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The Food Environment in an Urban Mexican American Community

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Abstract

The objective was to determine whether ethnic composition of neighborhoods is associated with number and type of food stores in an urban, Mexican American US community. Data were from a commercial food store data source and the US Census. Multivariate count models were used to test associations with adjustment for neighborhood demographics, income, and commercialization. Neighborhoods at the 75th percentile of percent Mexican American (76%) had nearly four times the number of convenience stores (RR=3.9, 95% CI: 2.2–7.0) compared with neighborhoods at the 25th percentile (36%). Percent Mexican American in the neighborhood was not associated with the availability of other food store types (supermarkets, grocery stores, specialty stores, convenience stores with gas stations) in the adjusted model. The impact of greater access to convenience stores on Mexican American residents' diets requires exploration.

Keywords

Mexican American; ethnicity; food; residence; neighborhood

INTRODUCTION

Recent research suggests that the food environment, including the number and type of food stores available to residents of a neighborhood, is associated with diet quality and consumption of specific food items such as fruits and vegetables. For example, larger stores such as supermarkets may have a greater variety of healthy food items, and these items may be more affordable compared to similar items at smaller, independently owned stores (Bustillos et al., 2009, Liese et al., 2007). Supermarket density within neighborhoods has been linked to overall diet quality, consumption of fruits and vegetables, and to the prevalence of overweight and obesity among residents (Moore et al., 2008, Morland et al., 2002a, Morland et al., 2006).

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In the US, several studies have found poorer access to supermarkets, defined as fewer stores in the neighborhood or an increased distance to the store, in predominantly African American compared with white neighborhoods (Moore and Diez Roux, 2006, Morland and Filomena, 2007, Morland et al., 2002b, Powell et al., 2007b, Shaffer, 2002, Zenk et al., 2005, Galvez et al., 2008). Several of these studies have also noted increased access to smaller grocery stores thought to offer fewer healthy food options at less affordable prices in African American communities (Moore and Diez Roux, 2006, Morland and Filomena, 2007, Morland et al., 2002b, Powell et al., 2007b). Although there are fewer studies, a similar trend of decreased access to supermarkets and increased access to smaller grocery stores for neighborhoods with a greater proportion of Hispanic residents has been noted in some US studies (Moore and Diez Roux, 2006, Powell et al., 2007b). In contrast, other studies have reported no difference in supermarket and grocery store access in predominantly Hispanic compared with racially mixed neighborhoods (Galvez et al., 2008) and shorter distances to supermarkets and grocery stores in rural neighborhoods with a greater proportion of African and Hispanic Americans (Sharkey and Horel, 2008).

In addition to minority composition of neighborhoods, several of the aforementioned studies have separately considered the association of neighborhood socioeconomic status, most often measured as income, with access to various food stores. As the minority composition tends to correlate with socioeconomic status of neighborhoods, studies that found an association between increased minority status and decreased access to supermarkets and/or increased access to grocery stores tended to report similar trends with respect to food store access in low-income areas (Moore and Diez Roux, 2006, Morland et al., 2002b, Shaffer, 2002). Other US studies have also noted decreased access to supermarkets in low-income areas (Chung and J, 1999, Kaufman, 1998). Studies of neighborhood income and food store availability have also been conducted in the United Kingdom, Canada, Australia and New Zealand with mixed results (Beaulac et al., 2009). Studies outside of the US have noted greater numbers of total food stores (Cummins, 1999, Smoyer-Tomic, 2006), a greater number of large, independent stores but fewer chain stores (White et al., 2003), fewer grocery stores but more convenience stores (Latham and Moffat, 2007), and shorter distances to supermarkets in more deprived areas (Apparicio et al., 2007).

While studies have considered neighborhood race-ethnic composition and socioeconomic status separately due to their correlated nature (Moore and Diez Roux, 2006, Morland et al., 2002b), some work in the US has been conducted to explore this relationship. Powell et al in a national US study found that African and Hispanic American neighborhoods had fewer chain supermarkets and more grocery stores than white neighborhoods after adjustment for income level of the neighborhoods (Powell et al., 2007b). A study conducted in Saint Louis, MO noted that predominantly African American neighborhoods had decreased access to supermarkets offering healthy choices regardless of the income of the neighborhood (Baker et al., 2006). A study in metropolitan Detroit, MI found that the negative association between neighborhood racial composition (i.e., proportion African American) and access to supermarkets was most pronounced in lower income communities (Zenk et al., 2005). Finally, a study in East Harlem noted increased access to convenience stores in predominantly Latino compared with racially mixed neighborhoods but did not find differential access to supermarkets or grocery stores after adjustment for income (Galvez et al., 2008). Taken together, these studies suggest that there may be important differences in access to food stores based on the race-ethnic composition of neighborhoods beyond socioeconomic status of the neighborhood or perhaps modified by the socioeconomic status.

Although there have been some exceptions as noted, numerous studies suggest that individuals residing in minority and/or low-income neighborhoods, particularly in the US, may have less access to food stores where healthy food items are more readily available and affordable (i.e.,

supermarkets) compared with those in wealthy and/or predominantly white neighborhoods (Larson et al., 2009, Beaulac et al., 2009). Less access and inability to afford healthier food items in low SES and minority neighborhoods may translate into an increased consumption of high fat food items and a decreased consumption of fruits and vegetables by residents, as well as a greater prevalence or risk of obesity (Liu et al., 2007, Morland et al., 2006, Morland et al., 2002a). Therefore, the food environment may have implications for the health of minority populations and may contribute to disparities in cardiovascular disease and other health-related behaviors and outcomes.

Mexican Americans comprise the largest subgroup of Hispanic Americans, the largest minority group in the US. Mexican Americans tend to live in more socioeconomically disadvantaged areas and have a less favorable cardiovascular disease risk factor profile, including obesity (Ogden et al., 2006), than non-Hispanic whites, a trend that is evident even among children (Tortolero et al., 1997, Webber et al., 1991). Mexican Americans are also at an increased risk of diabetes (Haffner et al., 1991) and stroke (Morgenstern et al., 2004), especially at younger ages. There are little published data which provide insight into food environments in Mexican American communities. As the local food environment is a potential target for intervention efforts, research in this area may be useful to assist in addressing cardiovascular and other health disparities in the Mexican American population.

Characterization of food environments is complicated and often relies on commercial data sources that differ in content (Wang et al., 2006). Research studies vary in their use of these data with some using solely the information and codes included in commercial lists, (Moore and Diez Roux, 2006, Morland et al., 2002b, Pearce et al., 2008, Powell et al., 2007b) and others taking additional measures to characterize the food environment such as telephone verification, (Zenk et al., 2005) interviews with employees, (Wang et al., 2007) or objective assessments (Liese et al., 2007, Wang et al., 2007). Correlation between these different data sources for enumerating food stores by neighborhood has been shown to be moderate (Wang et al., 2006). The choice of data and methods for classifying food stores has the potential to introduce measurement error in epidemiologic studies. This bias may be greater when studying ethnically diverse neighborhoods with an increased number of independently owned stores and/or ethnic markets.

The primary aim of this analysis was to determine whether ethnic composition of neighborhoods, specifically the percent of Mexican American residents, is associated with the number and type of food stores in the neighborhood using data from a bi-ethnic, urban community in Texas. A secondary aim of this study was to determine the validity of a commercial food store data source to characterize the food environment in an ethnically diverse community.

METHODS

The analysis is part of the Brain Attack Surveillance in Corpus Christi (BASIC) Project (Morgenstern et al., 2004, Smith et al., 2004). This work was approved by the Institutional Review Board at the University of Michigan. The BASIC Project is a population-based stroke surveillance study designed to identify and validate all stroke cases in a bi-ethnic community. The purpose of the study is to compare stroke risk and outcomes, and to uncover the conventional risk factors and access to care/acculturation differences between Mexican American and non-Hispanic white stroke patients. This project takes place in Nueces County, Texas, US, a bi-ethnic community with a population of 313,645. Roughly 56% of residents are Mexican American and 38% non-Hispanic white. The majority of Mexican Americans are second and third generation US citizens, and the community is relatively stable with 85% of residents residing in the same county in 1995 (based on 2000 US Census). The county contains

64 census tracts. The county's location and highway network, and the fact that over 95% of the population resides in the major city of Corpus Christi, make it unlikely for people to travel outside the county for shopping. Surrounding counties are much smaller in population, mostly rural, and comprised of small to medium-sized cities. Nueces County is also bordered by the Corpus Christi and Nueces Bays to the north-northeast, which makes distance to other northern counties about 4–5 miles by bridge.

Food stores

Data on food store establishments located in Nueces County, Texas were compiled from Reference USA, US Business Database. A custom search of the database was performed using 2002 North American Industry Classification System (NAICS) codes and Standard Industrial Codes (SIC). A broad search using any NAICS or SIC code related to consumer food purchase was conducted. Primary NAICS codes and primary and secondary (up to four) SIC codes were included.

Food stores were categorized into supermarkets, grocery stores, convenience stores, convenience stores with gas stations, and meat, seafood and produce specialty stores. Supermarkets were defined as large, national or regional corporate-owned "chain" stores offering a full line of groceries, meat, produce, a service deli, service bakery, with at least $2 million in annual sales. Grocery stores were defined as smaller, non-corporate-owned "Mom-Pop" stores selling a line of dry grocery, canned goods or non-food items plus some perishable items. Convenience stores included stand-alone convenience stores and convenience stores with gas stations and were defined as any full-line, self-service store offering high-convenience items with limited perishable items, usually open long hours, providing easy access, with a majority receiving $2 million or more in gasoline annual sales. Convenience stores and convenience stores with gas stations were considered as separate endpoints as previous research has suggested that the association of neighborhood racial composition with these food store types may vary in both magnitude and direction (Morland et al., 2002b). Specialty stores included meat markets, seafood/fish markets, and fruit/vegetable markets.

The following steps were used to categorize food stores and to clean data. First, investigators (including residents of Nueces County) categorized establishments using name recognition (Step 1). For any unrecognized food store, investigators contacted the establishments by telephone to inquire about food sales (Step 2). For example, stores listed as convenience stores according to Reference USA were asked if they considered themselves convenience stores or grocery stores and asked if they sold gasoline. The distinction between grocery stores and convenience stores was made according to the availability of a large selection of produce. All gas stations were called to assure that they sold food; those that did not were excluded. Establishments where telephone contact failed were coded according to primary SIC (Step 3). Stores with confirmed wrong numbers were deleted and those listed in duplicate with different names but same addresses were deleted (Step 4). Steps 1–4 resulted in a "verified" food store list.

Each food store was geocoded and for each type of food store, a count of the number per census tract was generated. These counts were used as the outcomes in the primary analysis. In addition, a one-mile buffer around each census tract was created and all food stores falling within the buffer and within the county (i.e., for census tracts on the edge of the county only those stores in the county were included) were counted. This buffered count was used in sensitivity analysis as previous research has demonstrated that residents' typically define their neighborhood as including multiple census tracts (Coulton et al., 2001). The one-mile criterion has been previously used (Block et al., 2004). US Census data for 2000 was the source for neighborhood-level variables including percent of Hispanic residents, mean age of residents, percent of female residents, median income, vehicle ownership, area in square miles and

population size of each census tract. Based on the 2000 US Census, only 1.2% of Hispanics in Nueces County, Texas identified an ancestral origin from a country other than Mexico; thus, percent of Hispanic residents was interpreted as the percent of Mexican American residents for the purpose of this analysis. To identify the predominant area of commercialization within Nueces County, an indicator variable was created representing those areas located within a three mile radius around the main downtown intersection (Water St and Lawrence St). This variable was set to one for census tracts falling within this circle (n = 16) and to zero for all other census tracts (n = 48).

Statistical Analysis

Neighborhood characteristics were summarized with medians and interquartile ranges (IQR). Number and type of food stores/restaurants per census tract were summarized by calculating totals, means and standard deviations. Given that the numbers of food stores of various types within a tract may be correlated, we used multivariate count models to examine the associations between number and type of food stores per census tract (multivariate dependent variable) and the proportion of Mexican American residents (modeled continuously) as follows. The food store counts were modeled with a Poisson distribution, using a log link to interpret associations as relative change, and population size of the census tract as an offset. That is, assuming Y_{ik}= number of food stores of type k in neighborhood i, and let $\mu_{ik}= E(Y_{ik})/\text{population}_i$ be the rate of food stores per person. We modeled $\log(\mu_{ik}) = \beta_{0k} + \beta_{1k}$ (% Mexican American) $_i$, and assumed $\text{var}(Y_{ik})= \mu_{ik}$ (i.e., regression coefficients and variance was specific for each food store type). Generalized estimating equations were used to fit the model using an exchangeable working correlation structure to account for the correlation of stores within tracts. Given the number of tracts (n = 64), using an unstructured correlation led to convergence problems. However, robust standard errors were used to draw inference on model coefficients as a protection from covariance misspecification. Models were run separately for ethnic composition and income, unadjusted and adjusted for demographic composition of the neighborhood (median age, percent female) and downtown status (an indicator of commercialization). A final model including all aforementioned predictors was also estimated. Model diagnostics and model fit were assessed as follows. Collinearity diagnostics were performed by calculating variance inflation factors, given the concern that the proportion of Mexican American residents and median income were significantly correlated ($r = -0.66$). Variance inflation factors >2.5 are a cause of concern for non-linear models (Allison, 1999). Since the presence of spatial autocorrelation among the residuals of the model would invalidate the standard errors of the coefficients, Pearson residuals from the models were obtained in SAS 9.1 and exported to ArcGIS 9.2 to assess spatial autocorrelation of the residuals using Morans I index (Lin and Zhang, 2007). Because the fitting procedure used does not allow us to estimate scale (overdispersion) parameters or goodness of fit statistics for each food store type, we also fit the model for each store type separately (univariate models) to assess overdispersion and goodness of fit and to compare with the results of the multivariate model. No overdispersion was found. Goodness of fit was assessed with scaled Pearson Chi squared statistic. This statistic is the sum of the squared, standardized residuals (i.e., $(\text{predicted-observed})^2/$ variance) and has an approximate Chi-squared distribution under the assumption of no lack of fit. As a sensitivity analysis, the final multivariable model was also run using counts of stores falling within a 1-mile buffer of the census tract to determine how sensitive the results were to our definition of shopping area (i.e., census tract of residence). Significant overdispersion was found in these counts; thus, a negative binomial instead of a Poisson distribution was used (i.e., $\text{var}(Y_{ik})= \mu_{ik} + \omega\mu^2_{ik}$, where ω is an over dispersion parameter). Rate ratios and robust 95% confidence intervals comparing the 75^{th} percentile with the 25^{th} percentile of proportion Mexican American were used to summarize the primary associations. Maps of the spatial distribution of percent Mexican and food store density (count per 10,000 population) were constructed in ArcGIS 9.2.

Validity Analysis

Two approaches were used to investigate the validity of the commercial database. Sensitivity and positive predictive value (PPV) of the primary SIC code for identifying food stores according to type were calculated using the "verified" store list as the gold standard. Primary SIC was chosen as this is a commonly used method in the literature. Sensitivity was calculated as the number of food stores identified by primary SIC as a particular type divided by the number of food stores of the same type identified on the "verified" list (true positives). PPV was calculated as the number of food stores of a given type identified on the "verified" list (true positives) divided by the number of food stores of the same type identified by primary SIC (true positives plus false positives). The following SIC codes were used to define food stores: supermarkets/grocery stores (541101, 541104–541106), convenience stores (541102, 541103), and meat, seafood and produce stores (all 5421 codes excluding 542103 and 542104, 549907, 549911). SIC codes were chosen based on available definitions and published literature (Labor, Moore and Diez Roux, 2006). As a second step, counts of food stores per census tract derived from the "verified" list were compared to counts of food stores per census tract identified from the primary SIC code of the commercial database. Kappa or Spearman's correlation between the two sources were calculated overall and stratified by ethnic composition of the neighborhood based on a median split. Kappa is a measure of overall agreement, ranging from 0 to 1, with higher values representing more agreement. Cut-points for the interpretation of kappa values exist with values around 0.5 representing moderate to fair agreement (Altman, 1991, Fleiss, 1981). Spearman’s correlation ranges from −1 to 1 with values closer to these extremes representing stronger correlations and values closer to zero suggesting the variables are not correlated. For the validity analysis, supermarkets and grocery stores were combined and convenience stores with and without gas stations were combined as SIC codes do not distinguish between these food store types. No buffer was used in the validity analysis.

RESULTS

Description of Study Community

The following summary statistics are provided at the census tract level (n = 64) and based on 2000 US census data. Median population size was 4,780 (IQR: 3,192, 6,602). Median percent of the population residing in an urban area was 100% (IQR: 98%, 100%). Median household income was $36,238 (IQR: $25,732, $44,274), and median percent of the population with at least a high school education was 78% (IQR: 58%, 88%). Median percent Mexican American was 50% (IQR: 36%, 76%). Median age was 34.7 years (IQR: 32.7, 37.2) and median percent female residents was 51.2% (IQR: 49.7, 52.2). Median percent of adult residents without a vehicle was 7% (IQR: 4%, 14%). The total and average counts of food stores per census tract are displayed in Table 1. A total of 254 food stores were identified.

Food Store Density in Relation to Ethnic Composition and Income

Table 2 presents the associations of percent Mexican American and income with the number and type of food stores in the neighborhood. In unadjusted analyses, neighborhoods with a higher percent of Mexican American residents were more likely to have convenience stores without gas stations compared with neighborhoods with a lower percent of Mexican American residents. Neighborhoods at the 75th percentile of the distribution of percent Mexican American (or roughly 76% Mexican American) had nearly five times the number of convenience stores per person (RR=4.77, 95% CI: 2.92–7.80) compared with neighborhoods at the 25th percentile (roughly 36% Mexican American). Figure 1 displays the distribution of convenience stores and the percent of Mexican American residents in the study community by census tract. The ethnic composition of the neighborhood was not associated with availability of supermarkets, grocery stores, convenience stores with gas stations or specialty stores in unadjusted analysis.

After adjustment for demographic characteristics, median income and downtown status of the neighborhood (Table 2), the association of neighborhood ethnicity with convenience stores was attenuated but remained significant (RR=3.94, 95% CI: 2.21–7.02). In unadjusted and adjusted models, increasing income was associated with fewer stores of all types, but only the association with convenience stores with gas stations reached significance in the final multivariable model (RR=0.79, 95% CI: 0.66–0.95). The variance inflation factors in the final model, including both income and percent Mexican American, were all less than 2.42. Residual spatial autocorrelation was not found for any of the food store types (all p values > 0.37). Significant lack of fit was found for the model of grocery stores, suggesting that there was a significant difference from the actual grocery store counts and those predicted by the five predictors in our model. No significant lack of fit was found for the count models of supermarkets, convenience stores (with or without gas stations) or specialty stores. Results for the association of ethnic composition of the neighborhood with the availability of the food store types were similar when univariate models were considered (supermarkets: RR = 1.83 (95% CI: 0.44–7.63); grocery stores: RR = 1.60 (95% CI: 0.39–6.55); convenience stores: RR = 4.06 (95% CI: 2.25–7.33); convenience stores with gas stations: RR = 0.88 (95% CI: 0.65–1.19); specialty stores: RR = 0.93 (95% CI: 0.24–3.67)).

When the multivariable analysis was repeated with the 1-mile buffers around the census tracts used to calculate counts of stores, the association of neighborhood ethnicity with convenience stores remained positive but was of a smaller magnitude (RR = 2.59). The associations of neighborhood ethnicity with supermarkets (RR = 1.86), grocery stores (RR = 1.86), and convenience stores with gas stations (RR = 0.97) were similar to the unbuffered analysis. The association with meat, seafood, and produce stores was positive when the buffers were used (RR = 1.25) in contrast to the association when no buffers were used (RR = 0.93). The focus of this sensitivity analysis is on the point estimates as spatial autocorrelation was detected in the buffered models and therefore estimates of standard error are not reliable.

Validity Analysis

Using primary SIC, 208 food stores were identified. A total of 254 food stores were identified following verification. There were 186 stores in common between the two sources, 68 stores included on the verified list but not identified by primary SIC, and 22 stores identified by the primary SIC but not included on the verified list. Of the 68 stores identified only on the verified list, the vast majority (n = 62) were convenience stores with gas stations which were not identified due to a primary SIC identifying sale of gas (554101, 554103). Of the 22 stores identified by primary SIC but not included on the verified list, 8 were excluded from the verified list because they were duplicates, 8 were excluded because they did not sell food or were not consumer retail stores, 4 were excluded because they were confirmed closed, and 2 were excluded because they were classified as food store types not part of this analysis (for example, fast food restaurant).

Sensitivity of primary SIC for classifying supermarkets/grocery stores was 85% and PPV was 45% (Table 3). Twenty-seven false positives were identified from primary SIC. Fourteen of these were verified as convenience stores and one store was verified as a specialty store. The remaining 12 stores were not included on the verified list because they did not sell food or were not retail stores (n = 7), they were verified as a store type not included in this analysis (n = 2), or they were confirmed closed (n = 7) or duplicate (n = 1). The sensitivity and PPV of primary SIC for classifying specialty stores were 88% and 96% respectively. The sensitivity and PPV of primary SIC for classifying convenience stores were 62% and 92% respectively. There were 78 false negatives based on use of primary SIC. Again, this was primarily due to stores identified by primary SIC as gas stations (n = 62).

Agreement between the two data sources on counts of food stores/restaurants per census tract is included in Table 4. Agreement for counts of supermarkets/grocery stores was moderate with a kappa of 0.51 (standard error (se) = 0.11), with agreement being slightly less in predominantly Mexican American neighborhoods (Mexican American: $\kappa = 0.46$ (se = 0.14); non-Hispanic white: $\kappa = 0.53$ (se = 0.17)). Agreement was higher for specialty stores with a kappa of 0.75 (se = 0.11), with agreement being higher in Mexican American neighborhoods ($\kappa = 0.81$ (se = 0.14)) compared with non-Hispanic white neighborhoods ($\kappa = 0.68$ se = (0.16)). Agreement for counts of convenience stores was fair (r = 0.49) and did not differ by ethnic composition.

DISCUSSION

The current findings add to the literature on the quality of food environments in the US by focusing on a predominantly Mexican American urban community. Access to high quality food items in Mexican Americans is of particular interest given the increased burden of obesity, stroke and diabetes in this population (Haffner et al., 1991, Morgenstern et al., 2004, Ogden et al., 2006). After accounting for the demographic composition and socioeconomic status of the neighborhood, as well as commercialization, predominantly Mexican American neighborhoods had a greater availability of convenience stores without gas stations compared with non-Hispanic white neighborhoods (RR = 3.94). A similar trend was not found for convenience stores with gas stations. Notably, convenience stores were more numerous than supermarkets and grocery stores combined in the study community. This predominance of convenience stores had been noted in other geographic areas in the US, including East Harlem, NY and Forsyth County, NC; however, there is marked variability in the distribution of food store types by study area (Galvez et al., 2008, Liese et al., 2007, Moore and Diez Roux, 2006). Other investigators have also noted increased access to convenience stores in predominantly Hispanic, urban US neighborhoods (Moore and Diez Roux, 2006, Galvez et al., 2008). In contrast, Powell et al did not report an association between access to convenience stores and Hispanic composition of the neighborhood in a US national study (Powell et al., 2007b).

We did not find differential access to supermarkets and grocery stores based on the ethnic composition of the neighborhood after accounting for demographics, socioeconomic status and commercialization. The predominance of the published US literature supports that minority communities in the US are often affected by poor access to supermarkets and chain grocery stores, as highlighted in a recent review; however, the majority of studies have focused on African American communities and studies examining Hispanic communities are more limited (Larson et al., 2009). Of the US studies that have considered food store access in Hispanic urban neighborhoods results have been conflicting. Two studies reported decreased access to supermarkets and increased access to grocery stores in neighborhoods with greater Hispanic representation (Moore and Diez Roux, 2006, Powell et al., 2007b); while two other studies have reported either no association or a positive association with Hispanic composition and supermarket/grocery store access (Galvez et al., 2008, Sharkey and Horel, 2008). Our study and the previous studies have varied considerably in their methodologies including the scale (i.e., national, multiple counties, one county, one city), socioeconomic status of study population and adjustment for socioeconomic status, Hispanic representation in the neighborhoods (i.e., 13% in national study versus 50% in current study), and statistical methods making comparisons across studies somewhat difficult. Although reasons for these disparate findings are not clear, they suggest that the association of ethnic composition of neighborhoods and food store access in the US varies by geography and may be related to other features of the community such as income level and minority status.

Consistent with our finding of increased access to convenience stores in Mexican American neighborhoods, there was a trend towards increased access to convenience stores in lower-income areas (RR = 0.75, p = 0.06). We did not observe significant associations of income with supermarkets or grocery stores, although point estimates for these food stores were in the direction of a greater number of stores in low-income neighborhoods. A recent review by Larson et al. highlighted that residents of low-income areas in the US are often subject to poor access to supermarkets and chain grocery stores (Larson et al., 2009). Our opposing findings could be due in part to the unique spatial geography of our study community with higher income areas being located on the waterfront. Nevertheless, our findings of a lack of differential access to supermarkets and grocery stores by neighborhood income level suggest that the presence of "food deserts" in low income urban areas may not be consistent across all regions of the US. Interestingly, studies outside of the US have reported more mixed results with respect to area-level income and food store access (Beaulac et al., 2009). More research is needed to understand the contexts in which low income leads to differential access to food stores in the US.

There is mounting evidence of a disparity in the food environments available to minority neighborhoods in the US (Beaulac et al., 2009, Larson et al., 2009). Our results and those of others provide an alternative angle, that predominantly Hispanic neighborhoods may have easier access to less healthy food items via convenience stores (Galvez et al., 2008, Moore and Diez Roux, 2006). Convenience stores are less likely to carry healthy food items and more likely to stock less healthful versions of food compared with supermarkets and grocery stores (Bustillos et al., 2009, Liese et al., 2007). In addition, convenience stores may charge more for healthy food items (Liese et al., 2007). Studies suggest that a greater presence of convenience stores in the neighborhood or closer proximity to these stores is associated with a higher prevalence of obesity in adults and children (Morland et al., 2006, Powell et al., 2007a). Given the greater provision of convenience stores in Mexican American neighborhoods, other aspects of person-based accessibility to food in this population, such as the availability of transportation, purchasing power and shopping preferences, should be studied to unravel the implications of greater access to convenience stores. Available Census data suggest that, if anything, Mexican Americans in this community experience more personal barriers to food access. For example, the percent of households without a vehicle is greater in Mexican American households (12.5%) than for non-Hispanic white households (5.5%); median household income is considerably lower for Mexican Americans ($31,694 versus $54,887 for whites); and a greater proportion of Mexican Americans live below the poverty level (24% versus 9% in whites). These data suggest that person-based accessibility may compound the association of ethnic composition and access to convenience stores but this requires further study. This avenue of research is important in light of the national growth in convenience stores (Fantegrossi, 2005) and may help inform environmental targets for intervention efforts. For example, a recent Los Angeles City Council decision to ban the opening of new fast food restaurants and to give economic incentives for new grocery stores and full-service restaurants provides such an urban planning example (Severson, 2008).

Our results from the validity analysis point to the imperfections of commercial data to characterize food environments as is commonly done. Use of primary SIC codes alone to identify and classify food store types without further verification resulted in low sensitivity or low PPV. With regard to supermarkets/grocery stores, the focus of much of the literature, there were nearly twice as many false positives compared with true positives. Many of these were convenience stores misclassified as supermarkets/grocery stores corrected only with verification. Similar to a previous study (Wang et al., 2006), we found moderate agreement between counts of supermarkets/grocery stores in neighborhoods between our verified data and the commercial database (using primary SIC), with less agreement in Mexican American neighborhoods. In general, use of the commercial database with SIC codes resulted in an overestimate of supermarkets/grocery stores in Mexican American neighborhoods. This

differential misclassification based on ethnic composition of the neighborhood may be a marker of potential bias in measures of association of neighborhood ethnicity and food store availability using unedited commercial data and advocates for a rigorous verification process to insure accurate description of food stores. However, such verification may not always be possible based on the scope of research.

Another fault in existing methods identified from our validity analysis was reliance on primary SIC for identifying convenience stores. Sixty-two of 203 convenience stores (30%) identified had a primary SIC of gas station and were only identified as carrying convenience items because of telephone calls to the stores and use of secondary codes to pull data. Additional issues encountered with the commercial database included duplicate store entries, closed businesses, and misclassification of stores/restaurants as retail food stores. These findings suggest that several additional steps for verifying food stores and accurately classifying stores according to type are necessary. Such steps are even more critical if the focus is on making race-ethnic comparisons across neighborhoods.

Limitations to this analysis warrant discussion. This analysis was limited to a specific geographic region and bi-ethnic, urban community. Our results may not be generalizable to other communities with a different sociodemographic composition. This analysis was ecologic in nature and focused only on availability of various food stores at the community level. The study did not include information on individual shopping preferences, diets of residents, person-based accessibility to stores, or service provision information, such as store hours, and therefore should only be used to generate hypotheses regarding the relationship between ethnic composition of the neighborhood and diet. The validity analysis was focused on one commercial list. Similar analyses should be carried out with other data sources to determine their validity.

In summary, Mexican American neighborhoods had greater access to convenience stores after accounting for demographics, socioeconomic status and commercialization of the neighborhood. The impact of greater access to convenience stores on residents' diets requires further exploration, including how issues of person-based accessibility such as mobility and purchasing power may interact with place-based provision of convenience stores. In addition, examination of commercial data for characterizing the food environment revealed several validity issues, including missed stores, misclassification of store types, and imprecise enumeration of stores within neighborhoods, especially Mexican American neighborhoods, advocating for additional verification steps to be taken when using commercial data sources for research.

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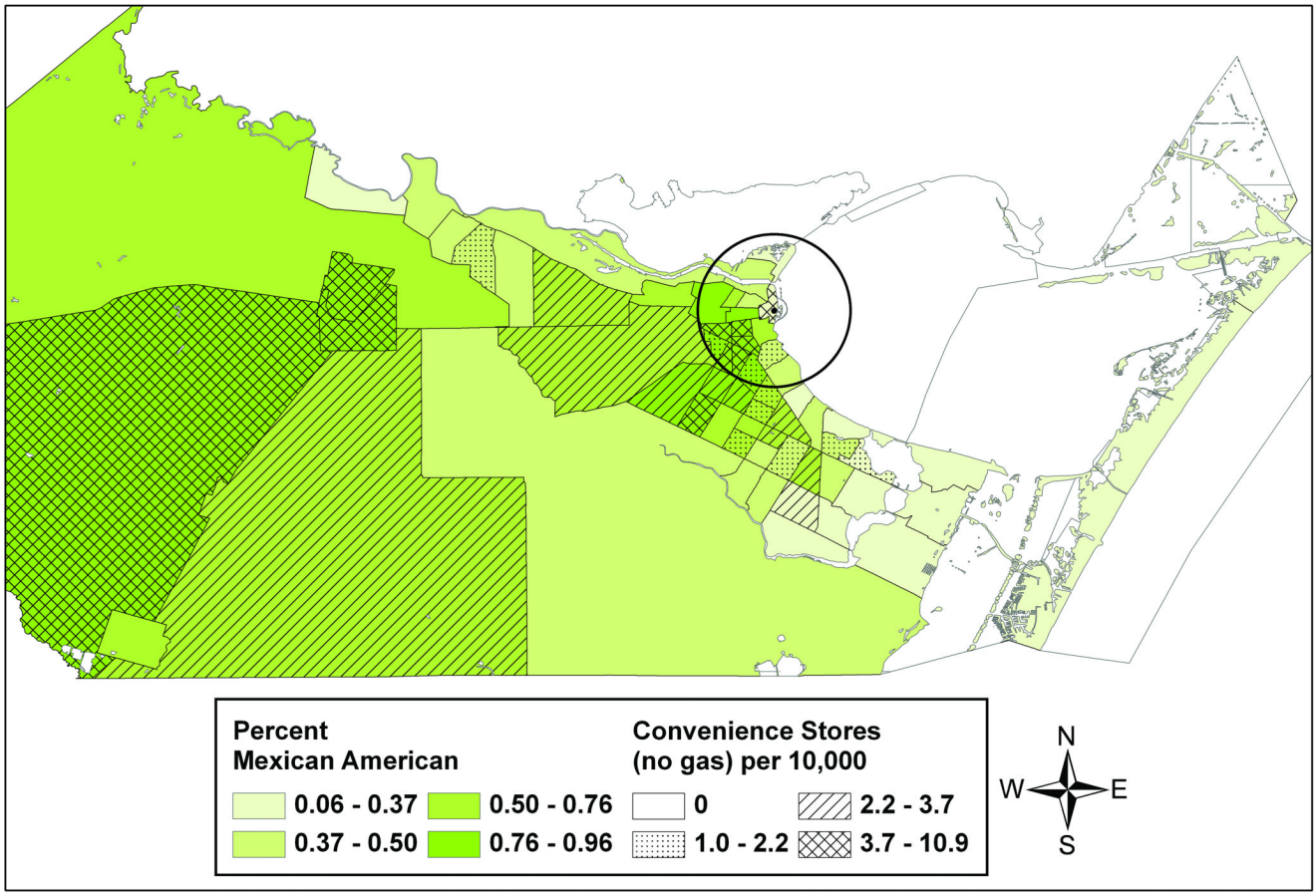

Figure 1.
Percent Mexican American and Density of Convenience Stores in Neighborhoods in Nueces County, Texas (n = 64 census tracts). Circle denotes downtown area.

Table 1

Description of Local Food Environment in Nueces County, Texas (n = 64 census tracts).

Food Store Type	Total	No Buffer Mean number per census tract (SD)	1-Mile Buffer Mean number census tract (SD)
Supermarkets	14	0.22 (0.42)	1.13 (0.93)
Grocery Stores	12	0.19 (0.43)	1.19 (1.52)
Meat, Seafood, Fruit and Vegetable Specialty Stores	25	0.39 (0.68)	2.75 (2.98)
Convenience Stores	52	0.81 (1.13)	4.84 (4.47)
Convenience Stores with Gas Station	151	2.36 (1.61)	12.09 (6.67)

Table 2

Associations of Percent Mexican American Residents and Income with the Number and Type of Food Stores Available Within the Neighborhood (n = 64 census tracts).

Model[a]	Variable	Supermarkets	Grocery Stores	Meat, Seafood, Produce Stores	Convenience Stores	Convenience Stores with Gas Station
1	Ethnicity[b]	1.43 (0.63, 3.26)	2.73 (0.65,11.36)	1.32 (0.50, 3.46)	4.77 (2.92, 7.80)**	1.00 (0.78, 1.29)
2	Ethnicity	2.07 (0.91, 4.71)*	2.70 (0.84, 8.65)*	1.43 (0.57, 3.59)	5.89 (3.51, 9.86)**	1.24 (0.96, 1.62)
3	Income[c]	0.84 (0.62, 1.13)	0.54 (0.31, 0.96)**	0.65 (0.48, 0.87)**	0.50 (0.39, 0.64)**	0.87 (0.77, 0.99)**
4	Income	0.75 (0.53, 1.08)	0.56 (0.33, 0.97)**	0.75 (0.53, 1.04)*	0.46 (0.35, 0.63)**	0.82 (0.72, 0.95)**
5	Ethnicity	1.90 (0.45 ,8.06)	1.55 (0.38, 6.30)	0.93(0.24, 3.63)	3.94 (2.21, 7.02)**	0.89 (0.66, 1.20)
	Income	0.95 (0.50, 1.78)	0.65 (0.35, 1.22)	0.73(0.41, 1.29)	0.75 (0.53, 1.05)*	0.79 (0.66, 0.95)**
	Age[d]	1.65 (1.10, 2.49)**	1.19 (0.70, 2.03)	1.56 (1.12, 2.18)**	1.32 (1.03, 1.69)**	1.41 (1.27, 1.57)**
	Gender[e]	0.61 (0.46, 0.82)**	0.89 (0.47, 1.69)	0.65 (0.44, 0.96)**	1.07 (0.85, 1.37)	0.73 (0.66, 0.81)**
	Downtown	0.70 (0.21, 2.34)	1.17 (0.38, 3.60)	2.20(0.80, 6.04)	0.66 (0.40, 1.09)	0.90 (0.62, 1.29)
	Scaled Pearson Chi-Squared[f]	62.9	98.4	61.2	75.9	59.2

[a] Model 1 includes percent Mexican American residents only; Model 2 is Model 1 + Age, Female, Downtown; Model 3 includes income only; Model 4 is Model 3 + Age, Female, Downtown; Model 5 includes all covariates shown.

[b] Represents comparison of the 75th (76%) and 25th (36%) percentiles of percent Mexican American residents.

[c] Represents association with 10K increase in median household income.

[d] Represents comparison of the 75th (37.2yr) and 25th (32.7yr) percentiles of mean age.

[e] Represents comparison of the 75th (52.2%) and 25th (49.7%) percentiles of percent female residents.

[f] Scaled Pearson chi-square statistic obtained by estimating a Poisson regression model separately for each food store type with the same covariates as Model 5; approximate degrees of freedom = 58, critical value at significance level 0.05 is 76.8.

* p value < 0.10,

** p value < 0.05

Table 3

Sensitivity and Positive Predictive Value (PPV) of a Commercial Database for Identifying Food Stores According to Type.

	Supermarkets/ Grocery stores	Convenience Stores	Meat, Seafood and Produce Stores
Sensitivity (%)	84.6	61.6	88.0
PPV (%)	44.9	91.9	95.7

Table 4

Agreement of a Commercial Database and Verified Food Store Data for Number of Food Stores in the Neighborhood According to Store Type (n = 63 census tracts). X and y axis represent the counts of the stores (0–3) identified by the two methods.

Supermarkets/Grocery Stores

Commercial Data Source

Verified List	0	1	2	3
0	33	9	0	0
1	2	13	2	0
2	0	2	1	0
3	0	1	0	0

Agreement= 74.6

Kappa= 50.5

Meat, Seafood, Produce Stores

Commercial Data Source

Verified List	0	1	2	3
0	43	1	0	0
1	2	12	0	0
2	0	3	1	0
3	0	0	1	0

Agreemen

Kappa

Mexican American Neighborhoods (n = 32)

Supermarkets/Grocery Stores

Commercial Data Source

Verified List	0	1	2	3
0	13	6	0	0
1	0	8	2	0
2	0	1	1	0
3	0	1	0	0

Agreement= 68.8

Kappa= 46.0

Meat, Seafood, Produce Stores

Commercial Data Source

Verified List	0	1	2
0	21	1	0
1	1	7	0
2	0	1	1
3	0	0	1

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Non-Hispanic white Neighborhoods (n = 31)

Supermarkets/Grocery Stores

Commercial Data Source

Meat, Seafood, Produce Stores

Commercial Data Source

Verified List	0	1	2	3
0	20	3	0	0
1	2	5	0	0
2	0	1	0	0
3	0	0	0	0

Agreement= 80.6
Kappa= 52.4