for the grocery store and convenience store outcomes, we estimate negative binomial count models for these two outcomes. Regression models are estimated using the Poisson and nbreg commands in STATA version 9.0.

Table 2  
Summary statistics of food store outlets, United States, 2000

		Chain supermarkets	Non-chain supermarkets	Grocery stores	Convenience stores
<i>Full sample of zip codes (N=28,050)</i>					
Outlets per zip code (mean (SD))		0.30 (0.72)	0.22 (0.60)	3.04 (4.93)	1.80 (2.71)
Outlets per zip code by income category (mean (SD))	Low-income (N=5610)	0.16 (0.50)	0.21 (0.65)	3.46 (6.03)	1.77 (2.88)
	Middle-income (N=16,830)	0.29 <sup>a,b</sup> (0.72)	0.21 <sup>b</sup> (0.58)	2.88 <sup>a,b</sup> (4.76)	1.88 <sup>a,b</sup> (2.83)
	High-income (N=5610)	0.48 <sup>a</sup> (0.86)	0.27 <sup>a</sup> (0.59)	3.12 <sup>a</sup> (4.12)	1.58 <sup>a</sup> (2.05)
<i>Urban sample of zip codes (N=4404)</i>					
Outlets per zip code (mean (SD))		0.77 (1.02)	0.56 (1.02)	7.78 (8.61)	3.09 (3.26)
Outlets per zip code by income category (mean (SD))	Low-income (N=881)	0.45 (0.77)	0.73 (1.28)	11.18 (10.78)	3.72 (3.72)
	Middle-income (N=2643)	0.89 <sup>a</sup> (1.09)	0.57 <sup>a</sup> (1.01)	7.69 <sup>a</sup> (8.34)	3.39 <sup>a</sup> (3.28)
	High-income (N=880)	0.73 <sup>a,b</sup> (0.95)	0.39 <sup>a,b</sup> (0.02)	4.68 <sup>a,b</sup> (5.01)	1.56 <sup>a,b</sup> (1.96)

Notes. N represents the number of zip codes.

<sup>a</sup> Significantly different from low-income at  $p < 0.05$ .

<sup>b</sup> Significantly different from middle-income at  $p < 0.05$ .

## Results

### Descriptive summary statistics

Table 1 shows that median household income averages at about \$45,000 across zip codes. Zip codes are on average 75% White and 12% African American. By ethnicity, on average across zip codes, 12.5% of the population are Hispanic. Zip codes are populated on average by about 10,000 people. On average, 30% of zip codes constitute urban areas, while more than one half are rural. Regionally, 35% of all zip codes are located in the South, 31% in the Midwest, 18% in the Northeast and 16% in the West.

In terms of the presence of at least one food store by type, 20%, 17%, 72% and 59% of zip codes in the sample had at least one available chain supermarket, non-chain supermarket, grocery store and convenience store, respectively. Table 2 shows that on average there are 0.30 chain supermarkets, 0.22 non-chain supermarkets, 3.04 grocery stores and 1.80 convenience stores available per zip code. By income categories, zip codes falling into the lowest income quintile have fewer chain supermarkets per zip code compared with both middle- and high-income zip codes and fewer non-chain supermarkets compared to high-income areas, whereas these low-income zip codes have more grocery stores.

In the urban sample, food stores are much more prevalent (48%, 35%, 92% and 80% of zip codes in the urban sample had at least one available chain supermarket, non-chain supermarket, grocery store and convenience store, respectively) and are available in greater numbers compared to the country as a whole. Low-income urban areas have significantly fewer chain supermarkets than their middle- and high-income counterparts but have greater numbers of both non-chain supermarkets and grocery stores. Convenience stores are least available in high-

income zip codes in both urban areas and for the country as a whole.

*Regression results*

The results from our multivariate regression models for the full sample of zip codes (Table 3) show significant differences in food store availability by neighborhood income, racial and ethnic characteristics with different patterns by food store type. Low- versus middle-income neighborhoods have significantly fewer (only 75% as many) chain supermarkets available and slightly fewer convenience stores, though the low-income areas have a greater number of non-chain supermarkets and grocery stores. High- versus middle-income neighborhoods have significantly fewer of all food store types with the lowest relative availability for convenience stores. Given the higher counts of supermarkets and grocery stores in high-income areas shown in Table 2, these results emphasize the importance of controlling for population size and other covariates when examining raw outlet count data as dependent variables.

Table 3  
Availability of food store outlets by store type, United States, 2000: incidence rate ratios from multivariate count regressions models (full sample, N=28,050)

	Chain supermarket	Non-chain supermarkets	Grocery stores	Convenience stores
<i>Income: (referent: middle-income)</i>				
Low-income	0.75*** (-7.60)	1.10*** (2.64)	1.18*** (11.28)	0.96** (-2.47)
High-income	0.84*** (-6.39)	0.79*** (-6.95)	0.73*** (-21.46)	0.62*** (-26.31)
<i>Race: (referent: White)</i>				
African American	0.52*** (-9.62)	1.49*** (5.60)	1.69*** (15.70)	1.01 (0.34)
Asian	0.27*** (-6.44)	3.12*** (5.99)	4.15*** (12.27)	0.24*** (-9.24)
Other race	0.18*** (-6.98)	0.84 (-0.90)	0.78*** (-3.45)	0.88 (-1.46)
<i>Ethnicity: (referent: non-Hispanic)</i>				
Hispanic	0.32*** (-8.44)	0.88 (-1.08)	1.39*** (6.57)	0.68*** (-6.57)
Population (in 1000s)	1.04*** (58.26)	1.03*** (44.25)	1.04*** (86.06)	1.04*** (72.43)
<i>Urbanization (referent: Urban)</i>				
Suburban	1.68*** (12.55)	1.89*** (13.35)	1.54*** (19.82)	1.87*** (25.55)
Rural	0.14*** (-34.49)	0.43*** (-16.18)	0.55*** (-28.76)	0.55*** (-24.86)
Farm	0.00*** (-12.44)	0.01*** (-9.81)	0.08*** (-18.62)	0.02*** (-21.77)
<i>Region: (referent: Northeast)</i>				
Midwest	0.75*** (-7.18)	0.67*** (-10.74)	0.77*** (-15.17)	1.18*** (7.68)
South	2.00*** (21.97)	0.65*** (-12.69)	1.05*** (3.16)	2.05*** (36.96)
West	1.62*** (12.84)	0.62*** (-11.63)	0.76*** (-13.97)	0.98 (-0.93)

Notes. *t*-statistics are shown in parentheses. The symbols \*, \*\* and \*\*\* represent statistical significance at  $p < 0.10$ ,  $p < 0.05$  and  $p < 0.01$ , respectively.

Table 4

Availability of food store outlets by store type, United States, 2000: incidence rate ratios from multivariate count regressions models (urban sample, N=4404)

	Chain supermarket	Non-chain supermarkets	Grocery stores	Convenience stores
<i>Income: (referent: middle-income)</i>				
Low-income	0.74*** (-4.92)	1.10* (1.76)	1.40*** (11.12)	1.26*** (6.19)
High-income	0.89** (-2.49)	0.90 (-1.60)	0.83*** (-6.26)	0.58*** (-13.46)
<i>Race: (referent: White)</i>				
African American	0.41*** (-8.71)	2.26*** (8.65)	1.86*** (11.66)	0.77*** (-3.95)
Asian	0.31*** (-4.59)	5.39*** (7.11)	6.72*** (12.42)	0.54*** (-3.04)
Other Race	0.11*** (-5.77)	0.47* (-1.90)	2.20*** (3.47)	2.36*** (2.97)
<i>Ethnicity: (referent: non-Hispanic)</i>				
Hispanic	0.78 (-1.29)	2.38*** (3.92)	1.26* (1.82)	0.48*** (-4.73)
Population (in 1000s)	1.03*** (32.42)	1.03*** (29.86)	1.03*** (46.23)	1.03*** (32.77)
<i>Region: (referent: Northeast)</i>				
Midwest	0.75*** (-4.81)	0.53*** (-10.35)	0.68*** (-12.70)	1.04 (0.86)
South	1.73*** (11.42)	0.62*** (-8.78)	0.78*** (-9.06)	2.08*** (20.79)
West	1.68*** (9.75)	0.51*** (-10.78)	0.66*** (-12.88)	1.12*** (2.72)

Notes. *t*-statistics are shown in parentheses. The symbols \*, \*\* and \*\*\* represent statistical significance at  $p < 0.10$ ,  $p < 0.05$  and  $p < 0.01$ , respectively.

Controlling for income and all other variables, the results for the race and ethnicity variables reveal large inequities with respect to the availability of chain supermarkets. Neighborhoods with higher proportions of African American residents have significantly fewer chain supermarkets: the availability of chain supermarkets in African American neighborhoods is roughly just one half that of their counterpart White neighborhoods. On the other hand, African American neighborhoods are likely to have 1.5 and 1.7 times, respectively, the number of non-chain supermarkets and grocery stores compared to White neighborhoods. Neighborhoods with larger Asian populations have significantly fewer chain supermarkets but substantially greater numbers of non-chain supermarkets and grocery stores compared to White neighborhoods. Large significant differences also exist by ethnicity with chain supermarkets in Hispanic neighborhoods being available at a rate of only just under one third of that in non-Hispanic communities. In terms of other food store types, Hispanic neighborhoods are found to have significantly greater numbers of grocery stores and fewer convenience stores compared to non-Hispanic neighborhoods.

In our full national sample, controlling for population, rural and farm versus urban areas have significantly fewer numbers of available food stores of all types with the greatest lack of availability for chain supermarkets (14% of that available in urban zip codes). Suburban areas average between one and one half to two times the number of available food stores across the

four food store types compared to urban areas. By region, compared to the Northeast, zip codes in the South and West have substantially greater numbers of available chain supermarkets whereas zip codes in the Midwest have fewer available grocery stores and supermarkets.

Examining food store availability within urban areas, Table 4 shows that, similar to the findings for the full sample, low-income urban areas have significantly fewer available chain supermarkets with approximately three quarters of the availability of middle-income urban areas. Low- versus middle-income urban zip codes have just marginally more non-chain supermarkets and 1.4 times the number of grocery stores. While the findings for the full sample showed fewer available convenience stores in low- versus middle-income neighborhoods, convenience stores are found to be significantly more prevalent (1.3 times as many) in low- versus middle-income urban neighborhoods. Similar to the results from our full sample, high- versus middle-income urban areas have fewer of all types of food stores though the finding for non-chain supermarkets is not statistically significant.

Larger differences in food store availability are found to exist by race in the urban sample compared to the full sample. The availability of chain supermarkets in African American urban zip codes is only 41% of that in White urban zip codes, statistically significantly ( $p < 0.01$ ) lower than the rate of 52% found for the sample as a whole. In urban America, African American neighborhoods have 2.3 and 1.8 times as many non-chain supermarkets and grocery stores compared to White urban areas. Non-chain supermarkets and grocery stores are found to be particularly prevalent in urban areas with higher proportions of Asian populations.

The large disparity in the availability of chain supermarkets found in the full sample in zip codes with higher proportions of Hispanic population levels is not found to exist within the urban sub-sample. That is, controlling for all other covariates, no statistically significant differences are found in the availability of chain supermarkets across Hispanic versus non-Hispanic urban neighborhoods. Furthermore, Hispanic urban areas have just over two times the number of available non-chain supermarkets compared to non-Hispanic urban neighborhoods.

## Discussion

The results from this multivariate US national study show significant differences by neighborhood income, racial and ethnic characteristics in the availability of food stores for both the full and urban samples. Zip codes with median household income falling into the lowest income quintile were found to have fewer chain supermarkets with only three quarters of that available in middle-income neighborhoods. On the other hand, low-income neighborhoods were found to have greater numbers of available non-chain supermarkets and grocery stores both in the full sample and urban areas and more convenience stores in urban areas. High- versus middle-income neighborhoods were found to have fewer of all food store types, particularly convenience stores. The results in this study are consistent with previous study findings that report fewer available super-

markets in low-income neighborhoods (Cotterill and Franklin, 1995; Alwitt and Donley, 1997; Chung and Myers, 1999; Morland et al., 2002b; Zenk et al., 2005a,b; Moore and Diez Roux, 2006).

The lack of availability of chain supermarkets in low-income neighborhoods is of particular concern given that as noted earlier chain versus non-chain supermarkets and supermarkets versus other smaller grocery stores have been found to offer food at lower prices and to provide higher quality food products. The results found herein support the underlying premise of previous studies that have reported that low-income households face higher food prices in large part as a result of a lack of supermarket availability in their neighborhoods (BLS, 1966; Morris et al., 1990; Kaufman et al., 1997; Chung and Myers, 1999). Furthermore, given that low-income populations are less likely to have private means of transportation (U.S. Department of Transportation, 2003) and given that the nature of food shopping involves either transporting multiple shopping bags or making more frequent shopping trips, the mobility strategies for food shopping among low-income families will exacerbate the barriers to a limited number of available local area supermarkets, in particular chain supermarkets. Indeed, several studies have highlighted the mobility constraints faced by low-income households in their daily activities including food shopping (Murakami and Young, 1997; Clifton, 2004).

This study found large disparities by race in the availability of chain supermarkets even after controlling for differences in neighborhood income. The availability of chain supermarkets in African American neighborhoods was found to be only 52% that of their counterpart White neighborhoods and only 41% of that in White urban areas. These results are consistent with findings in other studies that show lower supermarket availability in predominantly African American neighborhoods (Cotterill and Franklin, 1995; Morland et al., 2002b; Shaffer, 2002; Zenk et al., 2005b; Moore and Diez Roux, 2006); however, the results from many of these previous studies confound income and racial effects (Cotterill and Franklin, 1995; Morland et al., 2002b; Shaffer, 2002; Moore and Diez Roux, 2006). Thus, even though African American persons live disproportionately in poorer neighborhoods, controlling for differences in neighborhood income, zip codes with higher proportions of African American residents were still found to have substantially fewer numbers of chain supermarkets available. These study findings shed light on the importance of the ongoing need to address issues related to racial segregation. A recent report finds that African Americans prefer to shop in chain supermarkets and that one of the key factors that influence these shoppers is transportation and location. Proximity is important—37% of African American shoppers travel one mile or less to their primary grocery store (The African American Grocery Shopper, 2000).

Also by race, Asian populations were found to have significantly fewer chain supermarkets but substantially greater numbers of non-chain supermarkets and grocery stores, which may be reflective of cultural preferences for specific food types that may be more abundantly available in specialized independent supermarkets and grocery stores. By ethnicity, Hispanic

neighborhoods have fewer available chain supermarkets compared to non-Hispanic neighborhoods controlling for income and all other covariates; however, in the urban sample, this association was not statistically significant.

Controlling for all covariates, the results showed that, compared to the rate of availability in urban areas, all food store types and, in particular, chain supermarkets are significantly less available among rural area residents: chain supermarket availability was found to be 7.4 times greater in urban versus rural areas with even greater availability in suburban areas. These findings are similar to another nationwide study on the availability of supermarkets in rural areas that found nearly eight times as many supermarkets per county in urban versus rural areas (Morris et al., 1990). These findings have implications regarding the relative food prices faced by rural versus urban residents as a whole and, in particular, among the rural poor populations whose shopping patterns can be expected to be further constrained by mobility issues compared to their rural non-poor counterpart residents (Burkhardt et al., 1998). Indeed, it is reported that 32% of food stamps were redeemed in smaller stores in poor rural America compared to 20% in the nation as a whole (Morris et al., 1990).

This study is not without its limitations. First, the geographic context of analysis was limited to within zip codes and did not account for the characteristics of adjoining zip codes. The extent to which neighboring zip codes have similar characteristics may only serve to worsen spatial availability for under-served areas. Second, results may be subject to measurement error if there is non-random under- or over-representation of food store outlets in our commercial database that varies systematically with our covariates of interest. However, the results are shown to be consistent with previous studies which have drawn on a range of food store outlet data sources. Third, while the D&B data allowed us to distinguish food store types and chain versus non-chain supermarkets providing a greater level of specificity than in previous studies, the data may be subject to misclassification and do not include information on informal food distribution channels such as farm stands or markets which may offer a healthy selection of foods to local residents.

Despite these limitations, existing evidence on greater availability and variety of more healthful foods combined with lower food costs at supermarkets versus smaller grocery stores and chain versus non-chain supermarkets underscores the implications of these results for the low-income and minority neighborhoods that are found to be under-served by chain supermarkets. Indeed, differential barriers to achieving a healthy diet may underlay the differential rates of obesity and diet-related diseases across different populations. To improve access to supermarkets, public health officials may pursue several strategies such as: economic and land-use policies that include development, zoning and commercial loan policies; transportation policies that address both affordability and a review of routes; community partnerships to foster development; social policies to address crime and safety issues that may affect the local retail environment; and the commitment to implement general policies that will help to reduce any systemic barriers that contribute to racial and wealth segregation.

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