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# Geographic and Multilevel Influences of School Environments on the Development of Obesity and Physical Activity Among School Children in a U.S.-Mexico Border Community

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# GEOGRAPHIC AND MULTILEVEL INFLUENCES OF SCHOOL ENVIRONMENTS ON THE DEVELOPMENT OF OBESITY AND PHYSICAL ACTIVITY AMONG SCHOOL CHILDREN IN A U.S.-MEXICO BORDER COMMUNITY


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## Dedication

This paper is dedicated in memory of Dr. Paula B. Ford and Dr. David Wittenburg. Dr. Ford Passed away on October 8, 2011. Dr. Ford and I began working on this project for my dissertation when I entered the Ph.D. program in 2010. She was an outstanding mentor, friend, and will never be forgotten. Dr. Wittenburg passed away on October 26, 2015. Dr. Wittenburg agreed to become my dissertation chair after several individuals turned me down and for that, I am forever grateful.

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## Abstract

Childhood obesity, especially in Hispanic populations, is the most serious public health challenge of the 21st century (World Health Organization, 2014). Identifying risk factors at the individual, school and neighborhood level will help prevent the development of poor health outcomes such as diabetes and heart disease. The purpose of this study was to determine the associations between neighborhood deprivation, the retail food environment, obesity and physical fitness in children residing in El Paso, Texas. The study population included children in grades three through eight attending school in the El Paso Independent School District from 2009 to 2013. Approximately 42,000 student records across 58 elementary and 17 middle schools were included in the analysis. Neighborhoods were defined geographically as the area within a one-half mile radius of a school. The retail food environment was characterized by store type density at a one-half mile radius of the school. Annual FitnessGram® testing in schools was used to evaluate obesity and physical fitness. Linear regression and ANOVA were used for the analyses. Curl-ups and BMI percentile were inversely rated ($\beta = -0.13$, $p = 0.01$). The PACER Run (Needs Improvement) was directly related to BMI percentile ($\beta = 1.66$, $p = 0.03$). High convenience store density was related with high BMI percentiles ($\beta = 1.41$, $p = 0.02$). Levels of neighborhood deprivation directly varied with BMI percentile means ($F = 10.38$, $p = 0.00$) and inversely with push-up passing percentage ($F = 4.25$, $p = 0.01$). Levels of neighborhood deprivation varied directly with convenience store ($F = 3.69$, $p = 0.02$) and unhealthy specialty store ($F = 6.96$, $p = 0.00$) densities. These findings suggest that school and neighborhood environments are related to obesity and physical fitness in children. Additional research should include factors of the built environment such as access to parks. Future recommendations may include healthier land use policies and zoning ordinance aimed at decreasing obesity in children.

## Table of Contents

## List of Tables

## List of Figures

# Chapter 1: Introduction

## Project Aims

Childhood obesity is the most serious public health challenge of the 21st century (World Health Organization, 2014). Approximately 170 million children under the age of 18 are estimated to be overweight around the world (World Health Organization, 2012). In addition, the prevalence of overweight and obesity in children and adolescents has become a major public health concern in the United States (Langellier, 2012). In the past thirty years, the prevalence of obesity among children has tripled, with approximately 17% in the United States classified as obese in 2012 (Ogden, Carroll, Kit, & Flegal, 2014). Childhood obesity is associated with poor health outcomes such as diabetes, psychosocial problems, and increased risk of adult obesity and cardiovascular disease (Anderson, & Butcher, 2006; Field, 2008). One in every three children born in the last decade is expected to develop diabetes in their lifetime (Everson, Maty, Lynch, & Kaplan, 2002; Rocchini, 2002; Schroeder, 2011), and obesity in general, is estimated to cause 112,000 deaths per year nationwide (Task Force on Childhood Obesity, 2010). Health care expenditures for the treatment and management of childhood obesity are expected to exceed 14 billion dollars in the United States by 2030 (Grier & Davis, 2013; Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008).

The highest rates of obesity occur among populations with the highest poverty rates and the least education (Drewnowski & Specter, 2004). Poverty is associated with food insecurity (Wight, Kaushal, Waldfogel, & Garfinkel, 2014). Schools play an important role in providing daily meals to children at risk for food insecurity. More than 51% of children's daily energy intake is often made possible by The United States Department of Agriculture (USDA) National School Lunch Program and School Breakfast program (Hollar et al., 2010). Students with fast

food restaurants within half of a mile from their school reported consuming fewer fruits and vegetables, more sugar sweetened beverages, and were more likely to be obese as compared to students in schools with fast food restaurants at greater distances (Davis & Carpenter, 2009).

Hispanics represent 17% of the United States population, making them the largest and fastest growing minority group (U.S. Census Bureau, 2013). Currently, 42% of Hispanics adults over the age of twenty are classified as obese compared with 32.6% non-Hispanic Whites (Ogden et al., 2014), and because the Hispanic population is growing so fast, the expected impact on the healthcare system and the economy is considerable. By the year 2050, the U.S. Census projects that one in three persons in the U.S. was a Hispanic (Motel, 2012; Murdock, 2011). As identified by Healthy People 2020 and the Department of Health and Human Services (DHHS) National Healthcare Disparities Report, Hispanics are underserved by the U.S. healthcare system, including a lack of culturally relevant and competent care (Healthy People 2020, 2013). Therefore, the health of Hispanic communities in the U.S. has national implications and is also emphasized in the National Institutes of Health Disparities Strategic Plan (National Institutes of Health, 2012). Hispanics are more likely to be overweight, which places them at an increased risk for developing diabetes and other chronic health conditions. The prevalence and rate of increase of obesity among Hispanic children is significantly greater than non-Hispanic children (Coleman, Heath, & Alcalá, 2004; Freedman, Khan, Serdula, Ogden, & Dietz, 2006; Ogden et al., 2006) and the environment may be a major risk factor. Evidence suggests that the characteristics of neighborhoods, particularly the food environment, influence the risk of obesity in adults (Sallis & Glanz, 2009). Individuals who do not have adequate access to retail food stores that offer healthy foods may be restricted to foods that are higher in fat and calories which places them at a nutritional risk (Barnes, Freedman, Bell, Colabianchi, & Liese, 2016).

The overall goal of this study was to investigate the relationships between the school characteristics, specifically the retail food environment and obesity and physical activity among children from a predominately Hispanic community. Studies of school environments and childhood obesity and physical activity in large Hispanic population along the U.S.-Mexico Border are lacking. This study has broadened the understanding of the retail food environment and childhood health and has assisted in narrowing down effective, multi-level interventions for Hispanic children along the U.S.-Mexico Border.

## Background

### Obesity

Childhood obesity is a serious public health challenge (World Health Organization, 2014) with over 150 million children under the age of 18 estimated to be overweight (World Health Organization, 2012). Over the past thirty years, the prevalence of obesity among children in the United States has tripled (Ogden, Carroll, & Flegal, 2008). In 2012, 32% of children in the United States were either overweight or obese, and more than 17% of were classified as obese (Ogden et al., 2014). Childhood obesity is defined as a Body Mass Index (BMI) at or above the $95^{th}$ percentile according to BMI-for-age growth charts by gender (Flegal, Tabak, & Ogden, 2006), while overweight is defined as the $85^{th}$ to less than the $95^{th}$ percentile (Hohensee & Nies, 2012).

**Table 1: BMI-for-age weight status categories and the corresponding percentiles.**

| **Weight Status Category** | **Percentile Range** |
|---|---|
| Underweight | Less than the 5th percentile |
| Healthy Weight | 5th percentile to less than the 85th percentile |
| Overweight | 85th percentile to less than the 95th percentile |
| Obese | Equal to or greater than the 95th percentile |

Source: (Centers for Disease Control and Prevention, 2015a)

Obesity is primarily caused by an energy imbalance where caloric input exceeds energy expenditure (World Health Organization, 2015). Childhood obesity is associated with poor health outcomes such as diabetes, psychosocial problems, heart disease and increased risk of adult obesity (Anderson, & Butcher, 2006; Field, 2008; Sahoo et al., 2015). Caloric intake and energy expenditure are influenced by a multitude of factors at the individual, family, neighborhood, and community level. Past and current research has indicated that a high BMI is hereditary (Allison et al., 1996; Lowe, Shank, Mikorski, & Butryn, 2015), and family history of obesity has been used to identify individuals that are at risk for gaining excessive weight in the future (Agras, Hammer, McNicholas, & Kraemer, 2004). Evidence suggests that genetics and the built environment are associated with obesity (Comuzzie, Williams, Martin, & Blangero, 2001). The built environment is conducive of good health and includes access to supermarkets selling healthy foods, the distance to and safety of playgrounds, and adequate housing (Singh, Siahpush, & Kogan, 2010). It is estimated that by 2030, health care expenditures for the treatment and management of childhood obesity in the United States are expected to exceed 14 billion dollars annually (Grier & Davis, 2013).

In a recent analysis of the National Health and Nutrition Examination Survey (NHANES) data, Ogden et al., (2010) reported that Hispanic boys and girls were more likely to be obese, with an odds ratio of 1.80 (95% CI, 1.26-2.58) and 1.70 (95% CI, 1.07-2.71) respectively, when

compared to their non-Hispanic counterparts. Ogden et al., reported 23.4% of Mexican-American and 23.2% of Hispanic boys and girls of 6 to 19 years of age were obese, compared to 17% of non-Hispanic White children (Ogden et al., 2010).

The prevalence of childhood obesity varies by gender, ethnicity, socioeconomic status, education, and geographic residence (Borders, Rohrer, & Cardarelli, 2006; Drewnowski, Rehm, & Solet, 2007). Currently, the 54 million Hispanics in the United States represent 17% of the national population, making them the largest and fastest growing minority group as compared to 13.2% African American (U.S. Census Bureau, 2013). By the year 2050, the United States Census projects that one in three persons in the U.S. was a Hispanic (Motel, 2012; Murdock, 2011). Hispanics, compared to non-Hispanic whites, are more likely to be overweight, which places them at an increased risk for developing diabetes and other chronic health conditions (Mier et al., 2008; Mier et al., 2013). Hispanic children experience a significantly greater prevalence and incidence rate of obesity than non-Hispanic children (Coleman, 2005; Freedman et al., 2006; Ogden et al., 2006). In 2010, the prevalence of childhood obesity for children between 2-19 years of age was 21% as compared to 14% among non-Hispanics (Arauz Boudreau, Kurowski, Gonzalez, Dimond, & Oreskovic, 2013).

## Physical Activity

Physical activity is defined as any bodily movement produced by skeletal muscles that result in energy expenditure (Caspersen, Powell, & Christenson, 1985). The Centers for Disease Control and Prevention (CDC) recommend that children and adolescents between six and 17 years of age participate in 60 minutes or more of daily physical activity (Centers for Disease Control and Prevention, 2015c). Physical activity is associated with overall improved health

outcomes (Centers for Disease Control and Prevention, 2015c). Current research states that 15.3% of all high school students meet the CDC physical activity recommendations (Mier et al., 2013). Physical activity differs by ethnicity; significantly lower rates were reported among Hispanic high school students (11.8%) as compared to non-Hispanic Whites (16.9%) (Mier et al., 2013). The availability and quality of school physical activity environments is associated with physical activity levels of students during lunch or after school (Booth, et al., 2001; Sallis et al., 2001). Physical activity environments differ by school (Hohensee & Nies, 2012) and accessibility of physical activity environments after school may vary by neighborhood.

**Physical Activity and Nutrition**

Approximately, half of all adults in the United States have one or more diet related chronic diseases, including cardiovascular disease, type 2 diabetes, and overweight and obesity (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). Evidence suggests that healthy eating and regular physical activity can assist individuals in maintaining good health and thus reduce the risk for chronic diseases.

Adults who participate in less than 30 minutes of physical activity should consume one and a half to two cups of fruit and two to three cups of vegetables daily (Moore & Thompson, 2015). However, during 2007-2010, 76% of the United States population did not meet the daily fruit intake recommendations, and 87% did not meet the daily vegetable intake recommendations (National Cancer Institute, 2011). The typical American diet, usually referred to as the Western diet (Cordain et al., 2005) includes an increased consumption of fat, processed meats, snack foods, and fast foods (Liu, Probst, Harun, Bennett, & Torres, 2009) and a decreased consumption of whole grains, fish, and vegetables (Bermudez, Falcon, & Tucker, 2000; Satia-Abouta,

Patterson, Neuhouser, & Elder, 2002). Low income areas tend to have limited access to healthy food, high access to unhealthy food, and low access to recreation facilities (City of El Paso Department of Public Health, 2013). Physical activity and dietary intake is related to the availability of resources such as transportation, and neighborhood characteristics (Macintyre, 2007).

**Neighborhoods**

Neighborhoods provide an important context for eating behaviors and physical activity (Macintyre & Ellaway, 2003). Neighborhoods are defined as small socially homogeneous areas using national census data (Lang et al., 2008). Census tracts often serve as proxies when evaluating neighborhoods because they have fairly consistent boundaries and provide outcome gradients that are typically consistent with those using individual measures (Krieger et al., 2003). Environmental features within a neighborhood, such as street design, lighting, safety, paved sidewalks, parks, playgrounds, and recreation facilities are all important factors related to physical activity and obesity (Davison & Lawson, 2006; Kaczynski, Potwarka, & Saelens, 2008). However, due to neighborhood segregation by race, ethnicity, and income, neighborhood resources can vary (Acevedo-Garcia, Lochner, Osypuk, & Subramanian, 2003) and physical activity may be limited.

**Neighborhood Deprivation**

Neighborhood deprivation refers to unmet basic human needs due to a lack of resources, such as income, housing, health, and education (Ball et al., 2008) that is typically operationalized as a composite of variables that reflect socioeconomic status (SES) of the residents. The relative

level of neighborhood deprivation reflects many things including low income, poor living environment, high crime levels and other indicators typically derived from census data (Lang et al., 2008). Neighborhood segregation by income is frequently the cause of disparities in a neighborhood's ability to support healthy eating and active lifestyles (Acevedo-Garcia et al., 2003).

Living in a deprived neighborhood has been associated with many unmet needs such as access to food stores with affordable fresh produce as well as safe places to exercise. Previous studies suggest that as neighborhood deprivation increases, the prevalence of supermarkets decreases (Powell, Auld, Chaloupka, O'Malley, & Johnston, 2007). Whereas, the frequency of convenience stores and fast food restaurants increases (Wang, McPherson, Marsh, Gortmaker, & Brown, 2007). Low income and minority populations are more likely to have limited access to supermarkets (Black & Macinko, 2008; Larson, Story, & Nelson, 2009). Further research is necessary to clearly determine if food environments impact the risks of obesity among children.

**The Cultural Environment**

Culture is defined as the learned and shared beliefs and values of a particular group that often influence an individual's thinking and actions (Micklesfield et al., 2013). One's cultural environment may have an effect on the quality of foods consumed and has been linked to overall health behaviors (Lara, Gamboa, Kahramanian, Morales, & Hayes Bautista, 2005). The impact of one's cultural environment varies depending on where you are and what you are exposed to. Mexicans, Mexican Americans and African Americans tend to live in different types of environments, and therefore their exposure to obesity risk factors may vary (Do et al., 2007). Research indicates that healthier ethnic food outlets and closer relationships with nearby

residents may offset adverse outcomes associated with obesity (Salinas, Rocha, Abdelbary, Gay, & Sexton, 2012).

## Colonias

The increased demand for low cost housing has led to the creation of over 2,294 colonias along the U.S.-Mexico Border (Sharkey, Dean, & Johnson, 2011). Individuals living in colonias face greater disparity in access to health care, and physical activity facilities (Umstattd Meyer, Sharkey, Patterson, & Dean, 2013). The term "colonia" in Spanish means a community or neighborhood (Texas Secretary of State, Cascos, Carlos H., 2016). Colonias are defined as a residential area along the Texas-Mexico Border that may lack basic infrastructures, such as potable water and sewer systems, electricity, paved roads, and safe, sanitary housing (Hargrove, Juarez-Carillo, & Korc, 2015). Mexican American children overall are at an increased risk of diabetes, obesity, high cholesterol, and hypertension, particularly those living in colonias (Umstattd Meyer et al., 2013).The lack of infrastructure and poverty often leads to food insecurity and poor nutritional health which can cause obesity (Marquez-Velarde, Grineski, & Staudt, 2015).

## Retail Food Environment

Evidence suggests that the characteristics of neighborhoods, particularly the food environment, influence the risk of obesity in adults (Sallis & Glanz, 2009). Neighborhood food environments include the availability and accessibility of all food sources within an area that may vary by store type, pricing, advertising, and distance (Glanz, Sallis, Saelens, & Frank, 2005; Glanz, Sallis, Saelens, & Frank, 2007). Retail food store types include fast food restaurants, full service restaurants, convenience stores, grocery stores and supermarkets (Glanz et al., 2005;

Saelens, Sallis, Black, & Chen, 2003). Additionally, deprivation may impact the availability retail food stores. Individuals who do not have adequate access to retail food stores that offer healthy foods may be restricted to foods that are higher in fat and calories which places them at a nutritional risk. Previous studies have analyzed the density and proximity to various retail food store types. Such that, living in close proximity to a supermarket is associated with a decreased risk of obesity (Liu, Wilson, Qi, & Ying, 2007), while higher BMIs have been reported among children living within a five minute walk of a fast food restaurant (Carroll-Scott et al., 2013). The majority of studies relating obesity and physical activity to the retail food environment have been conducted in regions that are primarily Caucasian or African American and we know little about how such process might operate in regions that are predominantly Hispanic.

**Household Food Insecurity**

Household food insecurity is defined as "reduced or uncertain access to healthful and safe foods or the limited ability to acquire enough foods in socially acceptable ways" (Coleman-Jensen, Rabbitt, Gregory, & Singh, 2015). Food insecurity refers to the inability to afford nutritionally adequate and safe foods (Seligman, Laraia, & Kushel, 2010). In 2014, 17.4 million U.S. households (14%) were food insecure (United States Department of Agriculture Economic Research Service, 2015). Approximately four million (9.4%) U.S. households with children under the age of 18 and adults were food insecure (United States Department of Agriculture Economic Research Service, 2015). These children have an increased likelihood of poor health and difficulties learning in school (Rosenkranz & Dzewaltowski, 2008). In 2014, 22.4% of Hispanic families in the United States were food insecure, and of U.S. households with child food insecurity 26.9% were Hispanic (Coleman-Jensen et al., 2015).

Household food insecurity consists of low food security, “a reduction in food quality, variety, or desirability and sometimes dietary intake and very low food security, reduced energy intake and change in eating habits at multiple times over the course of a year” (Nalty, Sharkey, & Dean, 2013a). Individuals at risk for food insecurity may be associated with poor access to supermarkets and grocery stores, limited access to physical activity facilities, inadequate transportation, and insufficient funds for purchasing food (Arteaga & Heflin, 2014; Edwards, Theriault, Shores, & Melton, 2014; Leung, Epel, Ritchie, Crawford, & Laraia, 2014; Rosenkranz & Dzewaltowski, 2008).

**Table 2. Food Security and Insecurity Measures**

| | |
|---|---|
| High food security | Households had no problems, or anxiety about, consistently accessing adequate food. |
| Marginal food security | Households had problems at times, or anxiety about, accessing adequate food, but the quality, variety, and quantity of their food intake were not substantially reduced. |
| Low food security | Households reduced the quality, variety, and desirability of their diets, but the quantity of food intake and normal eating patterns were not substantially disrupted. |
| Very low food security | At times during the year, eating patterns of one or more household members were disrupted and food intake reduced because the household lacked money and other resources for food. |

Source: (United States Department of Agriculture Economic Research Service, 2015)

**Food Banks and Food Pantries**

In response to hunger and food insecurity, numerous federal and private food assistance programs were created (Anderson, 2013). A food bank is defined as a "non-profit hunger relief organization that serves as a clearing house to solicit, inspect, repack and distribute food to the organizations like food pantries, soup kitchens and shelters that feed individuals" (El Pasoans Fighting Hunger Food Bank, 2015). The majority of food donations are made by the USDA, Feeding America, Feeding Texas, grocery chains, and local food manufacturers (El Pasoans Fighting Hunger Food Bank, 2015). A food bank or food pantry distributes food and grocery items to individuals that are at risk of hunger (Feeding America, 2016a).

**School Food Environments**

A student in the U.S. spends approximately 6 hours a day in school 180 days out of the year (Holub et al., 2014), and are exposed to a variety of food establishments on their way to and from school. One-third of all U.S. public middle and high schools have at least one fast food restaurant or convenience store within walking distance (Sánchez, Sanchez-Vaznaugh, Uscilka, Baek, & Zhang, 2012), making it easier for consumption before and after school. Students with fast food restaurants within half a mile of their school reported consuming fewer fruit and vegetables, more sugar sweetened beverages, and were more likely to be obese as compared to students in schools with fast food restaurants at greater distances (Davis & Carpenter, 2009). In contrast, other studies have reported no associations between proximity of fast food restaurants around schools and obesity in children (Burdette & Whitaker, 2004; Powell, Auld, Chaloupka, O'Malley, & Johnston, 2006; Sturm & Datar, 2005). Research has shown that schools located in low income neighborhoods are more likely to be near fast food and convenience stores (Simon, Kwan, Angelescu, Shih, & Fielding, 2008; Sturm & Datar, 2005; Zenk, & Powell, 2008).

Despite meaningful efforts, further research is necessary to clearly determine if the food environments near schools impacts the risks of obesity amongst children.

Federal food programs are designed to assist low income families in gaining access to nutritious food (Community Food Advocates, 2016). The USDA National School Lunch Program (NSLP) is a federally assisted meal program that operates in 100,000 public and non-profit private schools and residential child care institutions (United States Department of Agriculture Food and Nutrition Service, 2013). The NSLP was established in 1946 and currently serves more than 31 million children each school day (Jeon, Kim, & Kim, 2012). Schools that choose to participate in the lunch program get cash subsidies and USDA foods for each meal that they serve to any child that is enrolled in kindergarten through the twelfth grade (United States Department of Agriculture Food and Nutrition Service, 2013). In return, each school must serve lunches that meet federal requirements and offer free or reduced price lunches to all eligible children (United States Department of Agriculture Food and Nutrition Service, 2013). Children from families with incomes between 130 percent and 185 percent of the poverty level are eligible for reduced meals, where students can be charged no more than 40 cents (United States Department of Agriculture Food and Nutrition Service, 2013). Table 3 shows the regular meal prices and reduced price for elementary and middle school children attending the EPISD.

**Table 3. Meal Prices at EPISD Elementary and Middle Schools**

| Breakfast (Elementary and Secondary) | Lunch (Elementary) | Lunch (Middle) |
|---|---|---|
| Regular Price $1.25 | Regular Price $2.00 | Regular Price $2.25 |
| Reduced Price $0.30 | Reduced Price $0.40 | Reduced Price $0.40 |

Source: (El Paso Independent School District, 2017)

**Zoning Restrictions and Policy**

Zoning laws determine how city land is used and these different uses can take place (Wooten et al., 2013). The State of Texas city zoning ordinance requires liquor stores to be further than 300 feet of a public school which is identified in the Texas Alcoholic Beverage Code 109.33 (Texas Alcoholic Beverage Commission, 2015). Alcoholic beverage sales can be restricted to 1,000 feet of a public school if the governing body receives a request from the board of trustees of a school district under Section 38.007 (Texas Alcoholic Beverage Commission, 2015). Recently, zoning has been used to regulate fast food outlets which can be classified as a ban or restriction. Zoning bans may consist of complete bans on the creation of new fast food outlets within a city or banned from specific areas within a city (Corporations and Health, 2010). Restricting the number of fast food outlets places a cap on the number of outlets that can exist in a specific area or city (Corporations and Health, 2010). In addition, zoning restrictions can be placed on the density of fast food restaurants and the amount of space between various outlets. In 2008, the Los Angeles City Council approved zoning restrictions where one fast food outlet is allowed for every 400 feet (Robert Woods Johnson Foundation, 2016). More recently fast food zoning regulations have been placed on the distance to schools, churches, hospitals, nursing homes banned. Detroit, Michigan currently has a zoning code that prohibits most fast food restaurants from being built within 500 feet of all elementary, middle, and high schools (Corporations and Health, 2010).

Other than liquor stores, the City of El Paso does not have any policies that restrict the placement of retail establishments near public schools (The City of El Paso, 2016). All other store types can be located anywhere in El Paso as long as it is within the commercial zoning

areas. Individuals interested in opening a new establishment are required to obtain a building permit and business license (The City of El Paso, 2017).

Under the Affordable Care Act, menu labeling of calories became a law in 2010. This law covers certain foods prepared in supermarkets, food establishments with 20 or more outlet locations, and food establishments operating under the same name (U.S. Food and Drug Administration, 2016). In December 2009, a National Healthy Food Financing initiative was introduced into the House of Representatives (Centers for Disease Control and Prevention, 2011). In 2012, President Obama proposed funding for a Healthy Food Financing Initiative (HFFI) that hopes to increase access to healthier foods in underserved communities by providing financial assistance or incentives to attract healthier food outlets or improve healthier food offerings in existing stores (Centers for Disease Control and Prevention, 2011).

**Research Problem**

Childhood obesity is the most serious public health challenge of the $21^{st}$ century (World Health Organization, 2014). Hispanics are at higher risk for obesity, (Flegal et al., 2006; Mier et al., 2008) and because the Hispanic population is growing so fast, the expected impact on the healthcare system and the economy is considerable. Texas is currently the 19th most obese state in the nation, (Robert Woods Johnson Foundation, 2013) with 19.1% of children identified as obese, and 17.5% were overweight (National Survey of Children's Health, 2012). Compared to national averages, residents living along the U.S.-Mexico Border are reported to have increased poverty levels, low educational attainment, and higher rates of obesity (Bruhn, 2014). In the U.S.-Mexico Border the County of El Paso, Texas, it is estimated that 33% of adult Hispanics are

obese and that rate increases to 50% among individuals over 45 years of age (Coleman et al., 2004).

The factors that influence childhood obesity are many, occur at different levels, and interact amongst each other. Caloric intake and energy expenditure, the two most proximal variables in weight gain and loss, are influenced by factors at the individual, family, neighborhood, and community level. The majority of studies on the food environment analyze fast food restaurants and convenience stores, and its association with BMI among adults. Currently, the effects of the food environment and obesity among children remain unclear. Conducting research in El Paso, which is representative of the border region, is ideal to unravel how the multilevel factors interact in the border context. The interaction amongst the multilevel factors impacting obesity is expected to be different along the U.S.-Mexico Border. The range of access to and availability of foods from both countries and cultural influences are present, however, its impact on childhood obesity is unknown. There is limited information on the influences of neighborhood and school environments on the development of obesity among primarily Hispanic children in El Paso, Texas.

## Theoretical Framework

The first ecological model was proposed by Urie Bronfenbrenner in 1977 (Bronfenbrenner, 1977). This model provides a conceptual framework to analyze how the environment in which people live, plays a role in the development of behaviors and risk factors influences health outcomes (Bronfenbrenner, 1977). Approximately ten years later, McLeroy, Bibeau, Steckler, and Glanz (1988) adapted Bronfenbrenner's model to create a theoretical framework that is specifically related to health promotion and is called the social ecological model (McLeroy, Bibeau, Steckler, & Glanz, 1988). The social ecological model emphasizes the

interaction of complex factors that operate at multiple levels, including at the individual, interpersonal, organizational, community, and public policy layers.

The individual layer is the primary circle of the entire model and identifies that the individual is affected by other layers within the model. Individual factors that can influence health include behaviors, knowledge, and beliefs (Centers for Disease Control and Prevention, 2013). The next layer is the interpersonal level, which represents individuals' interactions with others such as family, friends, culture, and values. In this part of the framework, we can take a look at how family habits related to food consumption may also be affected by food choice, and traditional preparation, (Dietz & Gortmaker, 2001). The next layer is the organizational level. The organizational level pertains to specific to groups, including schools, and faith-based organizations (Centers for Disease Control and Prevention, 2013). The next layer is the community level. Within the model, communities are composed of larger groups of individuals that include a combination of the individual, interpersonal, organizational layers. Each community can be defined by location, neighborhood, park location, or recreation facility (Centers for Disease Control and Prevention, 2013). The outermost layer within the Social Ecological Model is Public Policy. This layer represents the local, state, and federal regulations that affect the built environment surrounding communities and individuals (Centers for Disease Control and Prevention, 2013). Figure 1 illustrates an ecological model highlighting the factors at different levels of influence that can impact childhood obesity. As the levels move away from the individual layer, they tend to have more of an indirect influence on health. The framework highlights the multiple levels of influence and the idea that behaviors both shape and are shaped by the social environment (Glanz et al., 2005).

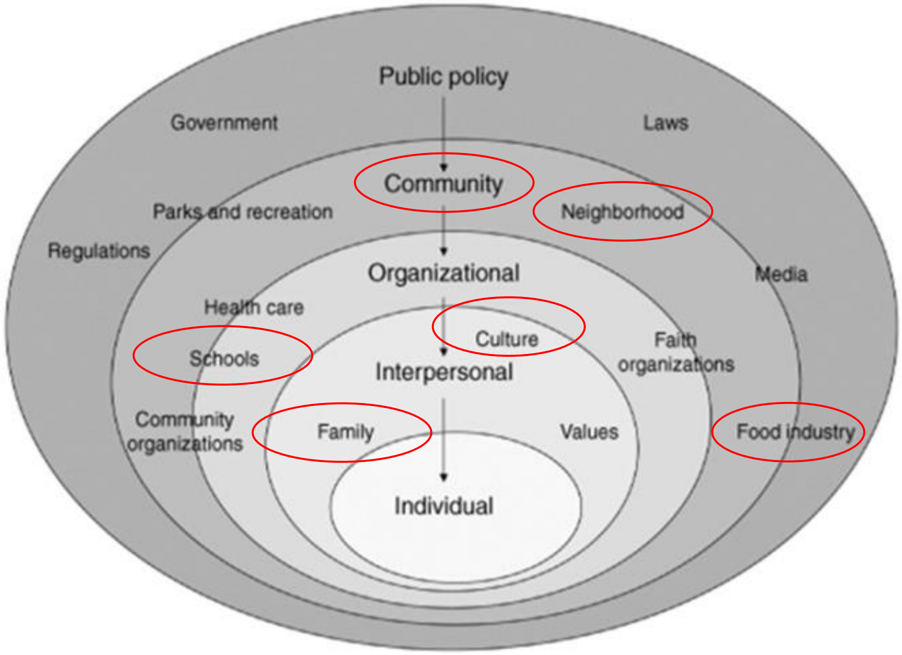


**Figure 1. The Social Ecological Framework (Caprio et al., 2008) Highlighting potential risk factors for childhood obesity in red.**

When analyzing childhood obesity, the model looks at characteristics that could affect a child's weight status in relation to the multiple environments surrounding the child (Davison & Birch, 2001). This model examines the combined effects of the community in which the child lives, parenting and family factors, along with individual factors that impact a child's weight (Peters et al., 2016).

## Purpose

The primary purpose of this study was to determine the associations of the retail food environment surrounding schools on the development of obesity and physical fitness in school-age Hispanic children. The study took place in El Paso, Texas, a U.S.-Mexico Border community with approximately 82% of the population classified as Hispanics (U.S. Census Bureau, 2013). In 2013, 30% of El Paso residents lived in food deserts, compared to 15% of Texans and 9% of

United States residents (City of El Paso Department of Public Health, 2013). Compared to national averages, residents living along the U.S.-Mexico Border are reported to have increased poverty levels, low educational attainment, and higher rates of obesity (Bruhn, 2014).

Additionally, the associations between neighborhood deprivation and the association of the retail food environment on the development of obesity and physical fitness in school age children at the school level. Finally, the results from this study increased our understanding of how unique characteristics of the built and sociocultural environments may influence the risk of obesity amongst children in El Paso, Texas and will support the development of more effective interventions applicable to the population living along the U.S.-Mexico Border.

**Overall Aim and Hypotheses**

**Aim 1**: To determine the associations between neighborhood deprivation, and the retail food environment around the school along with the influence of childhood obesity and physical fitness within EPISD elementary and middle schools.

**Hypothesis 1:** Schools with higher averages of physically fit children, will have lower BMI percentiles.

**Hypothesis 2:** Schools with higher averages of overweight or obese children, will have a higher density of unhealthy food stores (convenience stores, fast food restaurants, specialty food stores, and liquor stores) within a half mile radius around their school.

**Hypothesis 3:** Schools in more economically deprived neighborhoods will have lower average physical fitness scores and higher average BMI percentile scores than schools in less economically deprived neighborhoods.

**Hypothesis 4:** Schools in more economically deprived neighborhoods will have a higher density of unhealthy food stores (convenience stores, fast food restaurants, specialty food stores, and

liquor stores) and higher averages of BMI than schools in less economically deprived neighborhoods.

## Significance

The factors that influence childhood obesity are many, occur at different levels, and interact amongst each other. Hispanics are more likely to be overweight, which places them at an increased risk for developing diabetes and other chronic health conditions. El Paso, Texas is situated along the U.S.-Mexico Border and is home to over 800,000 individuals (U.S. Census Bureau, 2013). A quarter of El Paso County residents live below the federal poverty level, compared to 17% in Texas and 14% in the United States (City of El Paso Department of Public Health, 2013). El Paso's low income places residents at risk for overweight and obesity. The majority of studies on the food environment analyze fast food restaurants and convenience stores, and their association with BMI among adults. To date, the effects of the food environment and obesity among children remain unclear. This project addresses the current gaps in the research by examining both the school level sociocultural and built environmental influences on obesity prevalence and obesity risk among school children in El Paso, Texas. This application has assisted in identifying what is taking place inside the schools as well as the areas surrounding schools that creates an environment that either supports or hinders healthy eating. The identification of these modifiable characteristics is critical to developing interventions within schools and neighborhoods that can halt the rise and ultimate overturn the rates of obesity, particularly in school children along at the U.S.-Mexico Border.

**Assumptions**

1.) Obesity and overweight individuals are placed at an increased risk for many chronic health conditions including diabetes and cardiovascular disease (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010).

# Chapter 2: Review of the Literature

## Childhood Overweight and Obesity

The most current research indicates that 32% of children in the United States were either overweight or obese, and more than 17% were classified as obese in 2012 (Ogden et al., 2014). Texas is currently the 19th most obese state in the nation, (Robert Woods Johnson Foundation, 2013) with 19.1% of children identified as obese, and 17.5% were overweight (National Survey of Children's Health, 2012). Along the U.S.-Mexico Border in El Paso, Texas, it is estimated that 33% of adult Hispanics are obese and that rate increases to 50% among individuals over 45 years of age (Coleman, Heath, & Alcalá, 2004). Researchers have begun looking at the role of the neighborhood environment and its potential impact on obesity (Bodor, Rice, Farley, Swalm, & Rose, 2010). Such that the places where we live, the things we eat, and the way we choose to get around affect our health (Rahman, Cushing, & Jackson, 2011). The built environment has been defined as all aspects of physical environments that are created or modified by individuals (Van Hulst, Gauvin, Kestens, & Barnett, 2013). Characteristics of the built environment such as residential land use, access to recreation facilities, and parks have been related to obesity and physical activity (Harris et al., 2011). Researchers have begun to analyze the retail food environment to identify a potential impact on obesity. For instance, a greater density of fast food restaurants or convenience stores around residences is associated with increased rates of obesity, and access to supermarkets is associated with decreased rates of obesity (Epstein et al., 2012; Morland & Evenson, 2009). Evidence shows that modifying the built environment will increase children’s physical activity and access to healthy foods, and reduce their access to unhealthy foods (Rahman et al., 2011; Sallis & Glanz, 2006). Therefore, the built environment near schools may also have an impact on obesity among children.

## Physical Activity

Physical activity habits and food intake depend on environmental structures that promote food consumption and set the stage for an active or sedentary lifestyle (López-Barrón, Jiménez-Cruz, & Bacardi-Gascón, 2015). Environmental characteristics that facilitate walking and bicycling such as the presence of paved streets and sidewalks, adequate lighting, and neighborhood safety may be influenced by parents' household income which can contribute to differences in children's sedentary behavior, physical activity, and overall weight status (Kwon, Mason, & Welch, 2015; Tandon et al., 2012). Several studies have shown that as neighborhood deprivation increases, individuals are less likely to be physically active (Berry et al., 2010) whereas the frequency of physical activity among affluent neighborhoods, increases (Van Dyck et al., 2010). This may be due to the lack of physical activity resources including fitness facilities, safe parks, and bicycle and walking paths (Booth, Pinkston, & Poston, 2005) coupled with poor sidewalks, crime, lack of adequate street lighting, and abandoned buildings (Berry et al., 2010). Schools are important settings for physical activity, and because of the long amount of time spent there, they allow numerous opportunities to be made available to all students (Button, Trites, & Janssen, 2013).

## Neighborhoods

Neighborhood environmental characteristics, including the availability of healthy food, quality of the physical activity environment, and overall socioeconomic status are suggested to impact obesity (Black & Macinko, 2008; Laxy, Malecki, Givens, Walsh, & Nieto, 2015). Studies indicate that individuals living in traditional neighborhoods, characterized by a high population density, a mixture of residential and commercial land use, and street patterns with short block

lengths, are more likely to walk and bicycle as a mode of transportation (Saelens et al., 2003). Residents from poor and minority neighborhoods are reported to have decreased access to healthy food options when compared to predominately White neighborhoods (Lamichhane et al., 2013).

**Neighborhood Deprivation and the Retail Food Environment**

Studies suggest that children and adolescents that are raised in deprived neighborhoods are predisposed to negative health outcomes (van Vuuren, Reijneveld, van der Wal, & Verhoeff, 2014) including antisocial behavior, mental health problems, and are at an increased risk of becoming overweight (Odgers, Caspi, Bates, Sampson, & Moffitt, 2012). Boardman et al., conducted a study on the influence of neighborhood environment on the risk for obesity, and found that residence in a poor community was associated with an increased risk of obesity (Boardman, Saint, Rogers, & Denney, 2005). Neighborhood deprivation has been associated with poor quality food environments and low potential for physical activity (Black & Macinko, 2008). As neighborhood deprivation increases, the prevalence of high quality grocery stores and markets decreases (Powell et al., 2007) whereas the frequency of low quality food stores (e.g., convenience stores) increases (Wang, McPherson, Marsh, Gortmaker, & Brown, 2007). Presumably, this trend is driven by economic policies that do not provide retail food chains with financial support in low income neighborhoods. Previous studies on the retail food environment in El Paso, Texas identified that high neighborhood deprivation was associated with fewer supermarkets and approximately three times as many specialty stores when compared to low deprivation neighborhoods (Anchondo & Ford, 2011). Sharkey and Horel, (2008) conducted a study within a six county rural region in Texas (Sharkey & Horel, 2008). The findings identified

that high neighborhood deprivation was associated with increased supermarket and grocery store availability. A similar finding was reported in a study of the local food environment in North Carolina, Maryland, and New York. In this study, Moore et al., (2008) reported that low-income individuals lived in census tracts with more supermarkets (Moore, Diez Roux, Nettleton, & Jacobs, 2008). A recent review of the literature identified only one study that has examined the physical health and lifestyle of children in the United States using neighborhood constructs (van Vuuren et al., 2014). Unfortunately, the bulk of studies relating neighborhood deprivation to the retail food environment have been conducted in regions that are primarily White or African American, and we know little about how such process might operate in regions that are predominantly Hispanic.

**The Role of Colonias**

The increased demand for low cost housing has led to the creation of over 2,294 colonias along the U.S.-Mexico Border (Sharkey, Dean, & Johnson, 2011). Colonia residents face many challenges such as poverty, poor access to health care, and environmental threats which can lead to food insecurity and can cause obesity (Marquez-Velarde et al., 2015). Approximately 400,000 Texans reside in colonias with 64.4% Hispanic, and 85% under the age 18 (Texas Secretary of State, 2016). Mexican Americans living in colonias reside in low income communities that consist of trailers and self-built housing (Dean, Sharkey, & St. John, 2011).

**Figure 2. Montana Vista Colonia Housing Establishment in El Paso County**

**Source:** (Anchondo, 2017)

The estimated household income for colonia residents living along the U.S.-Mexico Border are less than $834/month (Umstattd Meyer et al., 2013). In 2010, 86,472 residents lived in 321 colonia communities in El Paso County (Marquez-Velarde et al., 2015). It is currently unknown as to whether or not students are living in the colonias and traveling to schools in the EPISD.

Living in a food insecure household is associated with increased rates of overweight and obesity (Adams, Grummer-Strawn, & Chavez, 2003; Basiotis & Lino, 2003). In 2009, the Colonia Household and Community Food Resource Assessment Surveyed 610 households in colonias along the U.S.-Mexico Border. Seventy eight percent of households were food insecure, and 61.8% of households with children (n = 484) experienced food insecurity (Nalty, Sharkey, & Dean, 2013b). Sharkey et al., conducted a survey to analyze food purchases among 610 Mexican-origin women from 44 colonias residing along the U.S.-Mexico Border (Sharkey, Dean, & Johnson, 2012). The findings indicated that 49% of households were considered child

food insecure, and more than 60% had to travel over ten miles one way to purchase groceries (Sharkey et al., 2012). The high prices and poor access to supermarkets causes colonia residents to purchase foods of low nutritional quality from convenience stores or mobile vendors.

**Neighborhoods and the Retail Food Environment**

Evidence suggests that the characteristics of neighborhoods, particularly the food environment, strongly influence the risk of obesity in adults (Cummins & Macintyre, 2005; Sallis & Glanz, 2009). Retail food store types include fast food restaurants, full service restaurants, convenience stores, grocery stores and supermarkets (Glanz et al., 2005; Glanz et al., 2007; Saelens et al., 2003). Neighborhood food environments include the availability and accessibility of all food sources within an area and may vary by store type, pricing, advertising, and distance (Glanz et al., 2005; Glanz et al., 2007; Saelens, Glanz, Sallis, & Frank, 2007). Food environments influence nutritional intake and physical activity through factors such as access to safe recreation, accessibility of recreation facilities, and transportation options (Popkin, Duffey, & Gordon-Larsen, 2005).

**Supermarkets**

Individuals who do not have adequate access to retail food stores that offer healthy foods may be restricted to foods that are higher in fat and calories, which places them at a nutritional risk. Supermarkets tend to offer a wider variety of healthy foods at a lower cost (Larson et al., 2009), and are reported to carry three times as many healthy foods compared to grocery and convenience stores (Apparicio, Cloutier, & Shearmur, 2007). Reports on the association between availability of supermarkets and obesity have been mixed (Larson et al., 2009). A literature review by Larson et al., 2009, reported that neighborhood residents who have better access to

supermarkets and limited access to convenience stores have healthier diets and lower levels of obesity (Larson et al., 2009). A number of studies suggests that limited availability of supermarkets is associated with increased risk of obesity (Liu, Wilson, Qi, & Ying, 2007; Morland, Wing, & Roux, 2002; Powell, Auld, Chaloupka, O'Malley, & Johnston, 2007; Wang, McPherson, Marsh, Gortmaker, & Brown, 2007), and other studies reported no association between supermarket availability and obesity (Ford & Dzewaltowski, 2010; Sturm & Datar, 2005).

**Grocery Stores**

Residence in a low quality retail food environment is associated with reduced fruit and vegetable intake and increased risk of obesity (Ford & Dzewaltowski, 2008). However, one exception to this general trend may be small grocery stores. Grocery stores are smaller in size and are commonly found in low income (Glanz et al., 2007) and minority neighborhoods (Powell et al., 2007). In a study by Bodor, Rose, Farley, Swalm, & Scott (2008), researchers found that residents living within 100 meters of a grocery store had a higher consumption of fruits and vegetables compared to those lacking a grocery store in their area (Bodor, Rose, Farley, Swalm, & Scott, 2008). In an examination of 243 school districts in Pennsylvania, Schafft, Jensen, & Hinrichs (2009), analyzed the relationship between BMI and access to large grocery stores (Schafft, Jensen, & Hinrichs, 2009). Their results indicated that populated areas with limited access to healthy foods were more likely to be economically disadvantaged and have higher rates of overweight and obese children. A study conducted by Zenk, et al., (2006) reported that disadvantaged neighborhoods have fewer grocery stores with a limited selection of fresh fruits and vegetables at a higher price, as compared to wealthier neighborhoods (Zenk, et al., 2006).

**Specialty Stores**

Supermarkets and grocery stores are not the only providers of healthy food options within neighborhoods. Specialty stores, including meat markets, fruit and vegetable markets, and bakeries may also play an important role by providing healthy food options within Hispanic and Latino communities (Ayala, Baquero, & Klinger, 2008; Espinosa de los Monteros, Karla, Gallo, Elder, & Talavera, 2008; Pérez-Escamilla, 2009). Specialty stores may fill the gaps by providing healthy foods within ethnic neighborhoods (Margheim, 2016), and individuals might prefer to shop at these local specialty stores rather than supermarkets. Behjat, Koc, & Ostry (2013), state that failing to include specialty stores in research is likely to underestimate the availability of healthy food options (Behjat, Koc, & Ostry, 2013).

**Convenience Stores**

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). Convenience stores are common in low income area zip codes (Powell et al., 2007). Residents who rely on convenience stores may have significantly poorer quality diets due to the higher prices and limited availability of healthy foods. Borradaile, et al., (2009), conducted a study on convenience store food purchases made by students in grades four through six, before and after school in Philadelphia, Pennsylvania (Borradaile, 2009). The results indicated that chips, sugar sweetened beverages, and candy were the most frequently purchased, with an average of 356 calories per purchase (Borradaile, 2009). The findings from this study suggest that convenience food store purchases made before and after school may be contributing to the increase in overweight and obese children.

## Fast Food Restaurants

Fast food restaurants typically consist of food purchased in self-service or carry out without waiter service (Satia, Galanko, & Siega-Riz, 2004). The ready availability of fast foods, which tend to be calorie-dense and nutritionally poor, has been associated with an increased risk of obesity among adults (Maddock, 2004; Mehta & Chang, 2008) and children (Davis & Carpenter, 2009). The large portion size, coupled with the high fat and sugar content, has been shown to be positively associated with weight gain (Austin et al., 2005; Jeffery, Baxter, McGuire, & Linde, 2006). Mixed findings have led to inconclusive results regarding the relationship between fast food restaurants and BMI. Several studies have shown a positive association between fast food restaurants and increased BMI (Bodor et al., 2010; Carroll-Scott et al., 2013; Maddock, 2004; Mehta & Chang, 2008) while others have reported no association (Hickson et al., 2011; Jeffery et al., 2006; Seliske, Pickett, Boyce, & Janssen, 2009; Simmons, 2005). A recent study by Grier, & Davis, (2013) investigated the relationship of fast food restaurants to middle and high school adolescent weight (Grier & Davis, 2013). Their results showed that African American and Hispanic students attending low income schools had access to four times as many fast food restaurants as compared to White students attending higher income schools and increased body weight.

## Food Banks and Food Pantries

Poverty, unemployment, and lack of access to healthy nutritious food are all associated with food insecurity. In 2014, 46.7 million people (14.8%) and 15.5 million (21.1%) children under the age of 18 were in poverty (Feeding America, 2016b). In 2014, the federal poverty level was $23,550 for a family of four (Feeding America, 2014). Between 2012-2014 Texas

household food insecurity rates of 17.2% were higher than the U.S. national average of 14.3%. Table 3 shows a breakdown of food insecure individuals in the United States, Texas, and El Paso. In 2014, El Paso County had 146,000 (18.24%) adults and children living with food insecurity (El Pasoans Fighting Hunger Food Bank, 2015).

**Table 4. Food Insecure Individuals in 2014**

| | Adults and Children | Children |
|---|---|---|
| United States | 15.59% | 20.84% |
| Texas | 17.55% | 26.13% |
| El Paso | 18.24% | 33.81% |

Source: (El Pasoans Fighting Hunger Food Bank, 2015; U.S. Census Bureau, 2013).

In effort to combat food insecurity, food banks and food pantries were established. Feeding America is a nationwide network that currently serves over 200 food banks across the country (Feeding America, 2014). With the assistance of their partners, Feeding America is able to provide meals to more than 46 million Americans including 12 million children and seven million senior citizens annually (Feeding America, 2014). Feeding America then, in turn, provides food to the West Texas Food Bank (WTFB) located in Odessa, Texas. The WTFB Texas Food Bank is the largest non-profit organization that distributes donated and purchased food to over 80 partner agencies in 19 counties in West Texas (West Texas Food Bank, 2016). One of the West Texas Food Banks partner agencies is the El Pasoans Fighting Hunger Food Bank. The El Pasoans Fighting Hunger Food Bank was established in 2011 and currently

distributes food to 122 local food pantries throughout El Paso, Culberson, and Hudsbeth Counties (El Pasoans Fighting Hunger Food Bank, 2015). Over 131,000 individuals (including 77,000 children) who are at risk for not being able to eat everyday (El Pasoans Fighting Hunger Food Bank, 2015). The El Pasoans Fighting Hunger Food Bank keeps track of the total number of individuals served, households served and applicants. Unfortunately, they do not ask for the specific ages of individuals receiving assistance. Individuals in need of assistance are required to complete an application, and acceptance is based on annual income and household size. A family of four qualifies for assistance if their annual household income is less than $44,955 (El Pasoans Fighting Hunger Food Bank, 2015).

**School Food Environments**

In a recent study by Rossen, Curriero, Cooley-Strickland, & Pollack (2013), researchers examined the density of various retail food stores and the availability of healthy food items along children's paths to school and its association to change in BMI over one year (Rossen, Curriero, Cooley-Strickland, & Pollack, 2013). Their findings suggest that healthy food availability along the child's paths to school was associated with smaller gains in BMI over the year. Similarly, Neckerman, et al., 2010 examined the relationship between five different food stores near schools and found that minority and low income students were more likely to attend schools with unhealthy food stores within close proximity (Neckerman et al., 2010). Harris, et al., (2011) analyzed the association between various types of retail food stores near schools and student risk of being overweight or obese (Harris et al., 2011). In contrast, however, researchers concluded that the proximity and density of food stores near schools had no significant effect on the likelihood of a student's being overweight or obesity.

Sanchez et al. (2012) investigated the relationship between fast food restaurants and convenience store density near schools and BMI (Sanchez-Vaznaugh, Sánchez, Rosas, Baek, & Egerter, 2012). Data from 926,018 students were included in the study, and FitnessGram® measures were obtained to assess physical fitness. The study found that fast food restaurant density around schools was significantly related to the prevalence of overweight. A higher prevalence of overweight was reported among Hispanics and African Americans, but lower among Asians. In a similar study, Langellier (2012) examined the presence of corner stores and fast food restaurants around Los Angeles public schools and the prevalence of overweight among students (Langellier, 2012). The results indicated a higher presence of corner stores and fast food restaurants among majority Latino schools and lower presence among majority white schools. Howard, Fitzpatrick, & Fulfrost (2011), examined the possible associations between the food environment and rates of overweight students in California public schools (Howard, Fitzpatrick, & Fulfrost, 2011). The presence of a convenience store within a ten minute walking distance of a school was associated with higher rates of overweight students compared to students without nearby convenience stores (Howard et al., 2011).

The factors that influence childhood obesity are many, occur at different levels, and interact amongst each other. The interaction amongst the multilevel factors was expected to be different along the U.S.-Mexico Border where the range of deprivation and the access and availability of foods from both countries and cultural influences are present. Despite meaningful efforts, further research is necessary to clearly determine if the food environments near schools impacts the risks of obesity amongst children. In this regard doing research in El Paso, which is representative of the border region, is ideal to unravel how the multilevel factors interact in the border context.

# Chapter 3: Methods

This project addressed the current gaps in the research by examining the relationship between school level BMI and contextual factors in the school environment in El Paso, Texas. First, school level data for children enrolled in grades 3-8 in El Paso was combined, within a geographic information system (GIS), to obtain school-level socioeconomic and built environment exposures associated with obesity risk. Secondly, the information on sociocultural and built environmental features around schools was used to develop disease maps that determined the contributions of neighborhood and school environments to the development of obesity and obesity risk among schoolchildren residing in El Paso, Texas.

This area of research is of critical importance to The University of Texas at El Paso (UTEP) investigators, school administrators, policy makers, and to the region as a whole. The prevalence of obesity among Hispanic children has increased, compared to non-Hispanic children however the effects on El Paso children is currently unknown. There are numerous factors contributing to the increased prevalence in childhood obesity, however; social, cultural, and environmental features of schools may provide important insight to the factors that contribute to obesity risk and development. To date, no studies have examined how these factors affect child obesity rates. Correspondingly, the project has the following aims:

**<u>Aim 1</u>:** To determine the associations between neighborhood deprivation, and the retail food environment around the school along with the influence of childhood obesity and physical fitness within EPISD elementary and middle schools.

**Hypothesis 1:** Schools with higher averages of physically fit children, will have lower BMI percentiles.

**Hypothesis 2:** Schools with higher averages of overweight or obese children, will have a higher density of unhealthy food stores (convenience stores, fast food restaurants, specialty food stores, and liquor stores) within a half mile radius around their school.

**Hypothesis 3:** Schools in more economically deprived neighborhoods will have lower average physical fitness scores and higher average BMI percentile scores than schools in less economically deprived neighborhoods.

**Hypothesis 4:** Schools in more economically deprived neighborhoods will have a higher density of unhealthy food stores (convenience stores, fast food restaurants, specialty food stores, and liquor stores) and higher averages of BMI than schools in less economically deprived neighborhoods.

## Setting, Population and Sample

**Setting**. This study was conducted in El Paso County, Texas, a metropolitan area situated on the U.S.-Mexico Border. El Paso is a densely populated city of 816,295 lying on the U.S.-Mexico Border (U. S. Census Bureau, 2013). The Paso del Norte border region, is an area made up of two countries (The United States and Mexico), three states (Texas, New Mexico, and Chihuahua), and three cities with a population of 2.61 million people (Regional Stakeholders Committee, 2009). An additional 1.6 million people currently reside in Ciudad Juarez, making it the fifth most populated city in Mexico (Regional Stakeholders Committee, 2009). The Paso del Norte Region is one of the busiest U.S. – Mexico Border crossings (Raysoni et al., 2011).

**El Paso Population**. In El Paso County, Texas, 81.7% of the residents identify themselves as Hispanic or Latino with the majority of those being of Mexican descent (78%) (U. S. Census Bureau, 2013). Some of the poorest counties in the United States are situated along

the U.S.-Mexico Border (The City of El Paso Department of Public Health, 2008). The Census Bureau data indicates that the proportion of El Paso residents who lived in poverty (24%) during 2008-2012 was elevated compared to the rest of Texas (17.4%) and the U.S. population (14.9%) (U. S. Census Bureau, 2013). This data also indicates a significantly lower median household income for El Paso, Texas with a reported $39,699 average compared to $51,563 in Texas and $53,046 in the United States (U. S. Census Bureau, 2013). A listing of sociodemographic characteristics of El Paso is presented in Table 5 and suggests that El Paso provides a unique study setting for examining the role of neighborhood deprivation on the development of obesity among children.

**Table 5. Selected El Paso County and EPISD Demographics**

| Demographic Variable | Estimate ± Margin of Error | % |
|---|---|---|
| Total population | 816,295 | |
| **Race/Ethnicity** | | |
| White | 656,307 ± 7,902 | 80.4 |
| Black or African American | 27,052 ± 1,140 | 3.3 |
| American Indian or Alaska Native | 4,429 ± 680 | 0.5 |
| Asian | 8,801 ± 505 | 1.1 |
| Some other race | 100,994 ± 7159 | 12.4 |
| Hispanic or Latino (of any race) | 666,967 | 81.7 |
| Foreign Born | 209,487 ± 4,830 | 25.7 |
| Speak a language other than English at home (population 5 years or older) | 547,898 ± 4,785 | 73.0 |
| Median household income (in 2012 inflation-adjusted dollars) | 39,821 ± 824 | |
| Median family income (dollars) | 43,412 ± 1,127 | |
| Per capita income (dollars) | 18,183± 296 | |
| Individuals below poverty level | | 24.0 |
| **El Paso Independent School District** | | |
| Total students enrolled in El Paso Independent School District (2013-2014) | 61, 620 | 100 |
| Elementary students (2013-2014) | 27,297 | 43 |
| Middle School Students | 13,043 | 21 |
| Hispanic or Latino | 51,121 | 83 |

Demographic data obtained from the American Community Survey 3 year estimates for 2010-2012 obtained from U.S. Census Bureau (http://census.gov). Data on EPISD demographics obtained from the El Paso Independent School District (http://episd.org)

**EPISD Population.** El Paso County is served by eight school districts (See Figure 3). The El Paso Independent School District (EPISD) is one of the largest urban school districts in the state of Texas, with a current enrollment of 61,620 children in grades K-12 (El Paso Independent School District, 2014). Approximately 28,000 students are currently enrolled in 58 elementary schools distributed across the city. The sociodemographic composition of El Paso schools mirrors the city, with approximately 83% of the student body reporting Hispanic ethnicity (El Paso Independent School District, 2014).

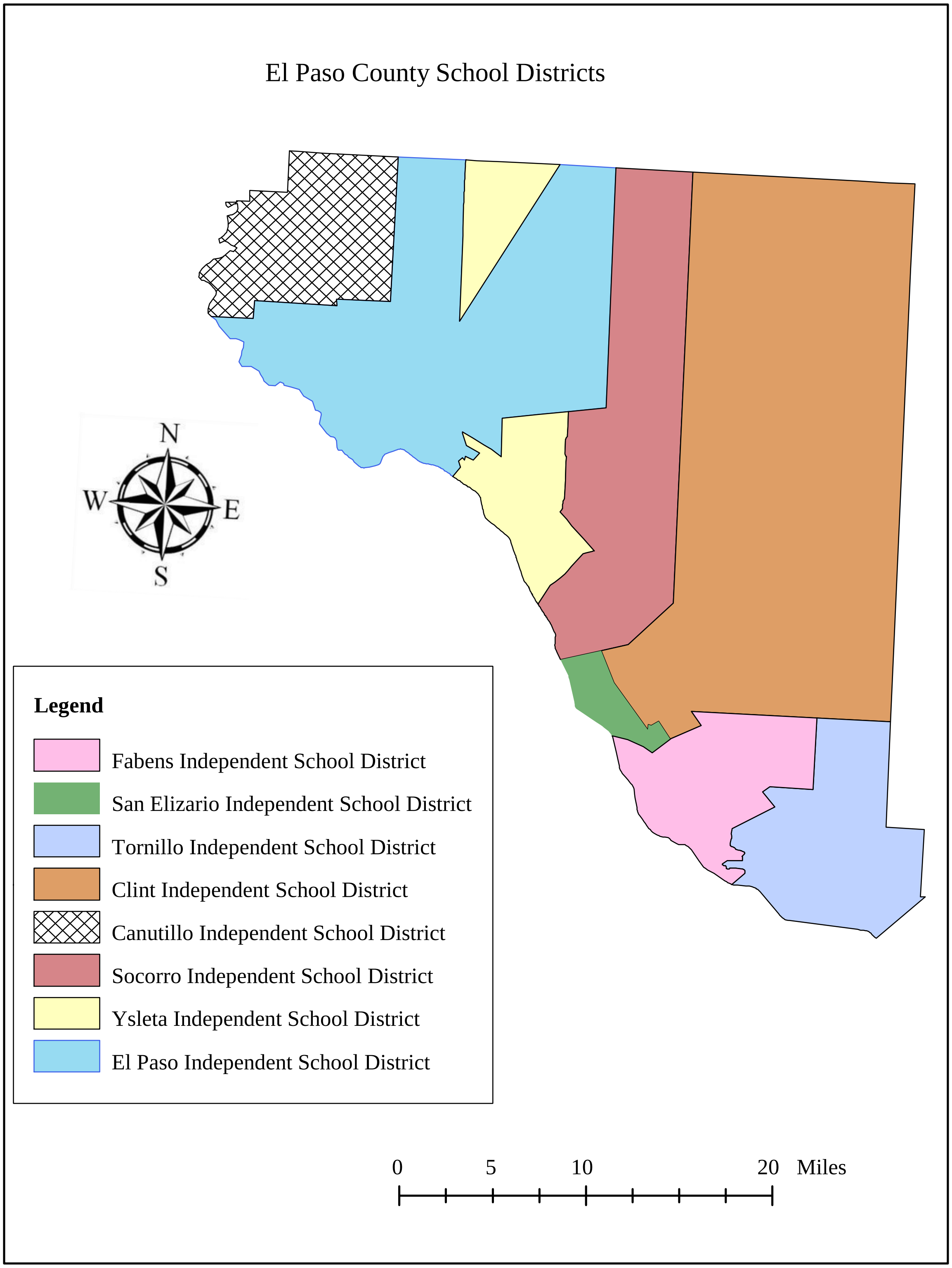


**Figure 3. El Paso County School Districts**

## Data Sources

**EPISD Elementary and middle schools.** Approximately 42,000 student records were obtained for children enrolled in EPISD in grades 3-8 (ages 7-14) from 2009-2013. Averages of all student data was calculated at the school level to obtain data for 58 elementary schools and 17 middle schools within the EPISD (See Figure 4). A list of all school names and addresses is provided in the appendix portion of this document.

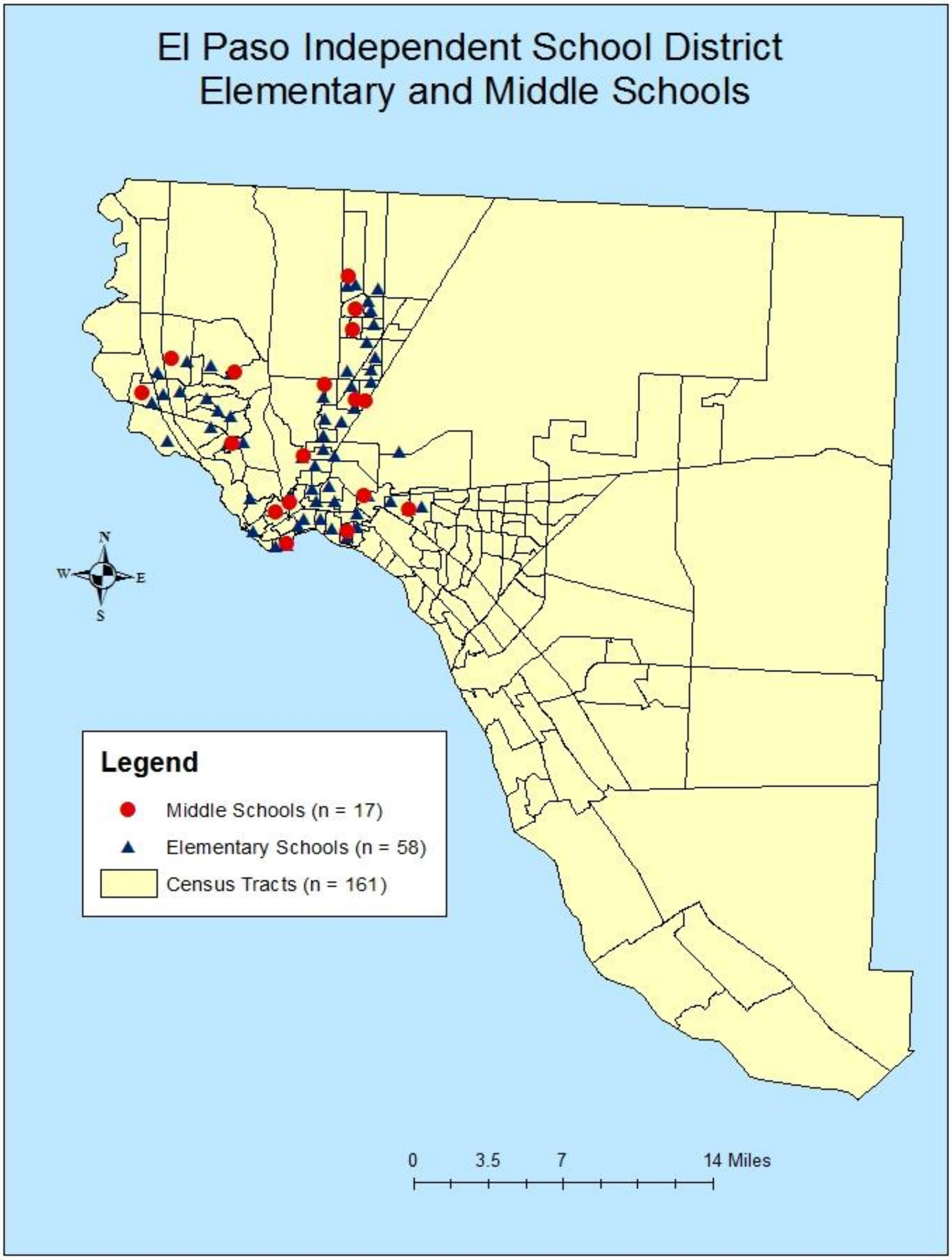


**Figure 4. EPISD Elementary and Middle Schools**

**EPISD FitnessGram®.** The FitnessGram® was developed by the Cooper Institute in Dallas, Texas and was endorsed by the American Alliance for Health, Physical Education, Recreation, and Dance (Aryana, Li, & Bommer, 2012). FitnessGram® is an educational assessment and reporting software system used within the EPISD on an annual basis to assess student physical fitness in accordance with the surveillance requirements of Texas Senate Bill 530. FitnessGram® uses criterion-referenced standards to evaluate aerobic capacity, muscular strength and endurance, flexibility, and body composition (Ogden et al., 2008). Physical Fitness data is collected annually by physical education teachers within the EPISD. FitnessGram® records include a student identifier that was used to track student's age, gender, ethnicity, height, weight, residential address, school name and school address.

Previous literature has established the importance of aerobic capacity in any physical fitness program (McClain, Welk, Ihmels, & Schaben, 2006) because of its association with a reduced risk of obesity, coronary heart disease and diabetes (Kim et al., 2005; Ortega, Lavie, & Blair, 2016). FitnessGram® measures aerobic capacity, flexibility, and muscular strength and endurance. Previous studies have measured FitnessGram® variables with various methods. For example, Joshi, et al., (2012) conducted a study among children enrolled in grades K – 12, in which, FitnessGram® measurements were combined to create an overall composite fitness score.

**Table 6. FitnessGram® Test Items**

| Component of Health-related Fitness | Definition | Fitness Test |
|---|---|---|
| Aerobic Capacity | The ability to perform large muscle, high intensity exercise for prolonged periods. | • PACER |
| Muscular Strength | The ability of the muscles to exert an external force. | • Pull-ups<br>• Curl-ups<br>• Trunk lift |
| Muscular Endurance | The ability of muscles to exert themselves repeatedly. | |
| Flexibility | The range of motion available in a joint. | • Back-Saver Sit and Reach<br>• Shoulder Stretch |
| Body Composition | The relative percentage of muscles, fat, bone and other tissues that comprise the body. | • BMI |

Source: (The Cooper Institute, 2015).

**Body Mass Index to Assess Overweight or Obese.** Body Mass Index (BMI) was computed using objectively measured height and weight. The Centers for Disease Control and Prevention 2014, classifies a healthy weight where the measured BMI is between the $5^{th}$ percentile to less than $85^{th}$ percentile (Paluch, Epstein, & Roemmich, 2007). Overweight is classified where the BMI is from the $85^{th}$ to less than the $95^{th}$ percentile, and obese as equal to or greater than the $95^{th}$ percentile (Centers for Disease Control and Prevention, 2015a).

**Retail Food Stores.** Data on the retail food stores was obtained from an InfoUSA Database. Establishment records will include company name, address, phone number, employee size range, sales volume range, store type/description, and square footage. To select food outlets, Primary Standard Industry Classification (SIC) codes was used to categorize the retail food stores generated by InfoUSA (Powell et al., 2011). InfoUSA gathers all information from phone books, business directories, U.S. Postal Service Change of Address files, country courthouse

filings, and Secretary of State data and then verifies all sources annually by telephone (Black & Macinko, 2008).

**El Pasoans Fighting Hunger Food Bank**. A list of local food pantries was obtained online at: http://www.elpasoansfightinghunger.org/home.html. The El Pasoans Fighting Hunger Food Bank currently has 120 local food pantries, and five of those are located within El Paso schools. A list of all food pantry names and addresses was obtained online and can be viewed in the appendix portion of this document.

**Paso del Norte Mapa**. The Paso del Norte Mapa is a website that was created by a combination of agencies that put together transboundary GIS data layers in the tri-state, binational region of far-west Texas, Southern New Mexico, and northern Chihuahua, Mexico. A few of the GIS data layers available at the Paso del Norte Mapa website include: bike routes, census tracts, park zones, school districts school locations, hospital locations, and zip codes. The El Paso County street layers was obtained from the Paso del Norte Mapa for the plotting of school addresses and all retail food store locations. Paso del Norte Mapa is available at www.pdnmapa.org.

**U.S. 2010 Census.** A total of 161 census tracts were utilized from the U.S. 2010 Census and was extracted to calculate neighborhood deprivation indices following methods described by Rothenberg co-workers (Rothenberg et al., 2014). The neighborhood deprivation indices was developed by utilizing three study areas from the 2010 U.S. Census including: economics, education, and demography.

**EPISD Free or Price Reduced School Lunches.** The percentage of students receiving free or price reduced school lunches was obtained from the EPISD Food and Nutrition Services

Department. All percentages were calculated at the school level to obtain data for 58 elementary schools and 17 middle schools within the EPISD.

## Preparation of Variables

**EPISD FitnessGram®.** Physical activity measures were based upon the FitnessGram® Performance Standards by age and gender. The FitnessGram® is measured annually by physical education instructors to measure their ability to complete specific physical activity tests and be able to complete an amount that is sufficient according to age and gender. The FitnessGram® variables include; students BMI, PACER run, pull-ups, curl-ups, trunk lift, back-saver sit and reach, and shoulder stretch. A full description on how each test variable is administered can be viewed in the appendix portion of this document. All data was pre-screened and data with missing information was excluded. FitnessGram® classifies children as either in "the healthy fitness zone (HFZ) or "not in the healthy fitness zone" according to their BMI for age and gender (The Cooper Institute, 2015). Students will then be grouped into pass or unable to pass categories for each physical activity measure. For example, a five year old male needs to be able to complete three push-ups to be categorized into the pass group. From there, the total pass/unable to pass score was combined by school. The entire FitnessGram® Performance Standards for age and gender can be viewed in the Appendix portion of this proposal.

**Table 7. FitnessGram® Healthy Fitness Zone Standards**

| | |
|---|---|
| **Healthy Fitness Zone** | The goal in FITNESSGRAM® is for children to achieve the Healthy Fitness Zone on as many assessments as possible. Because only modest amounts of activity are needed to obtain health benefits, **most students** who perform regular physical activity was able to achieve a score that will place them **within or above the Healthy Fitness Zone** on most FitnessGram® test items. If children are in the Healthy Fitness Zone they are considered to have sufficient fitness for good health. |
| **Needs Improvement (NI)** | Indicates that if the student continues to track at this level there is the *potential* for future health risks. However, this potential is *possible*, not probable. Increased activity as well as eating a healthy controlled diet could delay or reverse this potential risk. |
| **Needs Improvement (NI) – Health Risk** | Indicates that if the student continues to track at this level there is a clear *potential* for future health problem (a *more probable* risk). The need for increased activity and eating a healthy diet is more urgent for students in this category than those at Needs Improvement. |

Source: (The Cooper Institute, 2015).

**Body Mass Index to Assess Overweight or Obese**. BMI and BMI percentiles were computed using the Centers for Disease Control and Prevention BMI tool for schools (Centers for Disease Control and Prevention, 2015b). The BMI tool is an Excel spreadsheet that can be downloaded straight to your computer and can calculate BMI and BMI percentiles for up to 2,000 children at a time. The spreadsheet calculates BMI and BMI percentiles using height and weight measures, gender, date of birth, and date of assessment measures (Centers for Disease Control and Prevention, 2015b).

**Retail Food Stores.** Data on the retail food stores was grouped into eight categories following methods as identified by (An & Sturm, 2012; Powell et al., 2011; Shier, An, & Sturm, 2012). The eight categories include: 1) supermarkets, which will include large chain supermarkets, and small grocery stores, n = 167; 2) food pantries, n = 84; 3) specialty healthy

stores, which include meat markets, fruit and vegetable markets, n = 53; 4) full service restaurants, which include the option for patrons to receive table service, n = 477; 5) convenience stores, which will include service stations and truck stops, n = 252; 6) specialty unhealthy stores, which include bakeries, and confectionary and nut stores, n = 148; 7) fast food restaurants, (including pizza), n = 334; and 8) liquor stores, n = 71. A total of 1,586 stores were included in the analysis. From there, each retail food store was categorized as a healthy or unhealthy establishment. Finally, exposure was determined by calculating the density of retail food stores within a half mile radius centered at each EPISD elementary or middle school location. Please see Appendix 1 for a table of Healthy and Unhealthy Retail Food Store density within a half mile radius of each school by category.

**Table 8. InfoUSA Store Classification Definitions**

| Store Classification | InfoUSA Primary SIC Code | Healthy or Unhealthy Classification |
|---|---|---|
| Convenience Stores | • 541103 Convenience Stores<br>• 554101 Service Stations<br>• 554103 Truck stops | • Unhealthy Food Stores |
| Supermarkets | • 541101 Food Products<br>• 541104 Food Products Retail<br>• 541105 Grocers Retail | • Healthy Food Stores |
| Fast Food Restaurants | • 581206 Food Carry Out<br>• 581208 Delicatessens<br>• 581219 Sandwiches<br>• 581222 Pizza | • Unhealthy Food Stores |
| Full Service Restaurants | • 581208 Restaurants | • Healthy Food Stores |
| Specialty Food Stores | • 5421 Meat, Fish, and Seafood Markets<br>• 5431 Fruit and Vegetable Markets | • Healthy Food Stores |
| | • 5441 Confectionary and Nut Stores<br>• 5451 Dairy Product Stores<br>• 5461 Retail Bakeries and Snack<br>• 5499 Other Specialty | • Unhealthy Food Stores |
| Liquor Stores | • 592102 | • Unhealthy Food Stores |

***Source:*** (Han et al., 2012).

**Geographic Information Systems (GIS).** GIS was used for the input, storage, processing, and analysis of spatial data. All data layers containing local addresses and information was downloaded from the Paso del Norte Mapa website which is available at www.pdnmapa.org. First, school addresses were used to map student information at the street level. Address data on all retail food stores was obtained from InfoUSA, and exposure was determined by calculating the density of retail food stores within a half mile radius centered at each EPISD elementary or middle school location.

**U.S. Census Tracts and the Calculation of Neighborhood Deprivation.** Census Tracts will serve as the proxy for neighborhoods in the proposed study. Census tracts have fairly

consistent boundaries, and the measures of economic deprivation produce health outcome gradients that are consistent with those predicted using individual measures (Krieger et al., 2003).

**U.S. 2010 Census.** A total of 161 census tracts were utilized from the U.S. 2010 Census and was extracted to calculate an Urban Health Index (UHI) following methods described by Rothenberg co-workers (Rothenberg et al., 2014). The neighborhood deprivation indices was developed by utilizing three study areas from the 2010 U.S. Census including: economics, education, and demography. Examples of the variables that was used to calculate neighborhood deprivation included: 1) economic; percent of adults employed, percent of households above the federally designated poverty level, household median income, and household mean income; 2) education; percent with a high school graduate or higher, and percent with a bachelor's degree or higher; 3) demographic; percent households not headed by a single female with children under 18 years of age, median age, and percent non-dependent individuals that were between 16-64 years of age.

**Component Extraction and Index Construction.** The Census tract data was merged and standardized prior to calculating the deprivation index. Using the formula, we transformed the actual values into a dimensionless proportion: the distance of the value from the minimum, divided by the range:

$$I^S = \frac{I_i - \min^*(I)}{\max(I) - \min^*(I)}$$

Where $I^S$ is the standardized indicator, $I_i$ is the observation in the small area, "max (I)" is the maximum value for that indicator in the group, and min* (I) is the minimal value altered by a very small to avoid zero values in the numerator (Rothenberg et al., 2014). From there we constructed the Urban Health Index using the geometric mean of the standardized indicators. We

then calculated descriptive statistics for the rank order distribution of the UHIs for 161 census tracts.

**Table 9. Descriptive Statistics for the Urban Health Index in El Paso, Texas**

| | **Mean** | **Standard Deviation** | **Minimum** | **Maximum** |
|---|---|---|---|---|
| Urban Health Index | 3.55 | 1.06 | 0.00 | 6.07 |

Finally, quartiles of neighborhood deprivation were created including very high deprivation, high deprivation, low deprivation, and very low deprivation.

**Multilevel Modeling**

Multilevel modeling is a statistical technique that is frequently used when individual level observations are clustered within groups (Seliske, 2007). Before multilevel modelling can be assessed reliability needs to be established. The intraclass correlation (ICC) is a statistical technique that is used to measure reliability when measurements are made on units that are organized into groups (Koo & Li, 2016). Reliability can be defined as the extent to which measurements can be replicated (Koo & Li, 2016). However, multilevel modelling was not possible for this research because an ICC of 0.52 was obtained. Koo, et al., suggests that a ICC value is closer to one, which represents stronger reliability. Since the value is less than one, it suggests that there was not enough clustering to utilize multilevel modelling in the analysis.

## Generalized Linear Modeling and the Poisson Distribution

When using count data, the Poisson distribution is often ideal for analysis purposes (Coxe, West, & Aiken, 2009). However, two tests are typically run to make sure that the dependent variable follows the Poisson distribution. The first test ran was the One-Sample Kolmogorov-Smirnov Test which had a p-value of .004. Since it is significant it does not follow a Poisson distribution (Steyn, 2015). The second test is to compare means and variances of the dependent variable, which should be similar. The results came back with a mean of 0.89, and a variance of 2.53 once again suggesting that a Poisson Distribution is not an appropriate analysis.

## Research Design and Methods

**Aim 1:** To determine the associations between neighborhood deprivation, and the retail food environment around the school along with the influence of childhood obesity and physical fitness within EPISD elementary and middle schools.

The proposed research for the overall specific aim was a quantitative, retrospective cross-sectional study of fifty eight elementary schools and sixteen middle schools (75 schools total) within the EPISD. All individual student data was obtained from approximately 42,000 students enrolled in the EPISD in grades 3-8 for the years 2009-2013, which was aggregated at the school level. We utilized archival data for the specified ages and grade levels for the total population of EPISD students that was aggregated at the school level, and therefore human subjects were not recruited, consented, or contacted for primary data collection. EPISD data was combined with data from the City of El Paso as part of the overall project.

**Data Analysis**

**Hypothesis 1: Schools with higher averages of physically fit children, will have lower BMI percentiles.** In order to test this hypothesis all student data was aggregated within each school by age and gender to permit comparisons. First, school FitnessGram® data was grouped by physical fitness assessment measure (PACER run, pull-ups, curl-ups, trunk lift, back-saver sit and reach, and shoulder stretch). Pass or Unable to Pass physical fitness assessments was then be grouped into categories based on the student's age and gender. Finally, all individual data was aggregated at the school level to obtain school averages.

Calculations for student BMI percentile was completed using the CDC's Tools for Schools online measure which takes into account children's date of birth, age at assessment, height, and weight. Overweight is classified where the BMI percentile is from the 85th to less than the 95th percentile, and obese as equal to or greater than the 95th percentile (Centers for Disease Control and Prevention, 2015a). Once all individual percentiles are obtained, they were aggregated at the school level to obtain school averages.

**Hypothesis 2: Schools with higher averages of overweight or obese children, will have a higher density of unhealthy food stores (convenience stores, fast food restaurants, specialty food stores, and liquor stores) within a half mile radius around their school.** Calculations for student BMI and BMI percentile was completed using the CDC's Tools for Schools online measure which takes into account children's date of birth, age at assessment, height, and weight. Overweight is classified where the BMI percentile is from the 85th to less than the 95th percentile, and obese as equal to or greater than the 95th percentile (Centers for Disease Control

and Prevention, 2015a). Once all individual percentiles are obtained, they were aggregated at the school level to obtain school averages.

Calculations for the retail food environment was completed by obtaining the grouped data previously placed into eight categories and categorized as healthy or unhealthy and inputting the address locations into GIS software. From there, a half mile radius was calculated around each school. The sum of each retail food stores within the half mile radius was calculated using GIS software.

**Hypothesis 3: Schools in more economically deprived neighborhoods will have lower average physical fitness scores and higher average BMI percentile scores than schools in less economically deprived neighborhoods.** The neighborhood deprivation indices were developed by utilizing three study areas from the U.S. Census including: demographics (Rothenberg et al., 2014). Using SPSS software, version 22, quartiles of neighborhood deprivation was created including very high, high, low, and very low levels of neighborhood deprivation. In order to test this hypothesis all student data was aggregated within each school by age and gender to permit comparisons. First, school FitnessGram® data was grouped by physical fitness assessment measure (PACER run, pull-ups, curl-ups, trunk lift, back-saver sit and reach, and shoulder stretch). Pass or Unable to Pass physical fitness assessments was then be grouped into categories based on the student's age and gender. Finally, all individual data was aggregated at the school level to obtain school averages.

Calculations for student BMI percentile was completed using the CDC's Tools for Schools online measure which takes into account children's date of birth, age at assessment, height, and weight. Overweight is classified where the BMI percentile is from the 85th to less

than the 95th percentile, and obese as equal to or greater than the 95th percentile (Centers for Disease Control and Prevention, 2015a). Once all individual percentiles are obtained, they were aggregated at the school level to obtain and compare school averages.

**Hypothesis 4: Schools in more economically deprived neighborhoods will have a higher density of unhealthy food stores (convenience stores, fast food restaurants, specialty food stores, and liquor stores) and higher averages of BMI than schools in less economically deprived neighborhoods.** Using SPSS software, version 22, quartiles of neighborhood deprivation was created including very high, high, low, and very low levels of neighborhood deprivation following methods outlined by (Rothenberg et al., 2014). In order to test this hypothesis all student data was aggregated within each school by age and gender to permit comparisons. Calculations for the retail food environment was completed by obtaining the grouped data previously placed into eight categories and categorized as healthy or unhealthy and inputting the address locations into GIS software. From there, a half mile radius was calculated around each school. The sum of each retail food stores within the half mile radius was calculated using GIS software. Calculations for student BMI percentile was completed using the CDC's Tools for Schools online measure which takes into account children's date of birth, age at assessment, height, and weight. Overweight is classified where the BMI percentile is from the 85th to less than the 95th percentile, and obese as equal to or greater than the 95th percentile (Centers for Disease Control and Prevention, 2015a). Once all individual percentiles are obtained, they were aggregated at the school level to obtain school averages.

## Inclusion Criteria

The proposed study will include 75 schools (58 elementary and 17 middle schools) within the EPISD located in El Paso, Texas. Inclusion criteria required the participants to be enrolled in the EPISD from 2009-2013 in grades 3-8 (ages 7-14).

## Inclusion of Minorities

The NIH Policy on the inclusion of minorities in research defines a minority group as an identifiable division of the U.S. population that is distinguished by racial, ethnic, and/or cultural heritage (National Institutes of Health, 2012). In El Paso County, Texas, 81.2% of the 827,398 residents identify themselves as Hispanic or Latino with the majority of those being of Mexican descent (78%) (U. S. Census Bureau, 2013). Therefore, the use of minorities in the dissertation research was not done by deliberate minority selection; it is the result of city demographics.

## Protection of Research Participants and Subjects

All archival data received from the EPISD contained student identification numbers. In order to protect student confidentiality, each student identification number was reassigned. In order to maintain the confidentiality of the research, all data was analyzed and stored on a personal laptop computer that was password protected. The only foreseeable risk to participants is the potential loss of confidentiality. In order to minimize the risk of potential loss of confidentiality, each student identification number was reassigned in the study database. The original identification numbers received from the EPISD was stored on a password protected computer. All data was analyzed and stored on a password protected computer.

There were no personal benefits for participating in this research. However, this research may provide an understanding on the relationships between physical activity, neighborhood food environments, and obesity in Hispanic children along the U.S.-Mexico Border. Approval to conduct the research has been endorsed by James Steinhauser, Assistant Superintendent for Research and Evaluation. An approval letter from the EPISD is attached. This project has been reviewed by EPISD IRB, and a copy of this approval is attached.

The compliance of regulatory documents and study data accuracy was maintained through an internal study team quality assurance process. Confidentiality throughout the study was maintained to safeguard all data. All archival data received from the EPISD contained student identification numbers. In order to protect student confidentiality, each student identification number was reassigned. In order to maintain the confidentiality of the research, all data was analyzed and stored on a password protected computer. Security of the data was ensured by weekly system and file backups. Quality and rigor was ensured in the proposed research by ensuring that all variables obtained from EPISD are complete. The data was cleaned and analyzed in order to identify any outliers that may have existed.

The compliance of regulatory documents and study data accuracy was maintained through an internal study team quality assurance process. This study focused on children between 8-14years of age. The National Institutes of Health (NIH) Policy on the inclusion of children in research defines a child as an individual under the age of 21. The age group selection was based on the Texas Education Code (TEC). The Code states that a school district shall assess physical fitness of students in grades 3 through 12 annually (Texas Association of Health, Physical Education, Recreation and Dance, 2010).

This area of research was of critical importance to UTEP and to the region as a whole. The prevalence of obesity among Hispanic children has increased, compared to non-Hispanic children. There are numerous factors contributing to the increased prevalence in childhood obesity, however; social, cultural, and environmental features of schools and neighborhoods may provide important insight to the factors that contribute to obesity risk and development. To date, no studies have examined how these factors in combination affect child obesity rates.

**Procedures**

A total of 148,148 records with student information was obtained from the EPISD for 2009-2013 school years. Out of that sample, 51,001 were duplicate files which left us with 97,147 student records. From there, 12,547 were deleted for missing a school name. Since the FitnessGram® test is scored twice annually, records were separated into pre-test and post-test categories. Pre-testing took place at the beginning of the school year from August to December and was utilized in the analysis. The post-test records were deleted (n = 42,735), along with any individuals missing a date of birth. An additional 1,010 students were missing a weight, so the series mean was calculated by age and gender. Depending on the age and gender of the student, the missing value was replaced with the appropriate series mean. Similarly, 914 student height measurements were missing so they were replaced with the series mean depending on their age and gender. Table 10 and 11 shows the calculated series mean for weight and height by age and gender.

**Table 10. Series Mean of Student Body Weight by Age and Gender**

| | Weight in Pounds | |
|---|---|---|
| **Age in years** | **Males** | **Females** |
| 7 | 69.45 | 63.21 |
| 8 | 69.45 | 67.34 |
| 9 | 75.91 | 73.66 |
| 10 | 85.78 | 82.98 |
| 11 | 96.73 | 95.26 |
| 12 | 108.14 | 105.09 |
| 13 | 119.99 | 115.96 |

**Table 11. Series Mean of Student Height by Age and Gender**

| | Height in Feet | |
|---|---|---|
| **Age in years** | **Males** | **Females** |
| 7 | 3.96 | 3.94 |
| 8 | 3.96 | 3.94 |
| 9 | 4.00 | 3.99 |
| 10 | 4.06 | 4.06 |
| 11 | 4.23 | 4.27 |
| 12 | 4.50 | 4.51 |
| 13 | 4.76 | 4.74 |

The final sample included 20,405 females and 21,435 males for a total of 41,840 students included in the analysis. From there all individual student data was aggregated at the school level for analysis. A total of 75 schools were used in the analysis (58 elementary schools and 17 middle schools). All High Schools, Academies, Drop out recovery centers, and Early Colleges were not included in the analysis. Please see Appendix 1 for a table of the total number of students included in the analysis by gender for each school 2009-2013.

**Statistical Analysis**

All data was reduced and analyzed using SPSS software (v. 22, SPSS Inc., Chicago, IL).

In hypothesis 1, linear regression was utilized to evaluate the relationship between levels of physical fitness and obesity in children at the school level. Physical fitness by school was characterized as the percentage of students that met minimum FitnessGram® requirements for the following 1) curl-ups 2) trunk lift 3) sit and reach 4) push-ups and the 5) PACER run by age and gender. Measures of physical fitness were entered into the model as independent variables and mean BMI percentile by school was entered as the dependent variable.

In hypothesis 2, linear regression was used to evaluate the relationship between the retail food environment and childhood obesity at the school level. The retail food environment was characterized by store type density within a one-half mile (800 meter) radius of the school and included the following 1) Supermarkets or Grocery Stores 2) Healthy Specialty Stores 3) Food Pantries 4) Full Service Restaurants 5) Convenience Stores 6) Fast Food Restaurants 7) Liquor Stores and 8) Unhealthy Specialty Stores. The dependent variable, as used in hypothesis 1, remained the same, the mean BMI percentile by school. In model 1, the food stores were analyzed individually.

In hypothesis 3, An analysis of variance (ANOVA) was used to evaluate the relationships between neighborhood deprivation, physical fitness and obesity in children at the school level. Neighborhood deprivation was categorized into four levels including 1) very low deprivation 2) low deprivation 3) high deprivation and 4) very high deprivation. Physical fitness by school was characterized as the percentage of students that met minimum FitnessGram® requirements for the following 1) curl-ups 2) trunk lift 3) sit and reach 4) push-ups and the 5) PACER Run by age and gender. Levels of neighborhood deprivation were entered into the model as independent variables and measures of physical fitness and mean BMI percentile by school were entered as dependent variables. Post Hoc results were analyzed using Games-Howell post hoc tests.

In hypothesis 4, ANOVA was utilized to investigate the relationships between neighborhood deprivation, the retail food environment and childhood obesity at the school level. Neighborhood deprivation was categorized into four levels including 1) very low deprivation 2) low deprivation 3) high deprivation and 4) very high deprivation. Levels of neighborhood deprivation were entered into the model as independent variables and the retail food store density and mean BMI percentile by school were entered as dependent variables. The retail food environment was characterized by store type density within a one-half mile (800 meter) radius of the school and included the following 1) Supermarkets or Grocery Stores 2) Healthy Specialty Stores 3) Food Pantries 4) Full Service Restaurants 5) Convenience Stores 6) Fast Food Restaurants 7) Liquor Stores and 8) Unhealthy Specialty Stores. Post Hoc results were analyzed using Games-Howell post hoc tests.

**Descriptive Statistics**

A total of 75 schools were used in the analysis. Table 10 shows the basic descriptive statistics aggregated at the school level. The average BMI percentile for schools overall in the sample was 66.12 $\pm$ SD 5.17 (CI: [69.93, 67.31]). The average BMI percentile for schools overall is considered healthy according to CDC for children and adolescents (Centers for Disease Control and Prevention, 2015a).

**Table 12. Basic Descriptive Statistics of Overall School Means**

| Outcome | Mean | SD | 95% CI | |
|---|---|---|---|---|
| | | | Lower | Upper |
| BMI Percentile Mean | 66.12 | 5.17 | 64.93 | 67.31 |
| Curl Up – Percent Pass | 72.59 | 14.15 | 69.34 | 75.85 |
| Trunk Lift - Percent Pass | 77.17 | 14.60 | 73.81 | 80.53 |
| Sit and Reach Left - Percent Pass | 63.70 | 10.91 | 61.19 | 66.21 |
| Sit and Reach Right - Percent Pass | 68.56 | 10.97 | 66.03 | 71.08 |
| Push Up - Percent Pass | 67.08 | 14.96 | 63.64 | 70.52 |
| PACER Run - Percent Pass (Healthy Fitness Zone) | 7.25 | 6.14 | 5.83 | 8.66 |
| PACER Run - Percent Pass (Needs Improvement) | 1.31 | 0.92 | 1.10 | 1.52 |
| PACER Run - Percent Pass (At Risk) | 91.44 | 6.64 | 89.91 | 92.97 |
| Free/Reduced School Lunch | 74.77 | 21.50 | 69.83 | 79.72 |

# Chapter 4: Results

This chapter presents information gathered from a total of 75 schools (58 elementary schools and 17 middle schools) within the EPISD. The primary purpose of this study was to investigate the relationships between the retail food environment surrounding schools on the development of obesity and physical fitness among children from a predominately Hispanic community. This study will add to the limited body of knowledge because studies of school environments and childhood obesity and physical activity in large Hispanic populations along the U.S.-Mexico Border are lacking.

**<u>Hypotheses 1</u>: *Schools with higher averages of physically fit children will have lower BMI percentiles.*** Linear regression was utilized to evaluate the relationship between levels of physical fitness and obesity in children at the school level. Schools average physical fitness was characterized as the percentage of students that met minimum FitnessGram® requirements for the following 1) curl-ups; 2) trunk lift; 3) sit and reach; 4) push-ups; and the 5) PACER Run by age and gender. Measures of physical fitness were used to predict school average mean BMI percentile.

An overall variance of 28% was explained by the model which indicates a strong linear relationship. Table 11 provides the results of linear regression analysis. Statistical significance was observed for the inverse relationship between curl ups and BMI ($\beta = -0.13$, $p = 0.01$), i.e. a decrease in mean BMI percentiles were associated with an increase in curl up passing percentages. The PACER Run (Needs Improvement, NI) was directly related to BMI percentile ($\beta = 1.66$, $p = 0.03$) such that, a greater percent of students who were in the NI category was associated with a 1.66 higher BMI average.

**Table 13. Linear Regression Analysis of Measures of Physical Fitness on BMI Percentiles**

| Physical Fitness Variables | Unstandardized β | P-value |
|---|---|---|
| Curl Up Percent Pass | -0.13 | 0.01* |
| Trunk Lift Percent Pass | -0.02 | 0.55 |
| Sit and Reach Left Percent Pass | 0.12 | 0.56 |
| Sit and Reach Right Percent Pass | -0.02 | 0.93 |
| Push Up Percent Pass | -0.07 | 0.16 |
| PACER Run (Needs Improvement) | 1.66 | 0.03* |
| PACER Run (At Risk) | -0.06 | 0.59 |

*Pacer Run (Healthy Fitness Zone) is the referent category

In order to disentangle this relationship further, the inclusion of free or price reduced lunch (FPRL) was added to the model as a socio-economic status (SES) indicator. When the percentage of students on FPRL was included into the model the curl-up percent passing remained inversely statistically significant with BMI percentile in elementary schools ($\beta = -0.12$, $p = 0.01$) and overall, elementary and middle schools combined ($\beta = -0.11$, $p = 0.01$). Table 12 provides the results of linear regression analysis with the inclusion of the FPRL on BMI percentile. Also significant, however, directly related, was the PACER Run (NI) ($\beta = 1.27$, $p = 0.03$) with BMI percentile when evaluated in elementary and middle schools combined and ($\beta = 1.29$, $p = 0.07$), respectively. The SES indicator, FPRL, was also directly related and statistically significant with BMI percentiles in elementary ($\beta = 0.14$, $p = 0.00$) and middle schools ($\beta = 0.15$, $p = 0.00$) and overall ($\beta = 0.13$, $p = 0.00$). The FPRL variable was consistently significant with

BMI percentiles in elementary and middle school and overall. Suggesting that a greater percent of students who were on the FPRL was associated with an increased BMI percentile average.

**Table 14. Measures of Physical Fitness and Free or Price Reduced Lunch on BMI Percentile**

| Linear Regression Analysis | | | |
|---|---|---|---|
| | **All Schools** | **Elementary Schools** | **Middle Schools** |
| **Variable** | Unstandardized β (P Value) | Unstandardized β (P Value) | Unstandardized β (P Value) |
| Curl Up Percent Pass | -0.11 (0.01) | -0.12 (0.01) | 0.05 (0.60) |
| Trunk Lift Percent Pass | 0.01 (0.76) | 0.03 (0.52) | -0.02 (0.71) |
| Sit and Reach Left Percent Pass | 0.16 (0.31) | 0.12 (0.57) | 0.33 (0.02) |
| Sit and Reach Right Percent Pass | -0.08 (0.59) | -0.05 (0.79) | -0.31 (0.05) |
| Push Up Percent Pass | 0.00 (0.89) | 0.01 (0.75) | -0.08 (0.47) |
| PACER Run (NI) | 1.27 (0.03) | 1.29 (0.07) | -0.41 (0.60) |
| PACER Run (At Risk) | -0.11 (0.21) | -0.16 (0.19) | 0.14 (0.11) |
| Free or Reduced School Lunch | 0.14 (0.00) | 0.15 (0.00) | 0.13 (0.00) |

*Pacer Run (Healthy Fitness Zone) Percent Pass is the referent category. NI = Needs Improvement

The regression model when analyzing middle schools separately explained 93% of the overall variance, which indicates a very strong linear relationship. The FPRL variable was associated with a one unit increase in mean BMI percentiles. The sit-and-reach percent pass for the left and right sides of the body were both statistically significant, however, directly and inversely, at $p = 0.03$ and $p = 0.05$. The FPRL variable was directly related to BMI percentiles in middle schools ($\beta = 0.13$, $p = 0.00$).

**<u>Hypotheses 2</u>*: Schools with higher averages of overweight or obese children, will have a higher density of unhealthy food stores (convenience stores, fast food restaurants, specialty food stores, and liquor stores) within a half mile radius around their school.***

Linear regression was used to evaluate the relationship between the retail food environment and childhood obesity at the school level. The retail food environment was characterized by store type density within a one-half mile (800 meter) radius of the school and included the following 1) Supermarkets or Grocery Stores; 2) Healthy Specialty Stores; 3) Food Pantries; 4) Full Service Restaurants; 5) Convenience Stores; 6) Fast Food Restaurants; 7) Liquor Stores; and 8) Unhealthy Specialty Stores.  The dependent variable, as used in hypothesis 1, remained the same, the mean BMI percentile by school. In model 1, the food stores were analyzed individually. A significant regression equation was found ($p = 0.01$), with an $R^2$ of 0.27 indicating a strong linear relationship.  Table 13 provides the results of the linear regression analysis. Schools with a higher versus lower density of convenience stores were directly and significantly ($\beta = 1.41$, $p = 0.02$) related to higher mean BMI percentiles. Significance was not reached for all other food store types when assessed individually for their association to mean BMI percentiles by school.

In order to disentangle this relationship further, the stores were classified and summed into Healthy or Unhealthy Stores, which served as independent variables. The availability of healthy stores compared to unhealthy stores is important because residents in lower income neighborhoods tend to have limited options.  Healthy food stores included 1) Supermarkets or Grocery Stores; 2) Healthy Specialty Stores; 3) Food Pantries; and 4) Full Service Restaurants. Unhealthy food stores included 1) Convenience Stores; 2) Fast Food Restaurants; 3) Liquor Stores; and 4) Unhealthy Specialty Stores. A significant regression equation was found in model

2 ($p = 0.03$), with an $R^2$ of 0.09. The healthy food stores reached near significance ($\beta = 0.37$, $p = 0.05$) with BMI percentiles suggesting that healthy retail food stores were related to higher mean BMI percentiles.

In Model 3, all food stores were combined because we wanted to determine if any type of retail food store was associated with average BMI percentile. A significant regression equation was found in Model 3, with an $R^2$ of 0.09. Every 0.26 increase in store density (combined) was associated with a one-point increase in mean BMI percentile. Model 3 had the strongest significance ($\beta = 0.26$, $p = 0.01$), related to mean BMI percentiles compared to linear analysis by store type and summed healthy or unhealthy store groups. These results suggest that store density of all types may be a better predictor of measures of obesity than densities by store type and healthy/unhealthy classification. Any type of food store within a half mile radius around schools impacts BMI.

**Table 15. Linear Regression Analysis of BMI Percentile and the Availability of Retail Food Stores**

| | **Model 1** | **Model 2** | **Model 3** |
|---|---|---|---|
| **Independent Variables** | **Unstandardized β (P Value)** | **Unstandardized β (P Value)** | **Unstandardized β (P Value)** |
| Supermarkets/Grocery Stores | 0.19 (0.68) | | |
| Specialty Healthy | 1.40 (0.22) | | |
| Food Pantry | 1.32 (0.09) | | |
| Full Service Restaurants | 0.05 (0.90) | | |
| Convenience Stores | 1.41 (0.02) | | |
| Fast Food Restaurants | -0.59 (0.17) | | |
| Liquor Stores | 3.51 (0.11) | | |
| Specialty Unhealthy | -0.77 (0.49) | | |
| Sum Healthy Stores | | 0.37 (0.05) | |
| Sum Unhealthy Stores | | 0.12 (0.63) | |
| Combined Stores | | | 0.26 (0.01) |

<u>**Hypotheses 3**</u>***: Schools in more economically deprived neighborhoods will have lower average physical fitness scores and higher average BMI percentile scores than schools in less economically deprived neighborhoods.*** An analysis of variance (ANOVA) was used to evaluate the relationships between neighborhood deprivation, physical fitness and obesity in children at the school level. Neighborhood deprivation was categorized into four levels including 1) very low deprivation; 2) low deprivation; 3) high deprivation; and 4) very high deprivation. Physical

fitness by school was characterized as the percentage of students that met minimum FitnessGram® requirements for the following 1) curl-ups; 2) trunk lift; 3) sit and reach; 4) push-ups; and the 5) PACER Run by age and gender. Levels of neighborhood deprivation were entered into the model as independent variables and measures of physical fitness and mean BMI percentile by school were entered as dependent variables.

An overall variance of 29% was explained by the model. Table 14 presents the mean BMI percentiles by level of neighborhood deprivation. Table 15 provides post hoc tests for comparisons between each of the four levels of neighborhood deprivation. Statistical significance was observed for differences by groups of varying levels of neighborhood deprivation and BMI percentile mean ($F = 10.38$, $p = 0.00$). Statistically significant differences were observed in mean BMI percentiles for high (67.76, $p = 0.00$) and very high (69.24, $p = 0.03$) when compared to very low (62.61) neighborhood deprivation. Mean BMI percentiles also varied significantly ($p = 0.03$) between low (63.62) and very high (69.24) levels of neighborhood deprivation.

Statistically significant differences were also observed with respect to neighborhood deprivation and mean physical fitness, specifically, push-up passing percentage ($F = 4.25$, $p = 0.01$). The push-up passing percentage varied by neighborhood deprivation level, whereby differences were observed for high (65.09, $p = 0.03$) and very high (62.40, $p = 0.00$) when compared to very low (76.55) neighborhood deprivation. These results suggest that the percentage of students that passed FitnessGram® push-up requirements was lower for students in schools with higher levels of neighborhood deprivation when compared to students in schools with lower levels of neighborhood deprivation. The results for push-up passing percentage varied with levels of neighborhood deprivation similar to mean BMI percentiles i.e. both dependent

variables varied at the high and very high when compared to very low levels of neighborhood deprivation. These results suggest that students who reside in school neighborhoods with higher levels of deprivation are likely to have higher BMI when compared to students who reside in neighborhoods with very low levels of deprivation.

**Table 16. The Association of Neighborhood Deprivation on BMI Percentile and Physical Fitness**

| ANOVA Analysis | | | | | | |
|---|---|---|---|---|---|---|
| | **Very Low Deprivation Mean** | **Low Deprivation Mean** | **High Deprivation Mean** | **Very High Deprivation Mean** | **F** | **P-Value** |
| BMI Percentile Mean | 62.61 | 63.62 | 67.76 | 69.24 | 10.38 | 0.00* |
| Curl Up Percent Pass | 77.67 | 71.78 | 70.40 | 70.45 | 1.21 | 0.31 |
| Trunk Lift Percent Pass | 80.46 | 81.09 | 77.12 | 72.12 | 1.61 | 0.20 |
| Sit and Reach Left Percent Pass | 66.42 | 63.01 | 62.96 | 62.33 | 0.57 | 0.64 |
| Sit and Reach Right Percent Pass | 71.51 | 67.62 | 67.54 | 67.37 | 0.65 | 0.59 |
| Push Up Percent Pass | 76.55 | 63.72 | 65.09 | 62.40 | 4.25 | 0.01* |
| PACER Run (Healthy Fitness Zone) | 8.37 | 5.88 | 6.18 | 7.94 | 0.72 | 0.54 |
| PACER Run (Needs Improvement) | 1.30 | 0.90 | 1.41 | 1.46 | 1.16 | 0.33 |
| PACER Run (At Risk) | 90.32 | 93.22 | 92.42 | 90.60 | 0.75 | 0.53 |

**Table 17. Post Hoc Results Using Games-Howell Post Hoc Tests.**

| | | **BMI Percentile Mean P-Value** | **Push Up P-Value** |
|---|---|---|---|
| 1 – Very Low Deprivation | 2 – Low Deprivation | 0.96 | 0.12 |
| | 3 – High Deprivation | 0.00* | 0.03* |
| | 4 – Very High Deprivation | 0.00* | 0.00* |
| 2 – Low Deprivation | 1 – Very Low Deprivation | 0.96 | 0.12 |
| | 3 – High Deprivation | 0.17 | 1.00 |
| | 4 – Very High Deprivation | 0.03* | 1.00 |
| 3 – High Deprivation | 1 – Very Low Deprivation | 0.00* | 0.03* |
| | 2 – Low Deprivation | 0.17 | 1.00 |
| | 4 – Very High Deprivation | 0.54 | 0.92 |
| 4 – Very High Deprivation | 1 – Very Low Deprivation | 0.00* | 0.00* |
| | 2 – Low Deprivation | 0.03* | 1.00 |
| | 3 – High Deprivation | 0.54 | 0.92 |

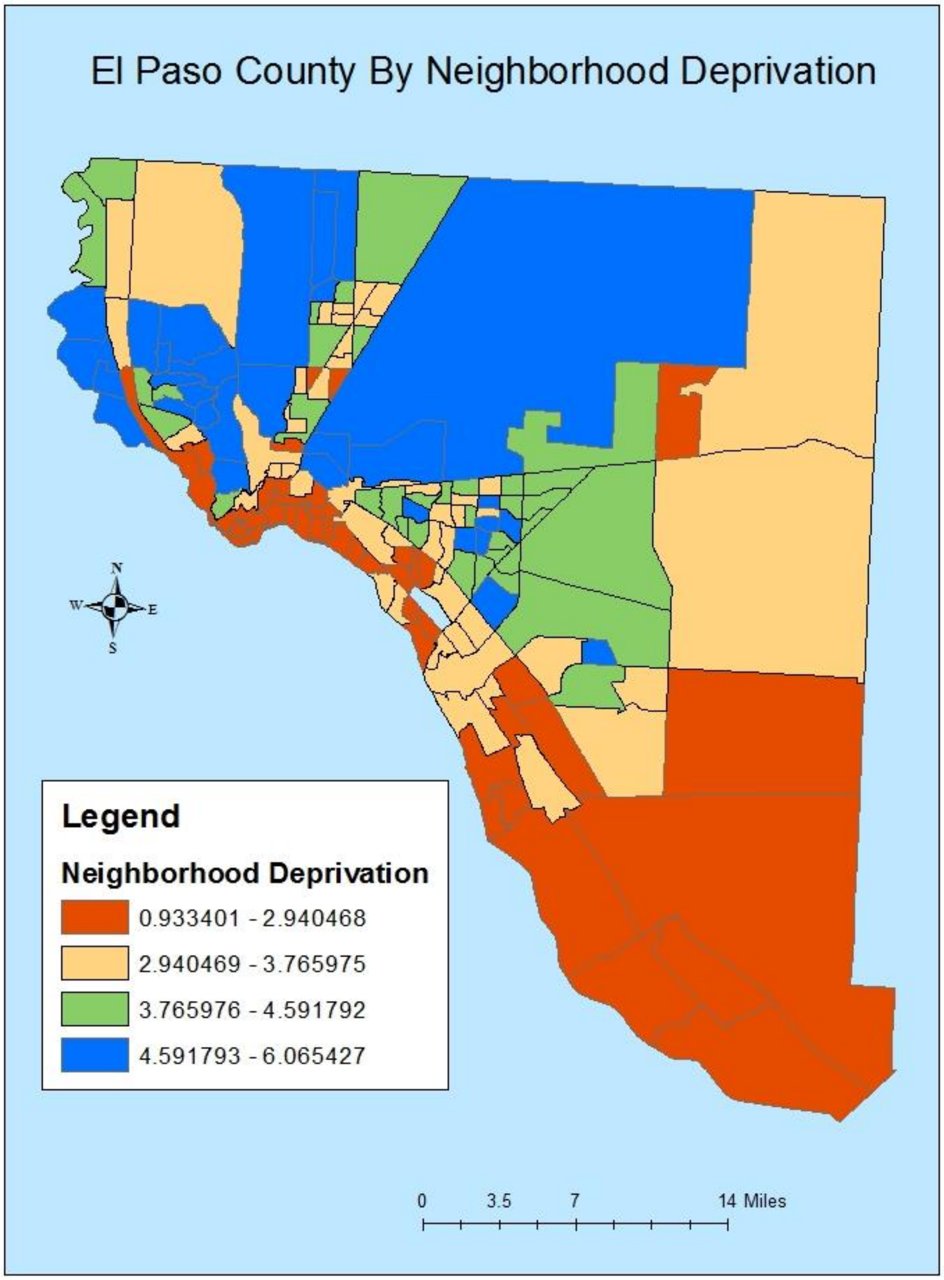


**Figure 5. El Paso County by Neighborhood Deprivation**

***Hypotheses 4: Schools in more economically deprived neighborhoods will have a higher density of unhealthy food stores (convenience stores, fast food restaurants, specialty food stores, and liquor stores) and higher averages of BMI than schools in less economically deprived neighborhoods.*** An analysis of variance was utilized to investigate the relationships between neighborhood deprivation, the retail food environment and childhood obesity at the school level. Neighborhood deprivation was categorized into four levels including 1) very low deprivation; 2) low deprivation; 3) high deprivation; and 4) very high deprivation. Levels of neighborhood deprivation were entered into the model as independent variables and the retail food store density and mean BMI percentile by school were entered as dependent variables. The retail food environment was characterized by store type density within a one-half mile (800 meter) radius of the school and included the following 1) Supermarkets or Grocery Stores; 2) Specialty Healthy Stores; 3) Food Pantries; 4) Full Service Restaurants; 5) Convenience Stores; 6) Fast Food Restaurants; 7) Liquor Stores; and 8) Specialty Unhealthy Stores.

Table 16 provides the results of the ANOVA analysis. Statistical significance was observed for differences between levels of neighborhood deprivation and BMI percentile means ($F = 10.38$, $p = 0.00$). Very low (62.61) versus very high (69.24) neighborhood deprivation had significantly ($p = 0.00$) different mean BMI percentile means. These results suggest that students in schools with very high vs very low levels of neighborhood deprivation had higher mean BMI percentiles. Mean BMI percentiles also varied significantly ($p = 0.03$) between low (63.62) and very high (69.24) levels of neighborhood deprivation.

Statistical significance was also observed in store density at different levels of neighborhood deprivation for both healthy and unhealthy food store types. Store density was measured by the number of stores per kilometer squared ($km^2$) within a one-half mile (800

meter) radius around a school. Two unhealthy food store types showed significant differences in store density byway of levels of neighborhood density. Specifically, convenience store ($F = 3.69$, $p = 0.02$) and unhealthy specialty store ($F = 6.96$, $p = 0.00$) density displayed differences by levels of neighborhood deprivation. First, convenience stores varied at very low versus very high neighborhood deprivation with a store density of 0.50 and 1.61 stores/$km^2$, respectively. Second, and similarly, unhealthy specialty store density also varied at very low versus very high neighborhood deprivation with a store density of 0.05 and 0.91 stores/$km^2$, respectively. In summary, there was a higher density of unhealthy stores (convenience and unhealthy specialty stores) in neighborhoods in which schools are located, compared to very high versus very low levels of neighborhood deprivation.

**Table 18. ANOVA on the Association of Neighborhood Deprivation on BMI Percentile Mean and Retail Food Stores**

| | Very Low Deprivation Mean | Low Deprivation Mean | High Deprivation Mean | Very High Deprivation Mean | F | P-Value |
|---|---|---|---|---|---|---|
| BMI Percentile Mean | 62.61 | 63.62 | 67.76 | 69.24 | 10.38 | 0.00* |
| Supermarkets/ Grocery Stores | 0.15 | 0.31 | 0.84 | 1.91 | 6.33 | 0.00* |
| Healthy Specialty | 0.05 | 0.08 | 0.26 | 0.57 | 3.01 | 0.04* |
| Food Pantry | 0.00 | 0.08 | 0.63 | 0.91 | 5.28 | 0.00* |
| Full Service Restaurants | 1.05 | 1.85 | 2.32 | 1.96 | 1.31 | 0.28 |
| Convenience Stores | 0.50 | 1.54 | 1.26 | 1.61 | 3.69 | 0.02* |
| Fast Food Restaurants | 0.60 | 1.69 | 1.26 | 1.09 | 1.17 | 0.33 |
| Liquor Stores | 0.00 | 0.08 | 0.11 | 0.13 | 0.88 | 0.45 |
| Unhealthy Specialty | 0.05 | 0.38 | 0.37 | 0.91 | 6.96 | 0.00* |
| Sum Healthy Stores | 1.25 | 2.31 | 4.05 | 5.35 | 5.86 | 0.00* |
| Sum Unhealthy Stores | 1.15 | 3.69 | 3.00 | 3.74 | 3.86 | 0.01* |
| Combined Stores | 2.40 | 6.00 | 7.05 | 9.09 | 5.83 | 0.00* |

Compared to very high, both very low (*p* = 0.00) and low (*p* = 0.02) deprivation had significantly higher store supermarket/grocery store densities (F = 6.33, *p* = 0.00). Very high neighborhood deprivation had a store density of 1.91 stores/$km^2$; whereas very low and low deprivation had store densities of 0.15 and 0.31 stores/$km^2$, respectively. These results suggest that when compared to very low neighborhood deprivation, higher deprivation levels had higher supermarket or grocery store densities. These results indicate that poorer neighborhoods had an increased availability of supermarkets and grocery stores as compared to more affluent neighborhoods. Healthy specialty food store density varied significantly with differing levels of neighborhood deprivation (F = 3.01, *p* = 0.04), but further post hoc pairwise comparisons showed no significant differences between the four groups.

Food pantry store density was significantly different at various levels of neighborhood deprivation (F = 5.28, *p* = 0.00). The post hoc results indicated a significant (*p* = 0.01) difference among food pantries density when comparing very low deprivation (0.00 stores/$km^2$) to very high deprivation (0.91 stores/$km^2$). Also significant (*p* = 0.02), was low deprivation (0.08 stores/$km^2$) when compared to very high deprivation (0.91 stores/$km^2$). These results suggest that schools with higher versus lower levels of neighborhood deprivation had higher food pantry store densities.

In an analysis that combined store type into healthy/unhealthy, very low versus high deprivation had a store density of 1.25 and 4.05 stores/$km^2$, respectively. The combined healthy store density also varied significantly between very low (1.25 stores/$km^2$) versus very high (5.35 stores/$km^2$) neighborhood deprivation (F = 5.86, *p* = 0.00). Previous results indicated that when analyzing retail food stores individually, poorer neighborhoods had an increased availability of supermarkets/grocery stores as compared to more affluent neighborhoods. However, when

combining them by healthy and unhealthy store type schools with higher levels of neighborhood deprivation had lower (combined) healthy food store densities.

The sum of unhealthy retail food stores also varied by deprivation level (F = 3.86, $p$ = 0.01). Very low versus very high had significantly ($p$ = 0.00) different store densities at 1.15 and 3.86 stores/km$^2$. These results suggest that schools with very high versus very low levels of neighborhood deprivation had higher levels of combined unhealthy food store densities. Finally, when all retail food stores were combined in the model, they were significantly different at different levels of neighborhood deprivation (F = 5.83, $p$ = 0.00). When combined, the very low deprivation store density was 2.40 stores/km$^2$ compared to the very high deprivation store density of 9.09 stores/km$^2$ and they differed significantly ($p$ = 0.00). Overall, the combination of retail store types in this study identified the influence of neighborhood deprivation and increased BMI regardless of store type.

**Table 19. Post Hoc Results Using Games-Howell Post Hoc Tests**

| | | BMI Percentile Mean P-Value | Supermarket/ Grocery Stores P-Value | Specialty Healthy P-Value |
|---|---|---|---|---|
| 1 – Very Low Deprivation | 2 – Low Deprivation | 0.96 | 0.92 | 0.99 |
| | 3 – High Deprivation | 0.00* | 0.17 | 0.27 |
| | 4 – Very High Deprivation | 0.00* | 0.00* | 0.10 |
| 2 – Low Deprivation | 1 – Very Low Deprivation | 0.96 | 0.92 | 0.99 |
| | 3 – High Deprivation | 0.17 | 0.53 | 0.48 |
| | 4 – Very High Deprivation | 0.03* | 0.02* | 0.15 |
| 3 – High Deprivation | 1 – Very Low Deprivation | 0.00* | 0.17 | 0.27 |
| | 2 – Low Deprivation | 0.17 | 0.53 | 0.48 |
| | 4 – Very High Deprivation | 0.54 | 0.22 | 0.57 |
| 4 – Very High Deprivation | 1 – Very Low Deprivation | 0.00* | 0.00* | 0.10 |
| | 2 – Low Deprivation | 0.03* | 0.02* | 0.15 |
| | 3 – High Deprivation | 0.54 | 0.22 | 0.57 |

**Table 20. Post Hoc Results using Games-Howell post hoc tests**

| | | **Food Pantry P-Value** | **Convenience Stores P-Value** | **Specialty Unhealthy P-Value** |
|---|---|---|---|---|
| 1 – Very Low Deprivation | 2 – Low Deprivation | 0.75 | 0.12 | 0.32 |
| | 3 – High Deprivation | 0.08 | 0.14 | 0.16 |
| | 4 – Very High Deprivation | 0.00* | 0.00* | 0.00* |
| 2 – Low Deprivation | 1 – Very Low Deprivation | 0.75 | 0.12 | 0.32 |
| | 3 – High Deprivation | 0.17 | 0.95 | 1.00 |
| | 4 – Very High Deprivation | 0.02* | 0.99 | 0.18 |
| 3 – High Deprivation | 1 – Very Low Deprivation | 0.08 | 0.14 | 0.16 |
| | 2 – Low Deprivation | 0.17 | 0.95 | 1.00 |
| | 4 – Very High Deprivation | 0.85 | 0.82 | 0.09 |
| 4 – Very High Deprivation | 1 – Very Low Deprivation | 0.01* | 0.00* | 0.00* |
| | 2 – Low Deprivation | 0.02* | 0.99 | 0.18 |
| | 3 – High Deprivation | 0.85 | 0.82 | 0.09 |

**Table 21. Post Hoc Results using Games-Howell Post Hoc Tests**

| | | Sum Healthy Stores P-Value | Sum Unhealthy Stores P-Value | Combined Stores P-Value |
|---|---|---|---|---|
| 1 – Very Low Deprivation | 2 – Low Deprivation | 0.70 | 0.16 | 0.30 |
| | 3 – High Deprivation | 0.02* | 0.06 | 0.01* |
| | 4 – Very High Deprivation | 0.00* | 0.00* | 0.00* |
| 2 – Low Deprivation | 1 – Very Low Deprivation | 0.70 | 0.16 | 0.30 |
| | 3 – High Deprivation | 0.35 | 0.94 | 0.95 |
| | 4 – Very High Deprivation | 0.07 | 1.00 | 0.50 |
| 3 – High Deprivation | 1 – Very Low Deprivation | 0.02* | 0.06 | 0.01* |
| | 2 – Low Deprivation | 0.35 | 0.94 | 0.95 |
| | 4 – Very High Deprivation | 0.68 | 0.80 | 0.59 |
| 4 – Very High Deprivation | 1 – Very Low Deprivation | 0.00* | 0.00* | 0.00* |
| | 2 – Low Deprivation | 0.07 | 1.00 | 0.50 |
| | 3 – High Deprivation | 0.68 | 0.80 | 0.59 |

# Chapter 5: Discussion

Childhood obesity is the most serious public health challenge of the 21st century (World Health Organization, 2014), with over 170 million children under the age of 18 are overweight or obese internationally (World Health Organization, 2012). The most current research indicates that 32% of children in the United States were either overweight or obese, and more than 17 % were classified as obese in 2012 (Ogden, Carroll, Kit, & Flegal, 2014). Hispanics represent 17% of the United States population, making them the largest and fastest growing minority group (U.S. Census Bureau, 2013). Over 21% of Hispanic children are obese compared to 14% of non-Hispanic Whites (Ogden, Carroll, Kit, & Flegal, 2012; Ogden et al., 2014). Texas is currently the 15th most obese state in the nation, with a combined overweight and obesity rate of 33.3 % among children between 10 to 17 years of age (Robert Woods Johnson Foundation, 2018). Along the U.S.-Mexico Border in El Paso, Texas, it is estimated that 33% of adult Hispanics are obese, and among 45 years of age or greater the rate is even higher at 50% (Coleman, Heath, & Alcalá, 2004). The prevalence of obesity among 4th graders in El Paso, Texas increased from 20% in 2005 to 30% in 2011 (Hoelscher, Ranjit, & Pérez, 2017).

Recent evidence suggests that characteristics of the built environment such as residential land use, access to recreation facilities, and parks have been related to obesity and physical activity (Harris et al., 2011). The majority of studies relating obesity and physical activity to the retail food environment have been conducted in regions that are primarily Caucasian or African American and has primarily focused on fast food restaurants and convenience stores (Currie, DellaVigna, Moretti, & Pathania, 2010; Davis & Carpenter, 2009; Forsyth, Wall, Larson, Story, & Neumark-Sztainer, 2012; Grier & Davis, 2013; Howard, Fitzpatrick, & Fulfrost, 2011). Little is known on whether relationships differ within a primarily Hispanic population. The purpose of

this study was to determine the relationship between obesity and physical fitness, and with neighborhood deprivation and the retail food environment in children attending the EPISD in El Paso, Texas. Children included were in grades three through eight attending school in the EPISD from 2009 to 2013. FitnessGram® records of 41,844 student records were used to create averages among 58 elementary schools and 17 middle schools. School BMI percentile mean was the primary outcome, and FitnessGram® data was used as a measure of fitness, retail food store concentration was used as a measure of the food environment, and the Urban Health Index (UHI) was used as a measure of neighborhood deprivation.

**Major Findings**

**Hypothesis 1**

Results from the study showed that schools with better fitness had lower average BMI percentiles which is consistent with the first hypothesis. An increase in curl up passing percentages was associated with a decrease in average BMI percentile. In addition, the PACER Run (NI) was directly related to average BMI percentile such that, a greater percent of students who were in the Needs Improvement category was associated with a higher BMI average. This is consistent with previous literature that has shown that the PACER run is associated with lower mean BMI percentiles, and the inclusion of BMI in the analysis has illustrated valid estimates of overall aerobic fitness in racial/ethnic populations (Mahar, Welk, & Rowe, 2018). The results did not show that an increase in the passing percentage of the trunk lift, sit and reach left and right, and PACER run (at risk) was significantly associated with lower BMI percentiles. This may be due to the importance of aerobic capacity in overall physical fitness. Aerobic capacity reflects an

individual’s ability to supply oxygen to the cardiovascular system during physical activity (Artero et al., 2011), and appears to be a stronger indicator of overall physical fitness.

In an effort to better understand deprivation within schools, the percentage of students on FPRL was added to the model. By doing so, it verified the importance of socio-economic status in the role of analyzing BMI in children by school. When only analyzing data among elementary schools, the passing percentages of curl-ups and PACER Run (NI) were inversely proportional with lower BMI percentiles. When analyzing data among middle schools separately the sit-and-reach flexibility passing percentages, right and left, were significantly associated with BMI percentiles, albeit in opposite directions. The differences between right and left sit-and-reach and BMI percentiles may be due to the majority of individuals being right versus left handed. The importance of flexibility measures among middle school students suggests that light intensity activity might also be an important indicator of physical fitness for this population.

The current study demonstrated the association between measures of physical fitness, SES and BMI percentiles at the school level. In general, schools with higher versus lower FitnessGram® passing percentages i.e. curl-ups and PACER Run (NI) were inversely and significantly associated with decreased mean BMI percentiles by school. The SES indicator FRPL was directly and significantly associated with mean BMI percentiles by school. In 2014, EPISD became a part of the Community Eligibility Provision (CEP). The CEP is a free meal service option for schools and school districts in low income areas (United States Department of Agriculture Food and Nutrition Service, 2017). Currently, two-thirds of the EPISD sites are on the CEP, where all students receive free breakfast and lunch and free/price reduced lunch applications are no longer required or collected. A list of the EPISD schools participating in the

CEP can be viewed in the appendix portion of this document. Continued investigation on the impact of SES on childhood obesity is warranted.

**Hypothesis 2**

The findings indicated that schools with more convenience stores had higher average BMI's, which may be due to the increased access to processed and unhealthy foods. These findings are consistent with previous literature that has found that an increased density of convenience stores within a school's zip code was significantly associated with increased BMI among $8^{th}$ and $10^{th}$ grade students (Powell, Auld, Chaloupka, O'Malley, & Johnston, 2007). Similar findings were reported among Galvez, et al., where they reported that an increase in the presence of a convenience store was associated with a higher BMI percentile, when compared to children without a convenience store on their block (Galvez et al., 2009).

In an effort to better understand the impact of retail food stores, all stores were classified into healthy and unhealthy categories. The results indicated that having any healthy food store such as a supermarket/grocery store, food pantry, full service restaurant, or healthy specialty store within a half-mile radius of each school was found to be associated with an increase in BMI. Reports on the association between availability of supermarkets and obesity have been mixed (Larson, Story, & Nelson, 2009). A number of studies suggests that limited availability of supermarkets is associated with increased risk of obesity (Liu, Wilson, Qi, & Ying, 2007; Morland, Wing, & Roux, 2002; Powell et al., 2007; Wang, McPherson, Marsh, Gortmaker, & Brown, 2007), and other studies reported no association between supermarket availability and obesity (Ford & Dzewaltowski, 2010; Sturm & Datar, 2005). The impact of healthy food stores on BMI is unique for this population and suggests that unhealthy food purchases can be made

anywhere. Further studies are needed to analyze the specific food purchases made by students before and after school.

When all retail food stores were combined there was a significant relationship, which may suggest that the specific type of food store is not as important as the overall commercial presence. These findings are similar to those reported by Lee, (2012) where she reported a high concentration of fast food restaurants, convenience stores, large scale grocery stores, and full-service restaurants near the homes of poor and minority children (Lee, 2012). Healthy and unhealthy food purchases can be made practically anywhere, and unhealthy foods are less expensive. These findings verify a shift in food access, where the current issue appears to be the overabundance of accessible food. Such that, retail food store concentration may be a better predictor of obesity within a primarily Hispanic population.

**Hypothesis 3**

The findings from the analysis indicated that BMI percentile means varied significantly by deprivation level. Such that, schools in more deprived neighborhoods had higher average BMI percentiles. In addition, the results for the push up passing percentage significantly varied with levels of neighborhood deprivation in the same direction. These findings are consistent with previous literature that has found that children had a greater chance of being overweight if they resided in neighborhoods with higher versus lower socioeconomically deprived conditions (Rossen, 2014; Singh, Siahpush, & Kogan, 2010).

Carroll-Scott et al. (2013) reported that students residing in neighborhoods with less deprivation were more likely to engage in frequent physical activity. In parallel, the current study provides results that suggest that physical fitness varies as a function of neighborhood deprivation i.e. push-up passing percentage were lower in schools with high levels of

neighborhood deprivation. Previous literature suggests that students living in more affluent neighborhoods ate healthier and participated in more frequent physical activity which may be true for this population as well. These results suggest that students who reside in school neighborhoods with higher levels of deprivation are likely to have higher BMIs when compared to students who reside in neighborhoods with very low levels of deprivation. The influence of neighborhood deprivation on mean BMI percentiles suggests the importance social and economic factors that contribute to child obesity at the school level. In addition, the results from this study suggest that the two most important categories of neighborhood deprivation are the very high deprivation and very low deprivation.

**Hypothesis 4**

The findings from the final analysis showed that BMI percentile means varied significantly by deprivation level, indicating that students residing in more deprived neighborhoods had an increased BMI. Similar findings were identified by Fitzpatrick et al., (2017) where they reported that schools located in more deprived neighborhoods were associated with increased overweight and obesity among children. The majority of previous literature on the retail food environment has focused on fast food restaurants and convenience stores (Currie et al., 2010; Davis & Carpenter, 2009; Forsyth et al., 2012; Grier & Davis, 2013; Howard et al., 2011). However, in this study the analysis was performed looking at supermarkets/grocery stores, food pantries, full service restaurants, healthy specialty stores, convenience stores, fast food restaurants, specialty food stores, and liquor stores. In this study, higher levels of neighborhood deprivation had higher supermarket/grocery store densities. Similar findings were reported by Sharkey et al., (2008) where they reported that the most deprived neighborhoods in the Texas Brazos Valley had increased availability of retail stores in comparison to remote rural

locations. The inclusion of numerous retail store types in this study has identified the influence of neighborhood deprivation and increased BMI regardless of store type. These findings suggest that the overabundance of stores, regardless of store type impact obesity within a primarily Hispanic population.

### Implications on Children's Health

Health care expenditures for the treatment and management of childhood obesity are expected to exceed 14 billion dollars in the United States by 2030 (Grier & Davis, 2013; Y. Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008) and obesity in general, is estimated to cause 112,000 deaths per year nationwide (Task Force on Childhood Obesity, 2010). A complete understanding in the development of obesity, however, is lacking (Sahoo et al., 2015). Individual factors such as race, age and gender are associated with children's weight (Ogden, Carroll, Kit, & Flegal, 2012; Ogden, Carroll, Kit, & Flegal, 2014). Parental characteristics such as income (Bhargava, Jolliffe, & Howard, 2008) and education level (Chivers, Parker, Bulsara, Beilin, & Hands, 2012; Elder et al., 2010; Keane, Layte, Harrington, Kearney, & Perry, 2012) have also been associated with children's weight.

Novel theories entrenched in social and ecological principals suggest that a series of complex obesity related factors interact across multiple levels, including the individual, organizational, and community level. Identifying risk factors at the school and neighborhood level will help prevent the development of poor health outcomes and decrease healthcare expenditures. Unfortunately, studies in the retail food environment and accessibility to physical activity facilities have produced mixed findings (Ohri-Vachaspati, Lloyd, DeLia, Tulloch, & Yedidia, 2013). The current study findings suggest that school and neighborhood environments are related to obesity and physical fitness in children. Future studies should include factors of

the built environment such as access to parks and recreational facilities. With supportive evidence, these and future findings may prove useful in providing policy recommendations that include healthier land use policies and zoning ordinances.

### *Policy Recommendations*

***Zoning Ordinances.*** The current study findings suggest that school and neighborhood environments are related to obesity and physical fitness in children. Community developers and city planners can benefit from incorporating zoning ordinances around schools that contribute to healthy retail food environments. Local governments have the power to utilize land-use policies that limit the number and location of businesses (Nixon et al., 2015). Zoning has been utilized in the past to reduce the negative influence of alcohol, tobacco, and firearms (Wilson, Hutson, & Mujahid, 2008), and restrict fast food establishments (Sturm & Hattori, 2015).

These *health zoning* ordinances are intended to modify the environment and protect the public's health (Maantay, 2002). Fast food restriction policies were implemented in Los Angeles, California in 2008 to encourage healthier food options (Sturm & Hattori, 2015). The fast food restriction was implemented in a low-income neighborhood to facilitate an increase in store density for supermarkets or grocery stores (Sturm & Hattori, 2015). Neighborhoods without healthy zoning ordinances place geographical barriers to healthy retail food options that result in longer transportation time and costs.

Zoning ordinances and city planning policies should increase access to parks and safe places that promote physical activity. Several studies have reported that park availability may not be distributed equally across deprived and ethnically diverse neighborhoods in the United States (Gordon-Larsen, Nelson, Page, & Popkin, 2006; Vaughan et al., 2013). Providing access

to parks and areas with green spaces can promote higher levels of physical activity (Elwell Bostrom, Shulaker, Rippon, & Wood, 2017). Urban green spaces tend to provide communities with a decrease in crime rates, higher property values, and an overall greater quality of life (Kim et al., 2016).

A recent study conducted by Kamel, et al., (2014) examined the disparities in park availability, features, and characteristics by income in El Paso, Texas. Their findings indicate that park availability and safety significantly differed by income (Kamel, Ford, & Kaczynski, 2014). The park quality and safety/quality concerns measured in their analysis were 1) evidence of threatening behavior 2) dangerous spots 3) vandalism 4) inadequate lighting and 5) graffiti (Kamel et al., 2014). These results suggest that the locations of parks, neighborhood safety, and high traffic on streets may make it difficult for a child to participate in physical activity. Thus, additional improvements are needed in order to make low income neighborhoods safe and walkable.

***EPISD.*** In order to better understand how EPISD students are performing on the FitnessGram® tests and to increase the validity of data collected for measures of obesity, the following recommendation are provided.

1) Standardized Test Dates. High levels of variability in the test dates were observed across and within schools making comparisons across time difficult. Future efforts should suggest that testing take place over the course of one week at all school locations. Students will be assessed twice annually to include a pre-test measure at the beginning of the school year, and a post test that takes place at the end of the school year.
2) Uniform Data Collection. Missing data and data incorrectly recorded was consistently observed and reduced the total observations for this analysis significantly. Future efforts

should adopt uniform data collection procedures and schools should provide ongoing training to data collection personnel.

3) Data Management. The minimum personnel required to enter data should be utilized to maintain consistency in data entry. Ongoing data management should include routine reviews for accuracy of data entry.

### *Limitations*

As with all research, there are limitations associated with this study. As an ecological study design using cross-sectional data, no inferences can be made pertaining to individual behavior, exposure, or causality. In addition, many residents may choose to shop outside their census tracts, and therefore food store availability within a census tract may not reflect utilization (Inagami, Cohen, Finch, & Asch, 2006). There is also a lack of information on store quality and types of foods offered specifically within the small grocery stores and specialty stores. There may be potential errors associated with food store misclassification and the geocoding of school addresses. In addition, there may be measurement errors associated with the data provided by the EPISD. Each individual school nurse collects the height and weight data, and to date, there are not a standardized set of scales that are used from one school to the next. In addition, physical education teachers administer the FitnessGram® performance test and each individual instructor style may vary by administrator. Another limitation, is that the FitnessGram® testing results did not identify individuals with a disability. Therefore, participation and inclusion of their FitnessGram® scores is unknown. Finally, high school age students were excluded from the study, because there are different FitnessGram® testing requirements for high school students enrolled in athletic and non-athletic programs (Vowell, Read, Meredith, & Fudge, 2015). By the

time students reach high school they may have already established set eating habits, which is why we are interested in younger aged children.

## Conclusion and Suggestions for Future Research

These findings provide additional evidence on the influence of neighborhood deprivation, physical activity, and the retail food environment on childhood obesity. This study highlights the importance of neighborhoods surrounding schools, because students pass through the same route at least a twice day when traveling to and from school. Schools are important settings for physical activity, and because of the long amount of time spent there, they allow numerous opportunities to be made available to all students (Button, Trites, & Janssen, 2013) regardless of socioeconomic status and safety issues.

The majority of previous research has focused on convenience stores and fast food restaurants. However, in this study, several healthy retail food stores significant predicted an increase BMI, which may suggest that there is an underlying cause to the problem. Any type of retail food store within a half mile radius around a school impacted BMI, and thus may be a potential zoning issue. Limiting the availability of any kind of retail food stores near schools may have an impact on decreasing the prevalence of childhood obesity.

Children may have access to parks in El Paso, however they may not be utilizing them because of safety and quality issues. It is recommended that El Paso City Parks and Recreation invest resources to make these spaces safe, accessible and affordable. This can be done by providing extra lighting, quickly removing any sings of graffiti, and adding a security guard during high peak hours. In addition, the community overall needs to assist in making poor neighborhoods walkable. This can be done by adding more roundabouts to high traffic areas. The

retail food stores surrounding schools is important, and further research is needed to investigate the specific purchasing and dietary habits children before and after school. Many students tend to live near their schools, which may impact the home environment as well. Further studies in this area might include the utilization and analysis of more than one school district simultaneously in order to obtain a various demographic representation of El Paso, Texas. In addition, it might be beneficial to compare one of our local school districts to others in Texas and other states. Each state has different zoning policies, and the inclusion of them in the analysis will assist researchers in understanding how zoning is driving rates of obesity by poverty level.

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# Appendix 1

## Definition of Terms

*Body Mass Index*- According to the CDC, BMI is a number calculated by dividing weight in pounds (lbs) by height in inches (in) squared and multiplying by a conversion factor of 703 (Centers for Disease Control and Prevention, 2015a).

*Body Mass Index Percentile*- after BMI is calculated it is plotted on the CDC BMI-for-age growth charts to obtain a percentile ranking. For children and teens, BMI is age and gender specific. The BMI percentile specifies the location of the child's BMI number among children of the same age and gender (Centers for Disease Control and Prevention, 2015a). The growth chart shown below in Table 1 indicates the weight status categories and percentile ranges.

**Table 2: BMI-for-age weight status categories and the corresponding percentiles.**

| Weight Status Category | Percentile Range |
|---|---|
| Underweight | Less than the $5^{th}$ percentile |
| Healthy Weight | $5^{th}$ percentile to less than the $85^{th}$ percentile |
| Overweight | $85^{th}$ percentile to less than the $95^{th}$ percentile |
| Obese | Equal to or greater than the $95^{th}$ percentile |

Source: (Centers for Disease Control and Prevention, 2015a)

*Back-Saver Sit and Reach* – Testing one leg at a time, students sit with one knee bent and one leg straight against a box and reach forward (The Cooper Institute, 2015).

*Buffer* – boundaries that are placed around specific points using a straight line or network distance. Buffers are useful for capturing features that surround a specific location (Thornton, Pearce, & Kavanagh, 2011).

*Childhood obesity* is defined as a Body Mass Index (BMI) at or above the 95th percentile according to BMI-for-age growth charts by gender (Flegal et al., 2006).

*Colonias* are defined as a residential area along the Texas-Mexico Border that may lack basic infrastructure, such as potable water and sewer systems, electricity, paved roads, and safe sanitary housing (Hargrove et al., 2015).

*Culture* is defined as the learned and shared beliefs and values of a particular group that often influence an individual's thinking and actions (Micklesfield et al., 2013).

*Curl Up* – Measuring abdominal strength and endurance, students lie down with knees bent and feet unanchored. Set to a specified pace, students complete as many repetitions as possible to a maximum of 75 (The Cooper Institute, 2015).

*Density* – a measure of the number of features within a specific area (Thornton et al., 2011).

*FitnessGram®* - is tool used to assess fitness and physical activity levels among children (The Cooper Institute, 2015).

*Food Bank*- a "non-profit hunger relief organization that serves as a clearing house to solicit, inspect, repack and distribute food to the organizations like food pantries, soup kitchens and shelters that feed individuals"(El Pasoans Fighting Hunger Food Bank, 2015).

*Geocoging* – "the process of matching address information with a spatial data set that includes all addresses within the area of interest mapped to latitude and longitude" (Thornton et al., 2011).

*Geographic Information Systems (GIS)* – "is a system for input, storage, processing, and retrieval of spatial data" (Kurland & Wilpen, 2006).

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

*Physical activity* - "any bodily movement produced by skeletal muscles that results in energy expenditure" (Caspersen et al., 1985).

*Progressive Aerobic Cardiovascular Endurance Run* (PACER) – Set to music, a paced, 20-meter shuttle run increasing in intensity as time progresses (The Cooper Institute, 2015).

*Push-Up* – Measuring upper body strength and endurance, student's lower body to a 90-degree elbow angle and push up. Set to a specified pace, students complete as many repetitions as possible (The Cooper Institute, 2015).

*Trunk Lift* – Measuring trunk extensor strength, students lie face down and slowly raise their upper body long enough for the tester to measure the distance between the floor and the student's chin (The Cooper Institute, 2015).

## Appendix 2. EPISD IRB Approval Letter

El Paso Independent School District®
Research and Evaluation

April 2, 2012

Teresa M. Anchondo, MPH
College of Health Sciences
500 W. University Ave.
HSSN 411
El Paso, TX 79968

Dear Ms. Anchondo,

We have received your request to conduct research in the El Paso Independent School District. Congratulations your study, *Geographic and Multilevel Influences if Neighborhood and School Environments on the Development of Obesity Among School Children in a Border Community*, has been approved. You will conduct the research district-wide under the endorsement of James Steinhauser, Assistant Superintendent for Research and Evaluation. As part of this approval, we require that you send a summary of your findings to our department for our records once your study is completed.

You have our best wishes for a successful study. Please contact me at (915) 881-2412 or email me at cperales@episd.org if you have questions. Thank you.

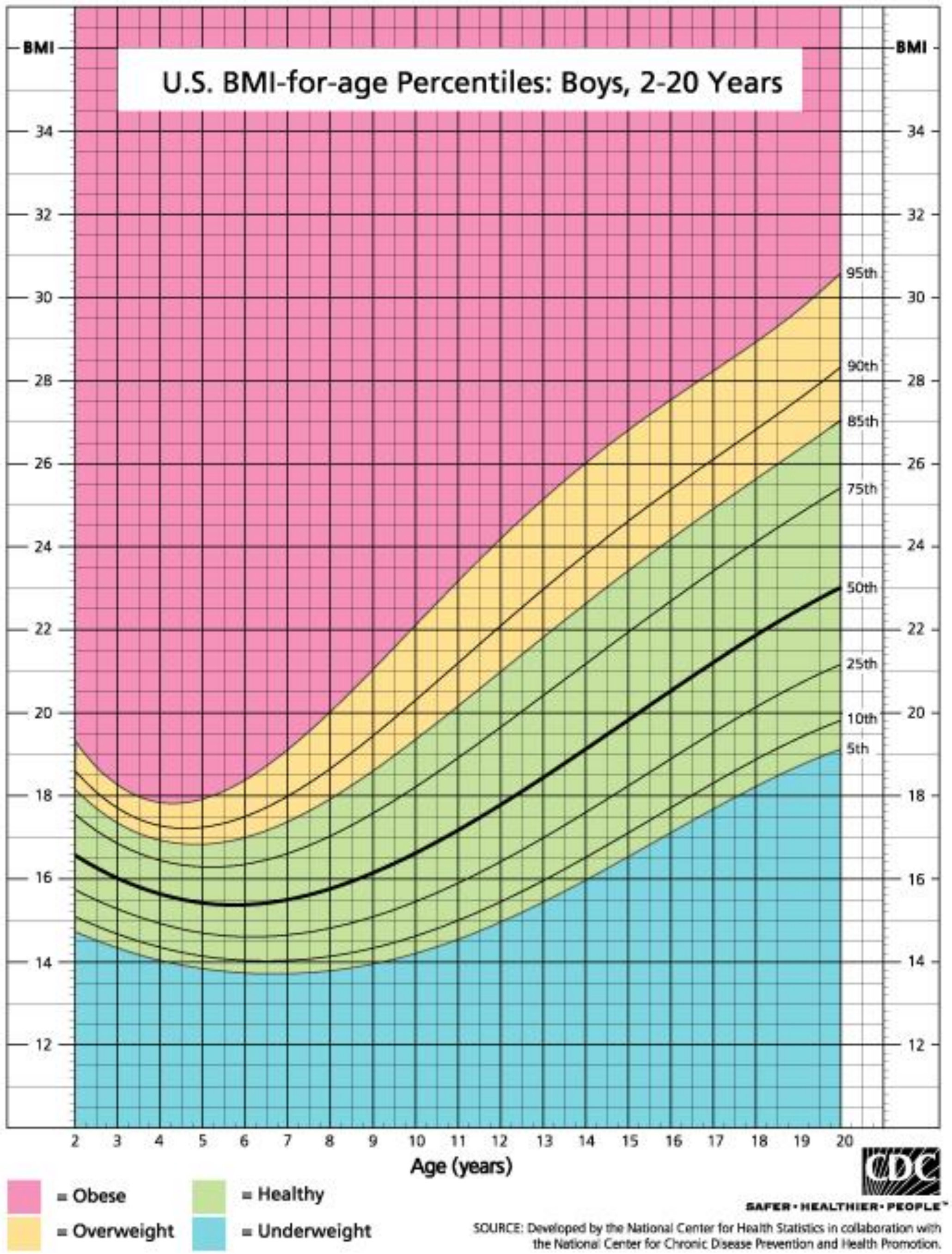
Sincerely

Carlos Perales
Researcher

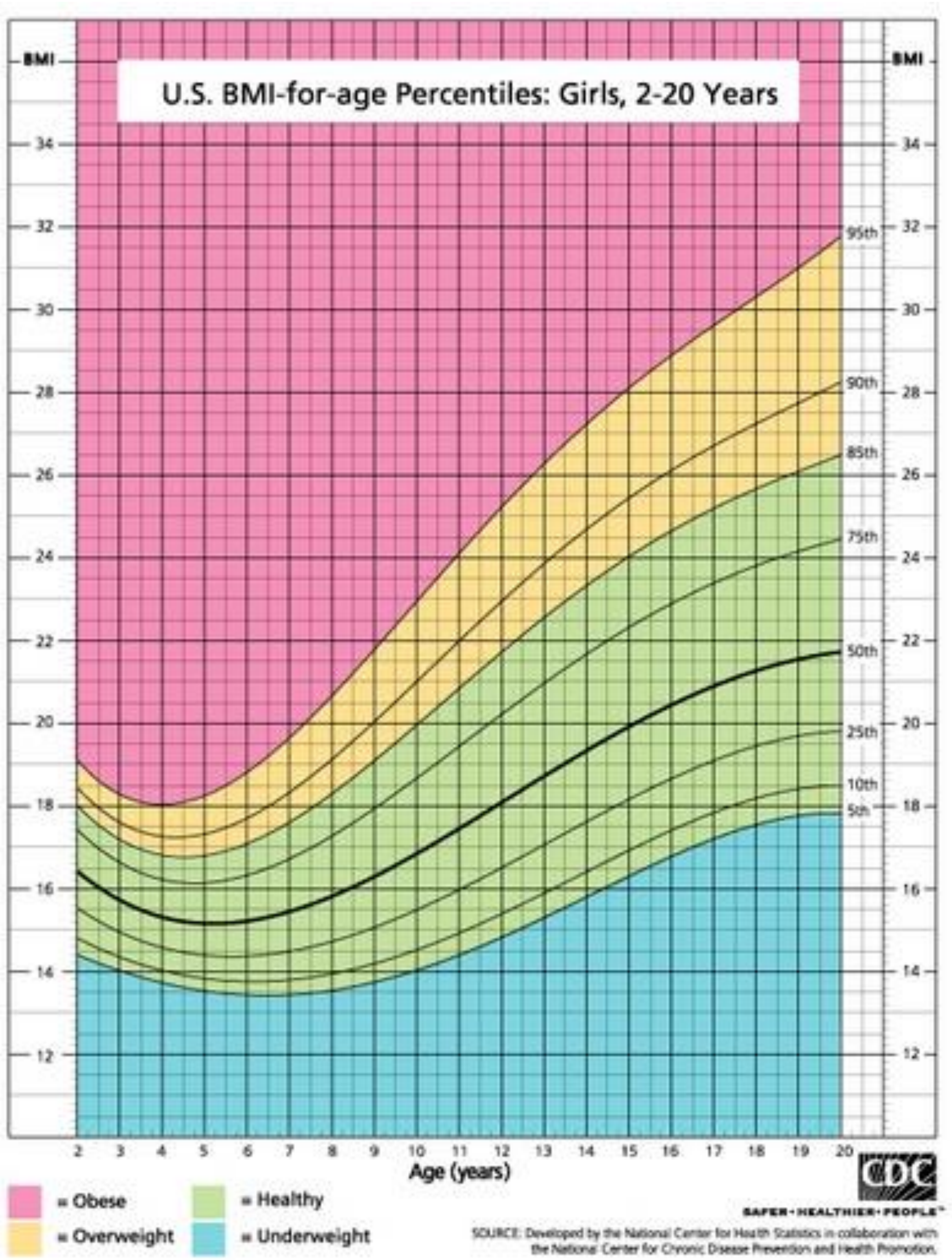
Approved: ____________________
James Steinhauser, Assistant Superintendent

Education Center-Boeing
6531 Boeing Drive • El Paso, Texas 79925 • (915)881-2400 • FAX (915) 771-1145
Mailing Address: P.O. Box 20100 • El Paso, Texas 79998-0100

**Appendix 3. U.S. BMI-for-Age Percentile Chart for Boys, 2-20 Years of Age**



**Appendix 4. U.S. BMI-for-Age Percentile Chart for Girls, 2-20 Years of Age**



## Appendix 5. FitnessGram® Test Items

The Cooper Institute
Healthy Living...Down to a Science

HUMAN KINETICS
The Information Leader in Physical Activity

### FITNESSGRAM® Tests

*Six Recommended Tests Are Bolded*


AEROBIC CAPACITY

1) **PACER** (Progressive Aerobic Cardiovascular Endurance Run) – Set to music, a paced, 20-meter shuttle run increasing in intensity as time progresses

Or:

- One-Mile Run – Students run (or walk if needed) one mile as fast as they can
- Walk Test – Students walk one mile as fast as they can (for ages 13 or above since the test has only been validated for this age group)


BODY COMPOSITION

2) **Skin Fold Test** – Measuring percent body fat by testing the tricep and calf areas

Or:

- Body Mass Index – Calculated from height and weight


MUSCULAR STRENGTH AND ENDURANCE

3) **Curl Up** – Measuring abdominal strength and endurance, students lie down with knees bent and feet unanchored. Set to a specified pace, students complete as many repetitions as possible to a maximum of 75


4) **Trunk Lift** – Measuring trunk extensor strength, students lie face down and slowly raise their upper body long enough for the tester to measure the distance between the floor and the student's chin

5) **Push-Up** – Measuring upper body strength and endurance, students lower body to a 90-degree elbow angle and push up. Set to a specified pace, students complete as many repetitions as possible

Or:

- Modified Pull-Up (proper equipment required) – With hands on a low bar, legs straight and feet touching the ground, students pull up as many repetitions as possible
- Flexed Arm Hang – Students hang their chin above a bar as long as possible


FLEXIBILITY

6) **Back-Saver Sit and Reach** – Testing one leg at a time, students sit with one knee bent and one leg straight against a box and reach forward

Or:

- Shoulder Stretch – With one arm over the shoulder and one arm tucked under behind the back, students try to touch their fingers and then alternate arms

# Appendix 6. FitnessGram® Performance Standards 2011-2013



## *FITNESSGRAM* Performance Standards[1]

For each test area, the *FITNESSGRAM* uses the Healthy Fitness Zone (HFZ) to evaluate fitness performance. For Aerobic Capacity and Body Composition, the *FITNESSGRAM* also provides Very Lean and Needs Improvement–Health Risk (NI–HR) standards to evaluate fitness performance. The performance goal for all test areas is the HFZ. These zones represent minimum levels of fitness that offer protection against the diseases that result from sedentary living.

### Females

| | Aerobic Capacity | | | Body Composition[3] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | One-Mile Run/20m PACER/Walk Test $VO_2max$ (ml/kg/min)[2] | | | Skinfold Measurements/ Bioelectric Impedance Analyzer Percent Body Fat | | | | Body Mass Index | | | |
| Age | NI – Health Risk | NI | HFZ | NI – Health Risk | NI | HFZ | Very Lean | NI – Health Risk | NI | HFZ | Very Lean |
| 5 | $VO_2max$ standards not available for students ages 5 through 9[4]. For Walk Test only, standards also not available for students ages 10, 11, and 12. | | | ≥ 28.4 | ≥ 20.9 | 20.8 – 9.8 | ≤ 9.7 | ≥ 17.3 | ≥ 16.8 | 16.7 – 13.6 | ≤ 13.5 |
| 6 | | | | ≥ 28.4 | ≥ 20.9 | 20.8 – 9.9 | ≤ 9.8 | ≥ 17.7 | ≥ 17.1 | 17.0 – 13.5 | ≤ 13.4 |
| 7 | | | | ≥ 28.4 | ≥ 20.9 | 20.8 – 10.1 | ≤ 10.0 | ≥ 18.3 | ≥ 17.6 | 17.5 – 13.5 | ≤ 13.4 |
| 8 | | | | ≥ 28.4 | ≥ 20.9 | 20.8 – 10.5 | ≤ 10.4 | ≥ 19.1 | ≥ 18.3 | 18.2 – 13.6 | ≤ 13.5 |
| 9 | | | | ≥ 30.8 | ≥ 22.7 | 22.6 – 11.0 | ≤ 10.9 | ≥ 20.0 | ≥ 19.0 | 18.9 – 13.8 | ≤ 13.7 |
| 10 | ≤ 37.3 | 37.4 – 40.1 | ≥ 40.2 | ≥ 33.0 | ≥ 24.4 | 24.3 – 11.6 | ≤ 11.5 | ≥ 21.0 | ≥ 19.6 | 19.5 – 14.1 | ≤ 14.0 |
| 11 | ≤ 37.3 | 37.4 – 40.1 | ≥ 40.2 | ≥ 34.5 | ≥ 25.8 | 25.7 – 12.2 | ≤ 12.1 | ≥ 21.9 | ≥ 20.5 | 20.4 – 14.5 | ≤ 14.4 |
| 12 | ≤ 37.0 | 37.1 – 40.0 | ≥ 40.1 | ≥ 35.5 | ≥ 26.8 | 26.7 – 12.7 | ≤ 12.6 | ≥ 22.9 | ≥ 21.3 | 21.2 – 14.9 | ≤ 14.8 |
| 13 | ≤ 36.6 | 36.7 – 39.6 | ≥ 39.7 | ≥ 36.3 | ≥ 27.8 | 27.7 – 13.4 | ≤ 13.3 | ≥ 23.8 | ≥ 22.1 | 22.0 – 15.4 | ≤ 15.3 |
| 14 | ≤ 36.3 | 36.4 – 39.3 | ≥ 39.4 | ≥ 36.8 | ≥ 28.6 | 28.5 – 14.0 | ≤ 13.9 | ≥ 24.6 | ≥ 22.9 | 22.8 – 15.9 | ≤ 15.8 |
| 15 | ≤ 36.0 | 36.1 – 39.0 | ≥ 39.1 | ≥ 37.1 | ≥ 29.2 | 29.1 – 14.6 | ≤ 14.5 | ≥ 25.4 | ≥ 23.6 | 23.5 – 16.4 | ≤ 16.3 |
| 16 | ≤ 35.8 | 35.9 – 38.8 | ≥ 38.9 | ≥ 37.4 | ≥ 29.8 | 29.7 – 15.3 | ≤ 15.2 | ≥ 26.1 | ≥ 24.2 | 24.1 – 16.9 | ≤ 16.8 |
| 17 | ≤ 35.7 | 35.8 – 38.7 | ≥ 38.8 | ≥ 37.9 | ≥ 30.5 | 30.4 – 15.9 | ≤ 15.8 | ≥ 26.7 | ≥ 24.7 | 24.6 – 17.3 | ≤ 17.2 |
| 17+ | ≤ 35.3 | 35.4 – 38.5 | ≥ 38.6 | ≥ 38.6 | ≥ 31.4 | 31.3 – 16.5 | ≤ 16.4 | ≥ 27.2 | ≥ 25.2 | 25.1 – 17.6 | ≤ 17.5 |

**≥ The score is greater than or equal to the indicated value.**
**≤ The score is less than or equal to the indicated value.**

[1] The *FITNESSGRAM* and Healthy Fitness Zones (HFZ) are registered trademarks of The Cooper Institute.

[2] $VO_2max$ reflects the maximum rate that oxygen can be taken up and utilized by the body during exercise. It is estimated by utilizing the student's height, weight, and other specific information, which is based on the test option (i.e., One-Mile Run, 20m PACER, or Walk Test) administered. The calculation procedures are found in the Reference Guide on the California Physical Fitness Test (PFT) Resources Web page at http://www.pftdata.org/resources.aspx.

[3] For Body Composition, the California Department of Education (CDE) considers a student who exceeds the HFZ as meeting the HFZ. Exceeding the HFZ means obtaining a score less than a number on the lower end or right side of the HFZ.

[4] Grade five students age 9 with time or laps reported have a $VO_2max$ calculated and are compared to the HFZ for students age 10. If a One-Mile Run time or PACER laps are reported for grade five students less than age 9, a $VO_2max$ will not be calculated, but the student will be reported in the HFZ.

## Females

| | Abdominal Strength and Endurance | Trunk Extensor Strength and Flexibility | Upper Body Strength and Endurance | | | Flexibility | |
|---|---|---|---|---|---|---|---|
| Age | Curl-Up # completed up to max of 75 | Trunk Lift # of inches up to max of 12 | 90° Push-Up # completed up to max of 75 | Modified Pull-Up # completed up to max of 75 | Flexed-Arm Hang # of seconds up to max of 90 | Back-Saver Sit & Reach[a] # of inches up to max of 12 | Shoulder Stretch |
| 5 | ≥ 2 | 6 – 12 | ≥ 3 | ≥ 2 | ≥ 2 | 9 | Touching fingertips together behind the back on **both** the right and left sides. |
| 6 | ≥ 2 | 6 – 12 | ≥ 3 | ≥ 2 | ≥ 2 | 9 | |
| 7 | ≥ 4 | 6 – 12 | ≥ 4 | ≥ 3 | ≥ 3 | 9 | |
| 8 | ≥ 6 | 6 – 12 | ≥ 5 | ≥ 4 | ≥ 3 | 9 | |
| 9 | ≥ 9 | 6 – 12 | ≥ 6 | ≥ 4 | ≥ 4 | 9 | |
| 10 | ≥ 12 | 9 – 12 | ≥ 7 | ≥ 4 | ≥ 4 | 9 | |
| 11 | ≥ 15 | 9 – 12 | ≥ 7 | ≥ 4 | ≥ 6 | 10 | |
| 12 | ≥ 18 | 9 – 12 | ≥ 7 | ≥ 4 | ≥ 7 | 10 | |
| 13 | ≥ 18 | 9 – 12 | ≥ 7 | ≥ 4 | ≥ 8 | 10 | |
| 14 | ≥ 18 | 9 – 12 | ≥ 7 | ≥ 4 | ≥ 8 | 10 | |
| 15 | ≥ 18 | 9 – 12 | ≥ 7 | ≥ 4 | ≥ 8 | 12 | |
| 16 | ≥ 18 | 9 – 12 | ≥ 7 | ≥ 4 | ≥ 8 | 12 | |
| 17 | ≥ 18 | 9 – 12 | ≥ 7 | ≥ 4 | ≥ 8 | 12 | |
| 17+ | ≥ 18 | 9 – 12 | ≥ 7 | ≥ 4 | ≥ 8 | 12 | |



≥ The score is greater than or equal to the indicated value.
≤ The score is less than or equal to the indicated value.

[a] Student must reach the distance on both the right and left sides to achieve the HFZ.

# *FITNESSGRAM* Performance Standards[1]

For each test area, the *FITNESSGRAM* uses the Healthy Fitness Zone (HFZ) to evaluate fitness performance. For Aerobic Capacity and Body Composition, the *FITNESSGRAM* also provides Very Lean and Needs Improvement–Health Risk (NI–HR) standards to evaluate fitness performance. The performance goal for all test areas is the HFZ. These zones represent minimum levels of fitness that offer protection against the diseases that result from sedentary living.

## Males

| | Aerobic Capacity | | | Body Composition[3] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | One-Mile Run/20m PACER/Walk Test $VO_2max$ (ml/kg/min)[2] | | | Skinfold Measurements/ Bioelectric Impedance Analyzer Percent Body Fat | | | | Body Mass Index | | | |
| Age | NI – Health Risk | NI | HFZ | NI – Health Risk | NI | HFZ | Very Lean | NI – Health Risk | NI | HFZ | Very Lean |
| 5 | $VO_2max$ standards not available for students ages 5 through 9[4]. **For Walk Test only, standards also not available for students ages 10, 11, and 12.** | | | ≥ 27.0 | ≥ 18.9 | 18.8 – 8.9 | ≤ 8.8 | ≥ 17.5 | ≥ 16.8 | 16.7 – 13.9 | ≤ 13.8 |
| 6 | | | | ≥ 27.0 | ≥ 18.9 | 18.8 – 8.5 | ≤ 8.4 | ≥ 17.8 | ≥ 17.0 | 16.9 – 13.8 | ≤ 13.7 |
| 7 | | | | ≥ 27.0 | ≥ 18.9 | 18.8 – 8.3 | ≤ 8.2 | ≥ 18.3 | ≥ 17.4 | 17.3 – 13.8 | ≤ 13.7 |
| 8 | | | | ≥ 27.0 | ≥ 18.9 | 18.8 – 8.4 | ≤ 8.3 | ≥ 19.0 | ≥ 17.9 | 17.8 – 13.9 | ≤ 13.8 |
| 9 | | | | ≥ 30.1 | ≥ 20.7 | 20.6 – 8.7 | ≤ 8.6 | ≥ 19.9 | ≥ 18.6 | 18.5 – 14.1 | ≤ 14.0 |
| 10 | ≤ 37.3 | 37.4 – 40.1 | ≥ 40.2 | ≥ 33.2 | ≥ 22.5 | 22.4 – 8.9 | ≤ 8.8 | ≥ 20.8 | ≥ 19.0 | 18.9 – 14.3 | ≤ 14.2 |
| 11 | ≤ 37.3 | 37.4 – 40.1 | ≥ 40.2 | ≥ 35.4 | ≥ 23.7 | 23.6 – 8.8 | ≤ 8.7 | ≥ 21.8 | ≥ 19.8 | 19.7 – 14.6 | ≤ 14.5 |
| 12 | ≤ 37.6 | 37.7 – 40.2 | ≥ 40.3 | ≥ 35.9 | ≥ 23.7 | 23.6 – 8.4 | ≤ 8.3 | ≥ 22.7 | ≥ 20.6 | 20.5 – 15.1 | ≤ 15.0 |
| 13 | ≤ 38.6 | 38.7 – 41.0 | ≥ 41.1 | ≥ 35.0 | ≥ 22.9 | 22.8 – 7.8 | ≤ 7.7 | ≥ 23.6 | ≥ 21.4 | 21.3 – 15.5 | ≤ 15.4 |
| 14 | ≤ 39.6 | 39.7 – 42.4 | ≥ 42.5 | ≥ 33.2 | ≥ 21.4 | 21.3 – 7.1 | ≤ 7.0 | ≥ 24.5 | ≥ 22.2 | 22.1 – 16.1 | ≤ 16.0 |
| 15 | ≤ 40.6 | 40.7 – 43.5 | ≥ 43.6 | ≥ 31.5 | ≥ 20.2 | 20.1 – 6.6 | ≤ 6.5 | ≥ 25.3 | ≥ 23.0 | 22.9 – 16.6 | ≤ 16.5 |
| 16 | ≤ 41.0 | 41.1 – 44.0 | ≥ 44.1 | ≥ 31.6 | ≥ 20.2 | 20.1 – 6.5 | ≤ 6.4 | ≥ 26.0 | ≥ 23.8 | 23.7 – 17.2 | ≤ 17.1 |
| 17 | ≤ 41.2 | 41.3 – 44.1 | ≥ 44.2 | ≥ 33.0 | ≥ 21.0 | 20.9 – 6.7 | ≤ 6.6 | ≥ 26.7 | ≥ 24.5 | 24.4 – 17.8 | ≤ 17.7 |
| 17+ | ≤ 41.2 | 41.3 – 44.2 | ≥ 44.3 | ≥ 35.1 | ≥ 22.3 | 22.2 – 7.0 | ≤ 6.9 | ≥ 27.5 | ≥ 25.2 | 25.1 – 18.3 | ≤ 18.2 |

**≥ The score is greater than or equal to the indicated value.**
**≤ The score is less than or equal to the indicated value.**

[1] The *FITNESSGRAM* and Healthy Fitness Zones (HFZ) are registered trademarks of The Cooper Institute.

[2] $VO_2max$ reflects the maximum rate that oxygen can be taken up and utilized by the body during exercise. It is estimated by utilizing the student's height, weight, and other specific information, which is based on the test option (i.e., One-Mile Run, 20m PACER, or Walk Test) administered. The calculation procedures are found in the Reference Guide on the California Physical Fitness Test (PFT) Resources Web page at http://www.pftdata.org/resources.aspx.

[3] For Body Composition, the California Department of Education (CDE) considers a student who exceeds the HFZ as meeting the HFZ. Exceeding the HFZ means obtaining a score less than a number on the lower end or right side of the HFZ.

[4] Grade five students age 9 with time or laps reported have a $VO_2max$ calculated and are compared to the HFZ for students age 10. If a One-Mile Run time or PACER laps are reported for grade five students less than age 9, a $VO_2max$ will not be calculated, but the student will be reported in the HFZ.

## Males

| | Abdominal Strength and Endurance | Trunk Extensor Strength and Flexibility | Upper Body Strength and Endurance | | | Flexibility | |
|---|---|---|---|---|---|---|---|
| Age | Curl-Up # completed up to max of 75 | Trunk Lift # of inches up to max of 12 | 90° Push-Up # completed up to max of 75 | Modified Pull-Up # completed up to max of 75 | Flexed-Arm Hang # of seconds up to max of 90 | Back-Saver Sit & Reach[1] # of inches up to max of 12 | Shoulder Stretch |
| 5 | ≥ 2 | 6 – 12 | ≥ 3 | ≥ 2 | ≥ 2 | 8 | Touching fingertips together behind the back on **both** the right and left sides. |
| 6 | ≥ 2 | 6 – 12 | ≥ 3 | ≥ 2 | ≥ 2 | 8 | |
| 7 | ≥ 4 | 6 – 12 | ≥ 4 | ≥ 3 | ≥ 3 | 8 | |
| 8 | ≥ 6 | 6 – 12 | ≥ 5 | ≥ 4 | ≥ 3 | 8 | |
| 9 | ≥ 9 | 6 – 12 | ≥ 6 | ≥ 5 | ≥ 4 | 8 | |
| 10 | ≥ 12 | 9 – 12 | ≥ 7 | ≥ 5 | ≥ 4 | 8 | |
| 11 | ≥ 15 | 9 – 12 | ≥ 8 | ≥ 6 | ≥ 6 | 8 | |
| 12 | ≥ 18 | 9 – 12 | ≥ 10 | ≥ 7 | ≥ 10 | 8 | |
| 13 | ≥ 21 | 9 – 12 | ≥ 12 | ≥ 8 | ≥ 12 | 8 | |
| 14 | ≥ 24 | 9 – 12 | ≥ 14 | ≥ 9 | ≥ 15 | 8 | |
| 15 | ≥ 24 | 9 – 12 | ≥ 16 | ≥ 10 | ≥ 15 | 8 | |
| 16 | ≥ 24 | 9 – 12 | ≥ 18 | ≥ 12 | ≥ 15 | 8 | |
| 17 | ≥ 24 | 9 – 12 | ≥ 18 | ≥ 14 | ≥ 15 | 8 | |
| 17+ | ≥ 24 | 9 – 12 | ≥ 18 | ≥ 14 | ≥ 15 | 8 | |



≥ The score is greater than or equal to the indicated value.
≤ The score is less than or equal to the indicated value.

[1] Student must reach the distance on both the right and left sides to achieve the HFZ.

## Appendix 7. EPISD Elementary Schools

| | Elementary School Name | Address | Zip Code |
|---|---|---|---|
| 1 | Alta Vista Elementary School | 1000 N. Grama Street | 79903 |
| 2 | Aoy Elementary School | 901 S. Campbell Street | 79901 |
| 3 | Barron Elementary School | 11155 Whitey Ford Street | 79934 |
| 4 | Beall Elementary School | 320 S. Piedras Street | 79905 |
| 5 | Bliss Elementary School | 4401 Sheridan Road | 79906 |
| 6 | Bond Elementary School | 250 Lindbergh Street | 79932 |
| 7 | Bonham Elementary School | 7024 Cielo Vista Drive | 79925 |
| 8 | Bradley Elementary School | 5330 Sweetwater Drive | 79924 |
| 9 | Burleson Elementary School | 4400 Blanco Ave. | 79905 |
| 10 | Burnet Elementary School | 3700 Thomason Ave. | 79904 |
| 11 | Cielo Vista Elementary School | 9000 Basil Court | 79925 |
| 12 | Clardy Elementary School | 5508 Delta Drive | 79905 |
| 13 | Clendenin Elementary School | 2701 Harrison Ave. | 79930 |
| 14 | Coldwell Elementary School | 4101 Altura Ave. | 79903 |
| 15 | Collins Elementary School | 4860 Tropicana Ave. | 79924 |
| 16 | Cooley Elementary School | 107 N Collingsworth | 79905 |
| 17 | Crockett Elementary School | 3200 Wheeling Ave. | 79930 |
| 18 | Crosby Elementary School | 5411 Wren Ave. | 79924 |
| 19 | Douglass Elementary School | 101 S. Eucalyptus | 79905 |
| 20 | Dowell Elementary School | 5429 Bastille Ave. | 79924 |
| 21 | Fannin Elementary School | 5425 Salem Drive | 79924 |
| 22 | Green Elementary School | 5430 Buckley | 79912 |
| 23 | Guerrero Elementary School | 7530 Lakehurst Road | 79912 |
| 24 | Hart Elementary School | 1110 South Park St. | 79901 |
| 25 | Hawkins Elementary School | 5816 Stephenson Ave. | 79905 |

| | | | |
|---|---|---|---|
| 26 | Herrera Elementary School | 350 Coates Dr. | 79932 |
| 27 | Hillside Elementary School | 4500 Clifton Ave. | 79903 |
| 28 | Hughey Elementary School | 6201 Hughey Dr. | 79925 |
| 29 | Johnson Elementary School | 499 Cabaret Dr. | 79912 |
| 30 | Kohlberg Elementary School | 1445 Nardo Goodman Dr. | 79912 |
| 31 | Lamar Elementary School | 1440 E. Cliff St. | 79902 |
| 32 | Lee Elementary School | 7710 Pandora St. | 79904 |
| 33 | Logan Elementary School | 3200 Ellerthorpe Ave. | 79904 |
| 34 | Lundy Elementary School | 6201 High Ridge Dr. | 79912 |
| 35 | Macarthur Elementary School | 8101 Whitus Dr. | 79925 |
| 36 | Mesita Elementary School | 3707 N. Stanton | 79902 |
| 37 | Milam Elementary School | 5000 Luke St. | 79908 |
| 38 | Moreno Elementary School | 2300 San Diego | 79930 |
| 39 | Moye Elementary School | 4825 Alps Dr. | 79904 |
| 40 | Newman Elementary School | 10275 Alcan St. | 79924 |
| 41 | Nixon Elementary School | 11141 Loma Roja Dr. | 79934 |
| 42 | Park Elementary School | 3601 Edgar Park | 79904 |
| 43 | Polk Elementary School | 940 Belvidere St. | 79912 |
| 44 | Powell Elementary School | 4750 Ellerthorpe Ave. | 79904 |
| 45 | Putnam Elementary School | 6508 Fiesta Dr. | 79912 |
| 46 | Rivera Elementary School | 6445 Escondido Dr. | 79912 |
| 47 | Roberts Elementary School | 341 Thorn Dr. | 79932 |
| 48 | Rusk Elementary School | 3601 N. Copia St. | 79930 |
| 49 | Schuster Elementary School | 5515 Will Ruth Ave. | 79924 |
| 50 | Stanton Elementary School | 5414 Hondo Pass Dr. | 79924 |
| 51 | Tippin Elementary School | 6541 Bear Ridge | 79912 |
| 52 | Tom Lea Elementary School | 4851 Marcus Uribe Dr. | 79934 |

| | | | |
|---|---|---|---|
| 53 | Travis Elementary School | 5000 N. Stevens St. | 79930 |
| 54 | Vilas Elementary School | 220 Lawton St. | 79902 |
| 55 | Western Hills Elementary School | 530 Thunderbird | 79912 |
| 56 | Whitaker Elementary School | 4700 Rutherford Dr. | 79924 |
| 57 | White Elementary School | 4256 Roxbury Dr. | 79922 |
| 58 | Zavala Elementary School | 51 N. Hammett St. | 79905 |

## Appendix 8. EPISD Middle Schools

| | **Middle School Name** | **Address** | **Zip Code** |
|---|---|---|---|
| 1 | Armendariz Middle School | 2231 Arizona Ave. | 79930 |
| 2 | Bassett Middle School | 4400 Elm St. | 79930 |
| 3 | Brown Middle School | 7820 Helen of Troy | 79912 |
| 4 | Canyon Hills Middle School | 8930 Eclipse St. | 79904 |
| 5 | Charles Middle School | 4909 Trojan Dr. | 79924 |
| 6 | Guillen Middle School | 900 S. Cotton | 79901 |
| 7 | Henderson Middle School | 5505 Robert Alva Ave. | 79905 |
| 8 | Hornedo Middle School | 6101 High Ridge | 79912 |
| 9 | LaFarelle Middle School | 320 S. Campbell St. | 79901 |
| 10 | Lincoln Middle School | 500 Mulberry Ave. | 79932 |
| 11 | Macarthur Middle School | 8101 Whitus Dr. | 79925 |
| 12 | Magoffin Middle School | 4931 Hercules Ave. | 79904 |
| 13 | Morehead Middle School | 5625 Confetti Dr. | 79912 |
| 14 | Richardson Middle School | 11350 Loma Franklin Dr. | 79934 |
| 15 | Ross Middle School | 6101 Hughey Dr. | 79925 |
| 16 | Terrace Hills Middle School | 4835 Blossom Ave. | 79924 |
| 17 | Wiggs Middle School | 1300 Circle Dr. | 79902 |

**Appendix 9. El Pasoans Fighting Hunger Food Bank Locations**

El Pasoans FIGHTING HUNGER FOOD BANK

MEMBER OF FEEDING AMERICA

**December, 2016**

Our Partner Agencies below will be happy to assist you with your need for food. Please call ahead of time to verify times and days of

Nuestras agencias enumeradas en la lista abajo serian encantadas de ayudarle con su necesidad de alimentos. Favor de llamar antes de ir para verificar el horario y dia de distribucion.

| AREA SERVICED | ADDRESS | PHONE | DAYS OF DISTRIBUTION |
|---|---|---|---|
| **WEST** | | | |
| Ministerio Sol de Justicia | 6730 Doniphan Canutillo,TX 79835 | 915-269-1566 | Every Friday 9:00 am - 10:00 am |
| Society of St. Vincent de Paul | 6950 Third St. Canutillo, TX 79835 | 915-877-7030 | Every Friday 10:00 am - 1pm |
| Westside Community Church | 201 E. Sunset El Paso, TX 79922 | 915-877-8000 | 1st Thursday of the Month 10am to 12pm |
| Jehova - Nissi Food Pantry | 105 Shorty Lane El Paso, TX 79922 | 915-626-7280 | Last Friday of the Month 9am to 12pm |
| Anthony P.D Food Pantry | 401 Wilcox Dr.Anthony,TX 79821 | 915-886-3838 | Monday thru Friday Open 8am to 5pm call first. |

| CENTRAL | | | |
|---|---|---|---|
| Templo El Calvario | 605 S. Kansas<br>El Paso, TX 79901 | 915-258-6026 | Every Friday & Satuday<br>From 5pm-7pm Call first |
| Emmanuel UMC | 1201 Magoffin Ave<br>El Paso, TX 79901 | 915-772-4127 | 3rd Saturday<br>of every month<br>10:00 am - 1:00 pm |
| Montana<br>Food Pantry | 3101 Montana St.<br>El Paso, TX 79903 | 915-497-0153 | 2nd Saturday<br>of each month<br>9am-12pm |
| Grace<br>Christian Center | 4310 Alameda Ave<br>El Paso, TX 79905 | 915-544-7400 | By Appointment |
| Houchen<br>Community Center | 609 S. Tays<br>El Paso, TX 79901 | 915-533-6445 | Last Friday<br>of every month<br>8:00 am - 1:00 pm |
| Unitarian Unversial Food Pantry | 4425 Byron El Paso, TX 79930 | 915-777-2597 | Monday 10am - 1pm |
| Primera Iglesia<br>Bautista Mexicana | 1212 N. Stevens<br>El Paso TX 79903 | 915-565-7047 | Second Wednesday of the Month<br>From 10am-12pm |
| Sacred Heart<br>Church | 610 S. Oregon<br>El Paso, TX 79901 | 915-544-4970 | 79901 zip code only<br>Friday 8am- 4 pm |
| Salvation Army<br>of El Paso | 4300 E. Paisano Dr.<br>El Paso, TX 79905 | 915-544-9811 | Monday - Thursday<br>8:00 am - 5pm<br>**Hot meals<br>for homeless** |
| Kelly Memorial<br>Food Pantry | 915 N Florence st<br>El Paso, TX, 79902 | 915-261-7499 | Wednesdays, Fridays<br>9am to 3pm and Saturday<br>9am - 12pm |
| First Assembly of God | 3928 Montana El Paso, TX 79903 | 915-565-2337 | Friday 10am - 2pm call First |
| Faith UMC | 3500 Pershing El Paso,TX 79903 | 915-566-1654 | Saturday 10am - 12pm |
| Hope is on the Rise | 3434 Duranzno El paso,TX 79905 | 915-407-3697 | Monday - Friday 9am to 6pm<br>Call first |
| Chelsea Community Center | 600 Chelsea El Paso, TX 79915 | 915-474-3537 | By appointment only |
| Rescue Mission | 1949 W. Paisano,TX 79922 | 915-532-2575 | Monday tru Sunday call first for times. |
| Iglesia Bautista Trinity | 201 Cargill St. El Paso, TX 79905 | 915-778-0763 | 1st Tuesday of each month.<br>Distribution starts at 10am, please arrive by 7-8am quantities limited |
| San Juan Bautista Catholic Church | 5649 Dailey El Paso,TX 79905 | 915-855-0167 | Monday thru Friday 8am - 3pm Call first |
| **NORTHEAST** | | | |
| Holy Spirit<br>Episcopal Church | 10500 Kenworthy<br>El Paso, TX 79924 | 915-821-1362 | 4th Saturday<br>of every month<br>From 11am-1pm |
| Templo<br>Monte Horeb | 8912 Marks St<br>El Paso,TX 79924 | 915-474-6515 | 3rd Wednesday<br>of every month<br>starts at 9am - 12:00pm |

| | | | |
|---|---|---|---|
| Northeast Community Food Pantry | 5501 Wren<br>El Paso,TX 79904 | 915-755-8206 | 1st four Wednesdays of the month10:00 am - 1pm |
| Open Gate Community Church | 9821 McCombs<br>El Paso TX 79924 | 915-751-2403 | 1st 50 only, Thursday 5:00 pm - 6:00 pm |
| New Jerusalem C.O.I.C | 8888 Dyer St.Suite 105 El Paso, TX 79904 | 915-539-8795 | 2nd Saturday and 4th Saturday of each month from 8am to 12pm |
| Unity Missionary Baptist Church | 4601 Maxwell St.<br>El Paso TX 79904 | 915-757-0426 | Every Tuesday 10:30 - 11:30 am |
| Sun City Christian Fellowship Baptist Church | 9609 Rutledge Pl<br>El Paso,TX 79904 | 915-757-1719 | Mondays from 10am to 1pm, each household may receive assistance at this site 1x month |
| Iglesia Bautista Colina Alta | 4846 Titanic<br>El Paso,TX 79904 | 915-799-2408 | Last Thursday of every month 10:00 am - 12:00 pm |
| Centro Cristiano Fortaleza De Esperanza | 4006 Mountain El Paso,TX 79930 | 915-822-3292 | Monday 10am Wednesday 11am Fri. 1pm and Sunday 3pm |
| youth Impact | 3000 Fort Blvd. El Paso, TX 79930 | 915-777-2334 | 3rd Saturday 10am to 12pm |
| Hillcrest Baptist Church | 4710 Hercules El Paso ,TX 79904 | 915-526-5350 | 3rd Saturday 10am to 12pm call first |
| New Direction Church | 9569 Dyer St. El Paso,TX 79924 | 915-588-7279 | Last Saturday of Month 11:30am - 2:30pm |
| **EAST / FAR EAST** | | | |
| Eastwood Church of Christ | 10104 Album<br>El Paso, TX 79925 | 915-593-2772 | 3rd Saturday of the month 9:00 - 11:00 am |
| El Paso Central SDA Church | 1801 McRae Blvd<br>El Paso, TX 79925 | 915-588-2705 | 2nd Wednesday of the month 6:00 - 7:00 pm |
| Un Nuevo Pacto Food Pantry | 1401 Lomaland<br>El Paso TX 79935 | 915-591-4092 | 1st 100, Tuesdays only 10:00 am - 12:00 pm |
| Ministerio Nuevo Amanecer | 6500 Boeing Dr.<br>Ste U1<br>El Paso, TX 79925 | 915-203-7505 | Last Thursday of the month 10am to 12pm |
| St. Paul's UMC Pantry | 7000 Edgemere Blvd<br>El Paso, TX 79925 | 915-772-2734 | 3rd Saturday of the month 9:00 am - 11:00 am |
| Una Mano Amiga | 1480 George Dieter<br>Suite A<br>El Paso TX 79936 | 915-740-4937 | Wednesday from 6:30-7pm |
| Adventist Family Clinic | 3379 Wedgewood<br>Suite B<br>El Paso, TX 79925 | 915-708-8801 | 3rd Thursday of each month @ 7:30am |
| The Rock Faith Community Center | 11201 Armour Dr.<br>El Paso, TX 79935 | 915-592-7625 | 3rd Monday of each month 10am-1pm and every Wednesday 1pm - 4pm |

| | | | |
|---|---|---|---|
| SVDP St Thomas Aquinas Church | 10970 Bywood El Paso, TX 79936 | 915-592-1313 | Tuesday or Thursday 12 - 2 (Upon availability) |
| Iglesia Cristiana Tiempos de Restauracion | 3611 N. Zaragoza El Paso, TX, 79938 | 915-920-1692 | Wednesdays at 7pm |
| Crosspoint Church | 11995 Montwood Dr. El Paso, TX 79936 | 915-257-7492 | 4th Thursday each month from 7:30am-10am AND during Nov. and Dec. distribution is on 3rd Thursday |
| Celebrazion Church | 1188 N.Yarbrough Ste.F-2 El Pas, TX 79925 | 915-2151064 | Second Wednesday Times Vary call First |
| Life Gate church | 10555 Edgemere Blvd. El Paso, TX 79925 | 915-256-0112 | Saturday 11am To 12pm |
| Vista Hills Baptist | 2301 Lee Trevino El Paso, Tx 79936 | 915-740-0763 | .Call first |
| **LOWER VALLEY** | | | |
| Meraz Spanish SDA | 8084 Meraz El Paso TX 79907 | 915-422-1955 | Third Thursday of the month 5:30 pm - 7:00 pm |
| Open Arms Community of El Paso | 8210 North Loop El Paso TX 79907 | 915-595-0589 | **Location handles clients by Appointment Only** |
| Our Lady of Mt. Carmel | 131 S. Zaragoza El Paso, TX 79907 | 915-637-1668 | 3rd Saturday of every month 8:00 am - 11:00 pm |
| Santa Lucia Church | 518 Gallagher El Paso TX 79915 | 915-592-5245 | 3rd Saturday @ 9am to 12pm (dates,time varies) |
| St. James Myrtle UMC | 1128 Lomaland El Paso TX 79907 | 915-598-4413 | 2nd Thursday of the month 10:00 am - 12:00 pm |
| The Table/St. Marks | 400 Carolina El Paso, TX 79915 | 915-772-7481 | Every Thursday 9:30-12pm |
| Ysleta Lutheran Mission | 301 S. Schutz El Paso, TX 79907 | 915-858-2588 | Every Saturday 10:00 - 11:00 am (registration at 9am) |
| Encuetro &Conexion | 8800 Cristo Viene El Paso,TX, 79907 | 915-790-3549 | 3rd Saturday of each month 9am-1pm (Sat Jan 30th) |
| Centro Cristiano Sion | 1145 Zaragoza Rd. El Paso, Tx 79907 | 915-858-3163 | 1st and 3rd Saturday of the month 10am - 12pm |
| Ministerio Pescador | 315 N. Carolina El Paso, TX 79915 | 915-704-5509 | 4th Saturday of the Month 10am |
| Seed for His Harvest | 7016 Alameda Ave. El Paso,TX 79915 | 915-276-6008 | 1st Saturday of each month From 10am-12pm |
| La verdad Community Church | 7721 North loop Dr. El Paso,TX 79915 | 915-329-3697 | 3rd Saturday of the Month 11am to 12:30pm |

| | | | |
|---|---|---|---|
| New Hope Church Of God | 7623 Wilcox Dr. El paso, TX 79915 | 915-594-4076 | Monday thru Friday 5pm Call First and Saturday 10am |
| Mt. Olive Baptist Church | 718 La Paz Dr. El Paso,Tx 79915 | 915-206-0324 | 9am to 12pm every Fourth Sautrday |
| Apostolica Assembly church | 480 S. Yarbrough El Paso, TX 79915 | 915-256-3839 | Every Wednesday 6pm to 8pm |
| Valley Community | 218 Fresno El Paso, TX 79915 | 915-588-5178 | Times vary must call |
| **SOCORRO- OUTLYING AREAS** | | | |
| Camino A La Salvacion | 670 Old Hueco tanks Socorro,TX 79927 | 915-820-4280 | Contact Patsy for more information |
| Centro apostolico Nueva Vision | 645 Stedham El Paso,TX 79927 | 915-851-5474 | Last Wednesday and Friday of the month 4:00 pm - 6pm |
| 2nd Iglesia Apostostolica de la Fe en Cristo Jesus | 613 Gurdev Socorro, TX 79927 | 915-274-1630 | Wednesday 7:30pm |
| Ministerio Evangelistico en Accion Con Cristo | 10910 North loop El Paso, TX 79928 | 915-843-9046 | 1st Wednesday of the month 8:00am - 10am |
| Good News Apostolic Church | 12819 Alameda El Paso, TX 79927 | 915-851-1304 | Thursday After 12pm call first |
| Iglesia Eben-Ezer | 10561 Alameda El Paso,TX 79927 | 915-407-3693 | Wednesday only 7:00 pm - 9pm |
| Iglesia Fuente de Vida | 158 Villalobos Clint, TX 79836 | 915-851-5051 | Wednesday 9:00 am- 1:00 pm |
| Ministerio Apostolico Central | 862 Peyton Rd. Horizon City, TX 79928 | 915-852-0627 | 1st and 3rd Sunday 1pm to 3pm times may vary call first. |
| Socorro Coalition for Elderly Assistance | 681 Horizon Ste G Socorro, TX 79927 | 915-859-8671 | 8am to 4:30pm day vary so call first |
| Pueblo Nuevo Community Church | 12312 Alameda Ave Clint, TX 79836 | 915-603-6177 | 2nd Tuesday of every month from 6pm-7pm, arrive by 5pm. Office hours from 9am-12pm for Crisis situations |
| Clint Spanish Seventh Day Adventist Church | 364 El Caracol Rd. Clint, TX 79836 | 915-227-8310 | Last wednesday of each month @ 7pm |
| Good News Apostolic | 103 Main Clint, TX 79836 | 915-851-1304 | Times, days vary. Distributes 1x month, call ahead for info |
| Templo El Rey Ya Viene | 9955 Pioneer Socorro,TX 79927 | 915-540-4032 | 3rd Saturday of each month |
| Centro Nuevo Vida | 11627 Socorro Rd. Socorro,Tx 79927 | 915-851-4143 | Times, days vary. Distributes 1x month, call ahead for info |
| **SOCORRO- OUTLYING AREAS** | | | |

| | | | |
|---|---|---|---|
| Fort Hancock<br>Assembly of God | 581 Knox Ave<br>Fort Hancock, TX<br>79839 | 915-525-9152 | 3rd Thursday<br>of month from<br>10am |
| AYUDA | 1325 Beverly Ann<br>San Elizario, TX<br>79849 | 915-851-0272 | Times, days vary. Distributes 1x month, call ahead for info |
| Culberson County<br>Food Pantry | 1302 W Broadway<br>Van Horn, TX, 79855 | 432-940-0111 | 3rd Friday of the Month 9am-12pm |
| Ministerio<br>Evangelistico en<br>Accion Con Cristo | 1207 North Loop<br>El Paso, TX 79928 | 915-843-9046 | Every last Saturday<br>Starts at 11am |
| Sparks Housing<br>Development Corp. | 106 Peyton Rd.<br>El Paso, TX 79928 | 915-253-6545 | 3rd Friday, 11AM<br>**Must be there by 11am** |
| Organazacion Progrssiva | 1444 Main St. San Elizario, Tx 79849 | 915-820-1449 | Thursdays from 8am to 11am |
| First United Methodist of Fabens | 201 E. Camp St. Fabens, Tx 79836 | 915-851-3447 | 3rd Thursday 9am - 12pm |
| Sierra Blanca Food Pantry | 100 N. Sierra Blanca Ave.<br>Sierra Blanca, Tx 79851 | 432-284-0888 | Third Wednesday and Thursday of the month 12pm 2pm |
| Sierra Blanca | 104 N. Sierra Blanca<br>Sierra Blanca,TX | 915-986-2407 | Times, days vary. Distributes 1x month, call ahead for info |
| New Life<br>Border Ministries | 201 O. T Smith<br>Tornillo,TX 79853 | 915-764-2488 | Times, days vary. Distributes 1x month, call ahead for info |
| El Sembrador Ministries | 144 Peyton Horizon, Tx 79928 | 915-226-9090 | 1st. Wednesday of the Month at 6:30pm |
| | | | |
| | | | |

**Appendix 10. EPISD Elementary and Middle School Students by Gender**

| | School Name | Females | Males | Total |
|---|---|---|---|---|
| 1 | Alta Vista Elementary School | 136 | 160 | 296 |
| 2 | Aoy Elementary School | 169 | 194 | 363 |
| 3 | Armendariz Middle School | 837 | 1013 | 1850 |
| 4 | Barron Elementary School | 176 | 170 | 346 |
| 5 | Bassett Middle School | 508 | 510 | 1018 |
| 6 | Beall Elementary School | 140 | 158 | 298 |
| 7 | Bliss Elementary School | 57 | 96 | 153 |
| 8 | Bond Elementary School | 72 | 81 | 153 |
| 9 | Bonham Elementary School | 108 | 94 | 202 |
| 10 | Bradley Elementary School | 126 | 164 | 290 |
| 11 | Brown Middle School | 837 | 897 | 1734 |
| 12 | Burleson Elementary School | 132 | 149 | 281 |
| 13 | Burnet Elementary School | 90 | 97 | 187 |
| 14 | Canyon Hills Middle School | 811 | 817 | 1628 |
| 15 | Charles Middle School | 583 | 705 | 1288 |
| 16 | Cielo Vista Elementary School | 78 | 105 | 183 |
| 17 | Clardy Elementary School | 185 | 202 | 387 |
| 18 | Clendenin Elementary School | 156 | 152 | 308 |
| 19 | Coldwell Elementary School | 176 | 159 | 335 |
| 20 | Collins Elementary School | 172 | 193 | 365 |
| 21 | Cooley Elementary School | 130 | 130 | 260 |
| 22 | Crockett Elementary School | 211 | 216 | 427 |
| 23 | Crosby Elementary School | 201 | 220 | 421 |
| 24 | Douglass Elementary School | 124 | 146 | 270 |
| 25 | Dowell Elementary School | 125 | 114 | 239 |

| | | | | |
|---|---|---|---|---|
| 26 | Fannin Elementary School | 122 | 140 | 262 |
| 27 | Green Elementary School | 133 | 142 | 275 |
| 28 | Guerrero Elementary School | 198 | 186 | 384 |
| 29 | Guillen Middle School | 655 | 727 | 1382 |
| 30 | Hart Elementary School | 159 | 175 | 334 |
| 31 | Hawkins Elementary School | 124 | 77 | 201 |
| 32 | Henderson Middle School | 647 | 784 | 1431 |
| 33 | Herrera Elementary School | 129 | 143 | 272 |
| 34 | Hillside Elementary School | 246 | 209 | 455 |
| 35 | Hornedo Middle School | 966 | 1035 | 2001 |
| 36 | Hughey Elementary School | 180 | 170 | 350 |
| 37 | Johnson Elementary School | 211 | 201 | 415 |
| 38 | Kohlberg Elementary School | 237 | 244 | 481 |
| 39 | LaFarelle Middle School | 4 | 60 | 64 |
| 40 | Lamar Elementary School | 136 | 173 | 309 |
| 41 | Lee Elementary School | 206 | 198 | 404 |
| 42 | Lincoln Middle School | 1037 | 1073 | 2110 |
| 43 | Logan Elementary School | 57 | 47 | 104 |
| 44 | Lundy Elementary School | 243 | 284 | 527 |
| 45 | Macarthur Elementary School | 91 | 76 | 167 |
| 46 | Macarthur Middle School | 349 | 366 | 715 |
| 47 | Magoffin Middle School | 752 | 679 | 1431 |
| 48 | Mesita Elementary School | 320 | 280 | 600 |
| 49 | Milam Elementary School | 64 | 68 | 132 |
| 50 | Morehead Middle School | 874 | 921 | 1795 |
| 51 | Moreno Elementary School | 144 | 185 | 329 |
| 52 | Moye Elementary School | 176 | 175 | 351 |

| | | | | |
|---|---|---|---|---|
| 53 | Newman Elementary School | 112 | 120 | 232 |
| 54 | Nixon Elementary School | 184 | 171 | 355 |
| 55 | Park Elementary School | 75 | 103 | 178 |
| 56 | Polk Elementary School | 263 | 233 | 496 |
| 57 | Powell Elementary School | 132 | 103 | 235 |
| 58 | Putnam Elementary School | 161 | 151 | 312 |
| 59 | Richardson Middle School | 540 | 482 | 1022 |
| 60 | Rivera Elementary School | 163 | 213 | 376 |
| 61 | Roberts Elementary School | 192 | 210 | 402 |
| 62 | Ross Middle School | 633 | 873 | 1506 |
| 63 | Rusk Elementary School | 45 | 45 | 90 |
| 64 | Schuster Elementary School | 86 | 91 | 177 |
| 65 | Stanton Elementary School | 199 | 149 | 348 |
| 66 | Terrace Hills Middle School | 625 | 638 | 1263 |
| 67 | Tippin Elementary School | 256 | 224 | 480 |
| 68 | Tom Lea Elementary School | 173 | 147 | 320 |
| 69 | Travis Elementary School | 98 | 113 | 211 |
| 70 | Vilas Elementary School | 101 | 89 | 190 |
| 71 | Western Hills Elementary School | 201 | 198 | 399 |
| 72 | Whitaker Elementary School | 261 | 268 | 529 |
| 73 | Wiggs Middle School | 776 | 740 | 1516 |
| 74 | Zach White Elementary School | 221 | 216 | 437 |
| 75 | Zavala Elementary School | 108 | 95 | 203 |
| | | 20,405 | 21,435 | 41,840 |

**Appendix 11. EPISD's Missing Student Body Weight by School and Gender**

| | School Name | Females | Males | Total |
|---|---|---|---|---|
| 1 | Alta Vista Elementary School | 1 | 0 | 1 |
| 2 | Aoy Elementary School | 6 | 4 | 10 |
| 3 | Armendariz Middle School | 28 | 52 | 80 |
| 4 | Barron Elementary School | 1 | 4 | 5 |
| 5 | Bassett Middle School | 12 | 23 | 35 |
| 6 | Beall Elementary School | 1 | 1 | 2 |
| 7 | Bliss Elementary School | 1 | 6 | 7 |
| 8 | Bond Elementary School | 1 | 2 | 3 |
| 9 | Bonham Elementary School | 3 | 2 | 5 |
| 10 | Bradley Elementary School | 0 | 1 | 1 |
| 11 | Brown Middle School | 23 | 20 | 43 |
| 12 | Burleson Elementary School | 4 | 4 | 8 |
| 13 | Burnet Elementary School | 1 | 3 | 4 |
| 14 | Canyon Hills Middle School | 29 | 28 | 57 |
| 15 | Charles Middle School | 17 | 10 | 27 |
| 16 | Cielo Vista Elementary School | 2 | 0 | 2 |
| 17 | Clardy Elementary School | 2 | 3 | 5 |
| 18 | Clendenin Elementary School | 3 | 3 | 6 |
| 19 | Coldwell Elementary School | 0 | 0 | 0 |
| 20 | Collins Elementary School | 6 | 5 | 11 |
| 21 | Cooley Elementary School | 3 | 1 | 4 |
| 22 | Crockett Elementary School | 1 | 1 | 2 |
| 23 | Crosby Elementary School | 5 | 4 | 9 |
| 24 | Douglass Elementary School | 1 | 5 | 6 |
| 25 | Dowell Elementary School | 1 | 3 | 4 |

| | | | | |
|---|---|---|---|---|
| 26 | Fannin Elementary School | 1 | 1 | 2 |
| 27 | Green Elementary School | 2 | 0 | 2 |
| 28 | Guerrero Elementary School | 2 | 3 | 5 |
| 29 | Guillen Middle School | 30 | 43 | 73 |
| 30 | Hart Elementary School | 1 | 1 | 2 |
| 31 | Hawkins Elementary School | 6 | 3 | 9 |
| 32 | Henderson Middle School | 26 | 29 | 55 |
| 33 | Herrera Elementary School | 2 | 0 | 2 |
| 34 | Hillside Elementary School | 0 | 1 | 1 |
| 35 | Hornedo Middle School | 34 | 34 | 68 |
| 36 | Hughey Elementary School | 1 | 0 | 1 |
| 37 | Johnson Elementary School | 5 | 6 | 11 |
| 38 | Kohlberg Elementary School | 7 | 3 | 10 |
| 39 | LaFarelle Middle School | 0 | 3 | 3 |
| 40 | Lamar Elementary School | 1 | 1 | 2 |
| 41 | Lee Elementary School | 13 | 10 | 23 |
| 42 | Lincoln Middle School | 47 | 34 | 81 |
| 43 | Logan Elementary School | 0 | 0 | 0 |
| 44 | Lundy Elementary School | 2 | 4 | 6 |
| 45 | Macarthur Elementary School | 1 | 1 | 2 |
| 46 | Macarthur Middle School | 4 | 2 | 6 |
| 47 | Magoffin Middle School | 19 | 28 | 47 |
| 48 | Mesita Elementary School | 0 | 5 | 5 |
| 49 | Milam Elementary School | 0 | 0 | 0 |
| 50 | Morehead Middle School | 14 | 14 | 28 |
| 51 | Moreno Elementary School | 0 | 1 | 1 |
| 52 | Moye Elementary School | 2 | 5 | 7 |

| | | | | |
|---|---|---|---|---|
| 53 | Newman Elementary School | 6 | 13 | 19 |
| 54 | Nixon Elementary School | 0 | 1 | 1 |
| 55 | Park Elementary School | 2 | 3 | 5 |
| 56 | Polk Elementary School | 14 | 9 | 23 |
| 57 | Powell Elementary School | 4 | 5 | 9 |
| 58 | Putnam Elementary School | 7 | 8 | 15 |
| 59 | Richardson Middle School | 6 | 7 | 13 |
| 60 | Rivera Elementary School | 1 | 3 | 4 |
| 61 | Roberts Elementary School | 0 | 0 | 0 |
| 62 | Ross Middle School | 6 | 14 | 20 |
| 63 | Rusk Elementary School | 1 | 0 | 1 |
| 64 | Schuster Elementary School | 2 | 2 | 4 |
| 65 | Stanton Elementary School | 0 | 0 | 0 |
| 66 | Terrace Hills Middle School | 10 | 14 | 24 |
| 67 | Tippin Elementary School | 7 | 7 | 14 |
| 68 | Tom Lea Elementary School | 0 | 0 | 0 |
| 69 | Travis Elementary School | 0 | 2 | 2 |
| 70 | Vilas Elementary School | 1 | 1 | 2 |
| 71 | Western Hills Elementary School | 0 | 1 | 1 |
| 72 | Whitaker Elementary School | 2 | 0 | 2 |
| 73 | Wiggs Middle School | 26 | 33 | 59 |
| 74 | Zach White Elementary School | 0 | 0 | 0 |
| 75 | Zavala Elementary School | 2 | 1 | 3 |

**Appendix 12. Missing Student Height by School and Gender**

| | School Name | Females | Males | Total |
|---|---|---|---|---|
| 1 | Alta Vista Elementary School | 1 | 0 | 1 |
| 2 | Aoy Elementary School | 6 | 4 | 10 |
| 3 | Armendariz Middle School | 23 | 41 | 64 |
| 4 | Barron Elementary School | 0 | 3 | 3 |
| 5 | Bassett Middle School | 12 | 23 | 35 |
| 6 | Beall Elementary School | 1 | 1 | 2 |
| 7 | Bliss Elementary School | 1 | 6 | 7 |
| 8 | Bond Elementary School | 1 | 2 | 3 |
| 9 | Bonham Elementary School | 3 | 2 | 5 |
| 10 | Bradley Elementary School | 0 | 1 | 1 |
| 11 | Brown Middle School | 23 | 19 | 42 |
| 12 | Burleson Elementary School | 4 | 4 | 8 |
| 13 | Burnet Elementary School | 1 | 3 | 4 |
| 14 | Canyon Hills Middle School | 29 | 24 | 53 |
| 15 | Charles Middle School | 17 | 8 | 25 |
| 16 | Cielo Vista Elementary School | 1 | 0 | 1 |
| 17 | Clardy Elementary School | 2 | 3 | 5 |
| 18 | Clendenin Elementary School | 3 | 3 | 6 |
| 19 | Coldwell Elementary School | 0 | 0 | 0 |
| 20 | Collins Elementary School | 6 | 5 | 11 |
| 21 | Cooley Elementary School | 3 | 1 | 4 |
| 22 | Crockett Elementary School | 1 | 1 | 2 |
| 23 | Crosby Elementary School | 5 | 4 | 9 |
| 24 | Douglass Elementary School | 0 | 5 | 5 |
| 25 | Dowell Elementary School | 1 | 3 | 4 |

| | | | | |
|---|---|---|---|---|
| 26 | Fannin Elementary School | 1 | 1 | 2 |
| 27 | Green Elementary School | 2 | 0 | 2 |
| 28 | Guerrero Elementary School | 2 | 3 | 5 |
| 29 | Guillen Middle School | 30 | 43 | 73 |
| 30 | Hart Elementary School | 1 | 1 | 2 |
| 31 | Hawkins Elementary School | 6 | 3 | 9 |
| 32 | Henderson Middle School | 26 | 28 | 54 |
| 33 | Herrera Elementary School | 2 | 0 | 2 |
| 34 | Hillside Elementary School | 0 | 0 | 0 |
| 35 | Hornedo Middle School | 32 | 32 | 64 |
| 36 | Hughey Elementary School | 1 | 0 | 1 |
| 37 | Johnson Elementary School | 3 | 4 | 7 |
| 38 | Kohlberg Elementary School | 6 | 3 | 9 |
| 39 | LaFarelle Middle School | 0 | 3 | 3 |
| 40 | Lamar Elementary School | 0 | 1 | 1 |
| 41 | Lee Elementary School | 5 | 2 | 7 |
| 42 | Lincoln Middle School | 47 | 33 | 80 |
| 43 | Logan Elementary School | 0 | 0 | 0 |
| 44 | Lundy Elementary School | 2 | 4 | 6 |
| 45 | Macarthur Elementary School | 1 | 1 | 2 |
| 46 | Macarthur Middle School | 4 | 2 | 6 |
| 47 | Magoffin Middle School | 17 | 25 | 42 |
| 48 | Mesita Elementary School | 0 | 4 | 4 |
| 49 | Milam Elementary School | 0 | 0 | 0 |
| 50 | Morehead Middle School | 13 | 14 | 27 |
| 51 | Moreno Elementary School | 0 | 1 | 1 |
| 52 | Moye Elementary School | 1 | 5 | 6 |

| | | | | |
|---|---|---|---|---|
| 53 | Newman Elementary School | 1 | 4 | 5 |
| 54 | Nixon Elementary School | 0 | 0 | 0 |
| 55 | Park Elementary School | 2 | 2 | 4 |
| 56 | Polk Elementary School | 14 | 8 | 22 |
| 57 | Powell Elementary School | 4 | 5 | 9 |
| 58 | Putnam Elementary School | 7 | 8 | 15 |
| 59 | Richardson Middle School | 6 | 7 | 13 |
| 60 | Rivera Elementary School | 1 | 3 | 4 |
| 61 | Roberts Elementary School | 0 | 0 | 0 |
| 62 | Ross Middle School | 6 | 14 | 20 |
| 63 | Rusk Elementary School | 1 | 0 | 1 |
| 64 | Schuster Elementary School | 2 | 2 | 4 |
| 65 | Stanton Elementary School | 0 | 0 | 0 |
| 66 | Terrace Hills Middle School | 10 | 14 | 24 |
| 67 | Tippin Elementary School | 7 | 7 | 14 |
| 68 | Tom Lea Elementary School | 0 | 0 | 0 |
| 69 | Travis Elementary School | 0 | 0 | 0 |
| 70 | Vilas Elementary School | 1 | 0 | 1 |
| 71 | Western Hills Elementary School | 0 | 1 | 1 |
| 72 | Whitaker Elementary School | 2 | 0 | 2 |
| 73 | Wiggs Middle School | 20 | 27 | 47 |
| 74 | Zach White Elementary School | 0 | 0 | 0 |
| 75 | Zavala Elementary School | 2 | 1 | 3 |

**Appendix 13. Healthy Retail Food Stores within a Half Mile radius of Each School**

| | School Name | Supermarket and Grocery Stores | Food Pantry | Healthy Specialty Food Stores | Full Service Restaurants |
|---|---|---|---|---|---|
| 1 | Alta Vista Elementary School | 2.00 | 4.00 | 0.00 | 3.00 |
| 2 | Aoy Elementary School | 7.00 | 3.00 | 2.00 | 5.00 |
| 3 | Armendariz Middle School | 1.00 | 0.00 | 0.00 | 2.00 |
| 4 | Barron Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | Bassett Middle School | 0.00 | 0.00 | 0.00 | 2.00 |
| 6 | Beall Elementary School | 8.00 | 1.00 | 1.00 | 2.00 |
| 7 | Bliss Elementary School | 1.00 | 0.00 | 0.00 | 3.00 |
| 8 | Bond Elementary School | 0.00 | 0.00 | 1.00 | 5.00 |
| 9 | Bonham Elementary School | 0.00 | 1.00 | 0.00 | 8.00 |
| 10 | Bradley Elementary School | 0.00 | 0.00 | 0.00 | 1.00 |
| 11 | Brown Middle School | 0.00 | 0.00 | 0.00 | 0.00 |
| 12 | Burleson Elementary School | 2.00 | 2.00 | 1.00 | 1.00 |
| 13 | Burnet Elementary School | 0.00 | 0.00 | 0.00 | 1.00 |
| 14 | Canyon Hills Middle School | 0.00 | 0.00 | 0.00 | 0.00 |
| 15 | Charles Middle School | 0.00 | 0.00 | 0.00 | 0.00 |
| 16 | Cielo Vista Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | Clardy Elementary School | 1.00 | 0.00 | 0.00 | 0.00 |
| 18 | Clendenin Elementary School | 0.00 | 0.00 | 0.00 | 2.00 |
| 19 | Coldwell Elementary School | 1.00 | 0.00 | 0.00 | 0.00 |
| 20 | Collins Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 21 | Cooley Elementary School | 2.00 | 1.00 | 0.00 | 3.00 |
| 22 | Crockett Elementary School | 1.00 | 1.00 | 0.00 | 2.00 |
| 23 | Crosby Elementary School | 3.00 | 1.00 | 0.00 | 1.00 |
| 24 | Douglass Elementary School | 5.00 | 0.00 | 1.00 | 3.00 |

| | | | | | |
|---|---|---|---|---|---|
| 25 | Dowell Elementary School | 3.00 | 0.00 | 0.00 | 4.00 |
| 26 | Fannin Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 27 | Green Elementary School | 1.00 | 0.00 | 0.00 | 3.00 |
| 28 | Guerrero Elementary School | 0.00 | 0.00 | 0.00 | 1.00 |
| 29 | Guillen Middle School | 0.00 | 1.00 | 0.00 | 1.00 |
| 30 | Hart Elementary School | 0.00 | 1.00 | 0.00 | 1.00 |
| 31 | Hawkins Elementary School | 1.00 | 2.00 | 0.00 | 6.00 |
| 32 | Henderson Middle School | 2.00 | 0.00 | 0.00 | 2.00 |
| 33 | Herrera Elementary School | 1.00 | 1.00 | 0.00 | 1.00 |
| 34 | Hillside Elementary School | 1.00 | 0.00 | 1.00 | 0.00 |
| 35 | Hornedo Middle School | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | Hughey Elementary School | 0.00 | 0.00 | 0.00 | 3.00 |
| 37 | Johnson Elementary School | 0.00 | 0.00 | 0.00 | 6.00 |
| 38 | Kohlberg Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | LaFarelle Middle School | 0.00 | 1.00 | 1.00 | 0.00 |
| 40 | Lamar Elementary School | 3.00 | 0.00 | 1.00 | 4.00 |
| 41 | Lee Elementary School | 0.00 | 3.00 | 1.00 | 1.00 |
| 42 | Lincoln Middle School | 0.00 | 0.00 | 0.00 | 0.00 |
| 43 | Logan Elementary School | 0.00 | 0.00 | 0.00 | 1.00 |
| 44 | Lundy Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 45 | Macarthur Elementary School | 0.00 | 0.00 | 0.00 | 1.00 |
| 46 | Macarthur Middle School | 0.00 | 0.00 | 0.00 | 1.00 |
| 47 | Magoffin Middle School | 0.00 | 3.00 | 1.00 | 1.00 |
| 48 | Mesita Elementary School | 1.00 | 0.00 | 0.00 | 9.00 |
| 49 | Milam Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 50 | Morehead Middle School | 0.00 | 0.00 | 0.00 | 6.00 |
| 51 | Moreno Elementary School | 2.00 | 0.00 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| 52 | Moye Elementary School | 0.00 | 2.00 | 1.00 | 1.00 |
| 53 | Newman Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 54 | Nixon Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 55 | Park Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 56 | Polk Elementary School | 1.00 | 0.00 | 0.00 | 1.00 |
| 57 | Powell Elementary School | 0.00 | 0.00 | 0.00 | 1.00 |
| 58 | Putnam Elementary School | 0.00 | 0.00 | 1.00 | 3.00 |
| 59 | Richardson Middle School | 0.00 | 0.00 | 0.00 | 0.00 |
| 60 | Rivera Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 61 | Roberts Elementary School | 1.00 | 0.00 | 2.00 | 5.00 |
| 62 | Ross Middle School | 0.00 | 0.00 | 0.00 | 4.00 |
| 63 | Rusk Elementary School | 4.00 | 0.00 | 0.00 | 6.00 |
| 64 | Schuster Elementary School | 1.00 | 2.00 | 0.00 | 4.00 |
| 65 | Stanton Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 66 | Terrace Hills Middle School | 0.00 | 0.00 | 0.00 | 1.00 |
| 67 | Tippin Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 68 | Tom Lea Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 69 | Travis Elementary School | 2.00 | 1.00 | 0.00 | 2.00 |
| 70 | Vilas Elementary School | 2.00 | 0.00 | 0.00 | 1.00 |
| 71 | Western Hills Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 72 | Whitaker Elementary School | 0.00 | 0.00 | 0.00 | 2.00 |
| 73 | Wiggs Middle School | 3.00 | 0.00 | 1.00 | 4.00 |
| 74 | Zach White Elementary School | 0.00 | 0.00 | 0.00 | 1.00 |
| 75 | Zavala Elementary School | 4.00 | 3.00 | 4.00 | 2.00 |

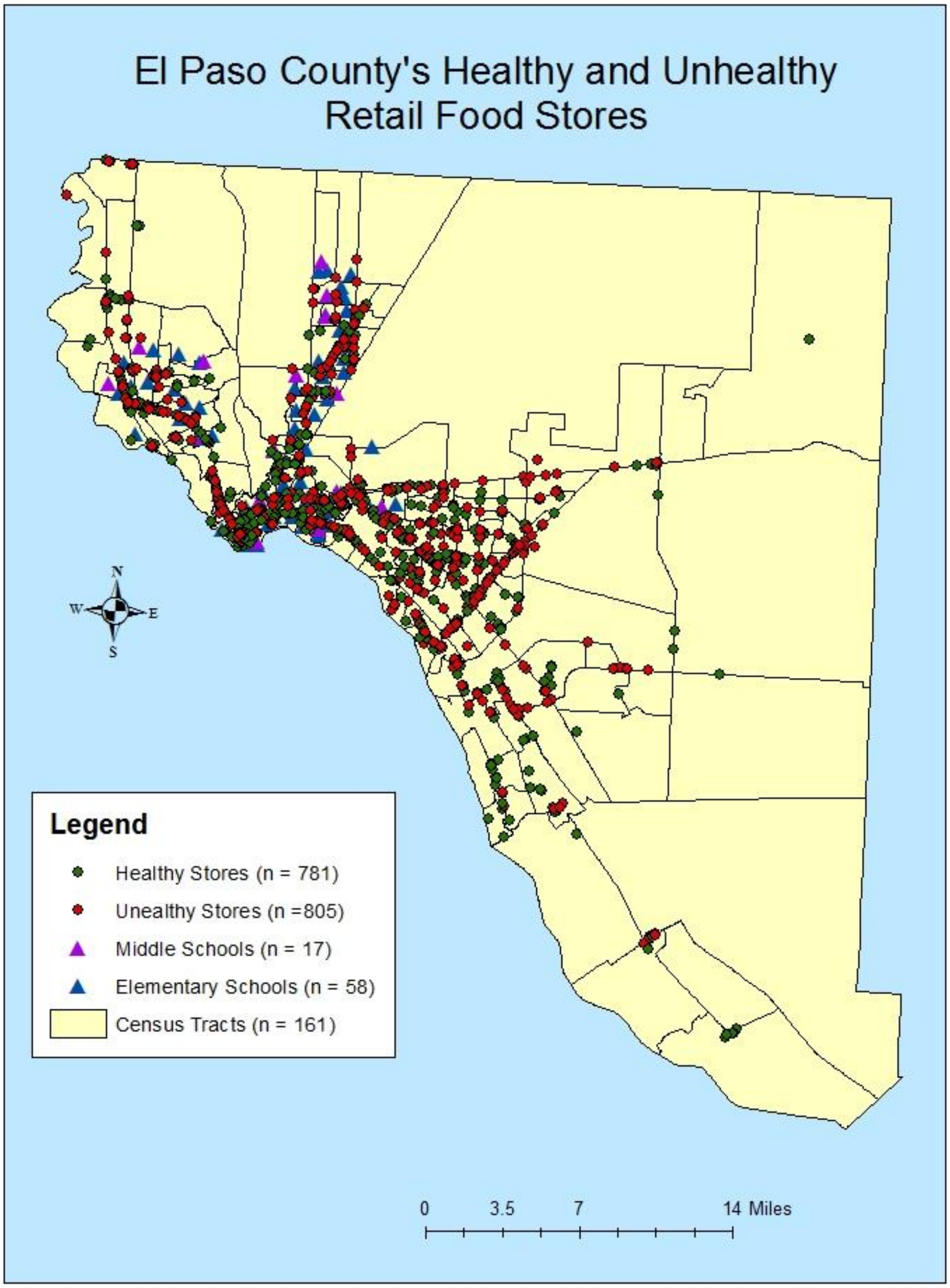
**Appendix 14. Unhealthy Retail Food Stores within a Half Mile radius of Each School**

| | School Name | Convenience Stores | Unhealthy Specialty Food Stores | Fast Food Restaurants | Liquor Stores |
|---|---|---|---|---|---|
| 1 | Alta Vista Elementary School | 3.00 | 1.00 | 2.00 | 0.00 |
| 2 | Aoy Elementary School | 3.00 | 2.00 | 3.00 | 0.00 |
| 3 | Armendariz Middle School | 1.00 | 0.00 | 0.00 | 1.00 |
| 4 | Barron Elementary School | 1.00 | 0.00 | 0.00 | 0.00 |
| 5 | Bassett Middle School | 1.00 | 0.00 | 1.00 | 0.00 |
| 6 | Beall Elementary School | 3.00 | 2.00 | 1.00 | 0.00 |
| 7 | Bliss Elementary School | 0.00 | 0.00 | 2.00 | 0.00 |
| 8 | Bond Elementary School | 0.00 | 0.00 | 3.00 | 0.00 |
| 9 | Bonham Elementary School | 5.00 | 1.00 | 7.00 | 0.00 |
| 10 | Bradley Elementary School | 2.00 | 0.00 | 0.00 | 0.00 |
| 11 | Brown Middle School | 1.00 | 0.00 | 1.00 | 0.00 |
| 12 | Burleson Elementary School | 2.00 | 2.00 | 1.00 | 0.00 |
| 13 | Burnet Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 14 | Canyon Hills Middle School | 1.00 | 0.00 | 0.00 | 0.00 |
| 15 | Charles Middle School | 2.00 | 0.00 | 0.00 | 0.00 |
| 16 | Cielo Vista Elementary School | 0.00 | 1.00 | 0.00 | 0.00 |
| 17 | Clardy Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 18 | Clendenin Elementary School | 1.00 | 0.00 | 1.00 | 0.00 |
| 19 | Coldwell Elementary School | 0.00 | 0.00 | 1.00 | 1.00 |
| 20 | Collins Elementary School | 0.00 | 0.00 | 2.00 | 0.00 |
| 21 | Cooley Elementary School | 2.00 | 1.00 | 3.00 | 1.00 |
| 22 | Crockett Elementary School | 3.00 | 1.00 | 0.00 | 0.00 |
| 23 | Crosby Elementary School | 3.00 | 0.00 | 2.00 | 0.00 |
| 24 | Douglass Elementary School | 3.00 | 2.00 | 1.00 | 0.00 |

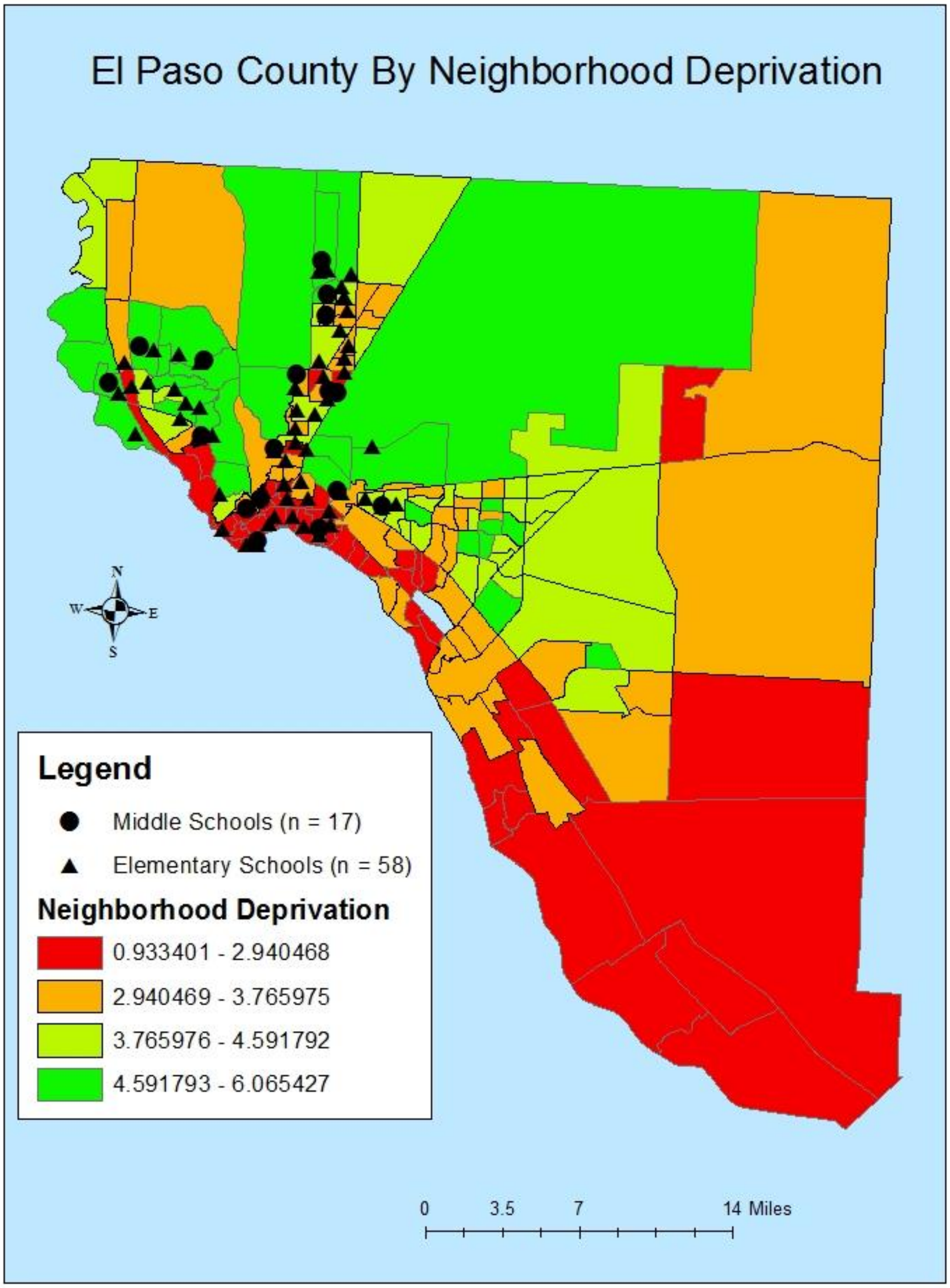
| | | | | | |
|---|---|---|---|---|---|
| 25 | Dowell Elementary School | 3.00 | 1.00 | 0.00 | 0.00 |
| 26 | Fannin Elementary School | 2.00 | 0.00 | 0.00 | 0.00 |
| 27 | Green Elementary School | 2.00 | 0.00 | 0.00 | 0.00 |
| 28 | Guerrero Elementary School | 1.00 | 0.00 | 3.00 | 0.00 |
| 29 | Guillen Middle School | 2.00 | 1.00 | 0.00 | 0.00 |
| 30 | Hart Elementary School | 3.00 | 1.00 | 0.00 | 0.00 |
| 31 | Hawkins Elementary School | 1.00 | 2.00 | 2.00 | 0.00 |
| 32 | Henderson Middle School | 3.00 | 2.00 | 5.00 | 1.00 |
| 33 | Herrera Elementary School | 1.00 | 1.00 | 0.00 | 1.00 |
| 34 | Hillside Elementary School | 3.00 | 1.00 | 2.00 | 0.00 |
| 35 | Hornedo Middle School | 0.00 | 0.00 | 0.00 | 0.00 |
| 36 | Hughey Elementary School | 1.00 | 0.00 | 5.00 | 0.00 |
| 37 | Johnson Elementary School | 1.00 | 1.00 | 0.00 | 0.00 |
| 38 | Kohlberg Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 39 | LaFarelle Middle School | 1.00 | 0.00 | 0.00 | 0.00 |
| 40 | Lamar Elementary School | 1.00 | 0.00 | 0.00 | 0.00 |
| 41 | Lee Elementary School | 1.00 | 0.00 | 0.00 | 0.00 |
| 42 | Lincoln Middle School | 0.00 | 0.00 | 0.00 | 0.00 |
| 43 | Logan Elementary School | 0.00 | 0.00 | 1.00 | 0.00 |
| 44 | Lundy Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 45 | Macarthur Elementary School | 1.00 | 0.00 | 0.00 | 0.00 |
| 46 | Macarthur Middle School | 1.00 | 0.00 | 0.00 | 0.00 |
| 47 | Magoffin Middle School | 1.00 | 0.00 | 0.00 | 0.00 |
| 48 | Mesita Elementary School | 1.00 | 1.00 | 6.00 | 0.00 |
| 49 | Milam Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 50 | Morehead Middle School | 3.00 | 1.00 | 0.00 | 0.00 |
| 51 | Moreno Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| 52 | Moye Elementary School | 3.00 | 2.00 | 3.00 | 0.00 |
| 53 | Newman Elementary School | 1.00 | 1.00 | 0.00 | 0.00 |
| 54 | Nixon Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 55 | Park Elementary School | 1.00 | 0.00 | 0.00 | 0.00 |
| 56 | Polk Elementary School | 1.00 | 0.00 | 0.00 | 0.00 |
| 57 | Powell Elementary School | 0.00 | 0.00 | 2.00 | 0.00 |
| 58 | Putnam Elementary School | 1.00 | 2.00 | 6.00 | 1.00 |
| 59 | Richardson Middle School | 0.00 | 0.00 | 0.00 | 0.00 |
| 60 | Rivera Elementary School | 1.00 | 0.00 | 0.00 | 0.00 |
| 61 | Roberts Elementary School | 0.00 | 0.00 | 2.00 | 0.00 |
| 62 | Ross Middle School | 1.00 | 0.00 | 5.00 | 0.00 |
| 63 | Rusk Elementary School | 0.00 | 1.00 | 0.00 | 0.00 |
| 64 | Schuster Elementary School | 5.00 | 0.00 | 3.00 | 0.00 |
| 65 | Stanton Elementary School | 1.00 | 0.00 | 0.00 | 0.00 |
| 66 | Terrace Hills Middle School | 0.00 | 0.00 | 2.00 | 0.00 |
| 67 | Tippin Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 68 | Tom Lea Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 69 | Travis Elementary School | 1.00 | 1.00 | 0.00 | 0.00 |
| 70 | Vilas Elementary School | 0.00 | 0.00 | 1.00 | 0.00 |
| 71 | Western Hills Elementary School | 1.00 | 0.00 | 0.00 | 0.00 |
| 72 | Whitaker Elementary School | 3.00 | 0.00 | 3.00 | 0.00 |
| 73 | Wiggs Middle School | 1.00 | 0.00 | 1.00 | 0.00 |
| 74 | Zach White Elementary School | 0.00 | 0.00 | 0.00 | 0.00 |
| 75 | Zavala Elementary School | 0.00 | 2.00 | 0.00 | 0.00 |

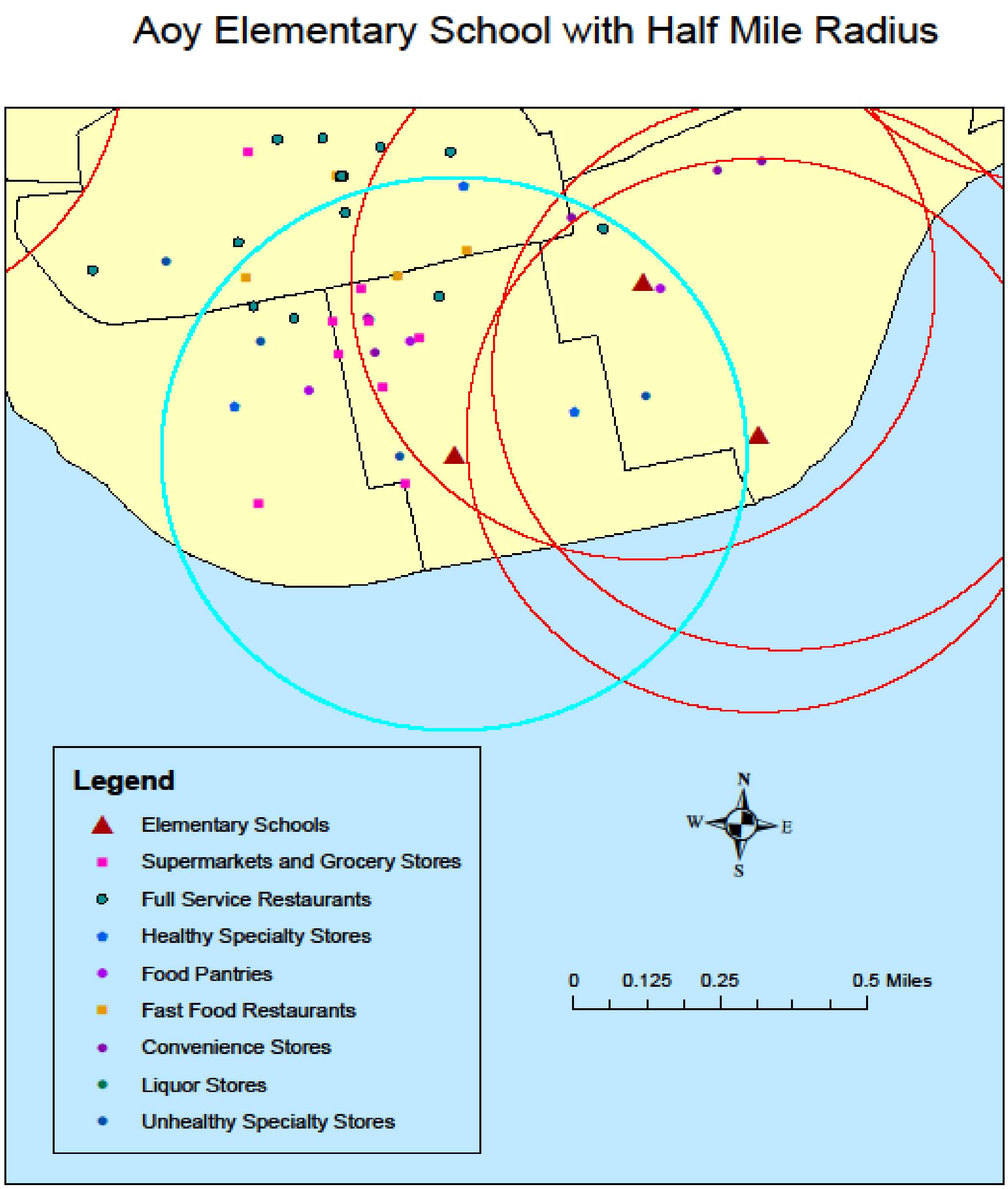
**Appendix 15. El Paso County's Healthy and Unhealthy Retail Food Stores**



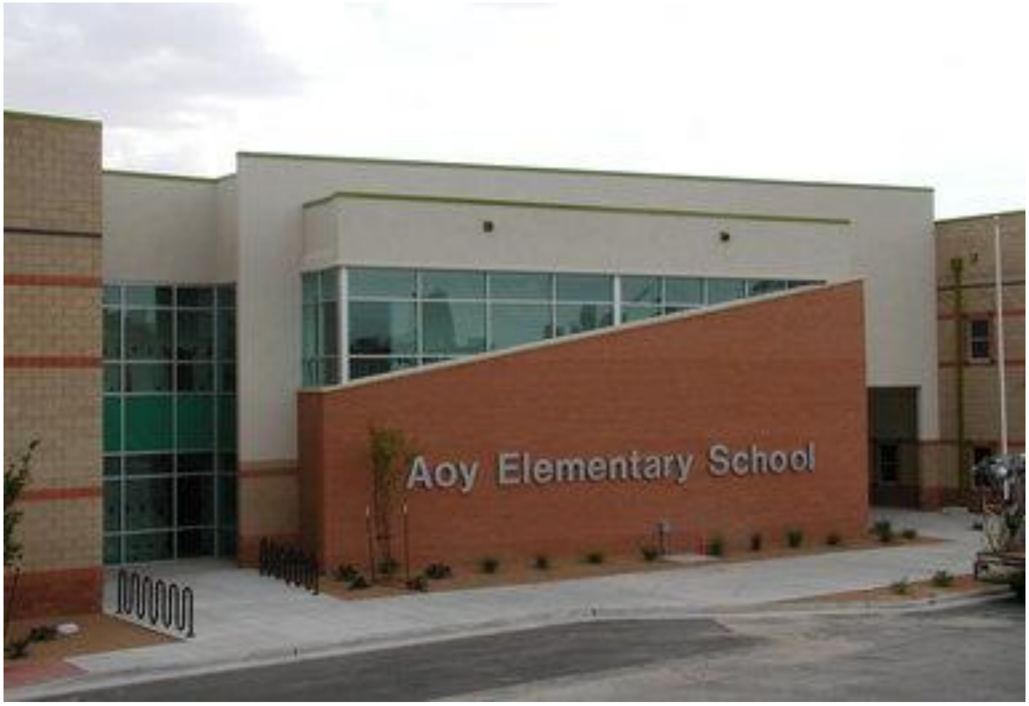
**Appendix 16. El Paso County by Neighborhood Deprivation**



**Appendix 17. EPISD's Aoy Elementary School with a Half Mile Radius Around the School**

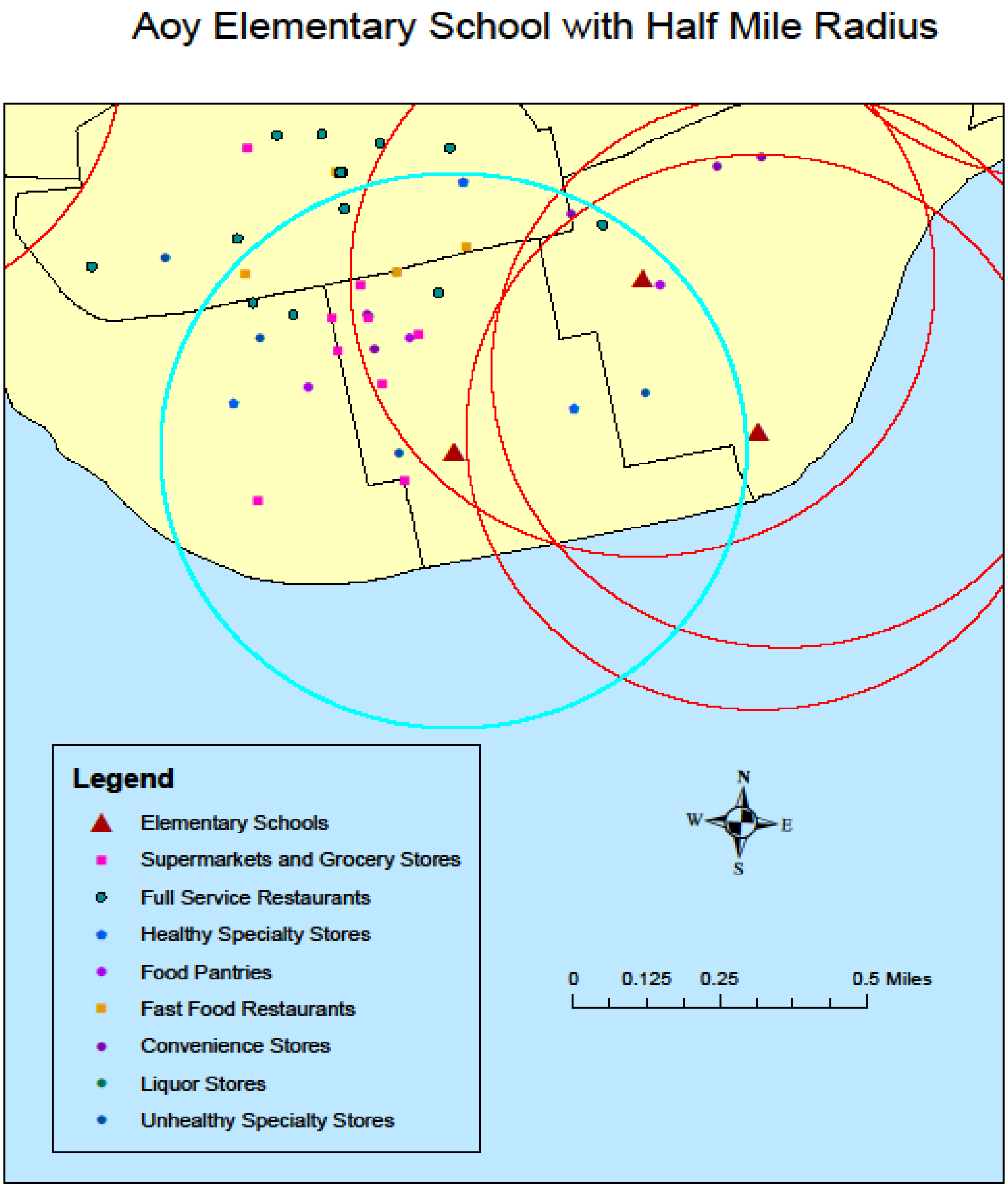


**Appendix 18. EPISD's Aoy Elementary School**




**Source: http://www.psrbbcommgroup.com/portfolio/8-aoy-elementary-school-e-p-i-s-d**

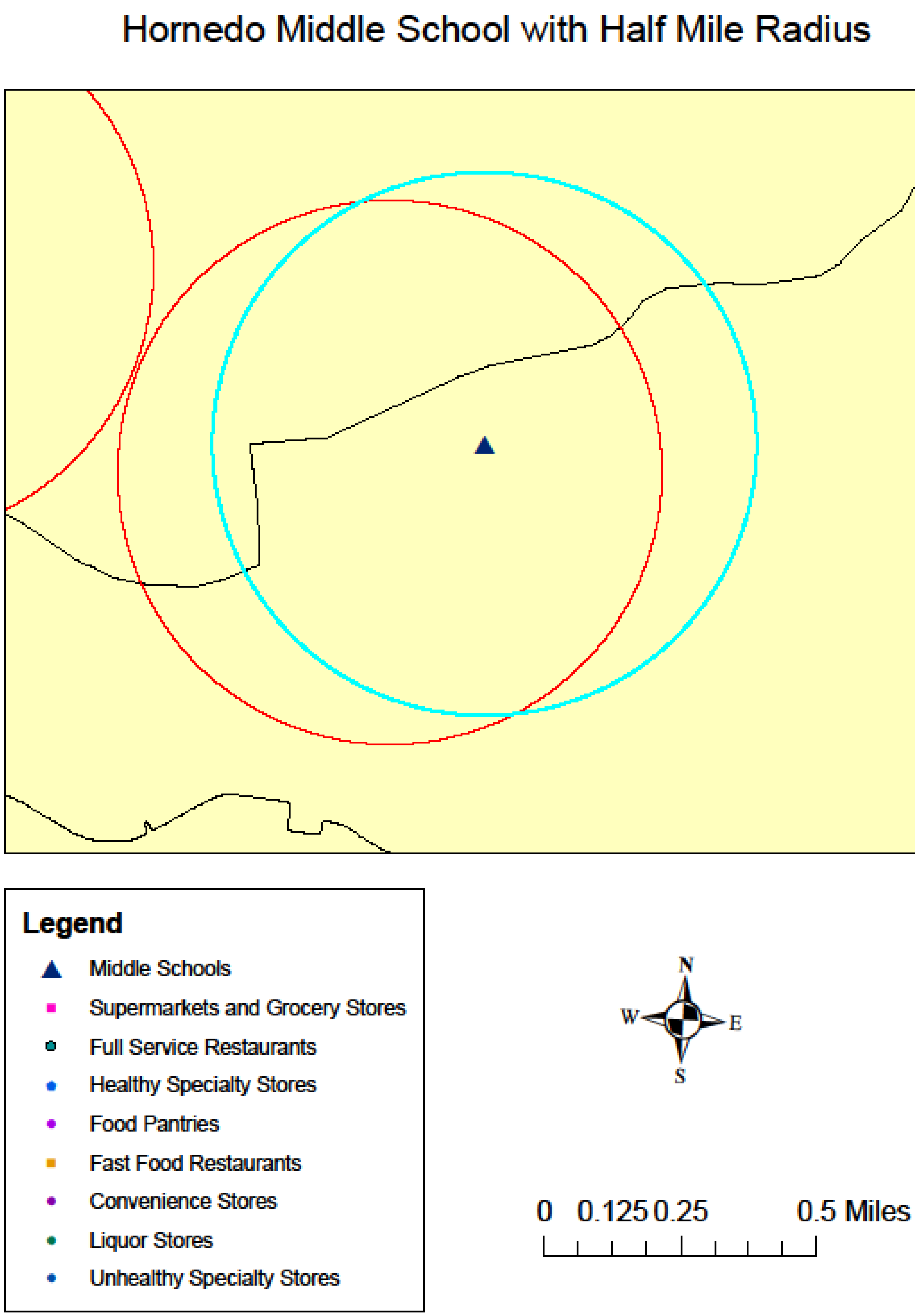
**Appendix 19. EPISD's Aoy Elementary School with a Half Mile Radius Around the School**



## Appendix 20. EPISD's Hornedo Middle School

**Source: https://www.episd.org/domain/748**

**Appendix 21. EPISD's Hornedo Middle School with a Half Mile Radius Around the School**



**Appendix 22. EPISD Schools participating in the Community Eligibility Provision (CEP)**

| | **School Name** |
|---|---|
| 1 | Alta Vista Elementary School |
| 2 | Aoy Elementary School |
| 3 | Armendariz Middle School |
| 4 | Barron Elementary School |
| 5 | Bassett Middle School |
| 6 | Beall Elementary School |
| 7 | Bliss Elementary School |
| 8 | Bonham Elementary School |
| 9 | Bradley Elementary School |
| 10 | Burleson Elementary School |
| 11 | Burnet Elementary School |
| 12 | Canyon Hills Middle School |
| 13 | Charles Middle School |
| 14 | Clardy Elementary School |
| 15 | Clendenin Elementary School |
| 16 | Coldwell Elementary School |
| 17 | Collins Elementary School |
| 18 | Cooley Elementary School |
| 19 | Crockett Elementary School |
| 20 | Crosby Elementary School |
| 21 | Douglass Elementary School |
| 22 | Dowell Elementary School |
| 23 | Fannin Elementary School |
| 24 | Guillen Middle School |

| | |
|---|---|
| 25 | Hart Elementary School |
| 26 | Hawkins Elementary School |
| 27 | Henderson Middle School |
| 28 | Hillside Elementary School |
| 29 | Johnson Elementary School |
| 30 | LaFarelle Middle School |
| 31 | Lamar Elementary School |
| 32 | Lee Elementary School |
| 33 | Logan Elementary School |
| 34 | Magoffin Middle School |
| 35 | Morehead Middle School |
| 36 | Moreno Elementary School |
| 37 | Moye Elementary School |
| 38 | Newman Elementary School |
| 39 | Park Elementary School |
| 40 | Powell Elementary School |
| 41 | Putnam Elementary School |
| 42 | Rivera Elementary School |
| 43 | Roberts Elementary School |
| 44 | Rusk Elementary School |
| 45 | Schuster Elementary School |
| 46 | Stanton Elementary School |
| 47 | Terrace Hills Middle School |
| 48 | Travis Elementary School |
| 49 | Whitaker Elementary School |
| 50 | Wiggs Middle School |
| 51 | Zavala Elementary School |

Source: EPISD Community Eligibility Provision

**Appendix 23. Neighborhood Deprivation Score by School**

| | School Name | Census Tract | Deprivation Score |
|---|---|---|---|
| 1 | Alta Vista Elementary School | 24 | 2.90 |
| 2 | Aoy Elementary School | 19 | 0.93 |
| 3 | Armendariz Middle School | 23 | 2.85 |
| 4 | Barron Elementary School | 102.12 | 4.73 |
| 5 | Bassett Middle School | 8 | 2.72 |
| 6 | Beall Elementary School | 28 | 1.04 |
| 7 | Bliss Elementary School | 101.02 | 4.66 |
| 8 | Bond Elementary School | 13.01 | 4.91 |
| 9 | Bonham Elementary School | 34.03 | 4.22 |
| 10 | Bradley Elementary School | 1.07 | 3.91 |
| 11 | Brown Middle School | 102.15 | 5.27 |
| 12 | Burleson Elementary School | 30 | 2.18 |
| 13 | Burnet Elementary School | 6 | 3.63 |
| 14 | Canyon Hills Middle School | 4.03 | 3.57 |
| 15 | Charles Middle School | 1.06 | 4.88 |
| 16 | Cielo Vista Elementary School | 34.04 | 4.42 |
| 17 | Clardy Elementary School | 31 | 2.29 |
| 18 | Clendenin Elementary School | 8 | 2.72 |
| 19 | Coldwell Elementary School | 25 | 3.41 |
| 20 | Collins Elementary School | 1.12 | 3.29 |
| 21 | Cooley Elementary School | 36.01 | 2.76 |
| 22 | Crockett Elementary School | 24 | 2.90 |
| 23 | Crosby Elementary School | 2.05 | 3.03 |
| 24 | Douglass Elementary School | 21 | 0.94 |
| 25 | Dowell Elementary School | 1.01 | 3.94 |

| | | | |
|---|---|---|---|
| 26 | Fannin Elementary School | 10.7 | 3.91 |
| 27 | Green Elementary School | 11.11 | 4.64 |
| 28 | Guerrero Elementary School | 12.02 | 4.16 |
| 29 | Guillen Middle School | 20 | 1.18 |
| 30 | Hart Elementary School | 20 | 1.18 |
| 31 | Hawkins Elementary School | 32 | 2.86 |
| 32 | Henderson Middle School | 31 | 2.29 |
| 33 | Herrera Elementary School | 102.16 | 3.50 |
| 34 | Hillside Elementary School | 33 | 2.92 |
| 35 | Hornedo Middle School | 102.14 | 5.82 |
| 36 | Hughey Elementary School | 34.02 | 3.10 |
| 37 | Johnson Elementary School | 11.14 | 3.13 |
| 38 | Kohlberg Elementary School | 102.15 | 5.27 |
| 39 | LaFarelle Middle School | 3.02 | 2.68 |
| 40 | Lamar Elementary School | 22.01 | 3.19 |
| 41 | Lee Elementary School | 3.01 | 3.21 |
| 42 | Lincoln Middle School | 13.01 | 4.91 |
| 43 | Logan Elementary School | 106 | 3.91 |
| 44 | Lundy Elementary School | 102.14 | 5.82 |
| 45 | Macarthur Elementary School | 34.03 | 4.22 |
| 46 | Macarthur Middle School | 34.03 | 4.22 |
| 47 | Magoffin Middle School | 3.01 | 3.21 |
| 48 | Mesita Elementary School | 15.01 | 4.75 |
| 49 | Milam Elementary School | 101.01 | 5.02 |
| 50 | Morehead Middle School | 11.14 | 3.13 |
| 51 | Moreno Elementary School | 23 | 2.85 |
| 52 | Moye Elementary School | 3.01 | 3.21 |

| | | | |
|---|---|---|---|
| 53 | Newman Elementary School | 1.09 | 3.10 |
| 54 | Nixon Elementary School | 102.10 | 5.04 |
| 55 | Park Elementary School | 4.01 | 4.72 |
| 56 | Polk Elementary School | 11.12 | 4.37 |
| 57 | Powell Elementary School | 106 | 3.91 |
| 58 | Putnam Elementary School | 11.04 | 4.31 |
| 59 | Richardson Middle School | 102.10 | 5.04 |
| 60 | Rivera Elementary School | 11.09 | 5.05 |
| 61 | Roberts Elementary School | 12.01 | 2.32 |
| 62 | Ross Middle School | 34.02 | 3.10 |
| 63 | Rusk Elementary School | 9 | 3.53 |
| 64 | Schuster Elementary School | 2.05 | 3.03 |
| 65 | Stanton Elementary School | 3.02 | 2.68 |
| 66 | Terrace Hills Middle School | 1.12 | 3.29 |
| 67 | Tippin Elementary School | 102.13 | 5.85 |
| 68 | Tom Lea Elementary School | 102.10 | 5.04 |
| 69 | Travis Elementary School | 8 | 2.72 |
| 70 | Vilas Elementary School | 16 | 2.57 |
| 71 | Western Hills Elementary School | 11.10 | 4.90 |
| 72 | Whitaker Elementary School | 1.01 | 3.94 |
| 73 | Wiggs Middle School | 22.01 | 3.19 |
| 74 | Zach White Elementary School | 1302 | 5.48 |
| 75 | Zavala Elementary School | 29 | 1.94 |

## Vita

Teresa M. Anchondo earned a Bachelor of Sciences Degree with a major in Kinesiology and a minor in Biology from the University of Texas at El Paso (UTEP) in 2005. In 2010, she earned a Master's Degree in Public Health with a concentration in Hispanic and U.S.-Mexico Border Health at UTEP. With a passion for public and minority health, Teresa thereafter began doctoral studies in Interdisciplinary Health Sciences (IHS) at UTEP.

Dr. Anchondo PhD worked part-time lecturing at UTEP for graduate courses in Health Sciences and as a research associate in the Department of Public Health Sciences at UTEP. Under the direction of the late and great Dr. Paula Ford, PhD, one of the first investigators at UTEP to use Geographical Information Systems to study obesity in children, Teresa began her own research under the greater NIH funded project.

Dr. Anchondo PhD presented her research during poster sessions at the IHS PhD Program Doctoral Student Research Conference in 2016 and 2017. Teresa earned Meritorious Student Abstract Honors at the Society of Behavioral Medicine's 34th Annual Meeting in San Francisco, California.

Her dissertation entitled, "Geographic and Multilevel Influences of School Environments on the Development of Obesity and Physical Activity Among School Children in a U.S.-Mexico Border Community", was overseen by her committee chair Dr. Eva Moya, PhD and other faculty from UTEP and Texas Tech HSC-El Paso, Paul L. Foster SOM, Department of Family and Community Medicine.

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