HHS Public Access
Author manuscript
Health Place. Author manuscript; available in PMC 2016 March 09.

Published in final edited form as:
Health Place. 2014 September ; 29: 10–17. doi:10.1016/j.healthplace.2014.04.011.

Do minority and poor neighborhoods have higher access to fast-food restaurants in the United States?

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Abstract

Background—Disproportionate access to unhealthy foods in poor or minority neighborhoods may be a primary determinant of obesity disparities. We investigated whether fast-food access varies by Census block group (CBG) percent black and poverty.

Methods—We measured the average driving distance from each CBG population-weighted centroid to the five closest top ten fast-food chains and CBG percent black and percent below poverty

Results—Among 209,091 CBGs analyzed (95.1% of all US CBGs), CBG percent black was positively associated with fast-food access controlling for population density and percent poverty (average distance to fast food was 3.56 miles closer (95% CI: -3.64, -3.48) in CBGs with the highest versus lowest quartile of percentage of black residents). Poverty was not independently associated with fast-food access. The relationship between fast-food access and race was stronger in CBGs with higher levels of poverty (p for interaction <0.0001).

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Conclusions—Predominantly black neighborhoods had higher access to fast-food while poverty was not an independent predictor of fast-food access.

Keywords

Food access; Poverty; Race

Background

Substantial health disparities in obesity and obesity-related diseases exist, with individuals of black race and lower income suffering a disproportionate burden (Ogden et al., 2006, Mujahid et al., 2005). In recent years, research on distal causes of obesity have explored whether neighborhood effects, or contextual factors in the neighborhoods in which people live, might play a role in driving these disparities (Lovasi et al., 2009, Ludwig et al., 2011). Although debate continues, evidence is growing that neighborhood access to fast-food establishments may lead to a diet that is high in fat, carbohydrates, and sugar and subsequent higher obesity risk (Larson et al., 2009, Caspi et al., 2012, Reitzel et al., 2013, Richardson et al., 2011, Morland et al., 2002, Burgoine et al., 2014). If fast-food access influences dietary patterns and obesity risk, different levels of fast-food access by neighborhood income or racial composition may contribute to the observed health disparities.

Researchers are beginning to examine whether neighborhood access to unhealthy food varies by neighborhood income or racial composition. Using a broad array of methods in a diverse range of settings, studies have demonstrated that low income neighborhoods with a large proportion of Black residents have higher access to unhealthy foods (Walker et al., 2010, Black et al., 2012, Block et al., 2004, Cummins et al., 2005, Kwate et al., 2009, Powell et al., 2007, Fraser et al., 2010). While the literature has elucidated variability in access to fast food by neighborhood race and poverty composition, we know little about the distribution of fast-food access relative to poverty and race across the entire US. This is due, in part, to a lack of reliable and valid measures of local food environments that can help researchers better understand the relationship between these environments and health, as well as to identify potential intervention points, such as food establishment zoning, to improve access to healthy foods (Kelly et al., 2011). The vast majority of fast-food access studies focus on small areas. Studies that have attempted to estimate the distribution of fast-food access across the US have relied on administrative boundaries and industry classification codes to determine restaurant types (Powell et al., 2007). Alternative approaches to measuring access to fast-food are necessary because individuals may obtain food outside of the administrative boundaries in which they live and research has demonstrated the inadequacy of industry classification codes to identify restaurant types (Powell et al., 2007). In order to build on the prior research, the present study identifies fast-food restaurants by their business name to reduce differential misclassification. In this analysis, we measure the average distance to the closest five fast-food restaurants from the centroid of Census block groups (CBGs), irrespective of Census boundaries, across the entire US and for each US state. We use these novel measures to estimate whether fast-food access varies according to CBG poverty and racial composition.

Methods

Data Sources

Fast-Food Data—We used geocoded information on businesses across the United States from the commercially available Dun & Bradstreet dataset based on the ArcGIS Business Analyst Package (ESRI, Redlands, CA) from 2013. Industry classification codes for business types have been shown to have extensive misclassification. The extent of this misclassification has been demonstrated to vary by the socioeconomic status (SES) and racial makeup of neighborhoods, with greater misclassification in lower SES and high minority neighborhoods (Powell et al., 2011). Therefore, we selected fast-food restaurants based on business names to improve accuracy in classifying fast-food establishments. Fast-food restaurants were selected from the 2011 top ten "limited service restaurants" sales list, a resource compiled by the food industry consulting firm Technomic Inc. (Technomic, 2013). These restaurants were McDonalds, Burger King, Starbucks, Dunkin Donuts, Pizza Hut, Subway, Taco Bell, KFC, Chick-Fil-A, and Wendy's. Although the choice of using the names of the top ten fast-food restaurants as a measure of fast-food access does not assess access to all types of fast-food destinations, this proxy of overall fast-food access is likely to capture a more homogenous, well-characterized category (Richardson et al., 2011) and has less potential bias than using industry classification codes due to the documented differential code misclassification of fast-food establishments by neighborhood socioeconomic status (SES) (Powell et al., 2011).

Neighborhood Composition—We used US Census American Community Survey 2006-2010 and 2010 Decennial Census data to characterize CBGs according to SES, percent black, and population density.

Access to Fast Food

The outcome for the study was a measure of *access to fast food* for each CBG. We calculated fast-food access based on the road network distance from each CBG population-weighted centroid to the five closest restaurants (Figure 1). The population-weighted centroid is based on the mean-weighted x- and y-coordinate values of the Census block population centroids. Road network distance accounts for both the location of fast food and the feasibility of accessing it from each CBG center, and taking an average of the closest five establishments provides insight into the multiple opportunities to access fast food compared to access to the single closest establishment. To estimate this measure, we used the closest facility calculation from the ArcGIS (ESRI, Redlands, CA) network analyst package. Similar methods have been applied in previous studies of food stores (Sharkey and Horel, 2008). CBG centroids more than 50km from a road were excluded, as were CBGs in Alaska and Hawaii. Calculations of the five closest facilities were estimated independent of administrative boundaries, such that the five closest facilities could be located across CBG, tract, or state boundaries.

Independent Variables

The covariates in this study included the following characteristics of the CBG: *% below poverty; % Black; and Population Density*. We characterized the socioeconomic and racial composition of each CBG based on American Community Survey five-year estimates of percent of individuals below poverty *(% below poverty)* and percent of individuals of black or African American race from 2006-2010 *(% Black)* (US Census Bureau, 2013a). We defined CBG population density as persons per square mile based on Census 2010 values (*Population Density*) (US Census Bureau, 2010).

Study Population

The US Census Bureau provides data for 219,831 CBGs across the United States and Puerto Rico. We excluded CBGs in Alaska, Hawaii, or Puerto Rico (n=3,940), CBGs with missing census data (n=5,984), and CBGs that did not have a road within 50km of their geometric center (n=816), retaining 209,091 (95.1% of all CBGs in the US, comprising 95.1% of the 2010 US population) CBGs for this analysis. Because we conceptualize each CBG's geometric center as its population center, we retained CBGs with roads located within 10 km of their geometric centers. CBG centroids farther than 6.2 miles from a road were assumed to be poor measures of population centers and were therefore excluded.

Statistical Analysis

We estimated fixed effects linear regression models to analyze the association between fast-food access and percent poverty and percent Black. The unit of analysis was the CBG. The CBG percent black was analyzed by quartiles and the CBG poverty rate was analyzed according to the cutoffs for estimating concentrated poverty as defined by the US Census (US Census Bureau, 2011). Fixed effects regression coefficients can be interpreted as the difference in road network miles between CBG centroids and the average distance to the five closest fast-food facilities as defined above for each poverty and race category compared to the reference category (<13.8% below poverty or lowest quartile of percent black (<0.01%)). Covariates for analyses included Census block population density, as well as fixed effects for states. Analyses were additionally stratified by state and rural/urban status as defined by rural-urban commuting area (RUCA) from the 2000 Census based on population density, urbanization, and daily commuting (US Census Bureau, 2000).

Results

Table 1 shows descriptive statistics according to quartiles of average distance to the closest five fast food facilities. The mean average distance to fast food in the first quartile (highest access to fast food) was 0.86 miles compared to 13.25 miles in the fourth quartile (lowest access to fast food). Areas of concentrated poverty had higher fast-food access compared to less impoverished CBGs. The CBG distribution across the categories of percent black and percent poverty is shown in Web Appendix Table 1. The distribution of % Black, % below poverty, access to fast food, and population density across the CBGs included in this analysis is presented in Figure 2. Generally, higher percent black CBGs are located in the southeast and higher poverty concentrations are seen in the southeast and southwestern states. Fast food access is highest on the coasts, which are the areas where population density is highest in the US.

Table 2 shows the results of the fixed effects linear regression analyses. Fast-food access was higher across neighborhoods that fell above the 25th percentile of concentration of black residents (0.04-100% black). . Crude models indicated that fast-food outlets were roughly 3.5 miles closer (95% Confidence Interval (CI): -3.58, -3.42) to the centroid of CBGs with the highest versus lowest percentages of black residents. This relationship attenuated somewhat after adjustment for population density, but a difference of about 3.23 miles persisted (95% CI: -3.31, -3.16). CBGs in the highest poverty category had higher fast-food access in crude and population adjusted models compared to the lowest poverty category, as indicated by a half-mile shorter difference in average distance to nearby fast food (95% CI: -0.64, -0.38) in the poorest versus least poor CBGs after adjustment for population density.

In models simultaneously adjusted for percent poverty and percent black, the relationship between CBG percent black and fast-food access grew stronger such that average distance to fast food was more than three miles closer in neighborhoods with the highest versus lowest concentration of black residents (-3.56 miles (95% CI: -3.64, -3.48)). In this fully adjusted model, the effect of poverty had a nonlinear relationship with fast-food access. Compared to CBGs with the lowest levels of poverty (<13.8% below poverty), CBGs with 13.8-20%, 20-40%, and >40% below poverty had lower access to fast food.

In analyses stratified by rural and urban CBG status (Web Appendix Tables 2-5), results were generally similar. The predicted average distance to fast food by poverty category and quartiles of race distribution after adjusting for population density are shown in Figure 3. There was an interaction between race and poverty, where the relationship between fast-food access and race was stronger with higher levels of poverty (p for interaction <0.0001).

Figure 4 shows the relationship between percent black and fast-food access adjusted for population density and percent poverty stratified by state. Some states had few (Montana, South Dakota, North Dakota, Wyoming, and Idaho) CBGs in the fourth quartile of percentage of black residents, therefore the y-axis has been adjusted to display confidence intervals for the majority of states. Point estimates below the reference line of 0 indicate that within a state, CBGs in the fourth quartile of percent black had greater access to fast food than the first quartile. Differences between the average distance to fast food between the fourth and first quartile of percent black varied between -16.28 and 0.22 miles, with 48 out of 48 states showing higher fast-food access for CBGs with higher percentages of black residents. For example, in New York the average distance to fast food was 2.45 miles closer (95% CI: -2.64, -2.27) comparing the top quartile of percent black CBGs to the bottom quartile. Only the District of Columbia showed an association between higher concentrations of black residents and lower fast-food access (average distance to fast food was 0.22 miles greater comparing CBGs in the highest quartile of percent black to the lowest quartile (95% CI: 0.03, 0.40).

Conclusions

In this analysis of national data, we found that racial composition of CBGs is positively associated with higher fast-food access, with higher concentrations of black residents associated with higher access to fast food, net of population density and poverty of the CBG.

These results were consistent across the majority of states in the country and did not vary greatly by rural or urban CBG status. Although concentrated poverty appeared to be a risk factor to fast-food access in crude models and population density-adjusted models, it was not associated with shorter distance to nearby fast food after accounting for CBG percent black.

Limitations of this analysis include the use of CBG population-weighted centroids as a proxy for the residential environment. Although this is a concern associated with conducting any analyses based on administrative boundaries, the CBG is the smallest available Census-defined area and therefore represents the best nationally available geography for constructing the residential environment. Second, we assume that each mile of road network is equivalent as a measure of access. Depending on numerous factors, such as access to automobiles or public transit, sidewalk availability, and crime, street network distance may have different meanings for different neighborhoods in terms of fast-food access. Third, we relied on commercially available data to locate fast-food restaurants, which have been argued to have poor validity for assessing establishment type (Powell et al., 2011). Some studies have demonstrated 37-59% undercounts of franchised limited-service restaurants or fast food chains from commercial databases compared to ground-truthed data (Liese et al., 2010, Powell et al., 2011, Liese et al., 2013), while others have shown high correlation for fast food outlets comparing commercial databases and ground-truthed data (Gustafson et al., 2012). In our study we aimed to reduce the error in misclassifying business types by searching based on business name rather than on industry codes (Simon et al., 2008, Ohri-Vachaspati et al., 2011). We attempted to address this misclassification by using a name-based method to identify the top chain fast food restaurants in the US, which should lead to fewer missing outlets, fewer false-positives (restaurants identified as fast food that do not serve fast food), and reduced systematic bias due to differential classification of fast food establishments. Despite this, the name-based approach cannot completely overcome misclassification, as studies have shown a 30% undercount when comparing the name-based commercial database to food inspection databases (Simon et al., 2008). Finally, we did not explore neighborhood racial composition beyond percent black/African American race within the CBG.

As the first nationwide study in the US to examine area-level racial composition (% black/African American) as a predictor of fast-food access, our analysis makes several contributions to the literature. First, we use network distances to measure fast-food access, which provides a more realistic metric of the ease of reaching fast-food establishments compared to measures based on straight-line distance. Further, averaging distances to the five closest fast-food restaurants serves as a more stable measure of fast-food access compared to estimating access based on a single closest establishment. Third, unlike previous analyses that have used density measures within Census tracts and are therefore affected by the modifiable areal unit problem (Powell et al., 2007), our network distance calculation estimates access to fast-food establishments independent of arbitrary administrative boundaries that may have no bearing on the spatial scale of an individual's food environment. Finally, CBGs are a small spatial unit of analysis representing an approximation of the neighborhood for 1,500 individuals (US Census Bureau, 2013b), and may be a more relevant central indicator of neighborhood access compared to larger geographic units.

Our results are consistent with previous findings that highlight the importance of historical determinants (such as racial segregation) of area-level racial composition in shaping food environments (Kwate, 2008). Evidence is growing that access to unhealthy food establishments increases consumption of fast food (Boone-Heinonen et al., 2011) and fast food consumption is a risk factor for obesity (Anderson et al., 2011, Garcia et al., 2012, Duffey et al., 2007). Studies have demonstrated a U-shaped relationship between income and fast food consumption, with the highest consumption occurring among middle-income individuals (Kim and Leigh, 2011). This may explain the absence of an association between CBG percent poverty and fast food access. Conversely, studies have shown that black individuals are more likely to consume fast food than other races (Moore et al., 2009). The results of the present study indicate that access might be a likely determinant of this association. The associations observed in our study may reflect the increased demand for fast food in predominantly black neighborhoods, as the lack of association between poverty and fast-food access suggests that price may not be a main determinant of access to fast food. Alternatively, aggressive advertising by the fast food industry could be creating demand in neighborhoods with a higher concentration of Black residents (Grier and Kumanyika, 2008, Grier et al., 2007). We cannot determine the mechanism underlying the association in this study but future research should continue to explore the factors that influence neighborhood food environments, as well as the health implications of easy access to fast food.

With municipalities across the county currently revisiting controls on fast-food establishments, such as zoning restrictions and menu labeling (Medina, 2011, Centers for Disease Control and Prevention, 2013), our finding that racial composition (% black) is an independent risk fact for fast-food access may help inform public discourse on how to improve neighborhood food environments that may have a disproportionate impact on racial/ethnic minority populations. Efforts should focus on neighborhoods with a high concentration of racial/ethnic minorities, in particular with a high percentage of black residents, rather than high-poverty areas to address disparities in fast-food access.

Acknowledgments

The research conducted for this manuscript was supported by the Harvard NHLBI Cardiovascular Epidemiology Training Grant T32 HL 098048 and the Robert Wood Johnson Investigator Award in Health Policy Research (PI Subramanian). Dr. Reginald Tucker-Seeley is supported by an NCI K01 Career Development grant (1K01CA169041).

Web Appendix

Appendix Table 1

Numbers for each Percent Poverty and Percent Black Category included in this analysis

	<13.8% Below Poverty Level	13.8-20% Below Poverty Level	20-40% Below Poverty Level	>40% Below Poverty Level	Total
Quartile 1 % Black N (%)	55,176 (26.39)	9,566 (4.58)	10,838 (5.18)	2,214 (1.06)	77,794 (37.21)
Quartile 2 % Black N (%)	18,875 (9.03)	3,464 (1.66)	3,691 (1.77)	698 (0.33)	26,728 (12.78)
Quartile 3 % Black N (%)	33,779 (16.16)	7,039 (3.37)	9,349 (4.47)	2,129 (1.02)	52,296 (25.01)
Quartile 4 % Black N (%)	20,492 (9.8)	7,739 (3.7)	16,412 (7.85)	7,630 (3.65)	52,273 (25)
Total N (%)	128,322 (61.37)	27,808 (13.3)	40,290 (19.27)	12,671 (6.06)	209,091 (100)

Appendix Table 2

Fast-food access by poverty category adjusted for population density stratified by urban/rural CBGs

Poverty Category	Average Distance to Fast-food (miles) and 95% Confidence Interval	
	Urban CBGs	Rural CBGs
<13.8% Below Poverty Level	3.89 (3.85, 3.92)	20.96 (20.52, 21.41)
13.8-20% Below Poverty Level	4.83 (4.76, 4.91)	21.63 (20.92, 22.33)
20-40% Below Poverty Level	4.36 (4.30, 4.43)	20.64 (19.96, 21.32)
>40% Below Poverty Level	3.51 (3.41, 3.62)	23.71 (21.84, 25.57)

Appendix Table 3

Fast-food access by quartiles of percent black adjusted for population density stratified by urban/rural CBGs

Percent Black Quartile	Average Distance to Fast-food (miles) and 95% Confidence Interval	
	Urban CBGs	Rural CBGs
Quartile 1 % Black	5.56 (5.52, 5.60)	22.33 (21.92, 22.73)
Quartile 2 % Black	4.33 (4.26, 4.41)	21.22 (20.40, 22.05)
Quartile 3 % Black	2.93 (2.88, 2.99)	18.19 (17.22, 19.17)
Quartile 4 % Black	2.98 (2.93, 3.04)	16.97 (16.01, 17.93)

Appendix Table 4

Fast-food access by percent black and poverty adjusted for population density for urban CBGs

Poverty Category	<13.8% Below Poverty Level	13.8-20% Below Poverty Level	20-40% Below Poverty Level	>40% Below Poverty Level
Percent Black Quartile	Average Distance to Fast-food (miles) and 95% Confidence Interval	Average Distance to Fast-food (miles) and 95% Confidence Interval	Average Distance to Fast-food (miles) and 95% Confidence Interval	Average Distance to Fast-food (miles) and 95% Confidence Interval
Quartile 1 % Black	5.00 (4.95, 5.05)	7.01 (6.88, 7.13)	6.88 (6.76, 6.99)	7.10 (6.85, 7.35)
Quartile 2 % Black	4.01 (3.92, 4.09)	5.40 (5.20, 5.61)	5.13 (4.93, 5.32)	3.98 (3.53, 4.43)
Quartile 3 % Black	2.77 (2.71, 2.84)	3.46 (3.32, 3.60)	3.27 (3.15, 3.39)	2.32 (2.07, 2.58)
Quartile 4 % Black	2.76 (2.68, 2.85)	3.32 (3.18, 3.45)	3.22 (3.13, 3.31)	2.76 (2.63, 2.90)

Appendix Table 5

Fast-food access by percent black and poverty adjusted for population density for rural CBGs

Poverty Category	<13.8% Below Poverty Level	13.8-20% Below Poverty Level	20-40% Below Poverty Level	>40% Below Poverty Level
Percent Black Quartile	Average Distance to Fast-food (miles) and 95% Confidence Interval	Average Distance to Fast-food (miles) and 95% Confidence Interval	Average Distance to Fast-food (miles) and 95% Confidence Interval	Average Distance to Fast-food (miles) and 95% Confidence Interval
Quartile 1 % Black	21.99 (21.46, 22.51)	22.65 (21.75, 23.55)	22.41 (21.48, 23.34)	28.16 (25.35, 30.96)
Quartile 2 % Black	20.34 (19.23, 21.44)	22.15 (20.46, 23.85)	22.13 (20.25, 24.02)	27.19 (20.88, 33.50)
Quartile 3 % Black	17.28 (15.86, 18.69)	19.88 (17.85, 21.91)	18.19 (16.34, 20.03)	20.50 (13.78, 27.22)
Quartile 4 % Black	15.83 (13.85, 17.81)	17.47 (15.46, 19.49)	16.86 (15.40, 18.33)	18.83 (15.94, 21.73)

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Highlights

- Fast-food access has been linked to obesity in low income and black populations.
- Most studies cover small areas and use administrative boundaries to define access.
- Do these populations have greater access to fast-food across the United States?
- Neighborhood poverty was not independently linked to fast-food access.
- Higher proportion black neighborhoods had higher fast-food access.

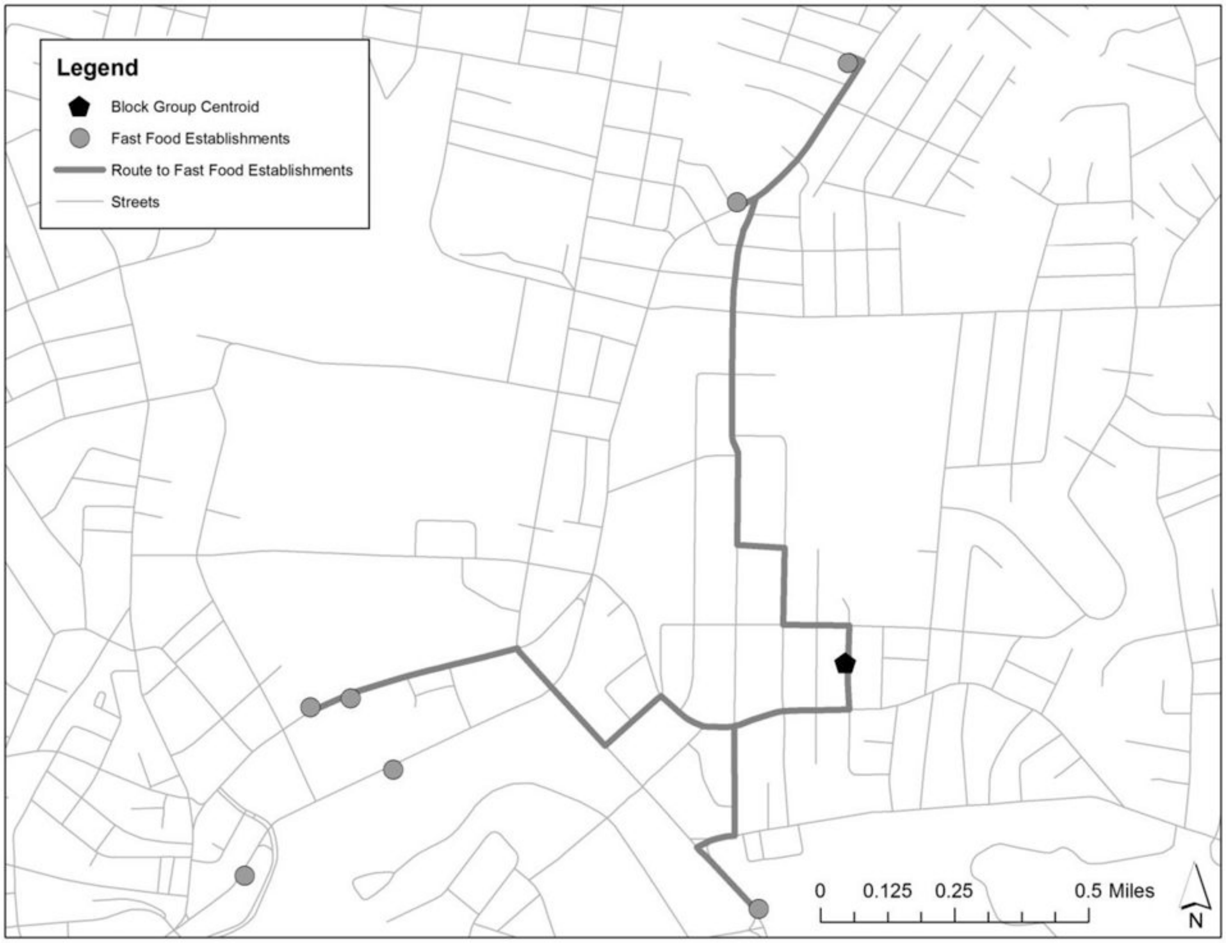

Figure 1. Example of Closest Fast-Food Establishment by Street Network Distance

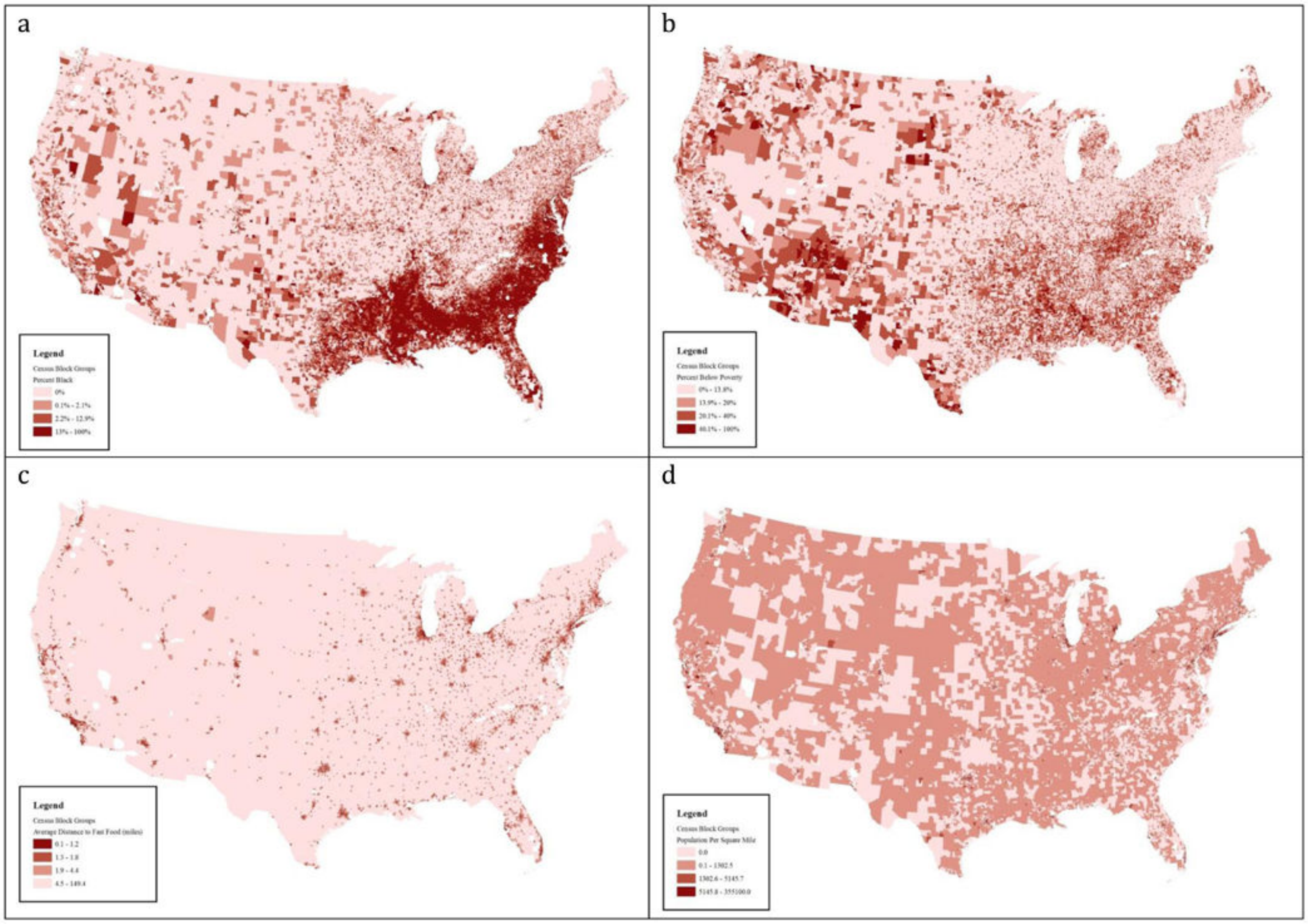

Figure 2. Percent black composition (2a), poverty composition (2b), access to fast-food (2c), and population density (2d) by CBG

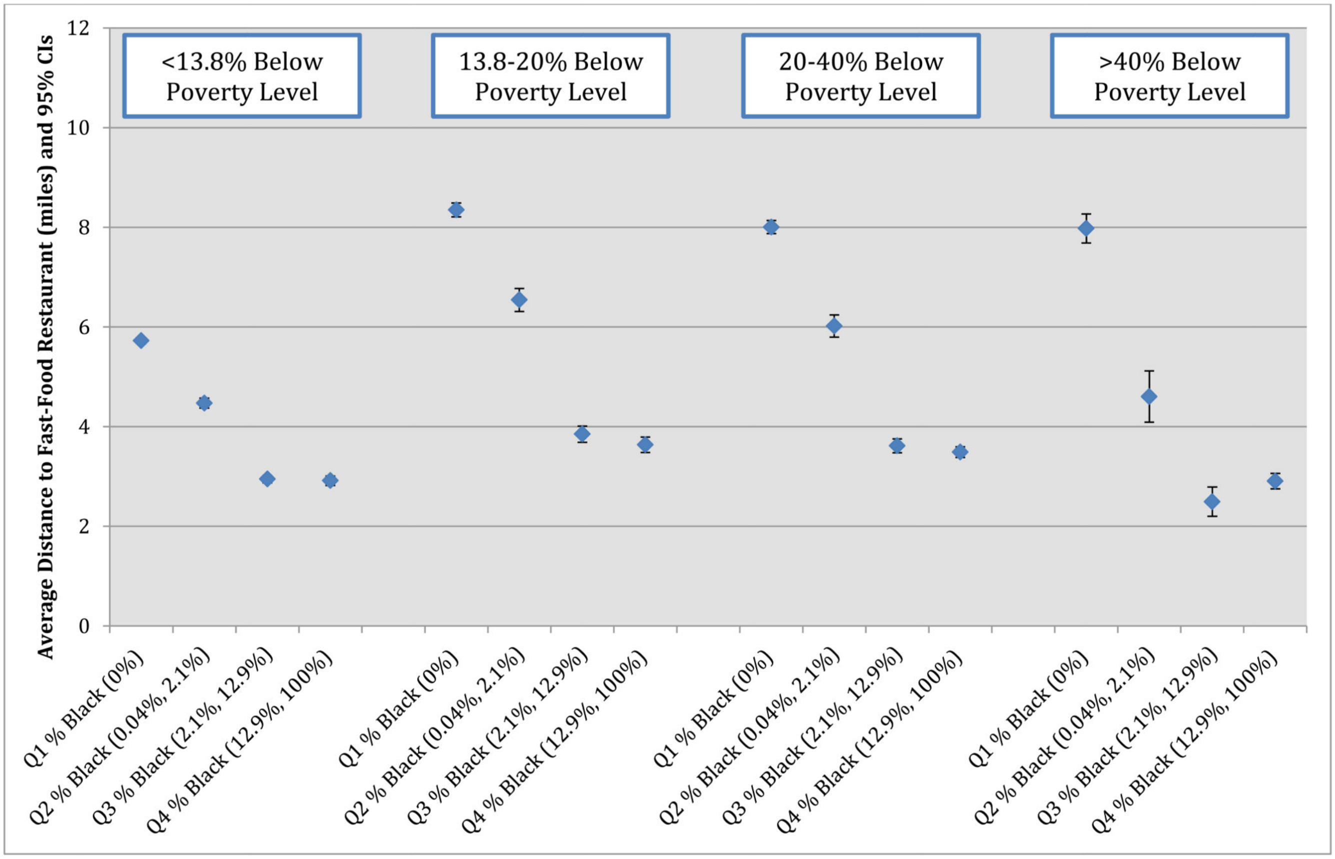

Figure 3. Predicted average distances to fast food by poverty category and percent black, adjusted for population density

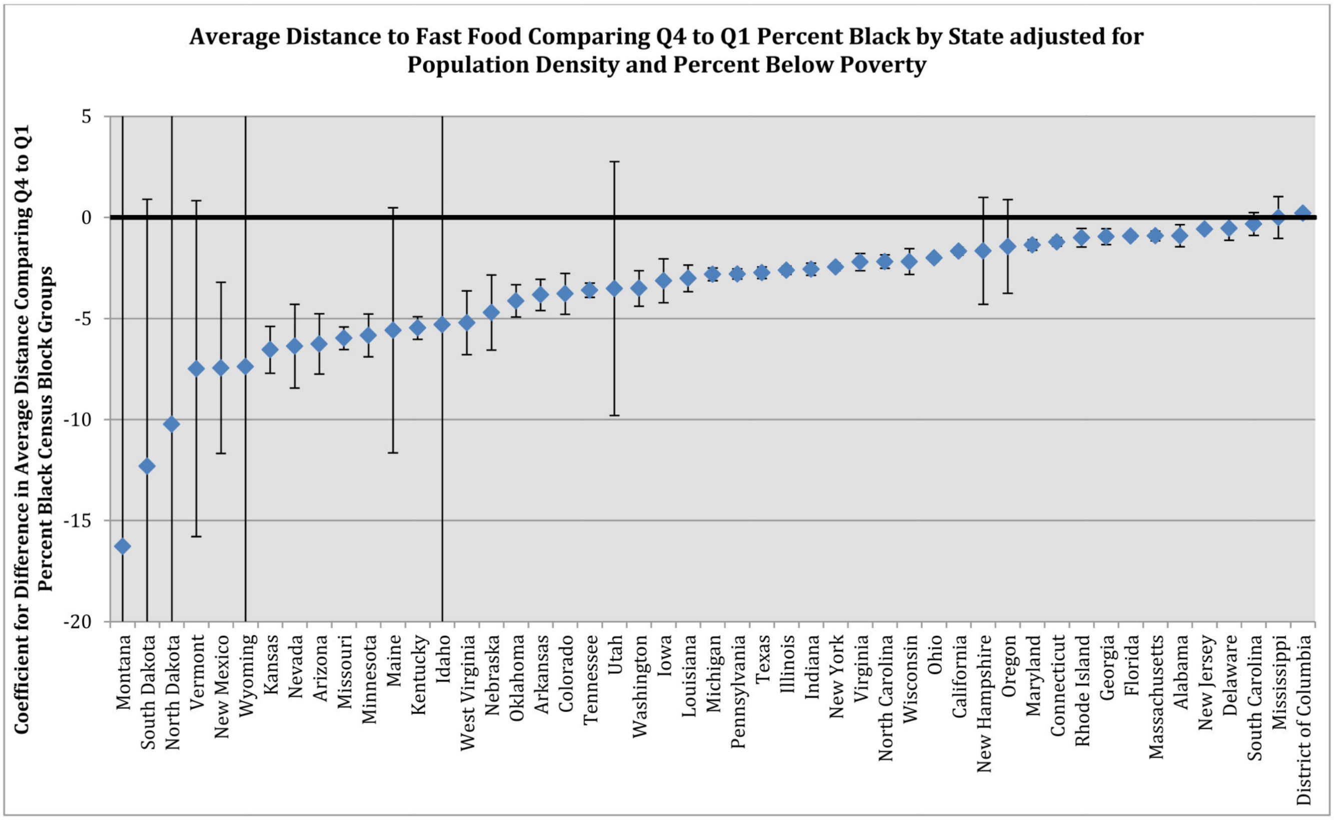

Figure 4. Access to fast-food by percent black adjusted by percent poverty and population density, stratified by state

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Table 1

Mean (standard deviation) for selected CBG characteristics by top ten fast-food restaurant distance quartile (n=209,091)

	Fast-food Distance Quartile 1 N=52,273	Fast-food Distance Quartile 2 N=52,272	Fast-food Distance Quartile 3 N=52,273	Fast-food Distance Quartile 4 N=52,273
Average Driving Distance to Five Closest Fast-Food Restaurants (miles)	0.86 (0.23)	1.50 (0.20)	2.86 (0.79)	13.25 (10.35)
Percent Below Poverty Line	0.17 (0.15)	0.15 (0.15)	0.11 (0.13)	0.13 (0.11)
Percent Black	0.16 (0.25)	0.17 (0.27)	0.13 (0.23)	0.06 (0.15)
Population Density (persons/sqmi)	13,209 (21148)	5,491 (5032)	3,332 (8788)	682 (4951)

Table 2

Model results for average distance in miles to five closest fast-food restaurants

	Model 1: Percent Black Crude	Model 2: Percent Poverty Crude	Model 3: Percent Black and Population Density	Model 4: Percent Poverty and Population Density	Model 5: Percent Black, Percent Poverty, and Population Density
Intercept	6.54 (6.49, 6.59)	4.44 (4.40, 4.48)	6.66 (6.61, 6.72)	4.67 (4.62, 4.71)	6.26 (6.20, 6.31)
Q2 (0.04%, 2.1%) v Q1 (0%) % Black	-1.55 (-1.65, -1.45)		-1.47 (-1.57, -1.38)		-1.48 (-1.57, -1.38)
Q3 (2.1%, 12.9%) v Q1 (0%) % Black	-3.39 (-3.47, -3.32)		-3.26 (-3.34, -3.18)		-3.34 (-3.41, -3.26)
Q4 (12.9%, 100%) v Q1 (0%) % Black	-3.50 (-3.58, -3.42)		-3.23 (-3.31, -3.16)		-3.56 (-3.64, -3.48)
13.8-20% v <13.8% Below Poverty Level		1.22 (1.12, 1.31)		1.32 (1.23, 1.42)	1.67 (1.58, 1.76)
20-40% v <13.8% Below Poverty Level		0.37 (0.29, 0.45)		0.63 (0.55, 0.71)	1.30 (1.22, 1.38)
>40% v <13.8% Below Poverty Level		-0.88 (-1.01, -0.75)		-0.51 (-0.64, -0.38)	0.58 (0.45, 0.71)