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Neighborhood Deprivation, Neighborhood Aculturation, and the Retail Food Environment in a U.S.-Mexico Border Urban Area

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NEIGHBORHOOD DEPRIVATION, NEIGHBORHOOD ACCULTURATION,
AND THE RETAIL FOOD ENVIRONMENT IN A U.S.-MEXICO BORDER
URBAN AREA

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RETAIL FOOD ENVIRONMENT IN A U.S.-MEXICO BORDER URBAN AREA

By

TERESA M. ANCHONDO, BS

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ABSTRACT

The prevalence of obesity in the United States is increasing at a rapid rate, and is the result of an imbalance of caloric intake and expenditure. Obese individuals are at significantly greater risk for coronary artery disease, high blood pressure, diabetes, and cancer, as compared to non-obese individuals. Both individual correlates and neighborhood conditions contribute to the risk for obesity. For example, family history, race/ethnicity, and residence in a low socioeconomic status neighborhood are all associated with increased risk of obesity. The retail food environment is one aspect of low socioeconomic status neighborhoods that may contribute to increased obesity risk. Emerging evidence suggests that the availability of food stores varies by neighborhood socioeconomic status and race/ethnicity, with fewer supermarkets available in low-income, high minority neighborhoods. In contrast, although neighborhoods with high immigrant populations may have fewer supermarkets, they also may have more small grocery and specialty (meat, produce, and bakery) stores that enable recent immigrants to maintain traditional diets that have been associated with overall healthy eating patterns.

The primary aim of this study was to examine the association between neighborhood deprivation, neighborhood acculturation, and the retail food environment within El Paso County, a major urban area located on the U.S.-Mexico border. The retail food environment was assessed by classifying, enumerating, and geocoding retail food stores obtained in a listing from the City of El Paso Department of Public Health. Data from the U.S. Census was used to develop indices of neighborhood deprivation and neighborhood acculturation at the tract level. The association between neighborhood deprivation, neighborhood acculturation, and the retail food environment, controlling for population density, at the tract level was determined using Poisson multivariate regression models. It was hypothesized that high levels of neighborhood deprivation will be

associated with reduced availability of supermarkets and grocery stores, and that low levels of neighborhood acculturation will be associated with reduced availability of supermarkets but increased availability of grocery stores and specialty stores. It was further hypothesized that neighborhood acculturation will moderate the effect of neighborhood deprivation on availability of grocery stores.

El Paso County has an estimated population of 731,496, and includes the City of El Paso, as well as surrounding areas. The relatively low socioeconomic status of El Paso county is also evident in relatively high percentage of individuals below the poverty line (23.8%), which is almost double that reported (12.4%) within the U.S. The proportion of the population that reports Hispanic/Latino ethnicity is 81.4%. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of 0.877 and Bartlett's Test of Sphericity ($X^2 = 1232.52$, $df = 36$, $p < 0.001$) both indicate appropriate selection and coverage of factors identified for inclusion in the deprivation index. A linear relationship was established along the gradient. As neighborhood deprivation increased there was a significant decrease in chain supermarkets. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of 0.791 and Bartlett's Test of Sphericity ($X^2 = 474.12$, $df = 6$, $p < 0.001$) both indicate appropriate selection and coverage of factors identified for inclusion in the acculturation index. Results from our study indicated that the availability of grocery and specialty stores was significantly greater in low acculturation neighborhoods; however, supermarket and convenience store availability were not associated at the tract level. The results from this multivariate study show that after controlling for population density, supermarket availability and convenience store availability were not consistently and significantly associated with neighborhood deprivation or neighborhood acculturation. However, the availability of grocery stores and specialty stores was highly correlated with both neighborhood deprivation and

neighborhood acculturation. Models testing whether neighborhood acculturation moderated the effects of neighborhood deprivation on retail food store availability indicated the interaction of neighborhood deprivation and neighborhood acculturation was not significant. Neighborhood acculturation, as opposed to neighborhood deprivation, appears to be the key environmental characteristic associated with the quality of the retail food environment in a border environment.

Obesity is documented as a major risk factor for a host of chronic health problems, including hypertension, cardiovascular disease, diabetes, and cancer. Our results suggest that further research examining retail food environments in border communities may provide insight into the dietary acculturation process among Hispanics. Research on the availability and quality of foods in smaller stores is needed in order to better estimate their influence on the overall retail food environment. Future research is needed to investigate the role and mechanism through which neighborhood level acculturation influences critical health outcomes, including obesity.

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GLOSSARY

Deprivation amplification – a process where disadvantages arise from poorer quality environments amplify individual disadvantages in ways which are detrimental to health (Macintyre, 2007).

Dietary acculturation - the process through which immigrants adopt the dietary practices of the host country (Satia-Abouta et al., 2002).

Geocoding- address matching with the utilization of specific software that is used to produce geographic coordinates for each address (Hay, Kypri, Whigham, & Langley, 2009).

Neighborhood acculturation – a proxy measure of acculturation (the exchange of cultural features that results when groups come into continuous contact; elements of both cultures change but each group remains distinct (Romero-Gwynn & Gwynn, 1993), at the neighborhood level.

Neighborhood deprivation - unmet basic human needs due to a lack of resources at a neighborhood level, such as income, housing, health, and education (Ball et al., 2008).

Retail food environment – different types of food establishments within a given area (e.g., supermarkets, grocery stores, and convenience stores) (Ford & Dzewaltowski, 2008).

CHAPTER 1

BACKGROUND AND SIGNIFICANCE

The prevalence of obesity has increased tremendously in the past 30 years, with more than thirty percent of adults in the United States classified as obese in 2004 (Ogden et al., 2006). Obesity is caused by a caloric imbalance at the individual level where caloric input exceeds energy expenditure. Caloric intake and energy expenditure are influenced by a multitude of factors at the individual, family, neighborhood, and community level. Socioecological theory provides a framework for examining the multiple levels of influence that impact obesity, and for understanding disparities in obesity (Stokols, 1996). The socioecological framework was recently used in a review by Ford and Dzewaltowski (2010) to examine whether differences in the availability of supermarkets could be linked to geographic, racial/ethnic, and socioeconomic disparities in obesity. Other research reviews have also suggested that disparities in supermarket availability are associated with increased risk of obesity among low-income and minority populations, particularly in urban areas (Black & Macinko, 2008; Larson, Story, & Nelson, 2009).

Neighborhoods provide an important context for physical activity and eating behaviors (Macintyre & Ellaway, 2003). However, due to neighborhood segregation by race/ethnicity and income, neighborhood resources vary (Acevedo-Garcia, Lochner, Osypuk, & Subramanian, 2003). Neighborhood deprivation, a composite of socioeconomic status (SES), has been associated with poor quality physical activity and food environment (Black & Macinko, 2008). Macintyre & Ellaway (2003) have suggested the socioeconomic and racial/ethnic disparities in health outcomes might be explained through a “deprivation amplification” effect whereby high deprivation neighborhoods lack resources

that contribute to healthy behaviors, thus amplifying the negative health effects of low socioeconomic status at the individual level (Macintyre & Ellaway, 2003).

Acculturation is used in public health research to examine dominant culture orientation (Cuéllar, Arnold, & González, 1995). Increased levels of acculturation have been identified with increased risk of obesity and a number of other negative health outcomes (Lee, Nguyen, & Tsui, 2009). Although acculturation is traditionally measured at an individual level, the use of neighborhood acculturation can be informative when examining the role of neighborhood environments on the acculturation process (Espinosa de Los Monteros, Gallo, Elder, & Talavera, 2008). Because varying acculturation levels are a characteristic of border communities, neighborhood acculturation may influence characteristics of the retail food environment and play a key role in the dietary acculturation process at an individual level. To date, no studies have investigated the association between neighborhood acculturation and retail food environments, or examined whether neighborhood acculturation moderates the impact of neighborhood deprivation on the overall quality of the retail food environment. This study examines neighborhood deprivation, neighborhood acculturation and the retail food environment in order to study the unique associations and determine whether neighborhood acculturation moderates the influence of neighborhood deprivation on food environments.

Socioecological Framework of Health Behavior

Access to healthy foods is a prerequisite for a healthy diet. Retail food environments, an important component of the built environment, are characterized by the presence of supermarkets, grocery stores, and convenience stores (Wang, Gonzalez, Ritchie, & Winkleby, 2006). Characteristics and features within the food environment can be evaluated to determine whether the environment acts as a barrier or facilitator for healthy eating. Hawkes (2008) reported that the diets of consumers are

influenced by the types of available foods, food cost, and the promotional strategies that they use to sell food items. Likewise, consumer's diets are affected by nutrition-related activities implemented by food stores (Hawkes, 2008). Individuals who do not have adequate access to supermarkets or grocery stores may be at a nutritional risk because their food purchasing options are restricted to establishments selling a limited selection of foods which are high in fat and calories (i.e., nutrient-empty foods). The availability of food in urban environments depends on the presence of supermarkets, grocery stores, convenience stores, fast food and other restaurants, and other food options in neighborhoods. Neighborhood nutrition environments vary by location which affects the accessibility, types of products offered, quality, and affordability.

The socioecological framework of health behavior proposes that the built environment plays an important role in directly shaping behaviors associated with obesity (Sallis, Johnson, Calfas, Caparosa, & Nichols, 1997) including energy intake and physical activity. According to Berkman & Kawachi (2000), the neighborhood environment also influences behavior by shaping norms, enforcing patterns of social control, providing or reducing environmental opportunities to engage in certain behaviors, and by promoting or decreasing stress for which certain behaviors may be an effective coping strategy. The socioecological framework emphasizes the holistic role of complex interacting factors that operate at multiple levels (i.e. individual, global, national, municipal, and neighborhood) in shaping health behaviors (Vlahov, 2007). One implication of this framework is that interventions which address modifiable factors at both the individual and neighborhood level are more likely to be effective at reducing obesity prevalence in populations in contrast to those that focus solely on individual-level factors (Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008).

Figure 1 illustrates the proposed theoretical framework for examining the role of neighborhood deprivation and neighborhood acculturation on the retail food environment within a border community

context. In this figure, neighborhood characteristics, such as population density, neighborhood deprivation, and neighborhood acculturation are interrelated because neighborhoods of high deprivation and low levels of acculturation tend to have higher population densities as compared to more affluent and acculturated neighborhoods. While high population density neighborhoods may be associated with more commercial activity (including the presence of supermarkets and grocery stores), neighborhood deprivation and neighborhood acculturation levels may moderate the effects of population density on the retail food environment. Based on previous studies (Ford & Dzewaltowski, 2008; Larson et al., 2009) high levels of neighborhood deprivation are hypothesized to be associated with fewer supermarkets and grocery stores, and more convenience stores (poorer quality food environment). Similarly, low levels of neighborhood acculturation are hypothesized to be associated with increased presence of grocery stores and specialty stores, and reduced presence of supermarkets. While the presence of supermarkets is to increase opportunities to access healthy food options and the presence of convenience stores is hypothesized to reduce healthy food options, the opportunity for healthy food options associated with grocery stores and specialty stores (produce, meat markets, and bakeries) requires further research. The interactive effects of neighborhood deprivation and neighborhood acculturation on the retail food environment are also unknown.

Characterization of the Neighborhood Food Environment

The North American Industry Classification System (NAICS) is often used to categorize food-related and other businesses into types (U. S. Census Bureau, 2009). A supermarket is defined as having more than two million dollars in annual sales. Traditionally supermarkets are large stores that provide a variety of healthy foods and at a lower cost (Powell, Slater, Mirtcheva, Bao, & Chaloupka, 2007). The larger size of supermarkets allows for greater variety and more economical brands and package sizes

(Family Economics & Nutrition Review, 1999). Supermarkets are reported to have three times the average number of healthy foods compared with grocery and convenience stores (Apparicio, Cloutier, & Shearmur, 2007). The availability and abundance of supermarkets has been linked with more frequent fruit and vegetable consumption and healthier diets (Morland, Wing, Diez Roux, & Poole, 2002; Zenk et al., 2006).

Grocery stores are smaller in size and stock fewer foods as compared to supermarkets. Specifically, the number of fresh produce and other healthy food items sold is often limited in grocery stores (Jetter & Cassady, 2006; Liese, Weis, Pluto, Smith, & Lawson, 2007). Small grocery stores are more common in lower income (Glanz, Sallis, Saelens, & Frank, 2007) and minority neighborhoods (Powell et al., 2007). Although they may offer fewer varieties of fresh produce, small grocery stores may play an important role in improving the availability of healthy foods to residents of urban neighborhoods. For instance, residents living within 100 meters of a grocery store had a significantly higher mean intake of fruits and vegetables than those without such access (Bodor, Rose, Farley, Swalm, & Scott, 2008). The availability of small grocery stores in immigrant communities, particularly those that offer ethnically appropriate foods, may play an important role in allowing residents to maintain traditional diets (Ayala, Baquero, & Klinger, 2008). Specialty stores, such as meat markets, bakeries, and produce stands may also play an important role in providing healthy food options within immigrant communities and their presence may influence dietary acculturation patterns (Ayala et al., 2008; Espinosa de Los Monteros, et al., 2008; Perez-Escamilla, 2009).

Convenience stores are commercial establishments that provide a limited variety of foods such as milk, bread, soda, microwaveable fast foods, snacks (e.g., candy, chips), and other food items with low nutritional value (Spence, Cutumisu, Edwards, Raine, & Smoyer-Tomic, 2009). They are often associated with a gas station (Liese et al., 2007) and for that reason, are usually situated along the

corners of busy streets or intersections. Convenience stores are more common in low income area zip codes (Powell et al., 2007). Residents who rely on convenience stores may have significant poorer quality diets due to the higher prices and limited availability of healthy foods. For instance, in a study in rural South Carolina, foods that were available at both supermarkets and convenience stores were significantly more expensive at convenience stores, and the availability of fresh fruits, vegetables, and other unprocessed foods were severely limited at convenience stores (Liese et al., 2007). Similar results highlighting the limited availability and higher costs of healthy food options convenience stores have been reported elsewhere (Glanz et al., 2007).

Factors that Influence Neighborhood Food Environments

Race/ethnicity, neighborhood deprivation, and other characteristics of a neighborhood can influence health related behaviors directly by providing structural barriers to accessing health promoting resources, or indirectly through psychosocial mechanisms that alter behavior (Franzini, Caughy, Spears, & Fernandez Esquer, 2005; Merkin et al., 2009). Recent reviews (Ford & Dzewaltowski, 2008; Larson et al., 2009) suggest that neighborhood food environments can vary dramatically by sociodemographic and racial/ethnic composition of residents. Powell et al., (2007) reported in a national study that low income neighborhoods had 25% fewer supermarkets as compared to middle income neighborhoods. The availability varied even more dramatically by neighborhood race/ethnicity, with predominantly African-American neighborhoods reporting only 48% of supermarkets as compared to predominantly white neighborhoods.

A multi-site study conducted in North Carolina, Maryland, and New York reported that minority and racially-mixed neighborhoods had half as many grocery stores and fewer supermarkets compared to majority white neighborhoods (Moore, Davis, Baxter, Lewis, & Yin, 2008). In a study in Detroit, Zenk

et al., (2006) reported that 70% of residents in white and ethnically mixed neighborhoods lived within a mile of at least one chain grocery store as compared to 17% of residents living within a predominately African American community. The investigators also reported that individuals with lower incomes paid a higher proportion of their income for fresh produce. This may have made it difficult to follow the recommended five servings a day proposed by the Centers for Disease Control and Prevention (2005). Interestingly, this study found that the racially heterogeneous neighborhoods had the greatest density of food stores at 52.8 per 100,000 residents compared to 26.5 per 100,000 residents in the predominantly African- American neighborhoods. These results suggest that groups of immigrants within the ethnically mixed neighborhoods may provide small grocery and specialty stores that allow residents to maintain more traditional diets.

In a detailed examination of food availability by neighborhood composition, Horowitz, Colson, Hebert, & Lancaster (2004) examined the availability of five foods (diet soda, one percent or fat free milk, high fiber/low carbohydrate bread, fresh fruits, and fresh green vegetables or tomatoes) identified as critical to maintaining a diabetic diet by neighborhood location in New York City. They contrasted the availability of these foods on Upper East Side (high SES and low minority population) with the East Harlem (low SES and high minority population) neighborhoods. Their results indicated that 58% of the grocery stores in the Upper East Side neighborhood stocked recommended foods as compared to only 18% of East Harlem neighborhood stores. When examining very small grocery stores (bodegas), 9% of the East Harlem bodegas carried all of the recommended food items compared to the 48% of Upper East Side bodegas. The key findings were that East Harlem residents were more likely (50.0% vs. 24.0%) to have stores on their block that stocked healthy foods (Horowitz et al., 2004).

The examination of the relationship between store availability and neighborhood demographics yielded slightly different results in a rural study conducted in the Texas Brazos Valley (Sharkey &

Horel, 2008). In this study, each rural county included five urban clusters with a population less than 2,500, several smaller towns, and many remote areas. The results indicated that the most deprived neighborhoods with the highest minority composition had better access to the nearest food store (Sharkey & Horel, 2008). These results mirror those reported by Ford & Dzewaltowski (2010) indicating that population centers within rural areas had increased availability of retail food stores in comparison to the more remote (and often more affluent) rural locations.

In contrast, more recent studies have examined the association between neighborhood need and access to food stores and fast food restaurants within neighborhood colonias. Colonias are unzoned residential areas along the U.S.-Mexico border characterized by limited access to water and sanitation, extreme poverty, and high risk of infectious diseases (Sharkey, Horel, Han, & Huber, 2009; Sharkey, 2009). The results indicated that while deprived neighborhoods in rural areas have increased access to stores, the extreme deprivation within the colonias resulted in very limited stores availability and few healthy food options.

Neighborhood Deprivation and Food Environments

Deprivation is defined as unmet basic human needs due to a lack of resources such as income, housing, health, and education (Ball et al., 2008). It can be measured at the neighborhood level by developing an index using characteristics of census tracts or census block groups. A study conducted by Sharkey & Horel, (2008) developed a neighborhood deprivation index by utilizing seven socioeconomic characteristics from Census Block Group (CBG) data. The socioeconomic measures consisted of neighborhood unemployment, poverty, low educational attainment, household crowding, public assistance, vehicle availability, and telephone service. Factor analysis was then utilized to reduce the number of linear combinations while identifying an overall index of socioeconomic deprivation.

Neighborhood deprivation was tested against store and fast food availability, and high neighborhood deprivation was associated with greater fast food and grocery store availability in rural areas within Texas (Sharkey & Horel, 2008). Similarly, Pearce, Blakely, Witten, & Bartie, (2007) measured neighborhood deprivation by the 2001 New Zealand Deprivation Index (NZDep). The (NZDep) was calculated from census data that focused on nine socioeconomic characteristics consisting of car access, tenure (household estimates by classification), benefit receipt (income support), unemployment, low income, telephone access, single-parent families, education, and living space (Pearce et al., 2007). The results indicated that there is a strong association between neighborhood deprivation and geographic access to fast food establishments. The use of neighborhood deprivation indices, as opposed to looking solely at median income, is preferred in many social epidemiology studies because it captures the multidimensionality of poverty (Krieger et al., 2003).

Living in a relatively impoverished area is positively associated with an increased risk of obesity (Boardman, Saint Onge, Rogers, & Denney, 2005). Neighborhood sociocultural and built environments may also contribute to observed disparities in obesity among minority and disadvantaged populations. For instance, in a multilevel study of neighborhood demographic factors associated with obesity, Boardman et al., (2005) reported that the risk of obesity associated with residence in a predominantly black neighborhood was increased by 13%, after controlling for individual-level factors. The results of a similar multilevel analysis conducted by Robert & Reither, (2004) indicated that residence in a neighborhood of high socioeconomic disadvantage was also associated with higher BMI even after controlling for individual level risk factors.

Previous studies have shown that positive associations between overweight and neighborhood deprivation remain after controlling for individual characteristics such as social class, age and gender (Macdonald, Cummins, & Macintyre, 2007). Van Lenthe, & Mackenbach, (2002) conducted research

on the association between neighborhood deprivation and overweight, and examined whether the association was modified by educational level, age, and sex of neighborhood residents. The results showed increased prevalence of overweight in more deprived neighborhoods even after controlling for individual level characteristics such as education level, age, and sex.

These research findings suggest that neighborhood deprivation is associated with increased obesity even after controlling for individual level variables. This supports the amplification-deprivation hypothesis which suggests that deprived neighborhoods may lack the resources necessary to support healthy physical activity and eating patterns (MacIntyre, 2007; Robert et al., 2004). Neighborhood deprivation or neighborhood socioeconomic position or status characteristics of a neighborhood, also referred to as neighborhood SES, can directly influence dietary choices through the quantity and quality of food stores and restaurants in the area, which, in turn, may determine access to nutritious foods, the availability and affordability of fruits and vegetables, and the ease of transportation to grocery stores (Dubowitz et al., 2008). Dubowitz, et al., (2008) found a positive association between neighborhood SES with fruit and vegetable intake as one important pathway through which the social environment of neighborhoods affects population health and nutrition for whites, blacks, and Hispanics in the United States.

A cross-sectional study conducted by Zenk et al., (2006) compared the availability, selection, quality, and price of fresh fruit and vegetables at food stores in four Detroit-area neighborhoods. The authors evaluated 304 establishments of chain grocery, large independent grocery, “mom-and-pop” grocery, specialty, and convenience without gasoline, and liquor stores. The results indicated that disadvantaged neighborhoods appear to have fewer grocery stores with more limited selections, poorer quality, and more expensive foods as compared to wealthier neighborhoods (Zenk et al., 2006).

A study conducted by Powell et al., (2007) utilized a multivariate analysis examining the association between the availability of food store outlets in the United States and race, ethnicity, and socioeconomic status, while controlling for population size, urbanization, and region. The results indicated that low-income neighborhoods had 25% fewer supermarkets as compared to middle-income neighborhoods. After controlling for income and other covariates, the availability of chain supermarkets in black neighborhoods was 52% of that in white neighborhoods (Powell et al., 2007). Hispanic neighborhoods had 32% as many chain supermarkets compared to non-Hispanic neighborhoods, and non-chain supermarkets and grocery stores were more prevalent among low-income and minority neighborhoods (Powell et al., 2007).

Morland, Diez Roux, & Wing, (2006) examined the possible link between characteristics of local food environments and risk factors for cardiovascular disease such as overweight and obesity. They identified an inverse association between supermarkets with a lower prevalence of overweight and obesity. Booth, Pinkston, & Poston, (2005) found that obesity was associated with an individual's area of residence, resources, walkability, land use, and level of deprivation. Therefore, the literature suggests that characteristics of local food environments may play an important role in the prevention of overweight and obesity (Morland et al., 2006).

Neighborhood Acculturation

There are many definitions of acculturation as well as a variety of different ways it can be measured. Romero-Gwynn & Gwynn, (1993) defined acculturation as the exchange of cultural features that results when groups come into continuous contact; elements of both cultures change but each group remains distinct. Acculturation refers to changes in the behaviors and cultural values of an individual or group as a result of contact with another culture (Cuéllar, Arnold, & González, 1995). Acculturation has

an effect on the quality of diet consumed and has been linked to poor health behaviors (Lara, Gamboa, Kahramanian, Morales, & Bautista, 2005). The acculturation process is accompanied by changes in diet, activity, and other lifestyle attributes that can increase the risk for many chronic diseases (Satia-Abouta, Patterson, Neuhouser, & Elder, 2002). The dominant United States dietary pattern tends to be high in fat and low in fruits and vegetables. Immigrants who are younger than 20 years of age at arrival in the United States may be at higher risk for overweight/obesity compared to those who arrive at later ages (Ayala et al., 2008; Roshania, Narayan, & Oza-Frank, 2008).

Although the measurement of acculturation at an individual level is a matter of controversy and debate in public health literature, the use of proxy measures such as nativity, nativity generational status, length of residence in the United States, and language use are common in the public health literature (Abraido-Lanza, Armbrister, Florez, & Aguirre, 2006). A study conducted by Deyo, Diehl, Hazuda, & Stern, (1985) examined the relationship between English language use, acculturation, and health behavior. After controlling for income and education, researchers concluded that the scale used to determine English language usage among Mexican Americans was associated with a variety of health behaviors and attitudes (Deyo et al., 1985). These findings suggest that while individual acculturation is a multidimensional, complex phenomenon, and that proxy measures such as years of residence and primary language use at home may be useful for examining acculturation at the neighborhood level.

Previous studies (Espinosa de Los Monteros et al., 2008; Park, Neckerman, Quinn, Weiss, & Rundle, 2008) have confirmed that neighborhood level acculturation is associated with measures of dietary acculturation among Mexican American groups. As individuals immigrate to a new community with greater food availability, there is a period of “nutrition transition,” where the individual’s dietary pattern is transformed to incorporate aspects of the majority diet (Lin, Bermudez, & Tucker, 2003). Espinoza de los Monteros et al., (2008), using census tract level data, found a significant inverse

association between individual and neighborhood measures of acculturation and dietary fat intake. This contradicts previous research indicating a deleterious dietary impact associated with acculturation (Ayala et al., 2008). The acculturation effects were independent of income and education, suggesting that other factors such as English language attainment, increased access to heart healthy food options, and recreation facilities may be responsible for the positive association (Espinosa de Los Monteros et al., 2008). They further hypothesized that other unique characteristics of the San Diego-Tijuana border context may have contributed to the positive impact of acculturation on dietary quality.

Methodological Approaches

The neighborhood food environment has been evaluated in previous studies by enumerating food retail stores using various methods and at different spatial scales. Scales of analysis included census tracts (Morland, Wing, & Diez Roux, 2002), zip codes (Lopez, 2007; Powell et al., 2007), and network distance (Sharkey & Horel, 2008). The majority of the studies measure store availability using the census tract as the area based unit of measure because tracts are stable boundaries, represent demographic clusters, and are strongly associated with gradients in other measures of health outcomes (Krieger et al., 2002). Ecological and multilevel research examining the associations between store availability and neighborhood characteristics use tract information including population density, household income, poverty rate, and racial/ethnic composition. However, because individuals are not limited to grocery shopping within the same census tract, its use as a unit of analysis may lead to spurious associations and requires careful control for other, unmeasured tract variables (Inagami, Cohen, Finch, & Asch, 2006).

Other studies have examined food store availability within zip codes, often for the analyses of larger geographic areas and populations (Powell et al., 2007). For example, Lopez, (2007) utilized this

method and successfully combined data from the U.S. Behavioral Risk Factor Surveillance System (BRFSS) with data from the U.S. Census. However, the use of zip codes as the area unit of analysis is problematic because they are not designed to represent a demographically homogeneous area and may include significant variation leading to regression towards the mean in associational studies (Krieger et al., 2003).

Another method uses network distance or miles traveled to a store to calculate the number of stores per square mile in relation to the number of residents living in that area. However, this method requires individual addresses, and may be problematic since individuals can shop at more than one store. Sharkey et al., (2009) calculated network distance from the number of each type of food store and fast food restaurant within a network distance of one, three, and five miles of each population-weighted census block group. Morland & Evenson, (2009) examined food store availability both at the tract level and by calculating network distance, and reported a significant association between supermarket availability and obesity at the tract level, but found no significant associations between network distance to stores and obesity.

The selection of area based unit and methodological approach is often dictated by both data availability and research question. While each method has its advantages, it is important to pay close attention to the limitations regarding the use of different area based units and methods.

CHAPTER 2

STUDY AIMS AND HYPOTHESES

The primary goal of this study is to investigate the influence of neighborhood deprivation and acculturation on food environments in the El Paso County, Texas, border urban area. This goal will be achieved through the following specific aims:

Specific Aim 1:

To investigate the association of neighborhood deprivation with food store availability in El Paso County, Texas.

Hypothesis 1:

Working Hypothesis: It is hypothesized that neighborhood deprivation will be inversely associated with the availability of supermarkets but positively associated with small grocery stores, specialty stores, and convenience stores.

Null Hypothesis: Neighborhood deprivation is not associated with the availability of supermarkets, grocery stores, or convenience stores.

Specific Aim 2:

To investigate the association of neighborhood acculturation and the availability of food stores in El Paso County, Texas.

Hypothesis 2:

Working Hypothesis: It is hypothesized that increased neighborhood acculturation is associated with a greater number of supermarkets, and fewer grocery, specialty, and convenience stores.

Null Hypothesis: Increased neighborhood acculturation is not associated with the availability of supermarkets, grocery stores, specialty, or convenience stores.

Specific Aim 3:

To investigate whether neighborhood acculturation modifies the association between neighborhood deprivation and the availability of supermarkets, grocery stores, and convenience stores.

Hypothesis 3:

Working Hypothesis: It is hypothesized that neighborhood acculturation modifies the association between neighborhood deprivation and the availability of supermarkets, grocery stores, and convenience stores.

Null Hypothesis: Neighborhood acculturation does not modify the association between neighborhood deprivation and the availability of supermarkets, grocery stores, and convenience stores.

CHAPTER 3

METHODS & MATERIALS

Description of the Study Population and Site

The site for the study is in El Paso County, Texas. The county is situated adjacent to the U.S.-Mexico border. It is one of 44 border counties that stretch almost 2,000 miles across four U.S. states from the Gulf of Mexico to the Pacific Ocean. The most recent 2000 Census estimated the population of El Paso County at approximately 731,496 individuals residing within a land area of 249 square miles. El Paso County is characterized by a relatively high population density, averaging 2,263 persons per mile² compared to the U.S. average of 79.6 persons per mile² (US Census Bureau, 2000 Census).

Some of the poorest counties in the United States are along the U.S.-Mexico Border (City of El Paso Department of Public Health, 2008). Census Bureau data (2009) indicate that the proportion of El Paso County residents who lived in poverty (28.4%) during 2007 was elevated compared to the rest of Texas (16.3%) and the U.S. population (13%).

The U.S.-Mexico border area has a large Hispanic population (78.2%), the majority of whom are of Mexican descent. It is characterized by rapid population growth, high unemployment, reduced access to healthcare (Cassady, Jetter, & Culp, 2007) and low education levels (Bath, 1982). A high proportion of border residents are foreign-born Mexican immigrants. Foreign-born noncitizens living in the border are twice as likely to be poor compared to foreign-born naturalized citizens (19.7% vs. 9.9%) (Schmidley, 2003). The prevalence of obesity/overweight, chronic disease (e.g., diabetes, hypertension, cirrhosis and other liver diseases) and infectious disease (tuberculosis, hepatitis) is increased among Mexican-Americans and other border residents as compared to the rest of the US population (Cassady et al., 2007; Mier et al., 2008).

Study Design

The study design is cross-sectional using data gathered at the ecological level. The major objective was to investigate the association between neighborhood deprivation, neighborhood acculturation, and the food environment. Key outcome variables include number of supermarkets, grocery stores, specialty stores, and convenience stores located within the census tract. Population density of census tracts was controlled for in statistical models.

Neighborhood Deprivation

Census tracts served as the proxy for neighborhoods in the proposed study. Census tracts were chosen as the unit of analysis because they are contained within a county, have fairly consistent boundaries, and census tract measures of economic deprivation generate health outcomes gradients consistent with those predicted using individual measures (Krieger et al., 2003). Most multilevel investigations in the United States use census tracts or census block groups as the unit of analysis (Krieger et al., 2003).

A total of 126 census tracts were identified by the 2000 Census for the El Paso County. These census tracts are within county boundaries and are designated to represent homogenous population characteristics with an average population of 4,000 individuals within each tract (U. S. Census Bureau, 2000). The lowest population within an individual tract was 648, therefore all 126 census tracts were utilized in the analysis.

Neighborhood deprivation indices were developed by utilizing seven study areas including: education, employment, housing, occupation, poverty, racial composition, and residential stability (Messer et al., 2006). Socioeconomic data from the census tract level were extracted from U.S. 2000 Census SF-3 files and used to calculate tract deprivation. Tract variables included 1) percent of adults

unemployed and actively seeking work, 2) percent of adults over the age of 25 with less than a 9th grade education, 3) percent households under the federally designated poverty level for household size, 4) percent households with more than one person per room, 5) percent female head of household with children, 6) percent of households with public assistance income, 7) median tract income, 8) percent of individuals employed in professional and managerial occupations, and 9) percent households with no access to a vehicle.

Principal components analysis (PCA) was performed within SPSS (v. 17.0, SPSS Inc., Chicago, IL) for data reduction, with extraction of one factor using varimax rotation to maximize factor score loadings (Messer et al., 2006). Loadings were used to weight the contribution of each item to the summary neighborhood deprivation index. The resulting index is standardized to have a mean of zero and a variance of one, and was entered into regression models as both a continuous measure and as quartiles.

Neighborhood Acculturation

Neighborhood acculturation was measured by utilizing census tract data to create a neighborhood acculturation index. Variables used to calculate a neighborhood acculturation index included 1) percent of foreign-born individuals, 2) percent of foreign-born individuals that arrived within 10 years prior to census, 3) percent of Spanish speaking households who reported speaking English less than very well, and 4) percent of households that report speaking a language other than English at home.

Principal components analysis (PCA) was performed within SPSS (v. 17.0, SPSS Inc., Chicago, IL) for data reduction, with extraction of one factor using varimax rotation to maximize factor score loadings (Messer et al., 2006). Loadings were used to weight the contribution of each item to the

summary neighborhood acculturation index. The resulting index was standardized to have a mean of zero and a variance of one, and was entered into regression models as both a continuous measure and as quartiles.

Store Classification and Availability

Data on food stores was obtained from the City of El Paso, Department of Public Health Food Inspection Program for 2009. Under the Texas Law, all food store establishments are required to operate with a valid permit or license that is issued by a local regulatory authority (Texas Department of State Health Services, 2008). Store license records included store type, separated according to city and county food establishments and then grouped into eighteen categories (bakery, bar, cafeteria, candy counter, convenience store, fast food, food supplement, meat market, nursing homes, processing plants, restaurants, school activity, school cafeteria, snack bar, supermarket, tortilla factory, warehouse, and other), store size (categorized by square footage), telephone number, and physical location (street address). The stores were re-coded using store size, and store type into five categories 1) chain supermarkets, 2) grocery stores, 3) specialty store (including bakery, fruit and vegetable market, meat markets), convenience, and 5) variety store. Stores in the variety category include dollar stores, pharmacies, and general merchandise stores without a specific grocery section. Supermarkets were classified based on chain affiliation (Ford, 2009).

Geocoding of Stores

Geographic Information Systems (GIS) are computerized systems that are used for the storage, retrieval, manipulation, analysis, and display of geographically referenced data (Kurland & Wilpen, 2006). A complete listing of retail food stores operating in 2009 (n=627) was geocoded by street

address within ArcGIS (v. 9.3, Redlands, CA) using street address files, and re-matching using a >30 percent matching criteria (Kurland & Wilpen, 2006).

Statistical Analysis

All data was reduced and analyzed using SPSS software (v. 17.0, SPSS Inc., Chicago, IL). The difference between store availability within census tracts was assessed by descriptive statistics and one way analysis of variance (ANOVA). Since the dependent variable (number of stores) is expressed as count data, multivariate count (Poisson) regression models were used to estimate incidence rate ratios for the availability of different types of retail food stores within census tracts (Powell et al., 2007). The main effects of neighborhood deprivation and neighborhood acculturation on store availability were tested in multivariate regression models, while controlling for population density within census tract. An interaction term was included in a subsequent multivariate regression model to determine whether neighborhood acculturation moderated the association between neighborhood deprivation and store availability.

CHAPTER 4

RESULTS

El Paso County Population Characteristics

Descriptive statistics of El Paso population are provided in Table 1. El Paso County has an estimated population of 731,496, and includes the City of El Paso, as well as surrounding areas. Table 2 presents the socioeconomic characteristics for the El Paso County from the 2000 U.S. Census. The median annual income reported for El Paso County was approximately \$31,000, which contrasts with \$42,000 reported as median income within the US for the same time period. The relatively low socioeconomic status of El Paso county is also evident in relatively high percentage of individuals below the poverty line (23.8%), which is almost double that reported (12.4%) within the US (Table 2).

As a large urban center on the US-Mexico border, El Paso County has a high proportion of Hispanics and recent immigrants. The proportion of the population that reports Hispanic/Latino ethnicity is 81.4% (Table 1). Approximately 27.4% of residents within El Paso County are foreign-born, of which 30.2% report having arrived in the U.S. between 1990-2000 (Table 3). A significant percentage (33.2%) of households report speaking English less than very well, and over 72% of households report speaking a language other than English at home.

Store Characteristics

All retail food stores registered and inspected by the City of El Paso Department of Public Health were geocoded within ArcGis (v. 9.3, Redlands CA), and a summary of store type by category is presented in Table 4. A total of 627 retail food establishments were included in the analysis, of which 6.2% were chain supermarkets, 21.7% were grocery stores, 32.5% were specialty stores, and 38.9%

were convenience stores. Specialty stores included bakeries, produce vendors, bakeries and tortillerias, and meat markets/carnecerias. A total of five retail food stores (1 %) were not successfully geocoded, due to street address misclassification errors. We deleted a total of four stores (1 grocery store, 2 specialty stores, and 1 convenience store) that fell outside of the study area.

Tract Deprivation

Socioeconomic data reported at the tract level (Table 2) were used to construct tract deprivation indices. Tract deprivation indices were calculated using Principal Components Analysis (PCA) with a varimax rotation to maximize factor score loadings (Messer et al., 2006). One factor was identified (Eigenvalue = 6.55) that captured a cumulative 72.8 % of variance. Loadings were used to weight the contribution of each item to the summary neighborhood deprivation index. The neighborhood deprivation component score matrix is presented in Table 5. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of 0.877 and Bartlett's Test of Sphericity ($X^2 = 1232.52$, $df = 36$, $p < 0.001$) both indicate appropriate selection and coverage of factors identified for inclusion in the index. The resulting index was standardized to have a mean of zero and a variance of one, and entered into regression models as both a continuous measure and as quartiles. Tracts were categorized into very low neighborhood deprivation, low neighborhood deprivation, high neighborhood deprivation, and very high neighborhood deprivation quartiles.

Neighborhood characteristics by deprivation level varied across the different quartiles (Table 6). The gradients in tract deprivation category were in the expected direction, with median household income and percent of individuals employed in professional occupations significantly higher in low deprivation tracts. The percent households with no access to a vehicle, percent female head of household, percent households on public assistance income, percent unemployed, percent household

crowding, percent adults with less than a high school degree, and percent households under the poverty level significantly greater in high and very high deprivation tracts as compared to low and very low deprivation tracts.

Tract Acculturation

Tract acculturation characteristics scores used to construct tract acculturation are presented in Table 3. Tract acculturation indices were calculated using Principal Components Analysis with a varimax rotation to maximize score loadings (Messer et al., 2006). One factor was identified (Eigenvalue = 2.79) that captured a cumulative 69.7 % of variance. Loadings were used to weight the contribution of each item to the summary neighborhood acculturation index. The neighborhood acculturation component score matrix is presented in Table 7. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) of 0.791 and Bartlett's Test of Sphericity ($X^2 = 474.12$, $df = 6$, $p < 0.001$) both indicate appropriate selection and coverage of factors identified for inclusion in the index. The resulting index was standardized to have a mean of zero and a variance of one, and entered into regression models as both a continuous measure and as quartiles. Tracts were categorized into very low neighborhood acculturation, low neighborhood acculturation, high neighborhood acculturation, and very high neighborhood acculturation.

Neighborhood characteristics by acculturation level varied across the different quartiles (Table 8). The mean percentage of foreign born individuals was significantly greater in very low neighborhood acculturated tracts (39.09 ± 6.25) as compared to the very high neighborhood acculturated tracts (15.55 ± 4.90). Similarly, the percentage of Spanish speaking households who reported speaking English less than very well was significantly greater among very low neighborhood acculturated tracts (51.18 ± 8.43) as compared to the very high neighborhood acculturated tracts (15.16 ± 5.59). The mean

percentage of households that reported speaking a language other than English at home was 89.07 (4.54) among very low neighborhood acculturated tracts, compared to 47.13 (14.41) among very high neighborhood acculturated tracts.

Univariate Analysis

The number and types of retail food stores available differed by neighborhood deprivation level (Table 9). The availability of supermarkets and convenience stores did not vary by tract deprivation level, but there were significantly fewer specialty stores among low neighborhood deprivation tracts (0.97 ± 1.56) as compared to very high neighborhood deprivation tracts (2.77 ± 2.17). The average number of grocery stores was significantly greater in very high neighborhood deprivation tracts (2.42 ± 1.96) as compared to very low neighborhood deprivation tracts (0.45 ± 0.89).

The number and types of retail food stores available differed by neighborhood acculturation level (Table 10). The availability of supermarkets and convenience stores did not vary by tract acculturation level, but there were significantly fewer grocery stores among very high neighborhood acculturation tracts (0.39 ± 0.88) as compared to very low neighborhood acculturation tracts (2.23 ± 2.05). The number of specialty stores was inversely related to neighborhood acculturation for each quartile. Mean specialty store availability in very low neighborhood acculturation tracts (2.71 ± 2.12) was significantly greater as compared to very high neighborhood acculturation (0.52 ± 1.55). The average number of specialty stores was significantly greater in low neighborhood acculturation tracts (1.69 ± 1.55) as compared to high neighborhood acculturation tracts (1.44 ± 1.66).

Multivariate Analysis

Chain Supermarkets. Multivariate regression estimates of incidence rate ratios for neighborhood deprivation and neighborhood acculturation are presented in Table 11. After controlling for population density and neighborhood acculturation high levels of neighborhood deprivation were significantly associated with fewer supermarkets. Neighborhoods with very high levels of deprivation had 88% fewer supermarkets, and neighborhoods with high levels of deprivation had 66% fewer supermarkets. In contrast, the relationship between neighborhood acculturation and supermarkets was not linear. Very low neighborhood acculturation neighborhoods had 4.8 times as many supermarkets as compared to very high acculturation neighborhoods. Low acculturation neighborhoods had 5.19 times as many supermarkets as compared to very high neighborhood acculturation neighborhoods, and high acculturation neighborhoods had 2.8 times as many supermarkets. Models testing whether neighborhood acculturation moderated the effects of neighborhood deprivation on supermarket availability indicated the interaction of neighborhood deprivation and neighborhood acculturation was not significant.

Grocery Stores. After controlling for population density and neighborhood acculturation, neighborhood deprivation was not significantly associated with the number of grocery stores. In contrast, low levels of neighborhood acculturation were significantly associated with more grocery stores, with very low neighborhood acculturation having 4.7 times as many grocery stores and low neighborhood acculturation having 3.4 times as many grocery stores. Models testing whether neighborhood acculturation moderated the effects of neighborhood deprivation on grocery store availability indicated the interaction of neighborhood deprivation and neighborhood acculturation was not significant.

Specialty Stores. The number of specialty stores was not consistently associated with neighborhood deprivation. While low deprivation neighborhoods had approximately half (0.55) as

many specialty stores as compared to the referent category, the number of specialty stores in high and very high neighborhoods were not significantly different as compared to neighborhoods with very low deprivation. There was a strong and consistently significant inverse relationship between neighborhood acculturation and availability of specialty stores, with neighborhoods characterized by very low acculturation having 5.48 times as many specialty stores as compared to very high acculturation neighborhoods. Models testing whether neighborhood acculturation moderated the effects of neighborhood deprivation on specialty store availability indicated the interaction of neighborhood deprivation and neighborhood acculturation was not significant.

Convenience Stores. Neighborhood deprivation was not consistently associated with differences in convenience store availability. There were no significant differences in convenience store availability between very high and very low levels of neighborhood acculturation. However, the intermediate categories of neighborhood acculturation had significantly greater availability of convenience stores. Models testing whether neighborhood acculturation moderated the effects of neighborhood deprivation on convenience store availability indicated the interaction of neighborhood deprivation and neighborhood acculturation was not significant.

CHAPTER 5

DISCUSSION

Importance

This study sought to examine the influence of neighborhood deprivation and acculturation on food environments in the El Paso County, Texas, border urban area. Access to quality foods is of particular interest given the increased risk for obesity, heart disease, and stroke in Mexican-Americans (Lisabeth et al., 2010). Living in a relatively impoverished area is positively associated with an increased risk of obesity (Boardman et al., 2005). Some of the poorest counties in the United States are along the U.S.-Mexico Border (City of El Paso Department of Public Health, 2008). El Paso is characterized by rapid population growth, high unemployment, reduced access to healthcare (Cassady et al., 2007) and low education levels (Bath, 1982). A high proportion of El Paso border residents are foreign-born Mexican immigrants, which highlights the importance of understanding the influence of acculturation on health outcomes. Retail food environments in border metropolitan areas may not exhibit the same patterns of those observed in other areas. This study provides insight into the relationships between neighborhood deprivation, neighborhood acculturation and the retail food environment.

The first hypothesis tested in this study was that the availability of supermarkets, grocery stores, specialty stores, and convenience stores would vary by neighborhood deprivation level. This hypothesis was developed based on the current literature which has found a relatively consistent relationship between high neighborhood deprivation (low SES) and limited availability of supermarkets (Larson et al., 2009; Ford & Dzewaltowski, 2010; and Black & Macinko, 2008). Results from our multivariate analysis indicate that high levels of neighborhood deprivation were significantly associated

with fewer supermarkets. Neighborhoods with very high levels of deprivation had 88% fewer supermarkets, and neighborhoods with high levels of deprivation had 66% fewer supermarkets. Powell et al., (2007) reported in a national study that low income neighborhoods had 25% fewer supermarkets as compared to middle income neighborhoods. In contrast, Sharkey & Horel, 2008, reported that high neighborhood deprivation was associated with increased supermarket and grocery store availability. Results of this study support previous research which suggests that there is a greater availability of supermarkets in low neighborhood deprivation tracts.

The associations between neighborhood deprivation and grocery store, specialty store, and convenience store availability were less consistent. There was no difference by deprivation level for grocery stores and convenience stores. These results contrast with other research (Powell et al., 2007; Zenk et al., 2006) reports indicating that high deprivation neighborhoods have greater availability of these types of stores. Our contrasting results might be due to controlling for neighborhood acculturation, which would be particularly significant when examining specialty stores. Our results indicated no consistent relationship between specialty store availability and neighborhood deprivation

The second hypothesis tested in this study was that the availability of supermarkets, grocery stores, specialty stores, and convenience stores would vary by neighborhood acculturation level. Espinoza de los Monteros et al., (2008), found an inverse association between individual and neighborhood measures of acculturation and dietary fat intake. Results from our study indicated that the availability of all types of retail food stores were significantly greater in low acculturation neighborhoods. For instance, neighborhoods of very low acculturation had 4.8, 4.71, and 5.48 times more supermarkets, grocery stores, and specialty store, respectively, than neighborhoods of very high acculturation. These results suggest that the very dense food environment in low acculturation

neighborhoods might contribute to increased obesity risk and enhance the rate of dietary acculturation among recent immigrants.

The largest impact of low levels of neighborhood acculturation were observed in specialty stores, with neighborhoods of very low acculturation having 5.48 times as many specialty stores as compared to very high acculturation neighborhoods. Our research results provide insight on the findings reported by Espinoza de los Monteros et al., (2008) and Reyes-Ortiz et al., (2009) suggesting that the relationship between dietary intake and neighborhood composition in Hispanic neighborhoods might be explained by the increased availability of small grocery stores and specialty stores in low acculturation census tracts. The relatively high availability of specialty stores may provide culturally appropriate foods that serve as protective barriers against the negative impacts of the dietary acculturation process.

The third hypothesis tested in this study was that neighborhood acculturation would modify the association between neighborhood deprivation and food store availability. Neighborhood acculturation did not moderate the association between store availability and deprivation for any type of retail food store.

Examining standardized regression coefficients we find that the overall effect of neighborhood acculturation on store availability is greater than the effect of neighborhood deprivation. Therefore, neighborhood acculturation, as opposed to neighborhood deprivation, appears to be the key environmental characteristic associated with the quality of the retail food environment in the border environment. The neighborhood food environment may influence dietary acculturation among immigrants by offering greater availability of specialty and grocery stores that stock foods associated with traditional diets. On the other hand, the very dense neighborhood food environment may also influence dietary acculturation and obesity in very low acculturation neighborhoods by providing many opportunities to over-consume.

Limitations

There are several limitations of the study that are worthwhile to mention. First, as an ecological study using cross-sectional data, no inferences can be made regarding individual behavior or exposure, or causality. Secondly, as noted by Inagami et al., (2006) many residents choose to shop outside of their census tract, so estimates of store availability at the tract level may not reflect utilization. Another critical limitation is the lack of information on store quality. Although most food environment research finds significant differences in food availability between supermarkets and convenience stores (Glanz, 2009), little research has examined specific food availability in smaller grocery stores and specialty stores. Further research on the availability and quality of foods in these smaller stores is needed in order to better estimate their influence on the overall retail food stores. There may be errors associated with store misclassification as well as geocoding errors. Lastly, temporal discrepancy between census data (2000) and store data (2009) differ which may impact the results.

Strengths

Despite its limitations, this study has several strengths. El Paso County is a unique study setting because it is located on the U.S. - Mexico Border, and has a majority Hispanic population. No studies have been conducted to examine the dual influences of neighborhood deprivation and neighborhood acculturation on the retail food environment within a border community. Understanding these relationships is important because the retail food environment may impact dietary acculturation patterns that contribute to increased risk of obesity among Hispanics. The use of a non-commercial list of retail food stores was utilized which provided a more accurate count of functioning facilities thus, allowing for a higher percentage of geocoded matching to take place.

Conclusion

The prevalence of obesity has risen in the United States. Obesity is documented as a major risk factor for a host of chronic health problems, including hypertension, cardiovascular disease, diabetes, and cancer. Hispanic ethnicity is associated with a higher risk for obesity when compared to non-Hispanic whites.

The literature strongly suggests that neighborhood food environments affect dietary quality. The availability of retail food stores varies by neighborhood characteristics. Prior studies indicate that supermarkets are more available in high income/low minority neighborhoods in contrast to the increased availability of small grocery and convenience stores in low income/high minority neighborhoods. Thus, the retail food environment within neighborhoods appears to provide a context that either facilitates or serves as a barrier to behaviors associated with healthy eating. Poor quality food environments, characterized by a lack of supermarkets and healthy food options can contribute to obesity by facilitating access to convenient, inexpensive, and nutrient-empty foods that are high in calories and fat, and restricting that to fruits, vegetables, and other foods associated with a healthy diet. Several studies have reported that living in an area with supermarkets is associated with lower obesity rates. This suggests that neighborhood retail food environments may be linked to disparities in obesity rates observed in minority and low income individuals.

The neighborhood food environment may also influence dietary acculturation among immigrants by offering greater availability of specialty and grocery stores that stock foods associated with traditional diets. Thus, living in a neighborhood in which acculturation status of most residents is low may actually protect against the potentially deleterious effect of dietary acculturation. Further research is needed to assess the culturally protective effects of Mexican-American foods. Our results suggest that further research examining retail food environments in border communities may provide insight into the

dietary acculturation process among Hispanics. Research on the availability and quality of foods in smaller stores is needed in order to better estimate their influence on the overall retail food environment. Future research is needed to investigate the role and mechanism through which neighborhood level acculturation influences critical health outcomes, including obesity.

To date, no studies have been conducted to examine the dual influences of neighborhood deprivation and neighborhood acculturation on the retail food environment within a border community. Understanding the relationships among neighborhood deprivation, neighborhood acculturation, and the retail food environment is particularly important for border communities because the retail food environment may influence the dietary acculturation patterns that contribute to increased risk of obesity among Hispanics.

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APPENDIX

Table 1. Demographic characteristics of El Paso County

	Number	Percent
Total Population	731,496	100.00
Male	351,416	48.0
Female	380,080	52.0
One race	715,965	97.9
White	570,152	77.9
Black/African American	20,615	2.8
Asian	7,995	1.1
Native Hawaiian/Pacific Islander	832	0.1
Other	112,213	15.3
Two or more races	15,531	2.1
Hispanic/Latino	595,176	81.4
Average Household Size	3.09	x
United States born	519,787	71.7
Foreign Born	198,834	27.2
Speak English only	159,900	24.2

Note: The federal government considers race and Hispanic origin to be two distinct categories.

SOURCE: U.S. Census Bureau, 2006-2008 American Community Survey

Table 2. Socioeconomic characteristics of El Paso County

	Median/ Mean	Standard Deviation	Minimum	Maximum
Median Household Income (in dollars)	\$31,304	\$13,256	\$8,490	\$74,375
% households with no access to a personal vehicle	11.96	12.06	0.00	61.40
% female head of household with children	13.31	5.43	3.54	31.97
% households with public assistance income	7.22	4.84	0.00	24.54
% adults unemployed and actively seeking work	10.71	5.66	0.00	37.20
% households with more than one person per room	14.94	7.53	1.60	41.50
% households under federally designated poverty level	25.13	14.63	0.00	72.30
% adults over 25 years with less than a high school degree	23.01	16.04	0.00	69.30
% of individuals employed in professional and managerial occupations	26.79	13.43	3.80	67.8

SOURCE: U.S. Census Bureau, 2000.

Table 3. Neighborhood acculturation characteristics in El Paso County

	Median/ Mean	Standard Deviation	Minimum	Maximum
% of foreign-born individuals	27.38	9.82	5.00	54.70
% of foreign born individuals who arrived within 10 years of the census	30.22	10.62	7.60	66.10
% of Spanish speaking households who reported speaking English less than very well	33.20	15.06	4.00	69.50
% of households that report speaking a language other than English at home	72.18	18.55	18.10	96.10

SOURCE: U.S. Census Bureau, 2000.

Table 4. El Paso store classification by type and percentage

Store Type	Number	Percentage
Chain Supermarkets	39	6.2
Grocery Stores	136	21.7
Specialty (produce, meat, bakery)	204	32.5
Convenience Stores	244	38.9
Total Stores	627	100

Note: See materials and methods for description of store classifications.

SOURCE: City of El Paso Department of Public Health, 2009

Table 5. Neighborhood deprivation component score coefficient matrix

	Component
	1
Median household income	-0.14
% Households with no access to a personal vehicle	0.12
% Female head of household with children	0.10
% Households with public assistance income	0.14
% Adults unemployed and actively seeking work	0.12
% Households with more than one person per room	0.13
% Households under federally designated poverty level	0.15
% Adults over 25 years with less than a high school degree	0.14
% Individuals employed in professional and managerial occupations	-0.13

Note: See materials and methods for description of principle components analysis.

Table 6. Neighborhood characteristics by quartile deprivation level

	Very Low Neighborhood Deprivation Mean (SD)	Low Neighborhood Deprivation Mean (SD)	High Neighborhood Deprivation Mean (SD)	Very High Neighborhood Deprivation Mean (SD)
Median Household Income	\$48,744a (\$10,329)	\$34,484b (\$5,570)	\$24,309c (\$2,737)	\$17,804d (\$4,480)
% Households with no access to a personal vehicle	4.43a (3.12)	5.51b (3.89)	12.57c (5.24)	25.53d (16.09)
% Female head of household with children	9.47a (3.34)	13.47b (3.95)	12.78c (4.36)	17.55d (6.46)
% Households with public assistance income	2.71a (1.45)	4.62b (2.20)	8.42c (2.48)	13.17d (4.23)
% Adults unemployed and actively seeking work	5.53a (1.76)	9.16b (3.87)	11.60c (2.26)	16.56d (6.58)
% Households with more than one person per room	6.54a (3.02)	12.22b (3.03)	17.41c (3.94)	23.60d (7.53)
% Households under federally designated poverty level	10.06a (4.19)	17.61b (6.43)	29.28c (5.04)	43.69d (11.67)
% Adults over 25 years with less than a high school degree	6.59a (3.00)	13.93b (7.93)	29.33c (7.17)	42.26d (12.35)
% Individuals employed in professional and managerial occupations	45.68a (8.74)	27.80b (5.69)	19.41c (4.96)	14.47d (5.67)

Means within the same row followed by different letters are significantly different at $P < 0.05$ level using Games-Howell post hoc tests.

Table 7. Neighborhood acculturation component score coefficient matrix

	Component
	1
% Foreign-born individuals	0.30
% Spanish speaking households who reported speaking English less than very well	0.31
% Households that report speaking a language other than English at home	0.29
% Naturalized	-0.22

Note: See materials and methods for description of principle components analysis.

Table 8. Neighborhood characteristics by quartile acculturation level

	Very High Neighborhood Acculturation Mean (SD)	High Neighborhood Acculturation Mean (SD)	Low Neighborhood Acculturation Mean (SD)	Very Low Neighborhood Acculturation Mean (SD)
% Foreign-born individuals	15.55a (4.90)	23.48b (2.90)	31.39c (3.14)	39.09d (6.25)
% Foreign born individuals who arrived within 10 years of the census	30.28a (13.40)	32.38a (10.57)	26.22b (8.25)	32.07b (8.89)
% Spanish speaking households who reported speaking English less than very well	15.16a (5.59)	25.72b (5.41)	40.76c (4.57)	51.18d (8.43)
% Households that report speaking a language other than English at home	47.13a (14.41)	67.88b (7.74)	84.39c (4.62)	89.07d (4.54)

Means within the same row followed by different letters are significantly different at $P < 0.05$ level using Games-Howell post hoc tests.

Table 9. Store availability by neighborhood deprivation

	Very Low Neighborhood Deprivation Mean (SD)	Low Neighborhood Deprivation Mean (SD)	High Neighborhood Deprivation Mean (SD)	Very High Neighborhood Deprivation Mean (SD)
Supermarkets	0.45a (0.72)	0.31a (0.59)	0.31a (0.54)	0.16a (0.37)
Grocery Stores	0.45ab (0.89)	0.59ab (0.98)	0.81b (0.90)	2.42b (1.96)
Specialty Stores	1.07a (1.67)	0.97a (1.56)	1.56ab (1.59)	2.77b (2.17)
Convenience Stores	2.16a (2.40)	1.72a (1.67)	2.03a (1.69)	1.84a (1.49)

Means within the same row followed by different letters are significantly different at $P < 0.05$ level using Games-Howell post hoc tests.

Table 10. Store availability by neighborhood acculturation

	Very High Neighborhood Acculturation Mean (SD)	High Neighborhood Acculturation Mean (SD)	Low Neighborhood Acculturation Mean (SD)	Very Low Neighborhood Acculturation Mean (SD)
Supermarkets	0.23a (0.56)	0.44a (0.72)	0.34a (0.55)	0.23a (.43)
Grocery Stores	0.39ab (0.88)	0.47ab (0.72)	1.19b (1.12)	2.23b (2.05)
Specialty Stores	0.52a (1.55)	1.44b (1.66)	1.69c (1.55)	2.71d (2.12)
Convenience Stores	1.52a (2.25)	2.25a (1.41)	2.03a (1.91)	1.94a (1.65)

Means within the same row followed by different letters are significantly different at $P < 0.05$ using Games-Howell post hoc tests.

Table 11. Availability of supermarkets, grocery stores, specialty stores and convenience stores by neighborhood deprivation (incidence rate ratios from multivariate count regression models)

Neighborhood Characteristics	Chain Supermarkets β (t-value)	Grocery Stores β (t-value)	Specialty Stores β (t-value)	Convenience Stores β (t-value)
Very High Neighborhood Deprivation	0.117** (6.52)	1.46 (0.55)	0.95 (0.02)	0.71 (1.33)
High Neighborhood Deprivation	0.24** (4.30)	0.57 (1.27)	0.60 (2.21)	0.69 (1.99)
Low Neighborhood Deprivation	0.38* (3.64)	0.85 (0.14)	0.55** (4.50)	0.70 (3.11)
Very Low Neighborhood Acculturation	4.80* (3.53)	4.71** (9.21)	5.48** (18.07)	1.60 (2.45)
Low Neighborhood Acculturation	5.19** (5.46)	3.39** (6.12)	4.16** (13.63)	1.92** (5.69)
High Neighborhood Acculturation	2.81** (4.58)	1.27 (0.32)	3.36** (15.81)	1.82** (9.27)

Referent categories are very low neighborhood deprivation and very high neighborhood acculturation. Parameter estimates followed by the symbols *, and ** represent statistical significance at the $p < 0.05$, and 0.01 level.

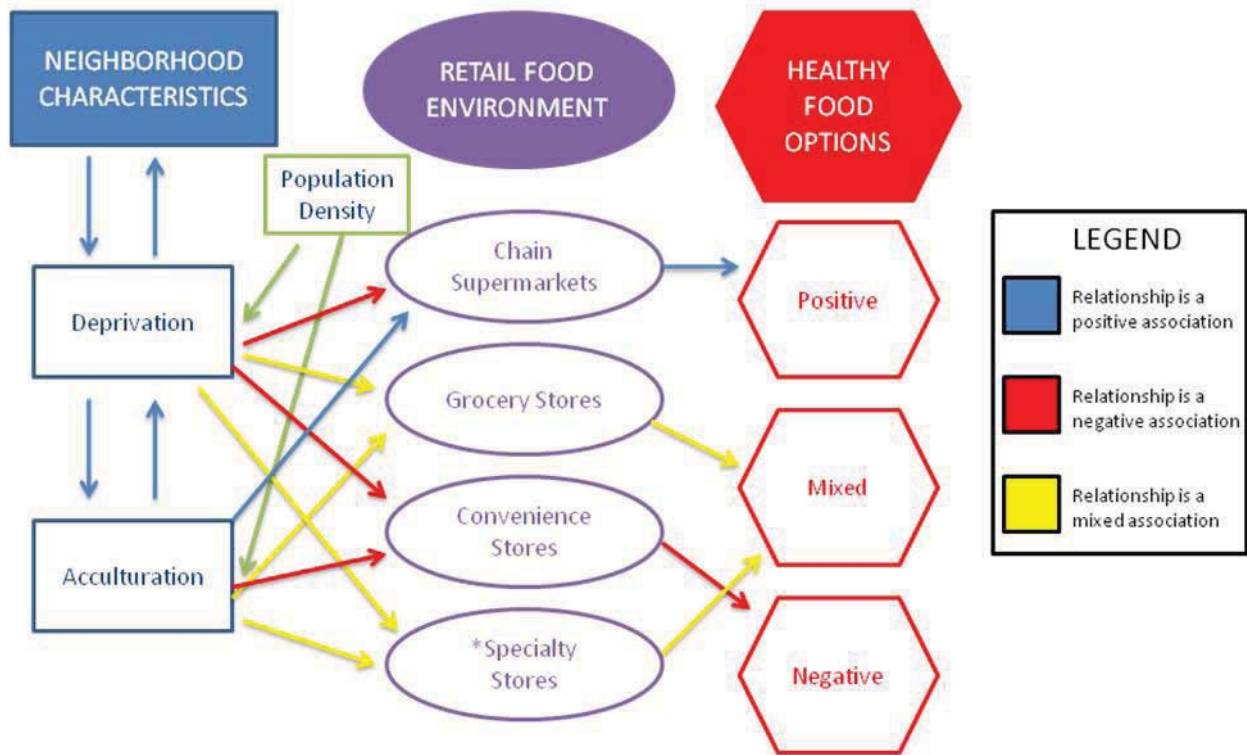


Figure 1. Previous research results showing associations between neighborhood deprivation, neighborhood acculturation, retail food stores, and healthy food options.

* Specialty stores include bakeries, fruit and vegetable markets, and meat markets.

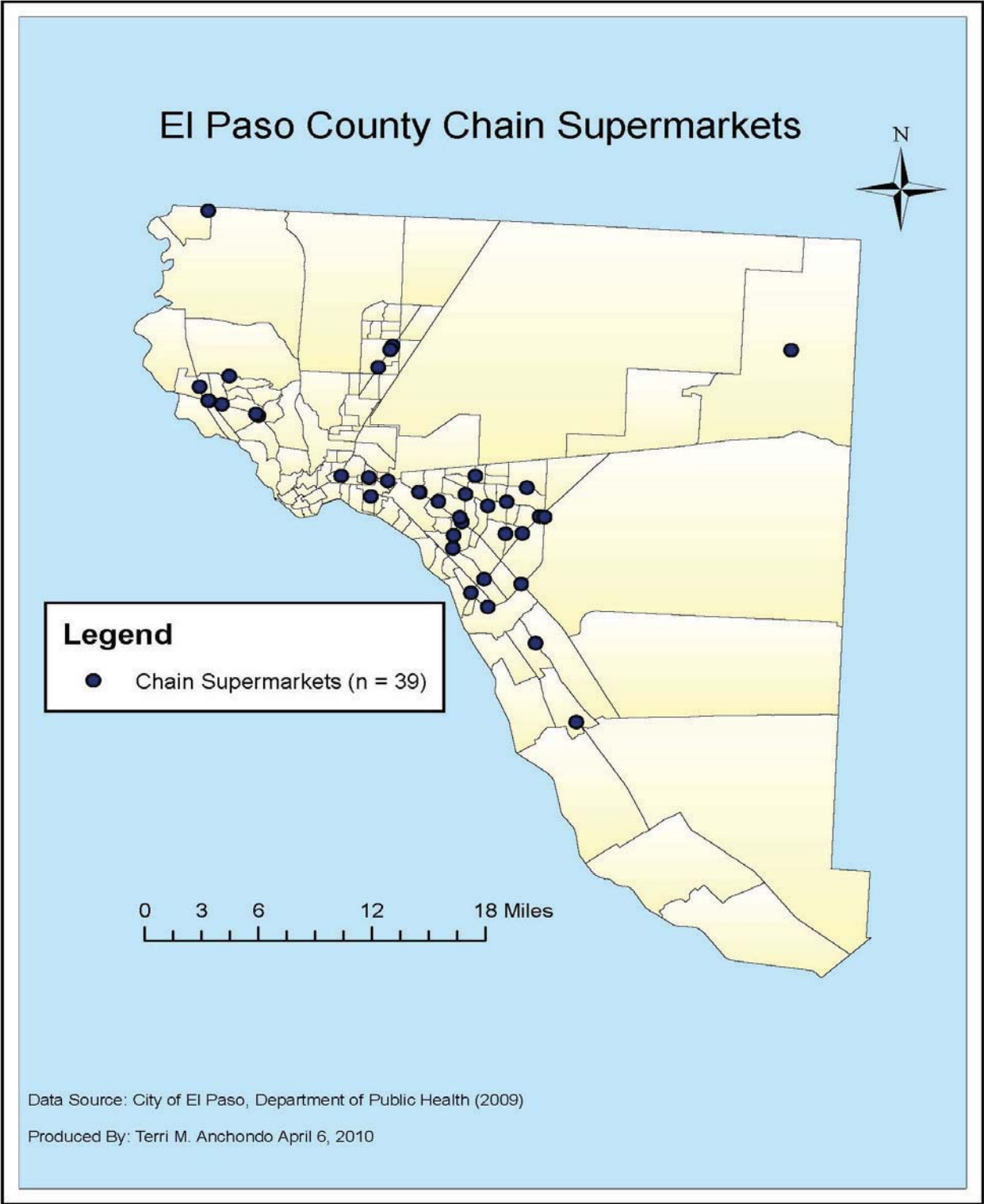


Figure 2. Chain Supermarkets in El Paso County

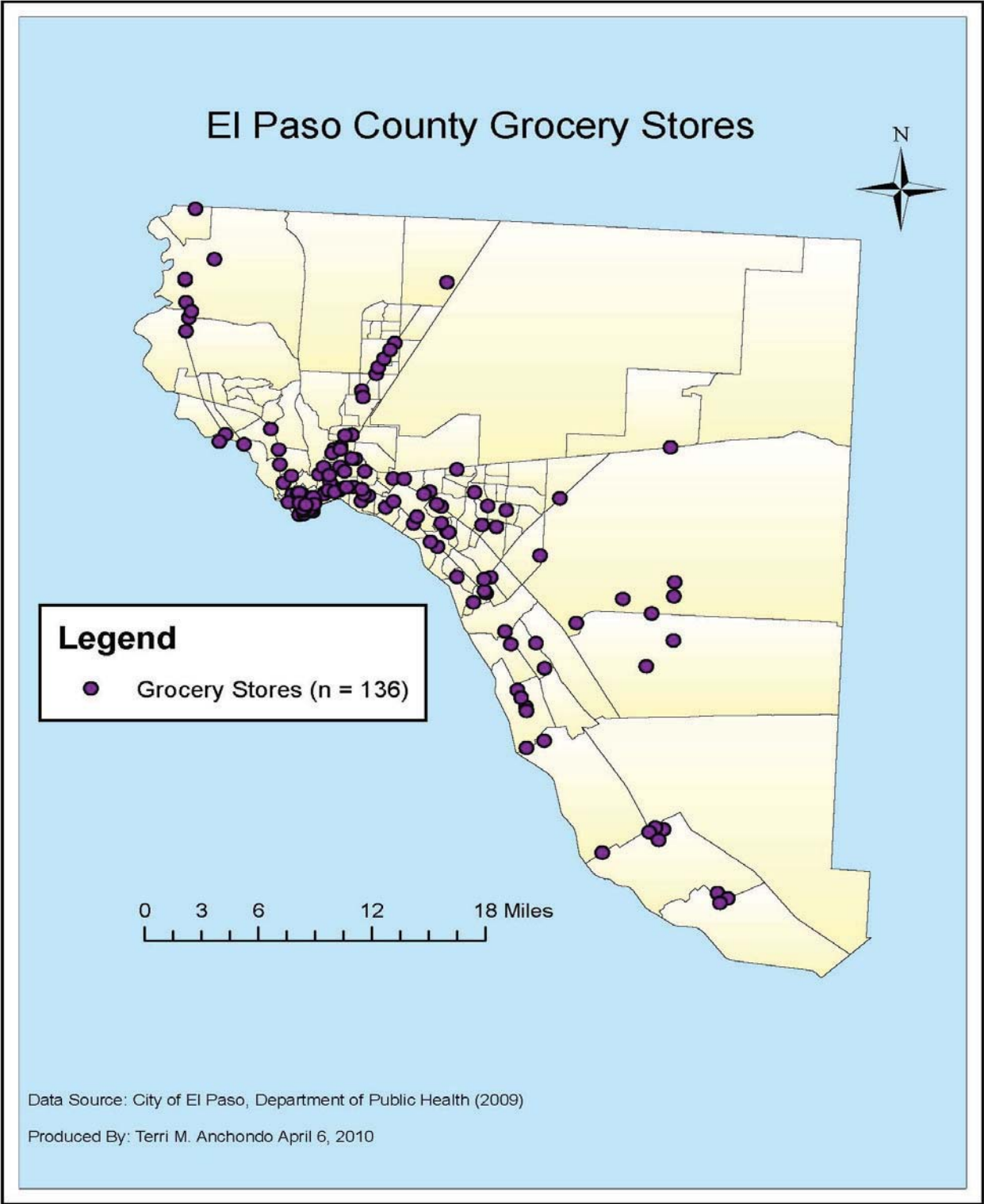


Figure 3. Grocery Stores in El Paso County

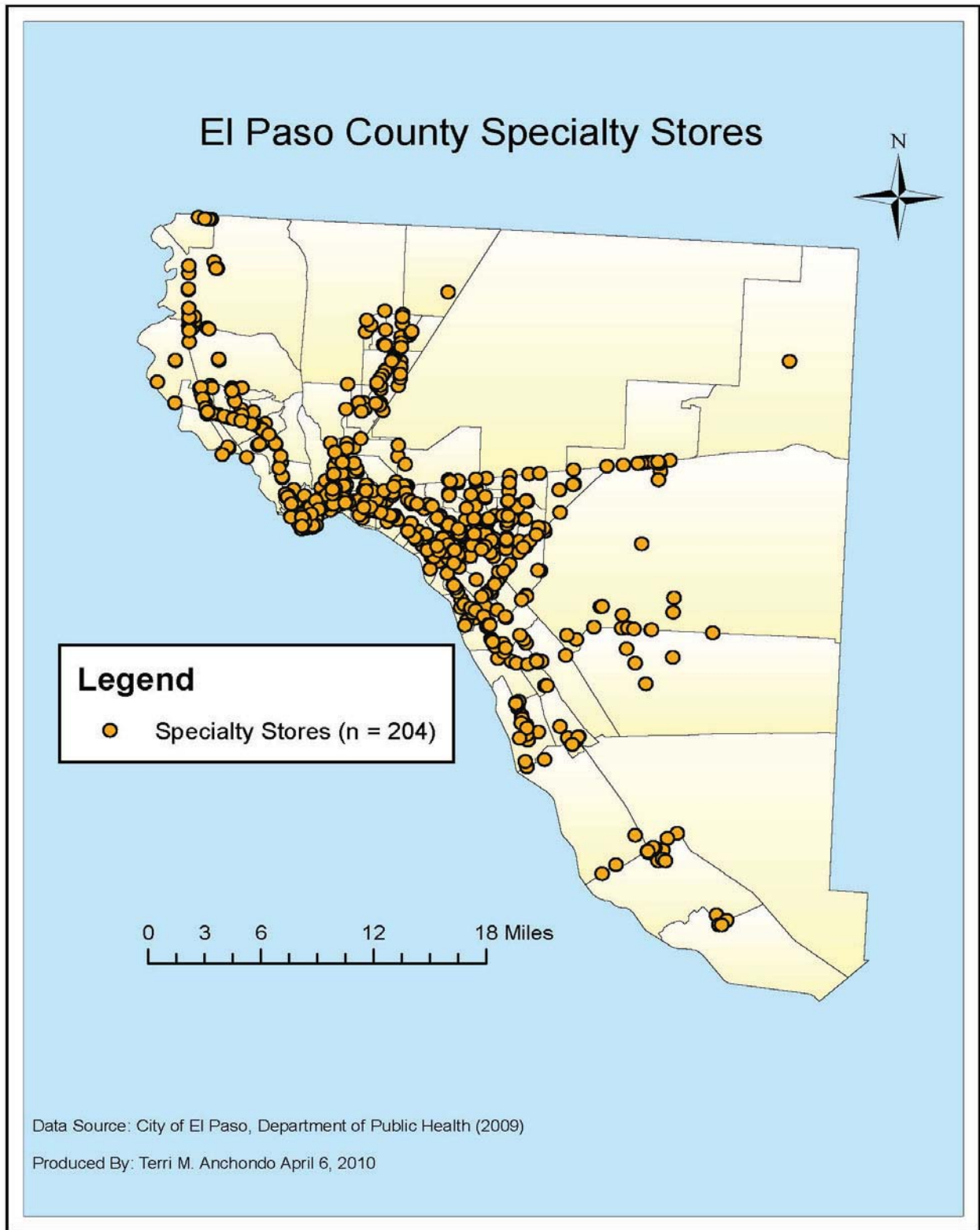


Figure 4. Specialty Stores in El Paso County

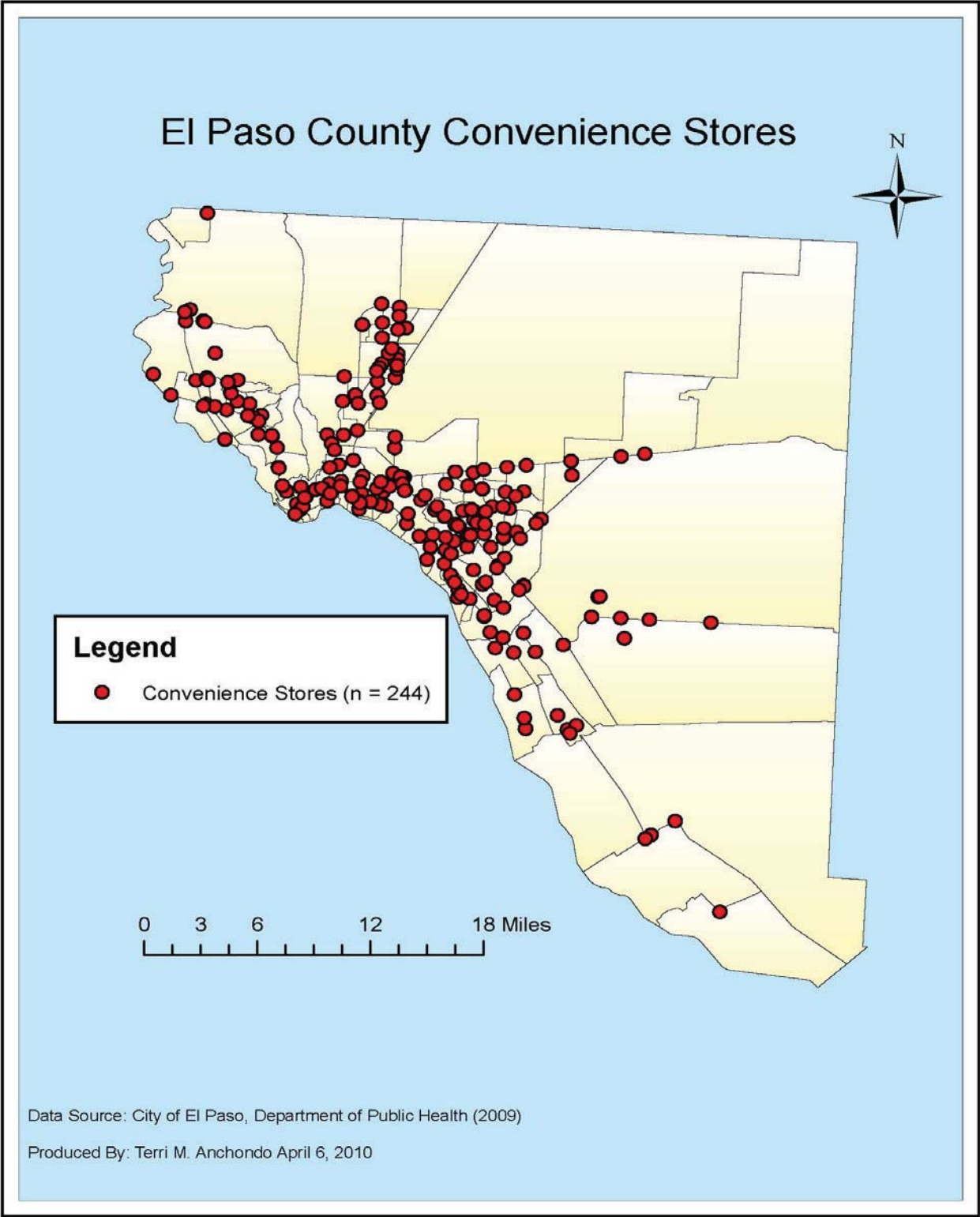


Figure 5. Convenience Stores in El Paso County

CURRICULUM VITA

Teresa Mercedes Anchondo was born in El Paso, Texas, the second daughter of Rick L. and Josie C. Anchondo. She has three sisters, Patricia, Cecilia, and Beatrice, and is the aunt of Erin Alexis Anchondo. In the fall 2005 Teresa graduated from the University of Texas at El Paso with a Bachelor's in Science, majoring in kinesiology with a minor in biology. After completion of her bachelor's degree, Teresa pursued a Master of Public Health at the University of Texas at El Paso. While pursuing a master's degree, she worked with the Texas Department of State Health Services on her Practicum during the summer and fall of 2008. Under the supervision of Adriana Corona she completed the 2007-2008 School Based Influenza like Illness Surveillance Project. Teresa graduated with a Master's of Public Health degree from the University of Texas at El Paso in May 2010 and plans to pursue a doctoral degree in public health. Her interests are chronic diseases and Hispanic health disparities along the U.S. – Mexico Border.