Fast Food, Race/Ethnicity, and Income

A Geographic Analysis

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Background: Environmental factors may contribute to the increasing prevalence of obesity, especially in black and low-income populations. In this paper, the geographic distribution of fast food restaurants is examined relative to neighborhood sociodemographics.

Methods: Using geographic information system software, all fast-food restaurants within the city limits of New Orleans, Louisiana, in 2001 were mapped. Buffers around census tracts were generated to simulate 1-mile and 0.5-mile "shopping areas" around and including each tract, and fast food restaurant density (number of restaurants per square mile) was calculated for each area. Using multiple regression, the geographic association between fast food restaurant density and black and low-income neighborhoods was assessed, while controlling for environmental confounders that might also influence the placement of restaurants (commercial activity, presence of major highways, and median home values).

Results: In 156 census tracts, a total of 155 fast food restaurants were identified. In the regression analysis that included the environmental confounders, fast-food restaurant density in shopping areas with 1-mile buffers was independently correlated with median household income and percent of black residents in the census tract. Similar results were found for shopping areas with 0.5-mile buffers. Predominantly black neighborhoods have 2.4 fast-food restaurants per square mile compared to 1.5 restaurants in predominantly white neighborhoods.

Conclusions: The link between fast food restaurants and black and low-income neighborhoods may contribute to the understanding of environmental causes of the obesity epidemic in these populations.

(Am J Prev Med 2004;27(3):211–217)

Introduction

While obesity has a range of causes from genetic to environmental, the environment is a key factor in the rapid development of the obesity epidemic.[1–4] Increased food consumption may be the most important of recent changes leading to an obesogenic environment.[5] Despite stable physical activity patterns during the last 20 years,[6,7] Americans are eating more,[8] portion sizes have increased substantially,[9] and inexpensive, high-calorie food is now ubiquitous.

The growth of the fast-food industry has been an important environmental inducement for increased food consumption. In the last 20 years, the percentage of calories attributable to fast-food consumption has increased from 3% to 12% of total calories consumed in the United States.[10] U.S. spending on fast food has risen from $6 billion to $110 billion over the last 30 years.[11]

Fast food is notably high in fat content,[12] and studies have found associations between fast food intake and increased body mass index (BMI) and weight gain.[13,14] These same studies reported increased consumption of fast food among nonwhite and low-income populations. Despite these relationships between income, race/ethnicity, obesity, and fast food, limited research to date has examined such associations on an ecologic level. Morland et al.[15] examined the relationship between fast-food restaurants, race/ethnicity, and wealth as an ancillary analysis in a large ongoing study based in the United States, and discovered no consistent relationship between wealth, measured with census tract median home values, and fast-food restaurants. Additionally, they found no difference between the numbers of fast-food restaurants in black and white neighborhoods. Reidpath et al.[16] found diverging results in a study addressing fast-food restaurant density and median individual income in Melbourne, Australia. Resi-

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The full text of this article is available via AJPM Online at www.ajpm-online.net.

0749-3797/04/$–see front matter
doi:10.1016/j.amepre.2004.06.007

Table 1. Fast-food restaurant chains included in the analysis

Name	Number of restaurants in Orleans Parish[a]
Bud's Broiler	5
Burger King	16
Chick-fil-A	3
Church's Chicken	11
Domino's Pizza	11
Kentucky Fried Chicken (KFC)	7
McDonald's	18
Papa John's	4
Pizza Hut	9
Popeyes Chicken and Biscuits	23
Rally's Hamburgers	9
Subway	23
Taco Bell	6
Wendy's Old Fashioned Hamburgers	10
Total	155

[a]Parish is the unique Louisiana designation for a county; the boundaries of Orleans Parish approximate the City of New Orleans.

dents of the lowest-income neighborhoods had 2.5 times more exposure to fast-food restaurants than those living in the most affluent neighborhoods. The current study was an assessment of whether black and low-income neighborhoods have increased geographic exposure to fast food restaurants.

Methods

Definition and Identification

Researchers defined fast-food restaurants as chain restaurants that have two or more of the following characteristics: expedited food service, takeout business, limited or no wait staff, and payment tendered prior to receiving food. The national chain restaurants included had at least two restaurants in Orleans Parish (parish is the unique Louisiana designation for a county; the boundaries of Orleans Parish approximate the City of New Orleans), and tend to be recognized as fast-food restaurants in the media and by the general public. Additionally, one local fast-food chain that has five restaurants in Orleans Parish was included (Table 1). These criteria allowed for inclusion of the fast-food restaurants that captured the largest portion of the fast-food market.

Between August and October 2001, researchers identified restaurants by examining the log books for the Orleans Parish Sanitation Department, which inspects all chain food outlets in the parish, by reviewing the local Yellow Pages phone book, and by accessing restaurant locator engines on fast food chain websites.

Geocoding and Census Tract Inclusion Criteria

Using geographic information system software, all fast food restaurants were geocoded in Orleans Parish.[17] Geocoding is a technique now widely used in public health research to create electronic mapping of exposure to physical structures such as toxic waste plants, alcohol outlets, or in this study, fast-food restaurants. The geocoded restaurants were imported onto a census tract map for Orleans Parish using MapInfo, version 6.2 (Matchware Technologies Inc., Troy NY, 2000). Previous small-area research guided the selection of census tracts as the model of a neighborhood in this study.[17,18]

The analysis was restricted to those census tracts with (1) >500 people, (2) >2000 people per square mile, and (3) <200 alcohol outlets per 1000 people. Researchers used alcohol outlet density as a proxy for commercial activity. These restrictions ensured that neighborhoods analyzed are similar (i.e., urban and residential). Despite these restrictions, fast-food restaurants in the excluded tracts are included in the analysis when these restaurants were located within the "shopping area" (described below) of a neighboring census tract that met the inclusion criteria.

Levels of Analysis

Because of interest in the association between environmental factors and neighborhood demographics, researchers used variables on two geographic levels. The first level was the census tract, where the population variables were measured. These variables—the percentage of black residents and median household income—describe the demographics of the neighborhoods. The second level was the "shopping area." On this level were the environmental variables, which describe geographic exposures to those living in the neighborhoods: fast-food restaurant density (FFRD), alcohol outlet density, presence of interstate or major state highways, and median home value as a proxy for property values.

We created "shopping areas" by producing buffers around census tracts. These shopping areas, which included the area of the census tract and the area between the buffer and the border of the tract, provide a more realistic representation of geographic exposure than census tracts alone because people often have to travel outside of their census tract to purchase goods. For example, many of the fast-food restaurants were located just beyond the border of a particular tract and would have been easily accessible to and patronized by many individuals living within that census tract. However, these restaurants would have been excluded in the calculation of geographic exposure for that tract unless buffers were used. In fact, 62% of the census tracts have no fast-food restaurants located directly within their borders. However, only 2% of the shopping areas with 1-mile buffers have zero fast food restaurants. For a sensitivity analysis, fast-food restaurant density was examined separately by creating buffers that were 1 mile and 0.5 mile from the census tract borders.

Variables

Using multiple regression in SPSS (Graduate Pack 10.0 for Windows, SPSS Inc., Chicago IL, 1999), the geographic association between FFRD and black and low-income neighborhoods was assessed after controlling for other key environmental variables: alcohol outlet density, presence of highways, and median home value. These variables were included as covariates in the model because they might influence the placement of fast-food restaurants. All variables in the analysis were log transformed, except for the dichotomous highway variable, to adjust for skew and to allow for elasticity calculations. Elasticity calculations show that for a given percentage

change in the independent variable, the dependent variable changes by a certain percentage.

The dependent variable—FFRD—was calculated as the number of restaurants per square mile in the shopping area. FFRDs were evaluated separately for shopping areas with 1-mile and 0.5-mile buffers.

The primary predictor variables were the following population variables: neighborhood percentage of black residents and median household income. We used census tract estimates for 1999, which were based on the 1990 census with adjustments made by a commerical vendor of census data (Claritas Trend Map, San Diego CA, 1999).

The environmental variables controlled for in the analysis required geocoding, and were collected at the level of the shopping area. Despite the classification of median home value as an environmental variable, it was only available at the level of the census tract.

We calculated the alcohol outlet density in the same manner as the FFRD for each shopping area. Locations of alcohol outlets were available in 1999 from the Louisiana Alcohol Policy Needs Assessment Database.[17] The database characterizes alcohol outlets as on-sale (sites where alcohol is sold for consumption on the premises, such as restaurants and bars) and off-sale (sites where alcohol is sold for consumption away from the premises, such as liquor or grocery stores). A summary alcohol outlet variable was created including both on-sale and off-sale outlets as a proxy variable for commerical activity. Controlling for commerical activity in this study was necessary because fast-food chains may place restaurants in highly commercial areas due to zoning restrictions. Alcohol outlets are an ideal proxy measure for commercial activity in Louisiana because these outlets include bars, restaurants, liquor stores, grocery stores, drug stores, and convenience stores.

The highway variable accounted for the presence of an interstate highway or state highway in each shopping area. The presence of highways may dictate fast food restaurant location. Median home values also may influence the placement of fast food restaurants because to control costs, chains may locate on land with lower property values.

Regression Analysis

In the regression analysis, the researchers expected that the environmental covariates would explain a large percentage of the variance in FFRD. Therefore, a base regression model was constructed with FFRD as the dependent variable and the environmental variables as the predictor variables. The population variables—median household income and the percentage of black residents—were sequentially added to the model to determine their effect on explained variance in FFRD. All variables were part of the final model.

Results

Descriptive

Of the 184 census tracts, a total of 156 met the inclusion criteria. Table 1 provides a list of fast food chains and numbers of restaurants in Orleans Parish. The census tract map of Orleans Parish in Figure 1 shows both the placement of fast food restaurants as well as excluded and included census tracts.

The mean FFRD for shopping areas defined with a 1-mile buffer was 2.48 fast food restaurants per square mile; the mean FFRD for shopping areas defined with a 0.5-mile buffer was 2.54 restaurants per square mile. In census tracts, the mean percentage of black residents was 60.6%. The mean household income at the census tract level was $25,450. Table 2 contains all relevant descriptive information.

Bivariate Analysis

Spearman's rank correlation coefficients were significant when comparing FFRD in the shopping areas with 1-mile buffers to the neighborhood percent of black residents and median household income ($r=0.160$, $p=0.046$ for percent black; $r=-0.275$, $p<=0.001$ for median household income). Similarly, correlations were significant in shopping areas with 0.5-mile buffers ($r=0.180$, $p<=0.024$ for percent black; $r=-0.266$, $p<=0.001$ for median household income). Correlation coefficients also were significant when comparing FFRDs to the presence of highways and alcohol outlet densities (all p values <0.001).

Regression

Regression statistics are shown in Table 3. Using the shopping areas with 1-mile buffers, the base model (Model 1: alcohol outlet density, presence of highways, median home value as predictor variables) explained 25.0% of the variance in FFRD. For Models 2 and 3, median household income and the percentage of black residents were added to the base model, respectively. Both variables were significant predictors of FFRD after controlling for the base model variables. Median household income explained an additional 3.3% of the variance in FFRD above that of the base model (F test change=7.87; $p=0.006$), and the percentage of black residents explained 19.1% of the variance above that of the base model (F test change=52.7; $p<0.001$). When all variables were included together in Model 4, median household income was no longer significant. However, the percentage of black residents remained a significant predictor of FFRD. Adding the percentage of black residents to Model 2 explained an additional 16% of the variance (F test change=44.2; $p<0.001$).

The sensitivity analysis found similar results for the shopping areas with 0.5-mile buffers. However, median household income was not a significant predictor of FFRD in Model 2 after controlling for the base model variables.

The regression equation for shopping areas with 1-mile buffers demonstrates that for every 10% increase in fast food restaurant density, neighborhood median household income decreased by 4.8% and the percentage of black residents increased by 3.7%. The regres-

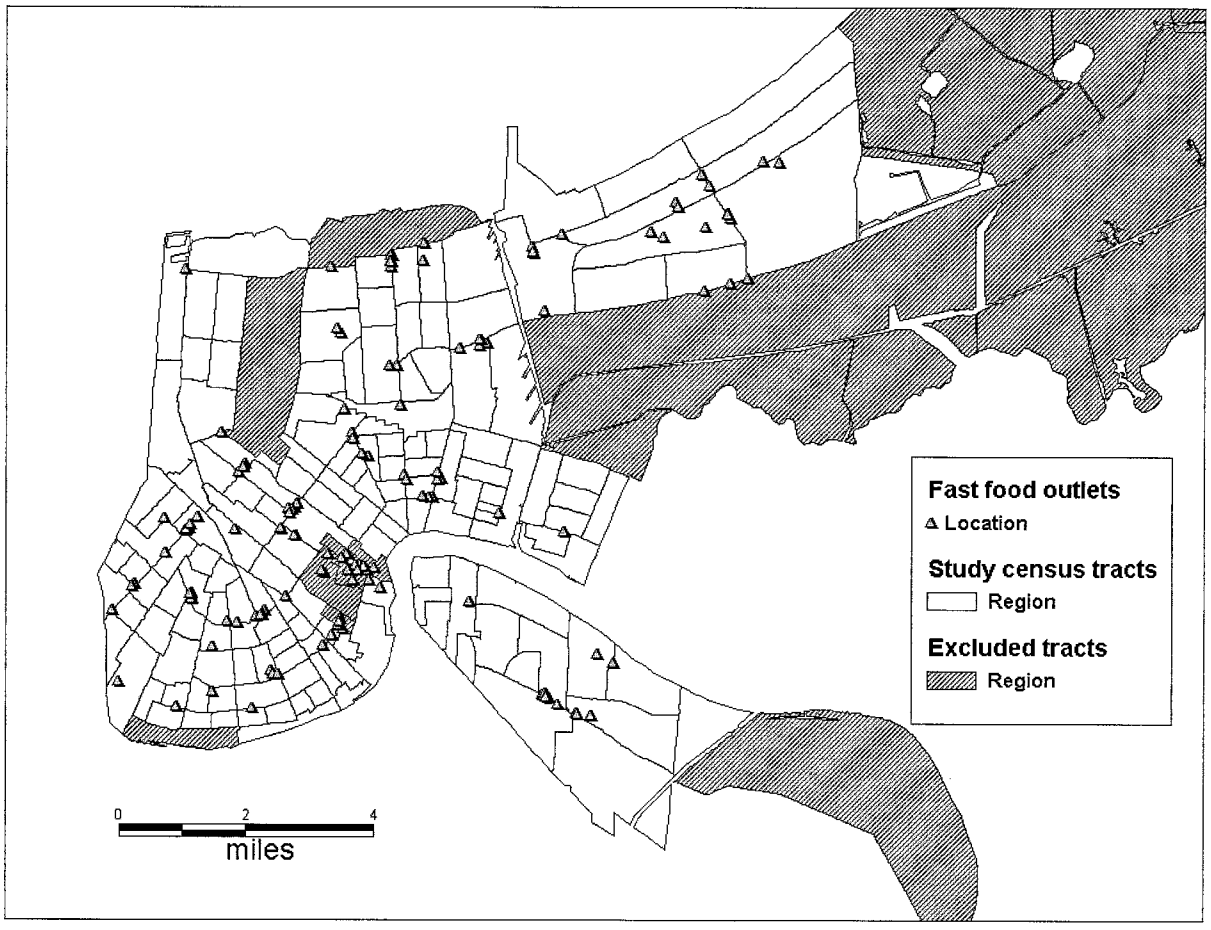

Figure 1. Census tract map of Orleans Parish, Louisiana.

sion equation was solved to determine how many more fast food restaurants are located in predominately black neighborhoods compared to predominately white neighborhoods. Neighborhoods with 80% black residents had 2.4 fast food restaurants per square mile compared to 1.5 restaurants per square mile in neighborhoods with 20% black residents. In this study, the mean size of a shopping area with a 1-mile buffer was 6.2 square miles, with a range of 4.2 to 15.0 square miles. Therefore, for an average-sized neighborhood shopping area, predominantly black neighborhoods were exposed to six more fast food restaurants than predominantly white neighborhoods.

Discussion

Fast-food restaurants are geographically associated with predominately black and low-income neighborhoods after controlling for commercial activity, presence of highways, and median home values. The percentage of black residents is a more powerful predictor of FFRD than median household income. Predominantly black

Table 2. Population and environmental variable descriptives

Variable	Mean	SD
Population		
Percentage of black residents	60.6%	32.9%
Median household income	$ 28,282	$17,211
Environmental: shopping areas with 1-mile buffer		
Fast-food restaurant density (restaurants/square mile)	2.48	1.6
Alcohol outlet density (outlets/square mile)	30.8	25.7
Percentage of census tracts with highway(s) in shopping area	81.4%	39.0%
Median home value[a]	$101,224	$61,947
Environmental: shopping areas with 0.5-mile buffer		
Fast-food restaurant density (restaurants/square mile)	2.54	2.0
Alcohol outlet density (outlets/square mile)	33.3	36.1
Percentage of census tracts with highway(s) in shopping area	66.7%	47.3%
Median home value[a]	$101,224	$61,947

[a]Median home value is an environmental variable but was available only at the level of the census tract.
SD, standard deviation.

Table 3. Regression models for shopping areas with 1-mile buffer

Model	Variables included	Coefficient (β)	SE	Two-sided p values	Adjusted r^2 of model
1	Alcohol outlet density	0.183	0.065	0.006	0.250
	Highway	0.407	0.071	<0.001	
	Median home value	−0.120	0.128	0.352	
2	Median household income	−0.485	0.173	0.006	0.283
	Alcohol outlet density	0.147	0.065	0.025	
	Highway	0.375	0.070	<0.001	
	Median home value	0.367	0.214	0.089	
3	Percentage of black residents	0.368	0.051	<0.001	0.441
	Alcohol outlet density	0.256	0.057	<0.001	
	Highway	0.364	0.061	<0.001	
	Median home value	0.631	0.152	<0.001	
4	Median household income	−0.195	0.158	0.221	0.442
	Percentage of black residents	0.350	0.053	<0.001	
	Alcohol outlet density	0.238	0.059	<0.001	
	Highway	0.353	0.062	<0.001	
	Median home value	0.790	0.199	<0.001	

SE, standard error.

neighborhoods (i.e., 80% black) have one additional fast-food restaurant per square mile compared with predominantly white neighbohoods (i.e., 80% white). These findings suggest that black and low-income populations have more convenient access to fast food. More convenient access likely leads to the increased consumption of fast food in these populations,[13,14] and may help to explain the increased prevalence of obesity among black and low-income populations.

Researchers chose to evaluate geographic associations with FFRD in shopping areas with 1-mile and 0.5-mile buffers because of an uncertainty of how far individuals were willing to routinely travel outside their census tract to purchase food. The use of shopping areas defined by 1-mile buffers seems more justified based on reports regarding McDonald's strategy for franchise locations. McDonald's has established a restaurant within a 3- to 4-minute trip for the average American.[19] Under the assumption that an individual drives 25 miles per hour, a McDonald's should be located within approximately 1.5 miles of the average American's home. This distance is more consistent with shopping areas with 1-mile buffers than those with 0.5-mile buffers, thereby potentially explaining the more powerful results for the 1-mile buffer analysis.

Geographic Associations

Morland et al.[15] reported contrasting results from the current study, but their study diverged from this study in several ways. First, they did not adjust their analysis for other environmental factors that might influence the placement of fast food restaurants. In the bivariate analysis, a significant (although weak) relationship between FFRD and the percentage of black residents existed, which increased substantially after controlling for environmental confounders, including alcohol outlet density, presence of highways, and median home values. Second, they did not utilize shopping areas as the area of geographic exposure for a neighborhood. This method is important because many census tracts do not have any fast food restaurants; however, people residing in these tracts are still geographically exposed to restaurants that are nearby but not within the tract boundaries. By creating shopping areas, geographic exposure is more effectively modeled. Third, the measure of wealth in the current study was median household income. No consistent relationships between FFRD and median home value (the measure of wealth used by Morland et al.[15]) were found in this study either.

Other geographic research has shown associations between neighborhood demographics and exposure to consumer goods that contribute to negative health consequences. As previously discussed, Reidpath et al.[16] found similar results to this study when comparing fast food restaurant density to median household income among neighborhoods in Melbourne, Australia. LaVeist and Wallace,[20] as well as Scribner et al.,[21] found that liquor stores are more commonly located in predominantly black and low-income neighborhoods. Other studies have found links between higher densities of alcohol outlets and increased rates of alcohol-related outcomes, such as motor vehicle crashes[22] and assaultive violence.[23] For food availability, Morland et al.[15] found that wealthy and predominantly white neighborhoods have more supermarkets and fewer neighborhood grocery stores than poor and predominantly black neighborhoods, an important finding because research indicates that supermarkets have more "heart-healthy" foods when compared to neighborhood grocery stores and convenience stores.[24] Still others have demonstrated a positive association between in-

come and the availability of "healthful products" in grocery stores at the community (city or county) level.[25]

Fast Food and Obesogenic Environment

Researchers have implicated environmental influences on body weight as the primary contributor to the development of the obesity epidemic.[3,4,26] The increased availability and consumption of food is a major component of an increasingly obesogenic environment.

Despite a decrease in the fat content (as a percentage of total calories) of the average American's diet, Americans are consuming more calories. The U.S. Department of Agriculture reported an increase in the average daily food energy intake from 1854 calories to 2002 calories between 1977–1978 and 1994–1996.[8] The growth of "dining out" has significantly contributed to this rise.[10] In 1995, "away-from-home" foods provided 34% of total caloric intake and 38% of total fat intake compared to 18% for both categories in 1977–1978. Fast food is a major component of the away-from-home food category, accounting for 12% of total caloric intake for Americans in 1995 compared to only 3% in 1977–1978.

Fast-food consumption is also related to obesity, and this relationship is strongest among low-income individuals.[13,14] All of this supporting evidence, coupled with the results of this study, suggests that fast food may play a role in the obesity epidemic among low-income and black communities.

Food Availability and Diet

These results suggest that black and low-income neighborhoods have increased exposure to fast food. Whether increased availability of fast food promotes consumption is not the subject of this study. However, theoretically, more convenient access to fast food coupled with the decreased availability of healthy food in black and low-income neighborhoods may increase consumption of unhealthy foods. In keeping with this theoretical construct, Cheadle et al.[25,27] reported that food availability in grocery stores was linked to the diet of residents in the nearby areas. They found that more "healthful products" in grocery stores were associated with increased consumption of "healthful products" by individuals living near those stores. Another study[18] reported that black Americans consume one third more fruits and vegetables for every additional supermarket found in their census tract.

Evidence also suggests that low-income and nonwhite individuals do consume more fast food and unhealthy food. French et al.[13] noted that low income and nonwhite ethnicity were associated with increased fast food consumption. According to a British study, lower socioecomic groups had diets with less vegetables and fruit, and more meat products, fats, and sugars compared to higher socioeconomic groups.[28]

One explanation for these findings is that restaurants and stores adapt their selection to the food preferences of individuals living nearby. Therefore, they may not offer healthy food options in black and low-income neighborhoods because their market research indicates that demand for such products is weak in those communities. However, the opposite might also be true. Food preferences could partly be dictated by available selection in a neighborhood, especially because of the lower access to transportation in black and low-income communities.[15,29] Likewise, because of limited financial resources, black and low-income populations may simply seek out the most calories for the lowest price.

Limitations and Future Research

Despite an exhaustive effort to identify all fast-food restaurants in Orleans Parish by searching telephone directories, websites, and the Orleans Parish Sanitation Department records, we may have missed some restaurants. However, it is unlikely that we under-counted restaurants disproportionately based on demographic characteristics of neighborhoods (i.e., nondifferential selection bias).

This study's definition of fast-food restaurants also excludes some similar restaurants. Many local restaurants may have expedited food service but are not connected to a chain, and some national chains may have only one restaurant in Orleans Parish. In an ongoing study of fast-food restaurants and full-service restaurants, we have discovered that the fast-food restaurants included in this study comprise 67% of all similar restaurants in Orleans Parish (including restaurants that do not fit this study's inclusion criteria such as single-site, fast-food restaurants, and chain, full-service restaurants identified as serving fried chicken, "po-boys," sandwiches, fries, burgers, hot dogs, shakes, pizza). These excluded restaurants may be located in areas of the parish that have different demographic characteristics than what was discovered for those restaurants included in this study. However, major fast-food chains with a significant presence in the area should serve the great majority of fast food meals and, therefore, are most relevant to this analysis. Furthermore, no data exist to suggest that these other restaurants serve different areas of the parish.

Despite this study's recognition of an association between FFRD and black and low-income neighborhoods, the directionality of the relationship cannot be determined by this study. For example, neighborhood demographics could be temporally shaped by the type of restaurants in the area (making a neighborhood more or less desirable) or other local features associated with these restaurants. Likewise, restaurants could be established within neighborhoods that demograph-

What This Study Adds . . .

The connection between fast-food restaurants and black and low-income neighborhoods may contribute to the understanding of environmental causes of the obesity epidemic in these populations.

This study is the first to document that predominantly black neighborhoods have higher densities of fast-food restaurants compared to largely white neighborhoods.

Additionally, this study contributes to the body of literature that has linked high fast-food restaurant density to low-income neighborhoods.

ically fit a restaurant's target audience. Future research should examine the association between fast food restaurants and neighorhood characteristics in a longitudinal manner. Only by tracking the demographics of neighorhoods over time and identifying the establishment date of fast food restaurants can researchers determine a temporal relationship.

This study's focus on one parish/county limits the generalizability of results. Orleans Parish has a very large poor and black population. The link between fast-food restaurants and these neighborhoods may exist due to unique characteristics of this region. Future research should attempt to duplicate this study's findings in diverse regions.

Studies should also examine the geographic association between neighborhood fast-food restaurant density and obesity rates at both the neighborhood and individual levels. The ability to geocode and use multilevel designs now make this type of study possible.[17]

Conclusions

Fast-food restaurants are more commonly located in black and low-income neighborhoods. This link may suggest environmental exposure to fast food as a contributor to the high prevalence of obesity in black and low-income populations.

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