The Food Environment of Immigrant Enclaves in Los Angeles County

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Abstract

Immigrant enclaves may influence health by providing access to healthier traditional foods, or unhealthy processed and fast foods, resembling the food environment of deprived neighborhoods. We used a commercial establishment dataset and the American Community Survey to characterize the food environment of immigrant enclaves in Los Angeles County. We defined immigrant enclaves as census tracts in which 10% or more of the residents emigrated from China, Guatemala, El Salvador, Iran, Korea or the Philippines; or 35% or more of the residents emigrated from Mexico. Using zero-inflated negative binomial regression and controlling for neighborhood SES, immigrant enclaves were associated with 28% more healthy food establishments and 7% fewer unhealthy food establishments than non-immigrant enclaves. These associations varied by immigrant country of origin. Immigrant enclaves' healthier food environment may help immigrants maintain traditional diets and prevent the erosion of health that can occur with increased time spent in the U.S.

Introduction

The neighborhood food environment, the types and quantities of food stores and restaurants in a neighborhood, can influence residents' dietary choices and health (Black and Macinko 2008; Dubowitz et al. 2012; Morland et al. 2006; Wang et al. 2007). While studies have examined neighborhood food environments by socioeconomic status and minority composition (Morland et al. 2002; Powell et al. 2007), few scholars have analyzed them by immigrant composition. Immigrant enclaves, neighborhoods with high concentrations of immigrants, may cater to their residents (Lee 1995) by providing affordable, healthy and traditional foods. However, since many immigrant enclaves tend to be poor and disadvantaged, residents may not have access to affordable and healthy foods, grocery stores and supermarkets. In this paper, we document the food environment of immigrant enclaves in Los Angeles County from 2003 to 2009, and test the hypothesis that immigrant enclaves offer healthier food environments than neighborhoods that have few immigrants.

The immigrant population, mostly from Latin America and Asia, has increased substantially in the United States over the past four decades due to the 1965 change in immigration legislation and significant unauthorized immigration since the 1970s (Passel 2011). Forty million immigrants currently live in the U.S, over one quarter of which live in California (Grieco et al. 2012). Within California, one third of the immigrant population lives in Los Angeles County (U.S. Census Bureau 2010).

Recent immigrants are more likely to live in neighborhoods with high concentrations of people from the same country or people of the same ethnicity because they can provide social ties, a similar culture, affordable housing and employment opportunities (Logan et al. 2002; Logan and Lewis Mumford Center 2003). The neighborhoods can be in central cities or suburbs (Logan et al. 2002). Logan et al. (2002) differentiate between two kinds of ethnic neighborhoods: "immigrant

enclaves" and "ethnic communities." Immigrant enclaves are disadvantaged neighborhoods with a disproportionately large number of people of the same ethnicity. They provide cheap housing for immigrants who do not have the resources to live in less disadvantaged neighborhoods. While in general these enclaves are considered temporary until immigrants' financial situation improves, some enclaves are similar to ghettos in that residents are very unlikely to ever have the resources to move out (Logan et al. 2002).

Ethnic communities are still composed of a large number of people of the same ethnicity but are in more affluent neighborhoods. The people who live in these neighborhoods choose to do so and are not constrained by resources (Logan et al. 2002; Logan and Lewis Mumford Center 2003). These ethnic communities can therefore be in very desirable places. As immigrants become more assimilated, including improved socioeconomic status and English-language ability, they are less likely to live in ethnic neighborhoods (Logan et al. 2002; Iceland and Scopilliti 2008).

In general, immigrants come to this country with a relative health advantage compared to natives, however, their health advantage tends to deteriorate as their financial situation improves and they spend more time in the US (Lara et al. 2005). Length of time in the US is associated with poorer diets and higher rates of obesity among immigrants (Lara et al. 2005; Park et al. 2008; Singh and Siahpush 2002). While acculturation—the acquisition of the "cultural elements of the dominant society" (Lara et al. 2005)—has been predominantly used to explain these changes, scholars are now beginning to look at the impact immigrants' neighborhoods can have on their health outcomes (Viruell-Fuentes et al. 2012). Both Kimbro and Denney (2012) and Nobari et al. (2013) find that neighborhood immigrant concentration was associated with obesity among young children.

One mechanism may be through the food environment of these neighborhoods. Osypuk et al. (2009) finds that neighborhoods with higher concentrations of immigrants are, according to

residents, more likely to offer a large selection of low-fat foods and fresh fruits and vegetables. While little research exists on the food environment of immigrant enclaves, one hypothesis is that businesses in enclaves may cater to their residents' demands by providing traditional and/or healthier foods (Lee 1995; Osypuk et al. 2009).

Yet enclaves tend to be poor, disadvantaged neighborhoods and poor neighborhoods are less likely than wealthier or non-Hispanic white communities to have chain supermarkets and grocery stores that provide healthy foods at affordable prices (Lovasi et al., 2009; Morland et al. 2002). It can also be difficult in these neighborhoods to purchase foods that immigrants consider to be healthy: ones that are fresh and local (Park et al. 2011). Individuals living in these communities may lack the transportation to visit super markets and grocery stores in other neighborhoods and may therefore be more reliant on fast food restaurants and local convenience stores that generally sell foods at higher cost and mainly carry processed and highly caloric foods (Azuma et al. 2010; Flournoy 2010). In three poor Latino communities in Los Angeles (one in which 61% of residents were foreign-born), Azuma et al. (2010) find that it is especially difficult to access healthy foods given the abundance of fast-food restaurants and liquor and convenience stores and the lack of nearby supermarkets.

Given these two competing hypotheses, we ask the following two questions, "Independent of neighborhood socioeconomic status (SES), do immigrant enclaves have a healthier food environment than non-immigrant enclaves?" and "Does the impact of immigrant enclaves vary by immigrant country of origin?" We tested the hypotheses that, after controlling for neighborhood SES, immigrant enclaves would have more healthy food establishments and fewer unhealthy establishments than non-immigrant enclaves. Additionally, we tested whether there are differences by immigrant country of origin.

Methods

Data Sets and Variables

Neighborhood was defined by census tract and 2006-2010 American Community Survey (ACS) data were used for the neighborhood level socio-demographic data. Percent of residents in poverty (<100% federal poverty level), median household income, percent of minority residents, and percent of non-Hispanic black residents were used as measures of neighborhood socioeconomic status. These variables were continuous.

Since defining an immigrant enclave is somewhat arbitrary (Blumenberg and Smart 2012), a binary variable was created based on an adaptation of Logan et al.'s (2002) definition of immigrant enclave. We used this definition because it takes into consideration the much larger concentration of Mexican immigrants (1.4 million) in Los Angeles compared to the immigrants from other countries. We classified census tracts as immigrant enclaves if 35% or more of their total residents were born in Mexico or 10% or more of the total residents were born in one of the following countries: China, Guatemala, El Salvador, Iran, Korea, or the Philippines. We chose these countries because more than 100,000 residents in LA County were born in each of these countries. We also created seven dummy variables for the immigrant enclave country of origin. The reference category was a non-immigrant enclave tract.

The neighborhood food store data were from the National Establishment Time-Series (NETS) database and obtained from Walls & Associates (Walls & Associates 2011). Walls & Associates used Dun and Bradstreet (D&B) archival establishment data to create a time-series dataset that included the type of food stores (based on Standard Industrial Classification (SIC) codes) and the years in which the food stores were active. For each of these types of food stores, we obtained counts and densities (number of food stores per square mile) for each census tract in Los Angeles County per year for 2003-2009. We considered fast food restaurants including pizza

restaurants, liquor stores, chain convenience stores, and candy, doughnut and ice cream shops to be "unhealthy" food stores, and supermarkets and fruit and vegetable markets to be "healthy" food stores. Grocery stores were excluded from the analyses since in Los Angeles they could be healthy or unhealthy. A study by Kipke et al. (2007) found that of the 62 grocery stores in East Los Angeles, a predominately Hispanic neighborhood, only 18% sold good quality produce. Additionally, while independent grocery stores are generally considered to be unhealthy, I excluded them from the analyses since in Los Angeles they may cater to their residents by offering healthy food choices (Dr. Michael Prelip personal communication, July, 2012).

Statistical analysis

All analyses were conducted using Stata version 11.2. We used descriptive statistics to summarize the characteristics of the census tracts and describe the food store environment of immigrant enclaves in Los Angeles County from 2003 to 2009. Using ArcGIS we also mapped the location of immigrant enclaves and the density of healthy and unhealthy food stores in Los Angeles County.

To determine the association between immigrant enclaves and the two dependent variables—the number of healthy food stores and the number of unhealthy food stores, we used multivariate analyses. Since the data on food stores is over-dispersed count data, we used zero-inflated negative binomial regression. Zero-inflated negative binomial regression is used when there are excess zeroes which may be generated by a process different from the one that predicts the count (number of stores).The choice to use this type of regression versus Poisson and the standard negative binomial regression was confirmed by a significant likelihood-ratio test of alpha=0 and a significant vuong test. Given that the misclassification of stores is more likely to occur in neighborhoods of low SES and a greater percentage of minorities, we included percent of poor residents and percent of minorities in the logit model predicting the presence of a food store.

The count model predicting the number of food stores was adjusted for the year the stores were in business and accounted for neighborhood SES by adjusting for neighborhood median household income and percent of non-Hispanic black residents. The size of the census tracts (in square miles) was included in the models as an exposure variable to adjust for the fact that larger tracts may have more stores than smaller tracts. To determine whether the association between immigrant enclave and healthy/unhealthy food stores varied by country of origin, we used seven dummy variables for country-specific enclaves. A chi-square test and the BIC post estimation statistic determined which zero-inflation negative binomial model was a better fit. Analyses were restricted to Los Angeles County census tracts without missing data and with populations of at least 885 residents (which is above the 1st percentile in total county population). Of the 2,346 census tracts in Los Angeles County, we had complete data on 2,293 census tracts (98%).

Results

Approximately 31% of tracts in Los Angeles County are immigrant enclaves and 69% are non-immigrant enclaves (see Table 1 and Figure 1). On average, immigrant enclaves are of significantly lower SES. Median household income of immigrant enclaves is $51,287 compared to $64,161 within non-enclaves (Table 2). Immigrant enclaves also have significantly higher concentrations of people living in poverty and more minorities; however, they have significantly smaller percentages of black residents (Table 2). Enclaves are also significantly smaller in size. The average area for an immigrant enclave is 0.47 square miles compared to 1.76 square miles for non-enclaves (Table 2).

Table 1. Immigrant enclaves in Los Angeles County by immigrant country of origin*, American Community Survey 2006-2010 (N=2,293)

	Tracts N (%)
Mexican enclave	211 (9.2%)
Chinese enclave	141 (6.2%)
El Salvadoran enclave	128 (5.6%)
Philippines enclave	101 (4.4%)
Korean enclave	100 (4.4%)
Iranian enclave	65 (2.8%)
Guatemalan enclave	46 (2.0%)
Non-immigrant enclaves	1,580 (68.9%)

*Categories are not mutually exclusive.

Figure 1. Immigrant enclaves in Los Angeles County, American Community Survey 2006-2010 (N=2,293)
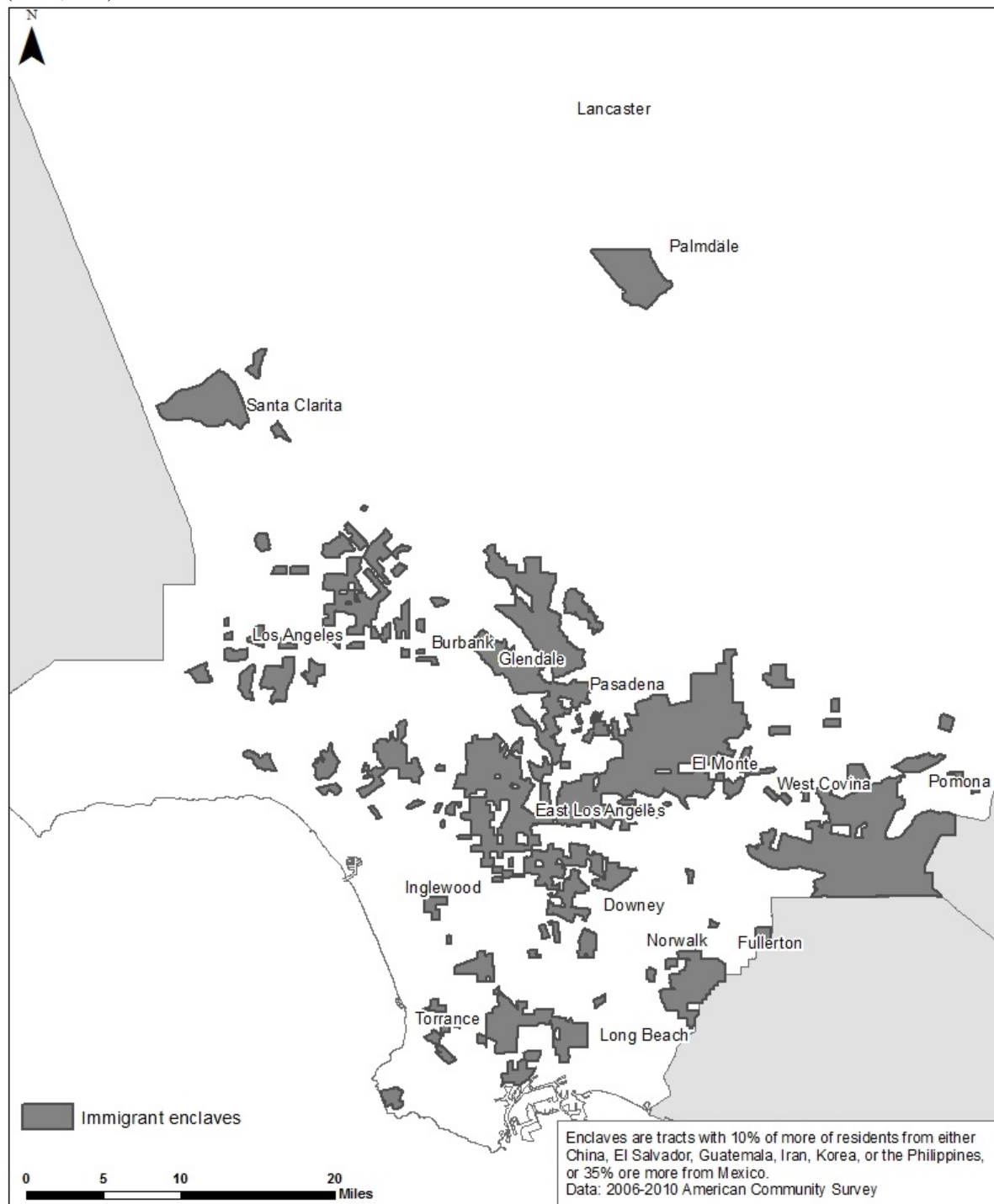
Table 2. Socio-demographic characteristics by enclave status, American Community Survey 2006-2010 (N=2,293)

Variable	Immigrant enclave (N=713) mean (SD)	Non-immigrant enclave (N=1,580) mean (SD)
Median household income	$51,287 ($26,221)	$64,161 ($30,130)*
Percent poverty	19.5% (12.2%)	14.4% (11.3%)*
Percent minority	57.9% (20.1%)	44.7% (20.4%)*
Percent non-Hispanic black	4.8% (8.1%)	10.3% (15.7%)*
Area (sq. mile)	0.46 (0.84)	1.76 (11.37)*

* p-value of t-test < .0001

The food store environment for Los Angeles County from 2003 to 2009 is shown in Figure 2. There are many more liquor stores, fast food restaurants and candy, ice cream and doughnut shops in the census tracts than other types of food stores. While the numbers of liquor stores and fruit and vegetable markets have remained relatively constant since 2003, the number of fast food restaurants and candy, doughnut and ice cream shops increased before starting to decline in 2007. Additionally, since 2007, the number of supermarkets has increased. In 2009, there were 3,071 fast food restaurants, 2,080 liquor stores, 1,397 candy, doughnut and ice cream shops, 741 supermarkets, 431 fruit and vegetable markets, and 467 chain convenience stores in Los Angeles County.

Figure 2. Food store environment of Los Angeles County, National Establishment Time-Series (NETS), 2003-2009 (N=2,293)
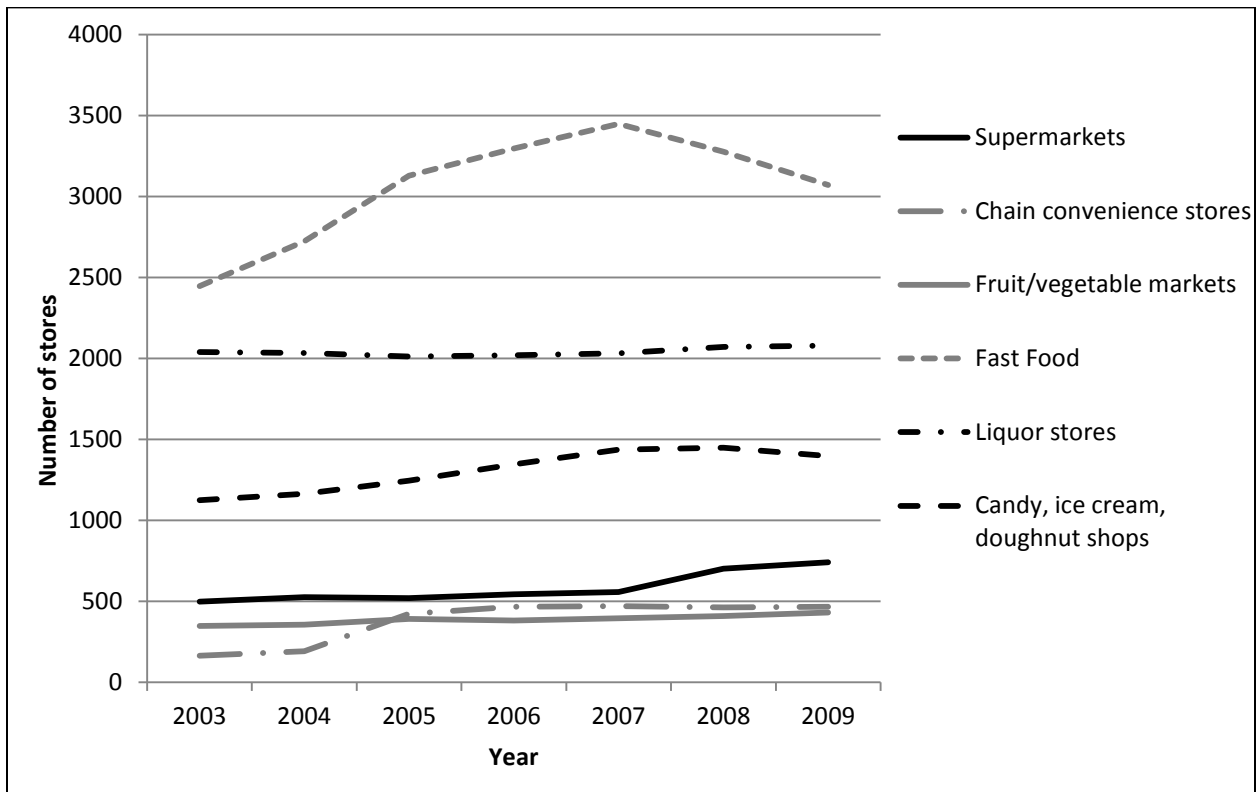
Overall, immigrant enclaves had significantly higher mean densities of healthy food stores (1.74 stores/sq. mile vs. 1.03 stores/sq. mile, p-value < .0001) and unhealthy food stores (9.68 stores/sq. mile vs. 7.70 stores/ sq. mile, p-value < .0001) than non-immigrant enclaves. From 2003 to 2009, immigrant enclaves had higher densities of healthy and unhealthy food stores compared to non-immigrant enclaves (Figure 3). Since 2003, the density of unhealthy food stores increased for both enclaves and non-enclaves until a decline in 2007-2008 which could be due to the recession. Since 2003, the density of healthy food stores remained relatively constant until 2007, when it started to increase for both immigrant enclaves and non-immigrant enclaves. In 2009, immigrant enclaves had a significantly higher density of healthy food stores (2.23 vs. 1.26 stores/sq. mile, p-value < .0001) and unhealthy food stores (10.08 vs. 7.98 stores per sq. mile, p-value < .0001) than

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non-immigrant enclaves. Figures 4 and 5 show the densities of healthy and unhealthy food stores in immigrant and non-immigrant enclaves in the central area of Los Angeles County in 2009. This area was chosen to highlight the patterns of food store density by enclave status. Because of their different distributions, we used different categories for the densities of healthy and unhealthy food stores. Maps of the food store densities for all of Los Angeles County are included in Appendix A.

Figure 3. Average density of healthy and unhealthy food establishments in immigrant enclaves and non-immigrant enclaves
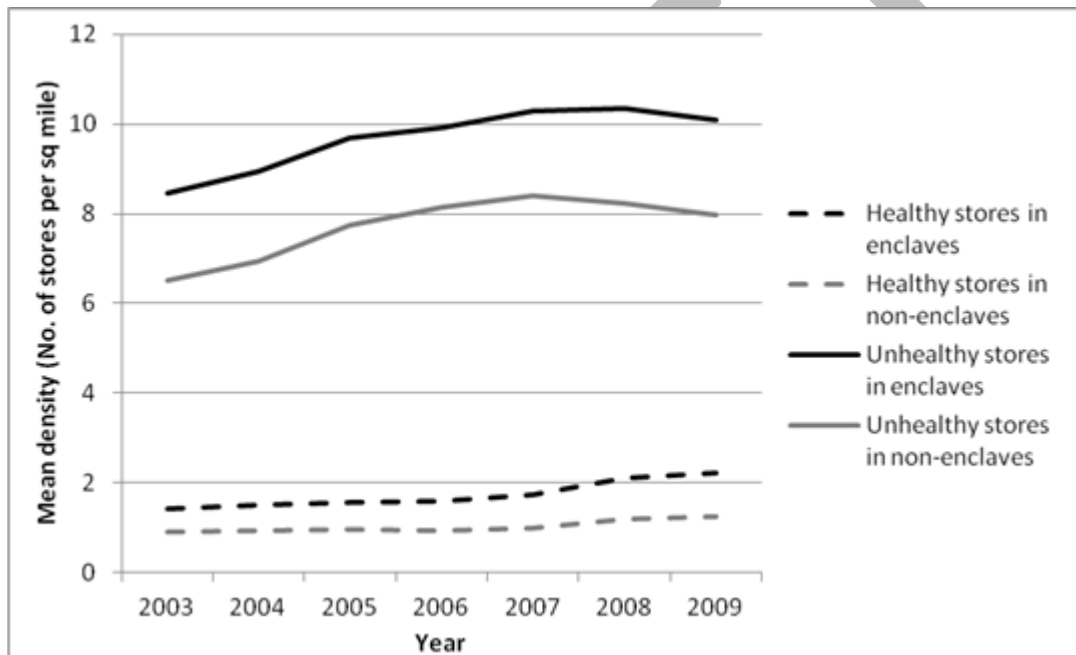
Figure 4. Density of healthy food stores in immigrant and non-immigrant enclaves in central Los Angeles County
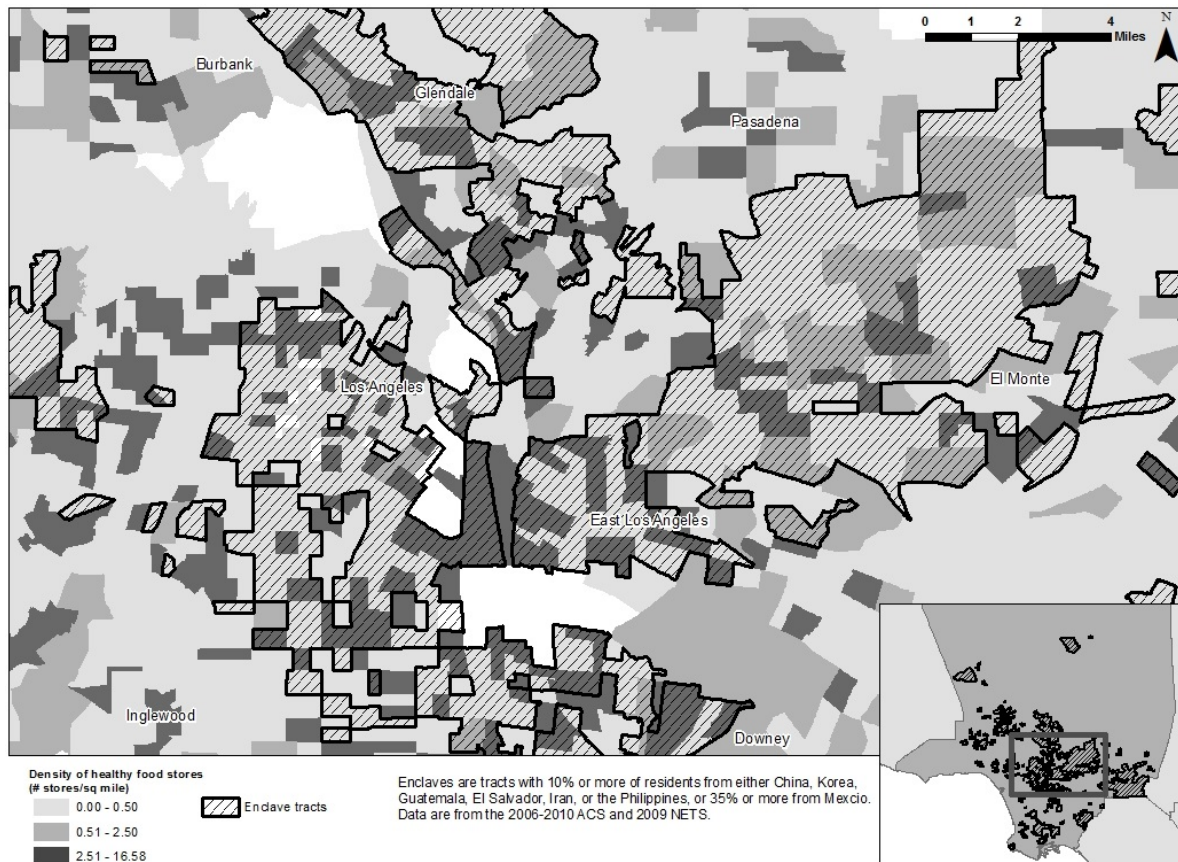
Figure 5. Density of unhealthy food stores in immigrant and non-immigrant enclaves in central Los Angeles County

Table 3 presents the results from the zero-inflated negative binomial regression models predicting number of healthy food stores. Adjusting for year of operation, the difference in the log of the number of healthy food stores for an immigrant enclave versus a non-immigrant enclave is 0.495 (Model 1). Specifically, after adjusting for year of operation, immigrant enclaves are associated with 64% more healthy food stores than non-immigrant enclaves. After adding median household income and percent non-Hispanic black residents to the model, the association between immigrant enclave and number of healthy stores decreases but remains significant (Model 3); immigrant enclaves are associated with 28% more healthy stores than non-immigrant enclaves. Furthermore, a $10,000 increase in neighborhood median household income is associated with a

20.5% decrease in the expected number of healthy food stores. A 10% increase in the number of

non-Hispanic Black residents is associated with a 10.4% decrease in the expected number of

healthy food stores (Model 3). Model 3 is the best-fit model for predicting the number of healthy

food stores in neighborhoods, given the highest likelihood ratio and lowest BIC.

From the logit model in Model 3, the percentage of residents in poverty is not associated

with the likelihood of a healthy food store. However, a one percent increase in minority residents

is associated with a decrease of 0.015 in the log odds of a healthy food store in the neighborhood

(i.e., a 1.5% decrease in the presence of a healthy food store).

Table 3. Effect parameters for a zero-inflated negative binomial regression model of the
determinants of number of healthy food stores in census tracts in Los Angeles County, with area of
tracts (in sq. miles) as the exposure variable (N=2,293)

	Model 1		Model 2		Model 3	
	b	e^b	b	e^b	b	e^b
Year	.063 (.008)***	1.06	.058 (.008)***	1.06	.059 (.008)***	1.06
Immigrant enclave	.495 (.036)***	1.64	.330 (.034)***	1.39	.249 (.035)***	1.28
Median income ($1,000 unit)			-.022 (.001)***	.98	-.023 (.001)***	.98
% NH black only					-.011 (.001)***	.99
Intercept	-125.642		-115.810		-116.158	
	(16.962)***		(15.989)***		(15.973)***	
Inflation variables (logit model)						
% minority	-.015 (.003)***		-.007 (.004)		-.015 (.004)***	
% poor	-.133 (.014)***		-.008 (0.007)		-.006 (0.008)	
Intercept	.497 (.122)***		- 1.313 (0.166)***		- 1.086 (.161)***	
LRChi^2	241.3***		1108.4***		1181.3***	
BIC	29,735		28,878		28,815	

Note: Standard errors are in parentheses. Healthy stores are supermarkets and fruit/vegetable markets.
*p < 0.05; ** p < .01; ***p<.001.

Table 4 shows that the association between immigrant enclave and *healthy* food stores varies by immigrant country of origin. After adjusting for median household income and percentage of non-Hispanic black residents, Chinese, Salvadoran and Filipino enclaves are not associated with a greater number of healthy food stores than non-immigrant enclaves. However, compared to non-immigrant enclaves, Guatemalan, Iranian, Korean, and Mexican enclaves are, respectively, associated with 62%, 63%, 73% and 21% more healthy food stores.

Table 4. Effect parameters for a zero-inflated negative binomial regression model of the determinants of number of healthy food stores in census tracts in Los Angeles County, with area of tracts as the exposure variable (N=2,293)

	Model 1		Model 2		Model 3	
	b	e^b	b	e^b	b	e^b
Year	.062 (.008)***	1.06	.058 (.008)***	1.06	.059 (.008)***	1.06
Enclave country of origin (reference: non-immigrant enclave)						
Chinese	.088 (.068)	1.09	.187 (.062)**	1.21	.074 (.063)	1.08
Salvadoran	.421 (.077)***	1.52	.076 (.076)	1.08	.071 (.076)	1.07
Guatemalan	.769 (.121)***	2.16	.495 (.118)***	1.64	.480 (.117)***	1.62
Iranian	.493 (.102)***	1.64	.550 (.091)***	1.73	.492 (.092)***	1.63
Korean	.755 (.078)***	2.13	.605 (.071)***	1.83	.551 (.071)***	1.73
Mexican	.622 (.054)***	1.86	.299 (.054)***	1.35	.187 (.056)**	1.21
Filipino	.016 (.081)	1.02	.124 (.078)	1.13	.066 (.078)	1.07
Median income ($1,000 unit)			-.021 (.001)***	0.98	-.022 (.001)***	0.98
% NH black only					-.011 (.001)***	0.99
Intercept	-125.175 (16.803)***		-115.758 (15.943)***		-116.005 (15.925)***	
Inflation variables (logit model)						
% minority	-.021 (.004)***		-.009 (.004)*		-.017 (.004)***	
% poor	-.133 (.015)***		-.010 (.008)		-.008 (.008)	
Intercept	.622 (.134)***		-1.208 (.166)***		-.989 (.160)***	
LRChi^2	378.1***		1171.1***		1247.1***	
BIC	29,657		28,873		28,807	

Note: Standard errors are in parentheses. Healthy stores are supermarkets and fruit/vegetable markets.
*p < 0.05; ** p < .01; ***p<.001;

Table 5 includes the results from the zero-inflated negative binomial regression models predicting number of *unhealthy* food stores. Adjusting for year of food store operation, there is a statistically significant difference of 0.194 in the log of the number of unhealthy food stores for an immigrant enclave versus a non-immigrant enclave (Model 1). In other words, adjusting for year of food store operation, immigrant enclaves are associated with 21% more unhealthy stores than non-immigrant enclaves. After adding median household income and percent non-Hispanic black residents to the model, the association between immigrant enclaves and number of unhealthy stores becomes negative and significant (Model 3). Controlling for median household income and percentage of non-Hispanic black residents, immigrant enclaves are associated with 7% fewer unhealthy food stores than non-immigrant enclaves. Furthermore, a $10,000 increase in neighborhood median household income is associated with a 16.5% decrease in the expected number of unhealthy food stores. A 10% increase in the number of non-Hispanic Black residents is associated with an 8.6% decrease in the expected number of unhealthy food stores (Model 3). Since model 3 has the highest likelihood ratio chi-square and lowest BIC, it is a better fit for predicting the number of unhealthy food stores.

From the logit model in model 3, the percentage of minority residents is significantly and negatively associated with the presence of an unhealthy food store. A one percent increase in minority residents is associated with a .026 decrease in the log odds of an unhealthy food store in the neighborhood (i.e., a 2.6% decrease in the likelihood of there being an unhealthy food store). A one percent increase in poverty is associated with a decrease of 0.102 in the log odds of an unhealthy food store in the neighborhood (i.e., a 9.7% decrease in the likelihood of there being an unhealthy food store).

Table 5. Effect parameters for a zero-inflated negative binomial regression model of the determinants of number of unhealthy food stores in census tracts in Los Angeles County, with area of tracts as the exposure variable (N=2,293)

	Model 1		Model 2		Model 3	
	B	e^b	b	e^b	b	e^b
Year	.038 (.005)***	1.04	.036 (.004)***	1.04	.036 (.004)***	1.04
Immigrant enclave	.194 (.021)***	1.21	-.009 (.020)	0.99	-.069 (.020)**	0.93
Median income ($1,000 unit)			-.017 (.0003)***	0.98	-.018 (.0003)***	0.98
% Black only					-.009 (.001)***	0.99
Intercept	-73.839 (9.649)***		-69.916 (8.932)***		-69.807 (8.894)***	
Inflation variables (logit model)						
% minority	-.013 (.004)**		-.023 (.006)***		-.026 (.006)***	
% poor	-.265 (.033)***		-.115 (.028)***		-.102 (.026)***	
Intercept	-.831 (.153)***		-1.848 (.203)***		-1.825 (.196)***	
LRChi^2	149.3***		2,334.5***		2,503.8***	
BIC	76,383		74,208		74,048	

Note: Standard errors are in parentheses. Unhealthy food stores are fast food restaurants, candy stores, doughnut shops, ice cream parlors, chain convenience stores, and liquor stores.
*p < 0.05; ** p < .01; ***p<.001;

The results in Table 6 show that the association between immigrant enclave and unhealthy food stores varies by immigrant country of origin. Except for Filipino enclaves, all immigrant enclaves are significantly associated with unhealthy food stores. While all are positively associated with number of unhealthy food stores, Chinese enclaves are associated with 32% fewer unhealthy stores compared to non-immigrant enclaves (Model 1). After adjusting for median household income and percentage of non-Hispanic black residents, the relationships for El Salvadoran and Mexican enclaves change direction to then be associated with 11% and 22% fewer unhealthy food stores, respectively (Model 3). In adjusted models, Guatemalan, Iranian and Korean enclaves remain positively and significantly associated with number of unhealthy food stores (23%, 38%, and 42% more unhealthy food stores, respectively).

Table 6. Effect parameters for a zero-inflated negative binomial regression model of the determinants of number of unhealthy food stores in census tracts in Los Angeles County, with area of tracts as the exposure variable (N=2,293)

	Model 1		Model 2		Model 3	
	b	e^b	b	e^b	b	e^b
Year	.038 (.005)***	1.04	.036 (.004)***	1.04	.036 (.004)***	1.04
Country of origin (reference = non-immigrant enclave)						
Chinese	-.385 (.040)***	0.68	-.315 (.036)***	0.73	-.386 (.037)***	0.68
El Salvadoran	.212 (.044)***	1.24	-.119 (.042)**	0.89	-.119 (.042)**	0.89
Guatemalan	.575 (.074)***	1.78	.247 (.070)***	1.28	.207 (.069)**	1.23
Iranian	.393 (.055)***	1.48	.387 (.051)***	1.47	.323 (.051)***	1.38
Korean	.558 (.047)***	1.75	.388 (.044)***	1.47	.349 (.044)***	1.42
Mexican	.186 (.033)***	1.2	-.157 (.032)***	0.85	-.255 (.033)***	0.78
Filipino	.029 (.045)	1.03	.056 (.042)	1.06	.018 (.042)	1.02
Median income ($1,000 unit)			-.017 (.0003)***	0.98	-.018 (.0003)***	0.98
% Black only					-.009 (.001)***	0.99
Intercept	-73.772 (9.523)***		-69.990 (8.864)***		-69.802 (8.822)***	
Inflation variables (logit model)						
% minority	-.020 (.004)***		-.025 (.006)***		-.027 (.006)***	
% poor	-.230 (.028)***		-.110 (.026)***		-.099 (.024)***	
Intercept	-.774 (.148)***		-1.776 (.196)***		-1.748 (.189)***	
LRChi^2	521.0***		2611.0***		2800.2***	
BIC	76,070		73,989		73,810	

Note: Standard errors are in parentheses. Healthy stores are supermarkets and fruit/vegetable markets. All models were adjusted for year.
*p < 0.05; ** p < .01; ***p<.001;

Discussion

As we predicted, living in an immigrant enclave is associated with a greater number of healthy food stores, even after adjusting for neighborhood SES. Living in an immigrant enclave is also associated with a greater number of unhealthy food stores. However, this relationship becomes negative after controlling for neighborhood SES. Additionally, we find that the association of immigrant enclaves with both healthy and unhealthy food stores varies by immigrant country of origin. Living in an immigrant enclave may provide a healthier food store environment for its residents making it easier for immigrants to maintain healthier diets compared to residents of other neighborhoods.

The change in the association between immigrant enclave and unhealthy food stores after controlling for neighborhood SES could indicate that the presence of a large concentration of immigrants may protect against the detrimental impact of the neighborhood disadvantage generally attributed with immigrant enclaves. Another reason for more unhealthy food stores in immigrant enclaves could be due to immigrant enclaves being more densely populated areas and stores, in general, are more likely to locate in neighborhoods with a large client base.

The higher number of unhealthy food stores in immigrant enclaves could also be due to the stores being misclassified. Commercial datasets can have documentation errors or incomplete information (Kelly et al. 2011). Furthermore, stores self-identify their type of food store, e.g., supermarket, grocery store, chain convenience store, and businesses in immigrant enclaves may be more likely to misclassify the store. In addition, while the store may be classified as unhealthy, in Los Angeles, "unhealthy" stores may cater to their customers and offer healthy and/or culturally-specific foods (Powell et al. 2007; Shaffer 2002, Dr. Michael Prelip personal communication July 2012).

The local food store environment of immigrant enclaves is likely to have a greater impact on poorer residents than higher-income residents. Low-income residents are more dependent on the stores in their neighborhoods as they are less likely than higher-income residents to have access to cars to travel to stores. In Los Angeles, 21% of poor adults and 20% of poor immigrant adults do not have a car (Ruggles et al. 2010). Project CAFÉ of South Los Angeles, a collaboration between Occidental College and three community groups, interviewed residents of South Los Angeles, a low-income, minority neighborhood, and found that participants do not have their own means of transportation and must therefore walk, take public transportation or use the grocery-store shuttle where a minimum purchase is required (Vallianatos et al., 2012). For people who do have cars, Vallianatos et al. (2012) find that concern over the price of gas and violent crime in the evenings, made residents likely to buy food every day from local convenience stores where healthy food is lacking and highly caloric and processed foods are available.

This study has a few limitations. We used census tracts to define the boundaries of neighborhoods, however, census tracts may not reflect residents' perception of their neighborhoods nor their actual access to food stores. Furthermore, although consistent with the broader literature, the thresholds used to determine whether a census tract is an immigrant enclave is somewhat arbitrary. However, we find the same statistically significant associations when we used percentage of residents born in one of the seven countries instead of the binary immigrant enclave variable.

In addition, the healthy and unhealthy food store variables do not reveal the actual food that is available in the store, including their price and quality (Farley et al. 2009; McKinnon et al. 2009). A store considered "healthy" can provide calorically-dense, processed options and a "healthy" store may sell expired and rotten food, especially in lower-income and minority

neighborhoods (Farley et al. 2009; Sloane, 2012). We tried to minimize the potential for misclassification by excluding grocery stores and independent grocery stores from the analysis.

Another limitation of this study is that we do not know anything about residents' food shopping behavior such as whether they shop in the census tracts in which they live, work or perhaps where their children go to school (Lytle 2009). People generally live and work in more than one area and both of these environments may be important for their access to food stores (Lytle 2009). One definition of neighborhood, therefore, does not present a complete picture of where people shop and makes assumptions such as how far people are likely to travel or the number of stores and the kinds of stores at which they shop (Lytle 2009).

Since the study is cross-sectional we cannot determine causation, i.e., whether residents choose to live in neighborhoods that had these food store environments or whether the food stores locate where residents with certain characteristics and purchasing power choose to live (Lytle 2009). The food store environment may be one reason why immigrants move to immigrant enclaves.

Given the sprawling nature of Los Angeles, future studies should look at the food store environment of immigrant enclaves in denser cities such as New York City, Chicago and San Francisco to determine if our findings are unique to Los Angeles. Furthermore, studies could take population density into consideration. While we considered the area of the tract as an exposure variable, where stores choose to locate may have more to do with their potential client base. Highly populated neighborhoods may be more likely to retain stores and/or attract new stores.

This study provided a description of the food environment of immigrant enclaves in Los Angeles County and found that living in an immigrant enclave may be protective of residents' health by increasing access to healthy and reducing access to unhealthy foods. While further

studies are needed, the findings from this study may help shed light on the pathways by which immigrant enclaves can influence health.

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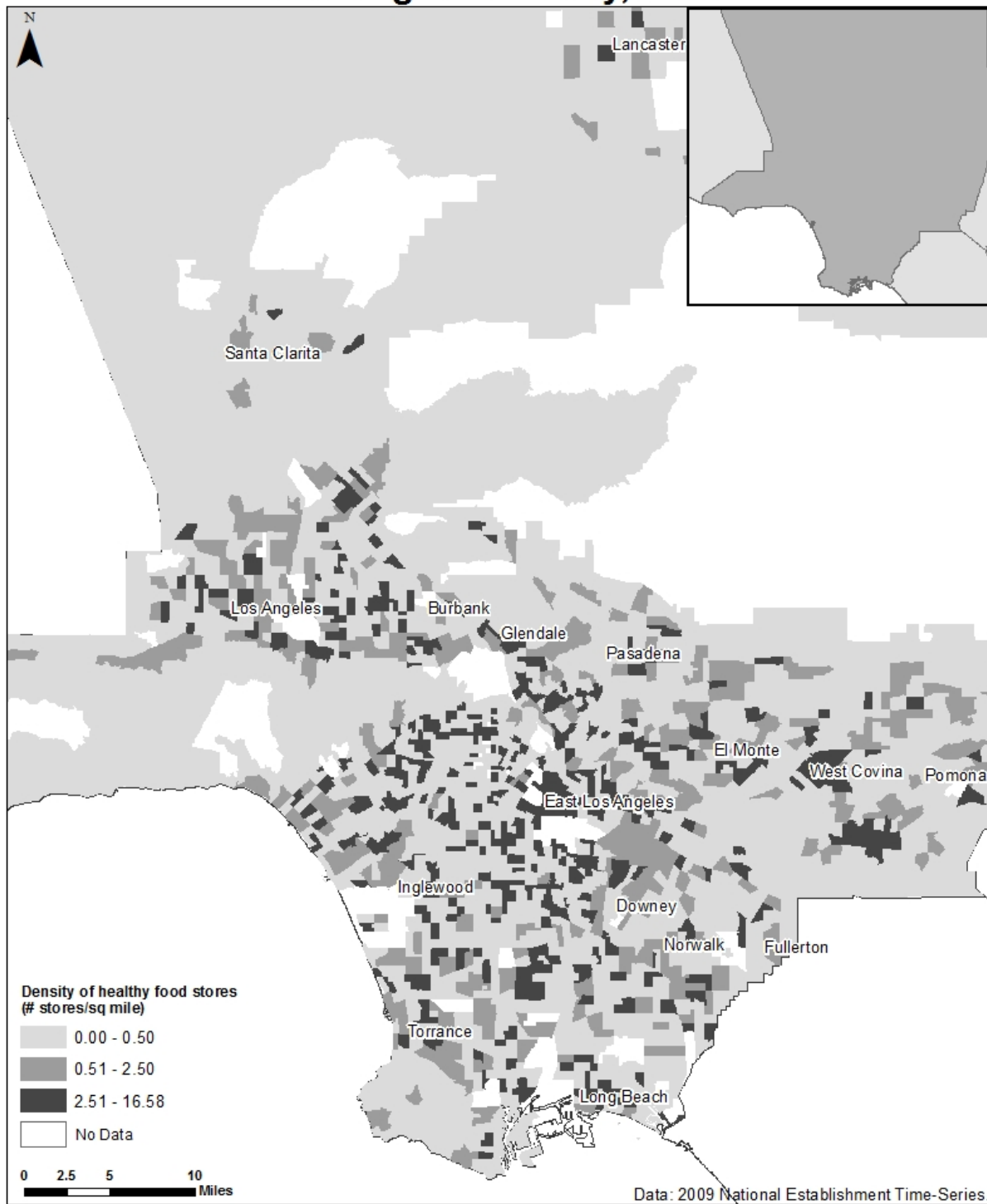
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Appendix A. Maps of the densities of healthy and unhealthy food stores in Los Angeles County in 2009*

Density of Healthy Food Stores in Los Angeles County, 2009

Density of healthy food stores (# stores/sq mile)

	0.00 - 0.50
	0.51 - 2.50
	2.51 - 16.58
	No Data

Data: 2009 National Establishment Time-Series.

*Please note that the density of healthy food stores and the density of unhealthy food stores are categorized differently.

Density of Unhealthy Food Stores in
Los Angeles County, 2009

Density of unhealthy food stores
(# stores/sq mile)

0.00 – 1.00	8.01 – 20.00
1.01 – 8.00	20.01 – 46.65
No Data	

0 2.5 5 10 Miles

Data: 2009 National Establishment Time-Series.

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