Racial, Ethnic, and Socioeconomic Disparities in Exposure to Fast Food in Hillsborough County, Florida

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ABSTRACT

Recent studies have linked the alarming obesity epidemic in the U.S. to the growth of the fast-food restaurant industry, which offers convenient service alongside inexpensive and high-calorie food. As the number of fast-food outlets increases, research demonstrates that their geographic location plays a significant role in creating obesogenic environments, potentially exposing socially disadvantaged groups to unhealthy nutrition choices provided by these outlets. Whereas previous studies have examined the distribution of positive health amenities such as supermarkets and health-food stores, there is a growing need to evaluate the socio-demographic characteristics of neighborhoods that contain negative health entities such as fast-food outlets. Accordingly, this study sought to determine whether access to fast-food restaurants varied by neighborhood racial/ethnic composition and socioeconomic status in Hillsborough County, Florida—an area that is relatively understudied in terms of its food environment and related health implications. Bivariate and multivariate statistical analyses indicated that race and ethnicity play a pervasive role in explaining the prevalence of fast-food outlets in the county. The results reveal a significantly higher density of fast-food outlets near neighborhoods characterized by a larger proportion of racial/ethnic minorities, even after controlling for the effects of socioeconomic factors and locational characteristics. The study underscores the need to consider both the healthy and unhealthy aspects of the food environment in formulating policy solutions for addressing the obesity epidemic.

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Background

Although the U.S. is one of the wealthiest and most technologically advanced countries in the world, it faces a growing and alarming epidemic - obesity. According to the National Health and Nutrition Examination Survey conducted by the Centers for Disease Control and Prevention [CDC] (2009), the number of adults at least 20 years of age classified as “obese” rose from 13.4% in 1960-62 to 34.3% in 2005-06. Additionally, 32.7% of adults are “overweight” and 5.9% are “extremely obese,” totaling a staggering 72.9% of all adults at least 20 years of age that are classified between “overweight” and “extremely obese.” Whereas many factors contribute to this obesity epidemic, behavioral and environmental factors have been documented to play an especially significant role. According to the World Health Organization [WHO] (2006), obesity can be linked to increased consumption of foods “that are high in fat and sugar but low in vitamins” (WHO, 2006). The CDC (2004) reports evidence linking increased food and caloric intake to a rise in obesity amongst Americans. It cites other studies linking this increased caloric-intake to increased “consumption of food away from home; increased consumption of salty snacks, soft drinks, and pizza; and increased portion sizes.”

The fast-food industry has been a significant contributor to this increased, often unhealthy, food consumption. This industry has grown rapidly in recent years as the number of fast-food outlets in the U.S. has increased from 30,000 in 1970 to 222,000 in 2001 (Paeratakul et al., 2003). Americans are also eating more fast-food as the percentage of total calories consumed nationwide from fast-food has grown from 3% to 20% in the past 20 years (Block et al., 2004). Fast-food outlets are restaurants that offer affordable, convenient, and unhealthy food that many believe have contributed significantly to this epidemic. Jeffery et al. (2006) surveyed a sample of Minnesota residents by telephone and found that eating fast-food is associated with a high fat diet and a higher BMI. Another study examined the geographic location of these entities in the entire U.S. and found that higher fast-food restaurant density is associated with a higher BMI and a greater risk of being obese (Mehta & Chang, 2008). Ultimately, fast-food outlets and their high-calorie food offerings play a pivotal role in creating these unhealthy environments.

Although many Americans are classified as obese, racial/ethnic minorities and lower-income individuals are more likely to suffer from this condition. Blacks are 1.4 times and Hispanics are 1.1 times as likely to be obese as non-Hispanic Whites (The Office of Minority Health, 2009). Regarding socioeconomic status, obesity is more prevalent amongst low-income women and adolescents than higher-income women and adolescents (Office of the Surgeon General, 2000; Healthy People, 2010). These staggering health outcomes can be linked to access to food entities. A Los Angeles study found low-income zip codes with a predominantly Black population to have fewer healthy food options than higher-income zip codes, both in terms of food preparation options and menu choices (Lewis et al., 2005).

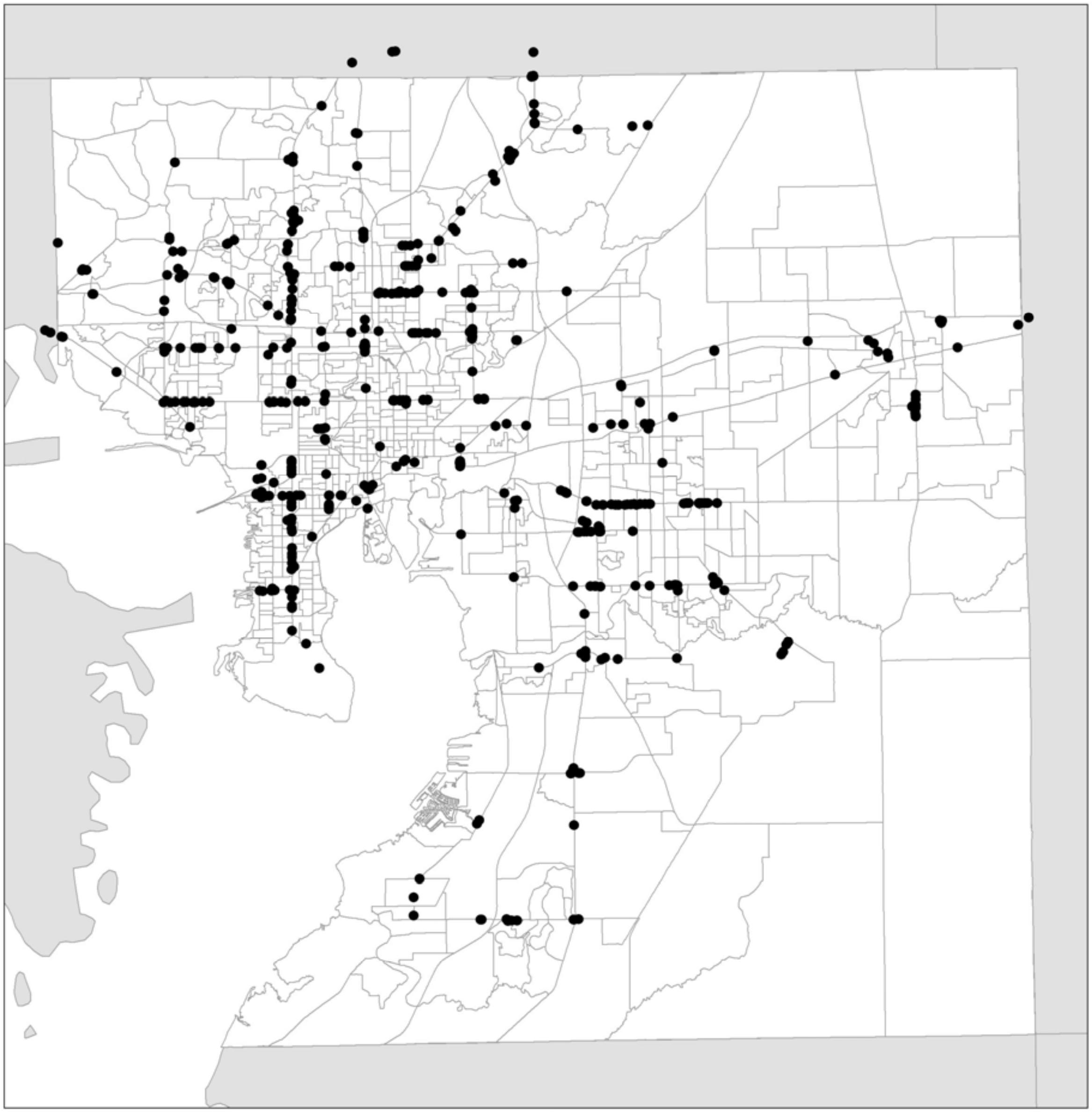
Because fast-food outlets have been linked to a rise in obesity, researchers have hypothesized that their geographic location potentially exposes socially disadvantaged groups to unhealthy nutrition choices. Block et al. (2004) found that predominantly Black and lower-income neighborhoods in New Orleans are more likely to have a higher number of fast-food restaurants per square mile. Another supporting study revealed food environment disparities in St. Louis communities by race and income when considering two factors: dietary guideline adherence by nearby restaurants and access to healthy food options (Baker et al., 2006). Finally, Pearce et al. (2007) found significant and negative statistical associations between access to the nearest fast-food outlet and social deprivation in New Zealand, both when considering neighborhoods and schools. Although a limited number of studies have been conducted, previous research suggests that fast-food outlets are more likely to be located in and accessible to neighborhoods that contain higher proportions of racial/ethnic minorities and/or low-income residents.

Despite this evidence, most recent studies have focused primarily on positive food entities such as supermarkets, health food stores, and farmer markets. Apparicio et al. (2007) examined the spatial location of supermarkets in Montréal and found that lower-income and socially deprived populations have sufficient access to these healthy food locations. Consequently, the authors recommend that research and policy efforts focus on other causes of an unhealthy diet that can lead to adverse health outcomes. Another study revealed that supermarkets are more likely to be located in mostly White neighborhoods than mostly Black neighborhoods in Maryland, Minnesota, Mississippi, and North Carolina (Morland et al., 2002). Finally, a comprehensive review of the food environment literature published between 1985 and 2008 indicated that communities with better access to supermarkets and less access to alcohol outlets tend to have healthier diets and lower tendencies toward obesity (Larson et al., 2009). However, this review found empirical results from studies examining restaurants, including those classified as fast-food, to be less consistent. More systematic research is clearly necessary to investigate the spatial and statistical associations between obesity, fast-food outlet locations, and the socio-demographic characteristics of neighborhoods in urban America.

More specifically, there is a growing need to examine these relationships in metropolitan areas of Florida - an area that is relatively understudied in terms of its food environment and related health implications. Previous studies have focused on other national and international communities, but few have investigated the obesity crisis and its causes in the populous “Sunbelt Region.” Florida’s growth has been extraordinary as its population surged by 76% between 1970 and 1990, compared to the nation’s population growth of 21% during the same time period (Mormino, 2002). Florida’s growing population has also been affected by the recent food crisis epidemic. According to the Food Research and Action Center [FRAC] (2010), Florida’s national rank jumped from 24th in 2008 to 12th in 2009 when considering “food hardship” (the inability to pay for food). Additionally, food stamp usage in Florida has increased by a staggering 70% between 2007 and 2009 (Bloch et al., 2009). Hillsborough County, the fourth most populous county in Florida and the one with the largest population in the Tampa Bay (Tampa/St. Petersburg/Clearwater) metropolitan statistical area (Office of Economic & Demographic Research, 2009), has been especially affected by this food access problem. Therefore, Florida, and more specifically Hillsborough County, is a pivotal location for a case study of unhealthy food environments.

The current study examined the relationship between exposure to fast-food and socio-demographic characteristics of neighborhoods in Hillsborough County, Florida. The specific objective was to determine if fast-food outlets were significantly more likely to be located near neighborhoods containing relatively higher proportions of racial/ethnic minorities, after controlling for the effects of socioeconomic status and other contextual factors. The analysis utilized precise locations of fast-food outlets, census socio-demographic data, and multivariate regression models to examine the statistical effects of various neighborhood-level explanatory factors on the density of fast-food outlets at the census block group level. The broader goal was to emphasize the need to consider unhealthy aspects of the food environment in formulating public policy solutions that address the obesity epidemic in the United States.

Figure 1. Locations of Fast-food Outlets (n=526) and Census Block Groups (n=795) in Hillsborough County, Florida



Data and Methods

The first step consisted of developing an operational definition of fast-food outlets in Hillsborough County, Florida that would be the basis for the geographic analysis. Fast-food chains were identified initially through utilizing *Superpages.com*, an online phone book. The term "Fast-Food Restaurants" was entered into the search field for each city in Hillsborough County and the ensuing results were further narrowed with the "Fast-Food Restaurants" link located below the "Best Match" category. For inclusion in the study, fast-food chains had to meet the following criteria: (1) have two or more locations within Hillsborough County, and (2) have at least one other location outside Hillsborough County.

These restaurant chains were further defined by using their Primary North American Industry Classification System (NAICS) Description and NAICS-1 Description. Both codes needed to be classified as “Full-Service Restaurant” and/or “Limited-Service Restaurant” to be included in the analysis. If one location of a restaurant chain that fit this criterion had a different code in either or both fields, it was viewed as a bureaucratic mistake and the location and the chain were retained for the study. This criterion resulted in a sample that included most of the fast-food market in Hillsborough County.

Individual restaurant locations were obtained from *ReferenceUSA*, a Web-based resource that compiles residential and business data nationwide from more than 5,000 public sources. Current data (updated within the past 12-month time period, 2010) for each fast-food outlet included the street-level latitude/longitude coordinates for locations in Hillsborough County and its five bordering counties (Hardee, Manatee, Pasco, Pinellas, and Polk). The analytical capabilities of geographic information software (ArcGIS version 9.3.1) were then used to geocode the location of each restaurant, based on these latitude and longitude coordinates. All fast-food outlets inside and within a mile of the Hillsborough County boundary were selected for this study. As Table 1 shows, the analysis included 39 fast-food restaurant chains and total of 526 fast-food outlets located in this area.

The spatial distribution of these fast-food outlets that were included is depicted in Figure 1. Most of these outlets are concentrated near major interstate highways in the county such as I-275 and I-4, or located in densely-populated urban areas such as Brandon, Plant City, Riverview, Tampa, Temple Terrace and Town n’ Country.

Dependent Variable

The food environment, which includes negative health entities such as these fast-food outlets, is a complex and dynamic entity that can vary based on geographic location and societal influences. Sharkey (2009) notes that there are several dimensions to the food environment: density that includes ratio of food outlets by geographic unit, proximity that includes distance to these food outlets, and variety that includes the differences in price, menu, and preparation. Because the current study aimed to provide insights on the relationship between fast-food location and neighborhood socio-demographics in Hillsborough County, density (number of outlets per square mile) was assumed to be the most appropriate measurement to represent the dependent variable. Census block groups represented the unit of analysis for the study because the block group is the smallest unit or finest spatial resolution at which the U.S. Census publishes socioeconomic data.

Table 1. Fast-Food Outlets in Hillsborough County, FL

Restaurant/Chain Name	**Number**
Arby’s	11
Blimpie	13
Boston Market	8
Burger King	27
Charley’s Grilled Subs	2
Checkers	17
Chick-fil-A	13
Chipotle Mexican Grill	5
CiCi’s Pizza	8
Domino’s Pizza	15
Evos	3
Firehouse Subs	7
Five Guys	8
Godfather’s Pizza	11
Hardee’s	5
Hungry Howie’s Pizza	24
Jason’s Deli	2
Jersey Mike’s Subs	3
Kentucky Fried Chicken (KFC)	18
Lenny’s Sub Shop	2
Long John Silver’s	5
McDonald’s	57
Moe’s Southwest Grill	9
Nick’s Gyros & Subs	2
Panda Express	5
Panera Bread	9
Papa John’s Pizza	14
Pizza Hut	24
Pollo Tropical	3
Popeyes Chicken & Biscuits	9
Quiznos	13
Sbarro	3
Sonic Drive-In	12
Subway	93
Taco Bell	23
The Pita Pit	2
Tijuana Flats	2
Wendy’s	30
Wingstop	2
Zaxby’s	4
Total	526

Fast-food density was calculated by using a one-mile buffer around each census block group located in Hillsborough County. There were two reasons for using these buffers: (1) travel patterns, and (2) edge effects. First, a buffer is necessary to account for the fact that individuals who live in a particular block group potentially travel to areas beyond these arbitrary boundaries for work, school, and/or recreation. People are likely to use connecting roads and encounter the fast-food outlets immediately outside their block group of residence as they travel to or from these activities. Second, the use of block group boundaries fails to account for potential boundary or edge effects (Fitos & Chakraborty, 2010). These effects deal with the possibility that a facility could be located so close to the edge of a census unit that its immediate and effective neighborhood includes portions of other surrounding units. Figure 1 illustrates this reality that few fast-food outlets in the study area are located at the center of their host block group and most outlets are located near the boundaries of block groups. Therefore, block groups may not suitable for representing neighborhood boundaries if restaurants tend to locate at their edges or borders.

Previous studies have recommended a one-mile buffer around census units as the preferred distance for analyzing access to fast-food outlets (e.g., Block et al. 2004). Additionally, a *New York Times* article reported that a McDonald's restaurant is located within a three-to-four-minute driving distance of every American home (Lubow, 1998). Accordingly, an assumption was made that residents of a block group would have access to all fast-food outlets within a mile of its boundary. Preliminary calculations indicated that only about 30% of block groups (236 of 795) in the study area contain at least one fast-food outlet inside their boundary, whereas almost 92% of block groups (729 of 795) contain at least one fast-food outlet within a mile of their boundary. If these buffers were not utilized, the analysis would lead to the potentially misleading conclusion that almost 70% of block groups in this county lack access to fast-food restaurants.

Ultimately, fast-food restaurant density was calculated as the number of fast-food chain outlets within a mile of each block group divided by the area of the block group in square miles. This calculation of areal density accounts for the size of the neighborhood within which fast-food outlets are located. The skewness of its distribution in the study area was addressed by taking the natural logarithm of fast-food restaurant density as the dependent variable for the statistical analysis. Summary statistics for all variables used in the study are provided in Table 2.

Table 2. Summary Statistics for Dependent and Independent Variables

Variables	Min	Max	Mean	SD	Pearson's *r*
Dependent:					
Fast-Food Restaurant Density (FFRD)	0.000	746.211	38.535	63.409	
Natural Logarithm of FFRD	-2.322	6.615	2.647	1.658	
Race/Ethnicity:					
Proportion Black	0.000	1.000	0.160	0.235	0.203**
Proportion Hispanic	0.000	1.000	0.175	0.147	0.149**
Socioeconomic Status:					
Median Household Income ($)	0	159,949	43,572	21,391	-0.175**
Median Home Value ($)	0	560,900	103,542	64,242	-0.130**
Proportion Higher Education	0.000	1.000	0.229	0.184	0.077*
Locational Characteristics:					
Population Density	0	64,819	3,544	3,812	0.543**
Highway Presence	0.000	1.000	0.886	0.319	0.175**

**$p<.01$; *$p<.05$ (two-tail)

Explanatory Variables

The statistical analysis includes three categories of explanatory variables: race/ethnicity, socioeconomic status, and locational characteristics. All data came from the 2000 U.S. Census at the block group level, except for the presence of highways. Although the census socio-demographic information came from a different year (2000) than the fast-food outlet location (2010), it was the best available resource for this information. For the race/ethnicity variables, it was determined that both Blacks and Hispanics needed to be included as they comprise the largest minority groups in Hillsborough County, accounting for almost 22% and 17% of the general population, respectively (U.S. Census Bureau, 2010). Previous studies on the local food environment also have analyzed the presence of Black and Hispanic residents (e.g. Mehta and Chang, 2008; Larson et al., 2009). Other minority populations (e.g., Asians) were not included as they comprised less than 6% of the total county population (U.S. Census Bureau, 2010). The Proportion Black variable was calculated as the total number of individuals identifying their race only as Black divided by the total block group population. The Proportion Hispanic variable was calculated as the total number of self-identified Hispanic/Latino residents (of any race) divided by the total block group population.

The socioeconomic variables were selected to represent a block group's class status as related to wealth and income. These included Median Household Income and Median Home Value, respectively. Previous studies have used either median household income (Block et al., 2004) or median housing values (Morland et al., 2002) to evaluate the relationship between location of food stores and neighborhood economic status. Both variables were included in the analysis to gain a better understanding of the relationship between fast-food restaurant density and class in Hillsborough County. An additional variable was included to represent the level of educational attainment and examine its geographic association with fast-food access. Although a previous study has included educational level as a component of a composite index of socioeconomic distress (Larsen & Gilliand, 2008), the independent effect of neighborhood education status on unhealthy food entities has not been investigated. To explore this relationship, the proportion of individuals with higher education was included in the analysis. The Proportion Higher Education variable was calculated as the number of adults (at least 25 years of age) with at least a Bachelor's Degree in a block group divided by the total block group population.

Table 3. Multiple Regression of Fast-Food Restaurant Density (Natural Log)

Variables	Model 1	Model 2	Model 3
Proportion Black	0.216	0.241	0.118
	(6.275)**	(6.618)**	(3.620)**
Proportion Hispanic	0.166	0.231	0.097
	(4.814)**	(6.612)**	(3.068)**
Median Household Income ($)		-0.314	-0.184
		(-5.944)**	(-3.895)**
Median Home Value ($)		-0.190	-0.147
		(-3.763)**	(-3.321)**
Proportion Higher Education		0.613	0.423
		(11.815)**	(9.045)**
Population Density			0.462
			(15.477)**
Highway Presence			0.162
			(5.559)**
N	795	795	795
Condition Index	3.245	9.953	14.051
Adjusted R-squared	0.066	0.205	0.396
F-statistic	29.124**	42.067**	75.510**

Note: standardized coefficients with t-values in parentheses;**p<.01 (two-tail)

Two variables were included to control for the role played by neighborhood population and accessibility in the relationship between fast-food density and socio-demographic factors: (1) population density (persons per square mile); and (2) the presence of major highways. Their inclusion is supported by previous studies which suggest that fast-food restaurants are more likely to locate in neighborhoods that are more densely populated (e.g., Apparicio et al., 2007) and are more accessible to highways (e.g., Block et al., 2004). The Population Density variable was calculated as the total block group population divided by the area of each block group in square mile. A qualitative variable was used to account for the presence of Interstate, U.S. and/or State highways within a mile of each block group. This dichotomous variable was coded as '1' if the block group was intersected by least one type of highway, and coded as '0' if no highways were present. Highways are an important consideration for this research because the fast-food industry began and grew alongside the interstate highway system boom of the 1950s (Schlosser, 2001). This highway information was obtained from Census TIGER/Line Street Files (2000 and 2002) and deemed sufficiently current.

Statistical Analysis

To identify the factors affecting fast-food restaurant density (FFRD), a combination of linear correlation and multivariate regression analysis was used. The first phase of the analysis uses bivariate parametric correlations to examine the relationship between each of the explanatory factors and the natural logarithm of FFRD. The second phase utilizes a three-stage multivariate regression analysis based on the least squares approach and three different combinations of explanatory variables (race/ethnicity, socioeconomic status, and neighborhood locational characteristics). All statistical analyses used SPSS statistical software (version 18).

Results

At the block group level, fast-food restaurant density (FFRD) in Hillsborough County varies from 0 to 746.211, with a mean of approximately 39 restaurants per square mile and a standard deviation of more than 63 per square mile. To account for skewness and to reduce the effect of extreme outliers, the natural logarithm of FFRD was used as the dependent variable. The mean of this variable is 2.647 with a standard deviation of only 1.658, and its frequency distribution is sufficiently normal to meet least squares regression requirements. Most of the explanatory variables suggest substantial variability in their values across block groups in this study area. Variables describing race and ethnicity, however, indicate higher standard deviations relative to their respective means compared to variables representing socioeconomic status. Summary statistics for all variables used in this study are provided in Table 2.

Bivariate parametric correlation is first used to investigate the nature and direction of the statistical relationship between the dependent variable and each independent variable at the block group level. Pearson's correlation coefficients (*r*-values), presented in Table 2, indicate that all variables were significantly associated ($p<.05$) with the density of fast-food restaurants. Both of the racial/ethnic variables were significantly and positively correlated with the natural log of FFRD, with the Black proportion showing a stronger association than the Hispanic proportion. Socioeconomic disparities in the distribution of fast-food outlets are also evident from Table 2. The natural log of FFRD increases significantly with a decrease in both median household income and median housing value, with household income showing a slightly stronger negative association with the dependent variable. In contrast, the proportion of individuals with a Bachelor's or higher degree is the only socioeconomic variable that is positively correlated with the natural log of FFRD. Both locational characteristic variables (population density and highway presence) indicate a significantly positive association with the dependent variable, with population density yielding a higher *r*-value than any other explanatory variable.

The next phase of analysis used a three-stage multivariate regression model to investigate the simultaneous effects of the explanatory factors on the density of fast-food restaurants in Hillsborough County. To analyze the effects of race/ethnicity, socioeconomic status, and locational characteristics separately and collectively, three different combinations of independent variables were employed. Because the main objective was to determine if fast-food outlets were more likely to locate near neighborhoods containing higher proportions of racial and ethnic minorities, variables that quantified both these characteristics were included in every model. Whereas model 1 was comprised of only the proportion of Black and Hispanic residents, model 2 combines these racial/ethnic attributes with the socioeconomic status variables. Model 3 includes locational characteristics in conjunction with variables in model 2, to encompass the entire set of explanatory variables. The standardized regression coefficients and corresponding *t*-values associated with each model are shown in Table 3. The ANOVA F-test indicates overall significance ($p<.01$) for all three regression models.

To check for multicollinearity, tolerance statistics for each independent variable in the regression models were examined. The values of the tolerance statistic for all variables were greater than 0.2, suggesting that there were no collinearity problems in these models. The multicollinearity condition index was also calculated for the combination of variables included in each regression model, as shown in Table 3. All three models yielded a condition index smaller than 30, confirming the absence of severe multicollinearity among independent variables.

In model 1, both explanatory variables were statistically significant ($p<.01$) and positive, with the Black proportion yielding a larger standardized coefficient than the Hispanic proportion. The inclusion of socioeconomic status variables in model

2 resulted in a substantial increase in explanatory power as measured by the adjusted R-squared, and all the variables show a highly significant relationship ($p<.01$) with the natural log of FFRD. Whereas the coefficients for the race/ethnicity variables from model 1 remained positive, median household income and median home value indicated a negative association, with household income yielding a smaller standardized coefficient than home value. The proportion of individuals with higher education, however, was the only socioeconomic status variable positively related to the log of FFRD.

Model 3, the final regression model, adds the locational characteristic variables to the explanatory variables previously included in model 2. An increase in both the adjusted R-squared and the ANOVA F-statistic suggests improvement in model fit. All variables, including the new additions, continued to show a statistically significant ($p<.01$) effect on the dependent variable. Whereas the race/ethnicity variables remained positive and similarly related, there was a decrease in their standardized coefficients. The coefficients for the three socioeconomic status variables maintained the same direction observed in model 2, but also decreased in value. Both locational characteristics were positively associated with the log of FFRD, with population density yielding a larger standardized coefficient than highway presence, and any other explanatory variable in model 3.

Discussion

This paper addresses the growing need to examine the unhealthy aspects of the food environment and their adverse implications for socially disadvantaged communities in metropolitan areas of Florida. This study focuses on analyzing the relationship between the spatial distribution of fast-food outlets and socio-demographic characteristics of neighborhoods in Hillsborough County, Florida. The bivariate correlation and multivariate regression analyses indicate that race and ethnicity play a role in explaining the prevalence of fast-food outlets in this study area. Specifically, the density of fast-food outlets is significantly greater in neighborhoods containing a higher proportion of Black and Hispanic residents, even after controlling for the effects of various socioeconomic factors and locational characteristics. These results are consistent with the few previous studies conducted in other places that found minority and low-income neighborhoods to have increased geographic exposure to fast food (Block et al., 2004; Pearce et al., 2007).

In addition to race/ethnicity, the distribution of fast-food outlets in the study area is strongly influenced by neighborhood socioeconomic status. The density of fast-food restaurants is significantly greater in areas with a lower median household income and a lower median home value, after accounting for the effects of race, ethnicity, and other locational characteristics. However, fast-food outlets are statistically more prevalent in neighborhoods containing a higher proportion of adults with a Bachelor's degree or higher. This finding can be explained, in part, by the presence of two major universities, which implies a relatively large graduate student population in Hillsborough County. Fast-food outlets often locate near residences of these students who tend to live in neighborhoods near their university campus that are characterized by rental housing and lower socioeconomic status. Consequently, the current results reveal a higher density of fast-food restaurants in less affluent neighborhoods with more educated adults. Lastly, the results indicate that locational characteristics of neighborhoods affect the spatial distribution of fast-food restaurants. The density of fast-food outlets is significantly greater in areas with a higher population density and those accessible to major highways.

Whereas the study represents the first systematic attempt to examine geographic exposure to fast-food outlets in a metropolitan area of Florida, there are certain limitations that should be addressed in future research to improve understanding of the unhealthy food environment and its social implications. In addition to analyzing the density of fast-food outlets, it is also necessary to investigate other dimensions of the food environment such as proximity and variety (Sharkey, 2009). Instead of relying on census unit boundaries, future studies would benefit from incorporating detailed street network data to improve the assessment of both travel time and distance from fast-food outlets. Instead of assuming that all outlets pose equal health risk, future studies would also benefit from implementing an index that evaluates the variety of meal choices and nutritional content of food served by these quick-service restaurants.

Additionally, this study may be limited in the selection of explanatory variables used for the statistical analysis. Future researchers may want to use a more complex variable for examining multiple factors that determine socioeconomic class or wealth, such as a composite index based on locally appropriate census variables (Apparicio et al., 2007; Larsen & Gilliand, 2008). Locational variables that represent land use planning or zoning decisions and the availability of public transportation could also be included as control factors to fully understand the relationship between urban spatial structure and obesogenic environments.

Finally, it is also important to consider the fact that conventional multivariate regression may not be the most appropriate technique for analyzing the geographic relationship between fast-food outlet density and neighborhood socio-demographics, because it assumes observations and error terms to be spatially independent. Spatial dependence or autocorrelation in the regression residuals could overstate the significance of multivariate relationships (Getis, 2007; Chakraborty, 2010). Future research should explore the use of spatial regression techniques that consider the effects of geographic clustering and control for spatial dependence in the data.

Despite the limitations noted, this study provides evidence that fast-food outlets in Hillsborough County are more likely to locate near predominantly Black, Hispanic, and lower income neighborhoods. These findings suggest that racial/ethnic minorities and individuals of lower economic status have greater exposure and more convenient access to these less healthy outlets, and are potentially more likely to partake in increased consumption of the high-calorie food they serve. Therefore, the location of these fast-food outlets could explain the higher occurrence of obesity in socially disadvantaged groups. Ultimately, these results highlight the important role that local environmental factors, especially unhealthy food entities, play in the creation and sustention of the obesity epidemic. These findings underscore the need to educate the public of the dangers associated with fast-food consumption and to implement appropriate policy solutions that consider both the healthy *and* unhealthy food environment when seeking to address the growing and alarming obesity epidemic.

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