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Ecological Influences on Dietary Behavior: The Interaction Between Person and Neighborhood  
Environment in a Low-SES, Hispanic Community

By  
Emily Kiresich

Claremont Graduate University  
2019

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## APPROVAL OF THE DISSERTATION COMMITTEE

This dissertation had been duly read, reviewed, and critiqued by the Committee listed below, which hereby approves the manuscript of Emily Kiresich as fulfilling the scope and quality requirements for meriting the degree of Doctor of Philosophy in Health Promotion Sciences with a concentration in Public Health.

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## ABSTRACT

Ecological Influences on Dietary Behavior: The Interaction Between Person and Neighborhood Environment in a Low-SES, Hispanic Community

By  
Emily Kiresich

Claremont Graduate University: 2019

Despite existing knowledge about lifestyle choices and their relationships to obesity and diabetes, the prevalence of Type 2 Diabetes Mellitus (T2DM) is increasing, and the number of Americans at risk is greater than 70% (CDC, 2019). Obesity is a complex, multifactorial, and largely preventable disease, affecting, along with overweight, over a third of the world's population today. A significant factor in lifestyle management is the ecology of food choice. Literature suggests that environment and exposure can predict food-related health risk behaviors and health outcomes. The objective of this dissertation was to conceptualize and carry out a series of pilot studies relative to the refinement of nutrition ecological issues, methodologies, and measures. After a review of methodological difficulties, gaps, and unresolved issues, I propose methodological solutions, present the methodologies and results of pilot studies about the feasibility of these solutions.

Study one involved database and windshield survey of more than 200 retail food locations in Jurupa Valley, CA. After redefining criteria for good quality food providers, this area was found to have an abundance of fast food and convenience stores and limited access to stores of the best nutritional quality. Study two included adaptations and implementation of a direct measure of the nutrition environment in Pomona, CA. The target area was a high-risk

corridor with a concentration of both community activity and retail locations. Using database analysis and visual assessment, a list of stores was compiled, and of the 91 stores in the target area, 60 were surveyed for overall scores, which was a sum score of quality, accessibility, availability of fresh fruits and vegetables, and price. The results indicated that Grocery, Independent Market, and Ethnic Food outlets could be considered together as high-quality or at least higher quality in that they provided overall, price, access, and quality scores in the modified NEMS survey that were not statistically different from one another in quality of offerings (Kruskal-Wallis H  $X^2(2) = .386-6.726$ ,  $p = .035$  to  $.832$  (only significant value was for availability of fresh fruits and vegetables)). Furthermore, all sub-types of convenience stores, including independent locations, those associated with a gas station, and liquor stores can be considered together, Kruskal-Wallis test  $X^2(1.788-5.535)$   $p = .63$  to  $.409$  (near-significant values for Price and Quality). Study three presents a methodology for accurately assessing the retail food environment using walking surveys on a GIS enabled mapping application. Results revealed significant inconsistencies between database (GIS) data and survey data acquired from current observations of the actual locations in the community; there was a 31% error in database findings. Additional comparisons were made between GIS results and participant data, which indicated possible patterns of positive or negative health and intake outcomes with neighborhood retail food availability.

Results from this series of developmental studies indicated a need for primary data sources whenever possible for compiling information about retail food locations. As well, the methodology for collecting business-types from databases and for completing a safe and thorough environmental scan for retail food locations was presented in this dissertation.

Additional findings indicated that a refined methodology to score store quality identified considerable variation between store types. These results may have implications for city planning, diabetes prevention, and lifestyle management programs.

## DEDICATION

This dissertation is dedicated to Gianna Joy. You have made me stronger, better, and more fulfilled than I could have ever imagined. I love you.

To my mom, thank you for your advice, your patience, and your faith in me, resolute when I was unsure. You've always believed in me; I hope I make you proud.

And lastly, to Mario, my amazing husband. Your consistent encouragement, unwavering belief in my abilities, and commitment to both me, and this process have made this possible. I will appreciate you forever.



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## CHAPTER I

### INTRODUCTION

Diabetes afflicts 30 million Americans and 422 million persons worldwide, up from 108 million in 1980, and Type 2 Diabetes Mellitus (T2DM) accounts for 90-95% of all cases (WHO, 2018). Obesity is the major preventable cause of T2DM and the target of numerous prevention programs. Using the 2010 NHANES data, relative risk of T2DM related to obesity was 3.43 and related to overweight was 1.52 (Milken Institute, 2018). Compared to normal weight, overweight and obese individuals are 1.5 times and 3.4 times more likely to develop T2DM, respectively. Further, using the population attributable risk (PAR), the percentage of cases where obesity increases the risk for a disease, the PAR for T2DM is 15% for overweight and 49% for obesity (Milken, 2018). According to the most recent National Health and Nutrition Examination Survey (NHANES), 18.5 percent of children and 39.6 percent of adults in 2015-2016 were obese. A total of 71.6% of adults were either overweight or obese and, therefore, at elevated risk for type 2 diabetes (CDC 2016c, Hales, et al. 2017, Fryer, Carrol, & Ogden, 2018). As of the 2015-2016 Centers for Disease Control and Prevention (CDC) data, 71.6% of adults were at risk for developing T2DM related to their weight status, independent of waist circumference.

Population studies also reported existing levels of T2DM in the community, and although the risk numbers were already alarmingly high, CDC results were of self-report by telephone interview and likely did not fully capture disease rates and risk. Analyses of 2012 NHANES population-representative data found that while 9.4% of respondents reported knowing they had diabetes, confirmatory fasting plasma glucose and HbA1C assays indicated that the best

estimate of true diabetes prevalence rate was between 10.9 (Selvin et al., 2017) and 14.3% (Menke et al., 2016) and the prediabetes rate was 38.0%. Among tested subgroups, total diabetes prevalence was highest in Hispanics at 22.6%, followed by 21.8% in Black, 20.6% in Asian, and 11.3% in White subject (Menke et al., 2016). An interesting phenomenon is the Hispanic paradox—the similarity in death rates between Hispanics and non-Hispanic whites despite Hispanics' socioeconomic disadvantage (Larisey, Hummer, & Hayward, 2014; Markides & Eschbach, 2005). This effect has been attributed to the notion that most migrants are relatively young, healthy people who are strong enough to travel and adapt to a new location, additional considerations are that there are strong social ties and support among migrant communities (Larisey et al., 2014; Markides & Eschbach, 2005).

Obesity is a complex, multifactorial, and largely preventable disease, affecting, along with overweight, over a third of the world's population today. If secular trends continue, by 2030, an estimated 38% of the world's adult population will be overweight, and another 20% will be obese (Hruby, A & Hu, F. 2015). In the United States, overweight and obesity, rather than normal or healthy weight, are becoming the norm, as greater than 70% of adults are considered overweight or obese, and between 13-20% of children are considered obese (CDC, 2016). In a newly published article outlining the likely decline in life expectancy, organ diseases such as those related to obesity and diabetes, were among the top culprits behind the increased mortality in mid-life in the United States (Woolf & Schoemaker, 2019). These trends in weight status and disease are attributable, in part, to the growing availability of abundant, inexpensive, and often nutrient-poor food, industrialization, mechanized transportation, urbanization (Hruby & Hu, 2015).



While the presence of neighborhood physical activity or recreational spaces has been associated with increased physical activity levels or energy expenditure, healthy food environments, characterized by the availability of produce or presence of supermarkets over convenience stores or fast-food restaurants, play a potentially more important role (Hruby & Hu, 2015). Numerous existing programs work to intervene upon lifestyle factors such as food intake and physical activity at an individual level; however, long-term success may also be related to environmental factors. Previous research has identified variables such as access to healthy food as possible neighborhood characteristics that influence health, (Moore & DiezRoux, 2006; Dunn, 2010) and that proximity to healthy food options is a leading factor in healthy eating habits, (Sisiopiku & Barbour, 2014). Although it has been established that proximity is a factor in healthy eating habits (Sisiopiki et al., 2014), and is well correlated with higher diet quality (Laraia, Siega-Riz, Kaufman, & Jones, 2014), access does not necessarily indicate intake. Food intake behaviors are likely an interaction between person and environment, and measures of access, alone, are not adequate in explaining the ecology of food choice. A challenge to understanding the retail nutrition environment is that when reviewing literature, there is no single approach considered as the gold standard for measurement. Instead, one of several methods are used to compile the list of resources (stores), measure distances from the point of origin (often home) and is subsequently compared to census or other widely available health data.

### Significance of the Problem

Nutrition environment and availability of a variety of fresh foods has been associated with higher intakes of fruits and vegetables, yet no standardized approach to measuring nutrition

quality and degree of access exists. While simple access (the existence of a food store) does not necessarily indicate healthy eating, low density of healthful food options is strongly correlated with chronic diseases such as diabetes and cardiovascular disease, as well as obesity.

Understanding how complex environmental and personal factors affect food intake and health outcomes are essential and can be instrumental in developing directed and efficacious local health initiatives. Also, having the most accurate understanding of the gradation of the nutrition environment within a network of local stores, particularly prevalent in ethnic minority neighborhoods, may have both research and policy indications. Data collected from these studies may help deepen the understanding of the Pomona retail food environment, indicators of access or accommodations, and use of this information may have implications for personal and environmental programming. Results may be useful in developing health programs policy or food industry regulation in the city of Pomona and other cities with similar demographic compositions.

### Theoretical Basis for Studies

While Geographic Information System (GIS) analysis of neighborhoods and the individual environment are readily available and often used, existing research inconsistently establishes a relationship between health and food resources, which may be partially due to inconsistencies in databases or in defining *access*. Furthermore, existing research indicates that looking at neighborhood characteristics using standard definitions may not be an accurate indicator of the food environment. Literature suggests that environment and exposure can predict food-related health risk behavior and health outcomes. The focus of much of the currently available research

that uses intake indicators is fruit and vegetable consumption or fast food intake alone. This study offers more indicators of diet quality as well as collecting cross-sectional biological outcomes such as blood pressure, HemoglobinA1c, blood glucose, and blood lipids, as well as anthropometrics of BMI and waist circumference.

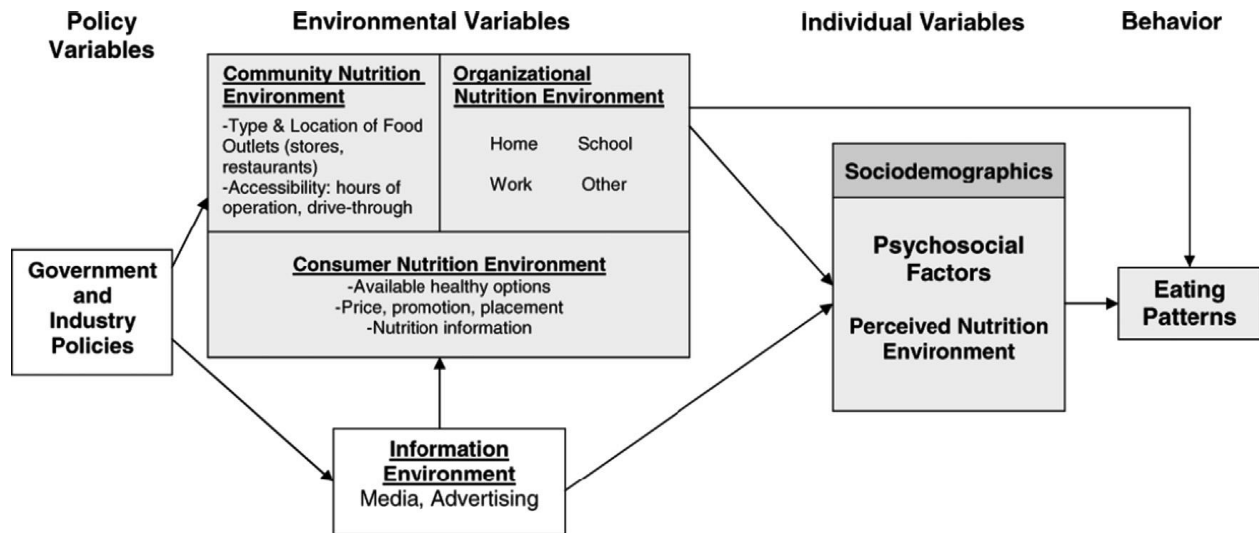
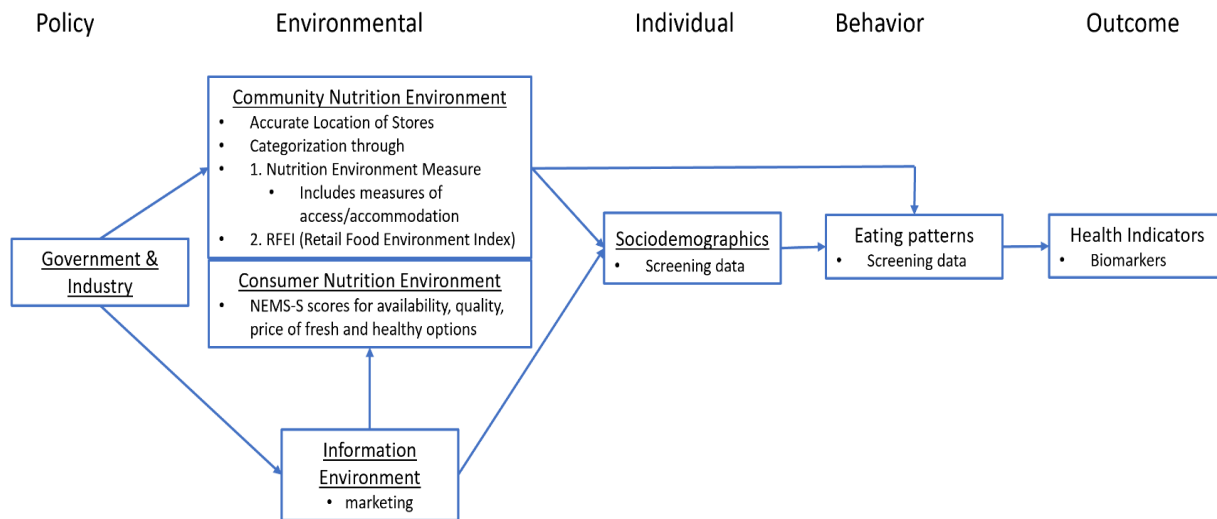


Figure 1: Glanz, Sallis, Saelens, & Frank (2005), developed the ecological model of food environments that has since been widely cited in research (Black, Moon, Baird, 2014; Glanz & Bishop, 2010; Richard, Gauvin, Raine, 2010).

These proposed studies piloted the use of data obtained at screening events for adult members of the Pomona, CA community, as well as data collected from visual environmental assessments. The screenings are part of the Stopping Diabetes in Its' Tracks (SDIT) program, which aims to identify community members at risk for, or who have T2DM, and enroll those interested in intensive lifestyle change programs. The set of studies in this dissertation aimed to address applying and comparing methodologies for obtaining data to measure the nutrition environment and evaluate different definitions of access using existing and modified data collection tools.



**Figure 2: SDIT edited Ecological Model of Food Environments, includes measures collected and available for this dissertation.**

Statement of the Ecological Problem

The nutrition retail environment, including all stores that sell foods as well as various restaurant-types, has an impact on the quality of dietary intake across the spectrum of age, gender, and ethnicity, although stronger effects are seen in low SES, ethnic minority communities. Communities such as Pomona, having large ethnic minority groups, are often served by networks of small, independent, and specialty stores that exist within or near neighborhoods (Zenk et al., 2005, D’Angelo, Suratkar, Song, Stauffer, Gittelsohn, 2011; Sharkey, Johnson, Dean, & Horel, 2011). The simple existence of stores or even specific store types is not enough to understand the complex nutrition choice environment. Numerous ecological factors have been indicated as influencing shopping behaviors. For example, access to a vehicle or nearness of a bus stop, availability of culturally appropriate options, and in the case of immigrants, language skills; in addition to location and price, (Mancino, Guthrie, Ver Ploeg, Lin, 2018; Volpe & Okrent, 2011 Vahabi & Danma,2013; Minger, A. L., Lloyd, T. D., Speirs, K. E., Riera,

K. C. & Srutzmacher, S. K., 2015; Byrne, 2019). Considering that nutrition is influential in five of the ten leading causes of death in the United States (CDC 2016d), more fully understanding the ecological factors that influence nutrition choice is crucial in making improvements to outcomes.

### Statement of the Methodological Problem

The objective of this dissertation was to conceptualize and carry out a series of pilot studies relative to the refinement of nutrition ecological issues, methodologies, and measures. The manuscript begins with a survey of methodological problems, gaps, and unresolved issues that limit the science of nutrition epidemiology, especially regarding ecological considerations. I propose methodological solutions, present the methodologies and results of pilot studies about the feasibility of these solutions. Finally, I suggest how future research might adopt these methodologies to study potential mechanisms for person-environment interactions relative to dietary behavior and its implications for cardiometabolic disease.

## CHAPTER II

### BACKGROUND AND RESEARCH GAPS

#### **Overview**

Bodies of research support that maintaining a healthy weight, or losing weight to achieve healthy body weight, contributes to longevity and decreases the risk for chronic illness (NIH, 2015; Negri, Pagano, Decarli, & LaVeccia, 1988). Individual weight status is the result of a combination of factors, some of which are non-modifiable, heredity and other modifiable factors, such as lifestyle choices. The foods we consume, the total number of calories we intake, and the choice to lead active or sedentary lives will influence weight status.

#### **Review of Literature**

##### Disparity in Food Access for Minority and low-SES Communities

Previous research using GIS and database analysis found that neighborhoods of color fare worse than predominantly white neighborhoods in terms of their share of supermarkets. Minority neighborhoods are often being served by an extensive network of small grocery stores and convenience stores (Raja, Ma, & Yadav, 2008). Other studies suggest healthy foods such as whole-grain products and fruits and vegetables might be less available to poor, and minority neighborhoods and prices tended to be higher, as well contributing to health disparities (Moore & Diez Roux, 2006). In their 2014 review, Black, Moon, and Baird found that in the United States, low-income and ethnic communities had fewer supermarkets per capita and had farther distances to travel to the closest store than more affluent communities; while finding that lower-income neighborhoods had 1.3 times the number of fast-food restaurants of high-income

neighborhoods. In a study of largely migrant-inhabited towns of South Texas, Sharkey, Horel, and Dean (2010), found that these neighborhoods generally had better access to convenience stores and fast food locations while the nearest supermarket was more than 3.6 miles from 25% of the census blocks and more than 78% had no large supermarket or supercenter within 1-mile, (Sharkey, Horel, Han, & Huber, 2009). Large markets are known to carry a variety of fresh foods such as fruits and vegetables, often have lower prices than small neighborhood markets and, national chains unilaterally accept forms of government assistance payments. Access to a large market, it follows, increases access and affordability of fresh foods. In 2011, research from Canada found that there was an increase in the availability of fruit and vegetable retailers as deprivation increased, but that the lowest 30% of deprivation scores had poor accessibility, (Gould, Apparicio, & Cloutier). Fruit and vegetable markets and farmers' markets increased the density of healthy food outlets, especially in neighborhoods with high concentrations of Hispanics, Asians, and foreign-born residents and in high-poverty neighborhoods (Bader, Purciel, Yousefzadeh, & Neckerma, 2010). Methods of determining which types of retail food establishments to be included in the definition of access varied between studies. For better comparison across studies, store-type inclusion criteria or definitions, related directly to store access and food availability and quality, may be helpful.

### The Trouble with Defining Food Access

*Which retailers are considered "good"?*

There is not a generally accepted definition of what kinds of stores to include when measuring the goodness of environmental food access. The concept of a food desert has been

used to represent areas with one or another challenge in food access. The term is interpreted in many ways; for example, the term can mean an area with no retail food outlets at all, one without access to “healthy food,” another area with no large grocery stores, or an area with *inequitable access*: only small grocery stores that may have only more expensive options, fewer options, or poorer quality options, compared to areas with a large grocery retailer. Communities considered food deserts also tend to be served by fast-food restaurants or convenience stores, which generally carry less healthy options (Sisiopiku & Barbour, 2014). The USDA, in particular, identifies, in their definition of access, large grocery stores, supermarkets, and supercenters that are eligible for SNAP while excluding military commissaries, warehouse club stores, convenience stores, drug stores and dollar-type stores, which they admit is likely to overestimate the number of people who lack access to food, (USDA report 2015). Other studies include small, independent store chains as well as specialty stores, noting that consumer preference for specialty stores was often high in low-income areas (Zenk et al., 2005, D'Angelo, Suratkar, Song, Stauffer, Gittelsohn, 2011). Zenk et al. found, in their Detroit-area research, that the women surveyed lived approximately 2.5 miles from the nearest Detroit supermarket and 4 miles from the nearest suburban market. Inclusion of non-traditional market types was also supported by Sharkey, et al., (2010) although the variety of fruits and vegetables was greater at supermarkets, among non-traditional and convenience stores the largest variety was found at dollar stores (Sharkey et al., 2010). In Chapter III, an expanded definition of grocery stores is used to measure ratios of low- and high-quality food (page 28). For Chapter IV, stores are surveyed, and their resultant scores are considered as a measure of "good" quality (page 61).



### *Spatial indicators of “good” access*

After identifying which stores should be included as a measure of good quality, we had to establish a definition of "good" spatial access. Review of existing options provides what the USDA defines as low-access, low-income census tracts: locations where, in urban areas, a significant number or share of residents is more than .5 miles or 1.0-mile from the nearest supermarket, (USDA 2015). There is no information about which measure is preferable; instead, both measures are available on the Low-Income Low-Access Atlas (USDA, 2017b). A similar definition is used by Hamrick and Hopkins (2012) in their analysis of the time-cost of food access, using high-, medium-, and low-access cut-off points as less than .5-mile, .5-1.0 mile, and greater than 1.0 miles. Not surprisingly, travel time to grocery stores in low-income, low-access areas was greater than high-access areas, 19.5 minutes versus 15.5 minutes (Hamrick & Hopkins, 2012). In a general study of walking distance, Yang and Diez-Roux found that median walking distance, for any reason, was .5-miles, and median walking duration was 10-minutes (2012). From this, it seems that access can be defined as good if the store-type in question, a supermarket or supercenter, is within .5 miles of one's home, and that access is considered less than good as this distance increases. Chapter III uses the USDA's definition of 0.5- to 1.0-miles walking, as well as 10-minutes driving to assess spatial accessibility (page 24)

### *Other Access Considerations*

Although walking for groceries is often considered a measure of access in food environment research, a review of national data indicates a variety of ways by which people travel to the store. Findings from the USDA National Food Acquisition and Purchase Survey

indicates that although 88% of consumers use a car to shop for groceries, fewer lower-income households used their cars and would rideshare, borrowed a vehicle, or walked, biked, or took public transit, and that 28% of food acquisitions were at large grocery stores, superstores, or club stores (Mancino, Guthrie, Ver Ploeg, Lin, 2018). The additional analysis found that those in lowest access areas were most likely to drive to the store, 93.3%, and those in low-income areas with a grocery store near were most likely to walk or bike to the store, 23.1%. Important to note is that at all income levels, people did not always shop at the location nearest to home, even the nearest supermarket (Hillier, Smith, Whiteman, & Chrisinger, 2017).

### *Cultural Considerations for Hispanic Populations*

In addition to geographical access which gets much of the research attention, there are other access factors that we want to consider related to speaking Spanish and having cultural origins outside of the United States. Hispanic/Latino immigrants cite that in addition to food cost, cultural food options, language skills, and limited knowledge about community resources were found to be perceived barriers to food access, (Vahabi & Danma, 2013; Minger, Lloyd, Speirs, Riera, & Srutzmacher, 2015; Byrne, 2019). Although convenience was among the top reasons for choosing a store, quality, variety, and price were considered more important (Cannuscio, Tappe, Hillier, Buttenheim, Karpyn, & Glanz, 2013). These measures of access may be split into two subcategories, one related to access in terms of price and location, including sidewalk access and store hours, while others could be called accommodation, those related to cultural, language, and personal environment while shopping.

## Use of GIS Technology to Assess Retail Food Environment

GIS technology is commonly used to evaluate the social and physical characteristics of communities and may be useful for assessing the relationship of concentrations of obesity risk where we often find poor diet quality, physical inactivity, racial or ethnic minority populations and disparities (Geraghty, 2010; McKinnon, Reedy, Handy, & Rogers, 2009; Raja et al., 2008). As with any research, conclusions drawn from GIS data are only as good as their data (Liese et al., 2010; Powell et al., 2011); confirmed by Liadsky and Ceh, who found that both proprietary and government-sources had been shown to be prone to inconsistent classification, geospatial inaccuracies, and bias towards undercounting food outlets (2017). When undertaking research that uses GIS to identify or quantify resources, analysis of database information only is likely to lead to misrepresentation of availability. To address this database issue, in this set of studies, we paired the use of database data with visual assessments of community resources (Chapters III and V).

Nonetheless, environmental factors are well-established as correlates of health behaviors, and GIS is a useful tool in the analysis of the environment. Hill and Peters (1998) stated that we must "cure" the environment of factors that promote behaviors that lead to or cause obesity; in order to do that, we need to identify and quantify those "factors." Research using GIS to investigate health have found that individual-level and residential area characteristic are good predictors of food environment exposure (Kestens et al., 2012). Additionally, using GIS spatial analysis, Chen, Florax, Snyder, & Miller, 2010 found increased access to chain grocers in low-income communities "decreased" the average BMI for all residents. This research also

supports the use of geographic data at a smaller unit than census tract, which forces administrative and arbitrary boundaries.

Researchers at the University of California, Los Angeles (UCLA), created an index of store quality for use in environmental comparisons for health (Designed for Disease, 2008). This study, called *Designed for Disease*, used California Health Interview Survey data from 2005 and retail food outlet information from InfoUSA Business File. Using GIS, they calculated an index called the **Retail Food Environment Index (RFEI)**, which divides the number of retailers of low quality (fast-food retailers plus the number of convenience stores) by the number of high-quality (grocery stores plus produce vendors) (Designed for Disease, 2008). For example, if there were six fast food and convenience stores and two grocery stores within 1-mile, the ratio is 3:1 (a score of 3.0). Any person living within a 1-mile radius of this area (with a score of 3.0) has three times as many low-quality retailers as they have high-quality. Findings from the Designed for Disease study (2008) indicate that, for California, obesity and diabetes prevalence was highest among adults with the highest number of low-quality foods near their homes (a higher RFEI score). When comparing high and low RFEI's, there was a 20% difference in obesity prevalence and 23% diabetes prevalence among individuals from RFEI 5.0 versus 3.0. In California, there appears to be a significant relationship between the availability of 'low-quality' foods and diabetes risk factors. The study in Chapter III applies the RFEI to Jurupa Valley, CA (page 29), and in Chapter IV, I challenge the restrictive definition of high-quality with research in Pomona, CA (pages 55-58). This research only considered database information and did not consider non-traditional food sources that may not exist in the database, such as fruit and food vendors and food trucks. Although database information is helpful in determining food-related retailers, there

appears to have significant inaccuracies that could lead to over or under-counting both potentially positive and negative resources.

### Estimating Dietary Quality in the Community

Food resources available to individuals are likely to influence food purchase and intake behavior. This section details the research used to choose only selected behaviors as representative of overall diet quality. In the study reported here, four items were used to assess quality of individual dietary intake. The items used to approximate dietary quality are fast food intake, fruit and vegetable intake, intake of sugar-sweetened beverages, and frequency of eating meals at home.

In a review of research, Rosenheck reports that two of the three cross-sectional studies reviewed found a significant positive relationship between fast food intake and body mass index (BMI); the third was not statistically significant (2008). Additionally, three prospective cohort studies found a direct link between fast food consumption and increased BMI, and the only experimental study found an increase in calorie intake with increased fast food intake (Rosenheck, 2008). In a 2011 review, six adult studies found higher BMI was associated with living in areas with increased exposure to fast food; four studies, however, did not find associations (Fleischhacker, Evenson, Rodriguez, & Ammerman). Although they were not surveyed in our study, research supports similar patterns in children, those who ate fast food, compared with those who did not, consumed more total energy, more energy per gram of food, more total fat, more total carbohydrate, more added sugars, more sugar-sweetened beverages, and fewer fruits and non-starchy vegetables, (Bowman, Gortmaker, Ebbeling, Pereira, & Ludwig,

2004). Also, among Hispanic/Latino adults, consuming foods away from home two or fewer per week compared to >5 times per week indicated a healthier diet but was not associated with overweight or obesity but eating from street vendors even once per week was associated with obesity (McClain et al., 2018).

### *Sugar-sweetened Beverages*

Aside from the intake of foods away from home, both fast food and other foods, there is also evidence that the intake of sugar-sweetened beverages (SSB's) is associated with obesity. According to a review of epidemiologic evidence, Hu and Malik, 2010, found that trend data shows a "close parallel between the obesity epidemic and rising levels of SSB consumption." In their review of prospective studies, they find that well-powered studies in adults that do not adjust for potential mediating effects of total energy, provide clear evidence for an effect of SSB's on weight gain (Hu & Malik, 2010). Additionally, in a study of development of type-II diabetes, women who consumed one or more SSB's per day had an 83% greater risk of developing T2DM over eight years, and in the Black Women's Health study, those who consumed two or more SSB's per day had a 24% greater risk of developing T2DM compared to those who consumed less than one per month (Hu & Malik, 2010). Although effects were diminished with adjustment for total energy were made, we are not interested in the effect of SSB's directly on outcomes; instead, we want to include intake of SSB as an indicator of overall diet quality.

### *Fruit and Vegetable intake*

Possible indicators of dietary quality include the intake of fruits and vegetables and the intake of more foods prepared at home. In a review of the relationship between fruit and vegetable intake and body fat, experimental studies found increased fruit and vegetable consumption (in conjunction with other behaviors) contributed to reduced adiposity among overweight or obese adults and in longitudinal studies among overweight adults found higher fruit and/or vegetable consumption was associated with slower weight gain, (Ledoux & Baranowski, 2011). In a 2016 meta-analysis of intake fruit, vegetables, or their fiber on diabetes risk, found that higher intake of fruits and vegetables was associated with a lower risk of T2DM (Wang, Fang, Gao, Zhang, & Xie, 2016). According to the American Diabetes Association, a healthy meal plan will include first, fruits, and vegetables, followed by lean meats, less added sugar, and no trans-fat (ADA, 2019a). On their superfood page, six of the ten foods they recommend are fruits or vegetables (ADA, 2019b).

### *Meals Consumed at Home*

Previously mentioned was a correlation of food cart food intake and obesity. Additionally, Wolfson and Bleich (2013) found in their cross-sectional study of 24h recall data that cooking dinner frequently at home was associated with a healthier diet. Further support in the form of a cross-sectional analysis of a population-based cohort found that eating home-cooked meals more frequently was associated with higher intake of fruits and vegetables and greater likelihood of having a normal BMI and normal body fat percentage (Mills, Brown, Wrieden, White, & Adams, 2017).

Analysis of food-related resources using GIS and survey data compared with indicators of dietary quality and biological outcomes can provide a valuable indicator of determinants of dietary behavior.

### **Synthesis of Research Gaps**

The existing body of research about nutrition, environment, and health is impressive, but does leave room for further methodological development:

1. Nutrition Environment measures: although numerous studies have used the various tools to measure to assess nutrition environment (Ball, 2006; Coulon et al., 2001; Jeffery et al., 2006; Trapp et al., 2015; Bodor et al., 2010), this review found no studies considering access in terms of cultural acceptability; having culturally appropriate foods, in clean stores, with affordable prices and/or accept government assistance payments (WIC, SNAP). Research about access perception does indicate that culturally appropriate options are important (Vahabi & Danma, 2013; Minger et al., 2015; Byrne, 2019).
2. Food Access: much existing research categorizes food stores into only a few categories such as grocery, convenience, or specialty types (Mancino et al., 2018; USDA 2017a, 2017b). Few studies found in this review have considered a more specific approach to the measurement of nutrition environment in the large variety of ethnic, specialty, discount, corner, and convenience-type stores that may service a given neighborhood (Powell et al., 2010).



3. Business database use alone in collecting retail food store information:  
inaccuracies of databases for retail food locations have been well documented; suggestions include the use of more than one secondary source (database) when assessing the built food environment (Liadsky & Ceh, 2017; Liese et al., 2010; Powell et al., 2011). In the largest study found by this review, the sensitivity of databases (to accurately identify food retailers and their locations) was only 76% at best, with a low of 43%, leaving much room for improvement. This large study focused on commercially available databases requiring a fee-for-service, some of which may not be accessible to all researchers.

This dissertation considered the existing body of research and explored the identified gaps, then used a multi-method approach to assess the ecology of nutrition and disease.

## **Research Questions and Hypotheses**

Three developmental studies were carried out to address several research questions and specific hypotheses.

### Developmental Study 1: (Chapter III)

Research question: What is the utility of database analysis versus a new method of visual environmental assessment in determining the retail food environment in a growing city?

- Hypothesis: An environmental scan will reveal at least 25% more and accurate sites of interest along traveled routes within the target area than found in database analysis alone along the same routes.

#### Developmental Study 2: (Chapter IV)

Research Question: To what extent do adaptation and implementation of a more explicit measure of nutrition environment within retail food stores challenge accepted definition of retail food quality, which considers only high- and low-quality variations?

- Hypothesis 1: Modified measures will show good interrater reliability for access, availability, quality, price, and overall score.
- Hypothesis 2: Quantified assessments of the nutrition environment will indicate statistically significant differences between low- and high-quality retailers and within sub-categories of retail locations (ethnic, specialty, discount, general stores, and large pharmacies).

#### Developmental Study 3: (Chapter V)

Research question: After the development of a GIS application-based environmental assessment methodology, what is the utility of database analysis versus the new method of visual environmental assessment in determining the retail food environment of a well-established city? As well, does the application of measures of nutrition environment (NEMS) to map locations of retail stores provide insight into select measures of dietary quality and cardiometabolic risk factors of community members?

- Hypothesis 1: Findings of new environmental scan methodology will reveal at least 25% more accurate sites of interest along traveled routes within target area than found in database analysis alone along the same routes.

- Hypothesis 2: Hot spot analysis of cardiometabolic risk factors will reveal significant clusters of lower risk values near stores of high-quality and increased risk values near stores of low-quality.
- Hypothesis 3: Hot spot analysis of select measures of dietary quality will reveal significant clusters of positive dietary indicators near stores of high-quality and negative dietary quality indicators near stores of low-quality.

## CHAPTER III

### **Developmental Study 1.**

#### **GIS using database versus Community windshield surveys**

This preliminary study established a method of protocol for environmental assessment and highlighted some of the food-related environmental challenges of a largely immigrant, low-income, community in Southern California.

#### **Introduction**

The Diabetes Free Riverside (DeFeR) project was a collaboration of several academic institutions the Riverside University Health System – Public Health, and community-based organizations for the purpose of controlling obesity and preventing Type 2 diabetes in Riverside County, California. The overall purpose of DeFeR was to assess the feasibility of community-based screening and evidence-based interventions for adults found to be at risk for T2DM. As part of the study, the ecology of relevant neighborhoods was assessed for its relevance to targeted risk-reduction behavior changes. This sub-study reported here assessed the utility of GIS data and windshield surveys in creating resource maps using ESRI ArcGIS to assess the nutrition landscape related to type-two diabetes (T2DM) risk for a city whose residents are majority Hispanic, largely immigrant, and low-income. The purpose of the present study is to determine the utility of database analysis versus visual environmental assessment in determining the retail food environment.

**Methods** (methods only related to this study are presented here)

### Neighborhood Selection

This study was carried out in the city of Jurupa Valley, California. Jurupa Valley was incorporated on July 1, 2011, becoming the 482<sup>nd</sup> city in California and the 28<sup>th</sup> city in Riverside County. At the time of this assessment, Jurupa Valley was the youngest city in Riverside County and California. This new city covers 44 square miles and includes the communities of Jurupa Hills, Mira Loma, Glen Avon, Pedley, Indian Hills, Belltown, Sunnyslope, Crestmore Heights, and Rubidoux (City of Jurupa Valley, 2018). Jurupa Valley has a mix of high and low-density residential development, rural areas, industry, retail stores, and commercial and warehouse districts. As of the 2015 Census information, Jurupa housed an estimated 98,030 people. Jurupa Valley is composed of nearly 50% Hispanic residents, 40% White, and less than 10% American Indian, Asian/Pacific Islander, Black non-Hispanic, or multi-racial. These numbers are consistent with Riverside County as a whole, with a slightly higher percentage of Hispanic residents (Table 1). Compared to Riverside County, Jurupa Valley is younger, more foreign-born, and has more residents who speak a language other than English at home.

Additionally, the number of residents who are 25 years or older without at least a high school degree is 14% higher in Jurupa Valley when compared to the County as a whole. Using these demographics, we extrapolated from NHANES data as reported by Menke et al. (2016), yielding an estimated diabetes prevalence of 15.82%-17.9% for Jurupa adults 20 years and older. DataUSA.com lists that fewer than 15% of households report having only one or fewer cars, lower than the national average but similar to Riverside County.

DeFeR screening and intervention sites were based on recommendations from key stakeholders, and community leaders, and venue accessibility and familiarity. Four screening sites were identified, two to gain access to young and middle aged adults and two to gain access to senior citizens: (1) Country Village Senior Apartments, (2) Eddie Dee Smith Senior Center, (3) Troth Elementary School, and (4) Ina Arbuckle Elementary School, more or less, the center of the residential area from which study participants were drawn. These sites are displayed in each map and analysis of resources center around these points, deemed central and accessible to Jurupa Valley residents and community members. As targets across the adult lifespan, we used both senior centers and elementary schools to provide access to adults with school-aged children to senior citizens. These surrogate population centers provide direct access to, at Country Village, a group of seniors directly in their place of residence, and Eddie Dee Senior Center reasonably draws its patrons from the seniors living in areas immediate surrounding the center.

According to the National Council on Aging, 60% of senior centers are focal points for the delivery of Older Americans Act services (NCOA, 2015). Eddie Dee Smith Senior Center is the only senior center in the Jurupa Valley community boundary and has a full schedule of events during weekdays, including monthly food distribution from the Second Harvest Food Bank (Riverside County Economic Development Agency, 2016). According to the California Department of Education, district and school boundaries are chosen and managed at the local level (CDE, 2018). Jurupa Unified School District policy indicates that students for each school will be drawn from the immediate surroundings or boundary for that school (JUSD, 2012). We assume that parents and family members attending screening events at one of the two school sites, Troth and Ina Arbuckle Elementary schools, are living in the areas surrounding each school and within reason,

neighboring schools. These site choices were supported by community stakeholders and represent the adult-senior population from regions in the North, South, West, and East of Jurupa Valley, within the community boundary.

TABLE 1 DESCRIPTIVE STATISTICS, JURUPA VALLEY & RIVERSIDE COUNTY		
	JURUPA VALLEY	RIVERSIDE Co.
POPULATION ESTIMATE	98,030	2,296,956
POPULATION GROWTH (APRIL 2010-JULY 2013)	3.2%	4.9%
PEOPLE 25 OR OLDER WITHOUT AT LEAST A HIGH SCHOOL DEGREE	34.5%	20.4%
MEDIAN AGE	30 YEARS	33 YEARS
FOREIGN BORN PERSONS (2009-2013)	28.1%	21.9%
LANGUAGE OTHER THAN ENGLISH SPOKEN AT HOME (2009-2013)	55.6%	39.9%
PERSONS LIVING BELOW POVERTY LEVEL (2009-2013)	15.8%	16.2%
HOMEOWNERSHIP RATE (2009-2013)	65.2%	66.5%
PERSONS PER HOUSEHOLD (2009-2013)	3.9	3.2
MEAN TRAVEL TIME TO WORK, MINUTES (2009-2013)	32.0	29.9
<b>POPULATION BY RACE/ETHNICITY</b>		
AMERICAN INDIAN, NON-HISPANIC	<1%	<1%
ASIAN/PACIFIC ISLANDER, NON-HISPANIC	2.2%	5.8%
BLACK, NON-HISPANIC	4.4%	6.0%
HISPANIC	48.7%	45.5%
MULTI-RACIAL	2.0%	2.2%
WHITE, NON-HISPANIC	42.1%	39.7%

#### Data Collection

Using ESRI ArcGIS, both desktop and web-based maps were created for aggregation of environmental data. Then, using the "create drive-time areas" tool (ESRI, 2019) four 10-minute driving buffers were created, each with one population loci (screening and intervention site) at the center. The 10-minute driving boundary was in consideration of a feasible driving distance

for residents to travel to a grocery store. Using this mapped area, resources were added from a variety of existing databases: Riverside County Department of Public Health, Reference USA, USDA, and US Census Bureau.

As noted by McKinnon et al. (2009), "GIS-based measures are only as useful as their data inputs." Accuracy and completeness of the map were verified by a panel of local community members and leaders who determined that the GIS maps created from archival databases were not a sufficiently comprehensive indicator of local resources. At that point, the researchers developed a strategy for visual assessment of retail outlets in the community. Using mobile devices or tablets, and the application ArcCollector (ESRI) designed for the purpose, a visual survey of the community, was conducted. To make the task manageable, the streets to be assessed were confined to those most strategic. Within the drive-time area, 17 main streets/roads totaling 115.85 linear miles were selected as driving routes for visual scans. Walk-time assessments were later added using ArcGIS.

### Local Food Availability

The existing USDA Atlas provides food desert location maps and defines "low access" as low-income census tracts where, in urban areas, a significant number or share of residents is more than 1-mile from the nearest supermarket, (USDA 2017). In a USDA report on low-income and low access to supermarkets, the analysis identifies large grocery stores, supermarkets, and supercenters that are eligible for SNAP. They exclude military commissaries, warehouse club stores, convenience stores, drug stores, and dollar-type stores from their analysis even though these locations sometimes do offer a selection of nutritious foods and accept SNAP benefits. As



stated in the report, "Excluding these types of food retailers from our store directory is likely to result in an overestimate of the number of people who lack access to nutritious food," (USDA report 2015). A study by Sharkey et al., (2010) about fruit and vegetable availability supports the inclusion of a variety of different stores as part of potential access to fruits and vegetables (2010). The research indicated that although the variety of fruits and vegetables was greater at supermarkets, among non-traditional and convenience stores, the largest variety was found at dollar stores (Sharkey et al., 2010). In analyzing the food environment in Jurupa, we wanted to capture affordable sources of fresh foods that may be missed when using the restrictions applied by the USDA but did not want to include convenience locations.

After collection of Jurupa-area resources via database analysis and visual assessment, we created a system of ranking for the stores in Jurupa's area of influence. A scale 1-5 was used to rank locations based on the ability to use SNAP, variety, and quantity of foods available, with a focus on fresh produce and non-packaged items. The following ranking system was used: 1 – any retailer that did not accept SNAP, 2 – SNAP retailers such as convenience stores or liquor stores, 3 - SNAP retailers with some fresh foods such as fruits and vegetables, includes small local stores, bodegas, larger convenience stores or the small markets attached to chain pharmacies, 4 - SNAP retailers with a variety of fresh fruits and vegetables such as 99 cents and dollar stores, local stores or bodegas, and 5 – SNAP retailers classified as grocery stores, department stores with large grocery sections, or supercenters

In addition to ranking food stores by food quality, we considered the **Retail Food Environments Index (RFEI)** which divides the number of 'low quality' fast-food retailers plus the number of convenience stores, by the number of 'high-quality' grocery stores plus produce

vendors (Designed for Disease, 2008). In our data collection, produce vendors are not assessed, but retailers ranked at 4, in addition to grocery stores, provides an estimate of locally available, affordable, fresh produce. To interpret the RFEI consider a score of 3, a person with a score of 3 has three-times as many 'low-quality' retailers nearby (within 1 mile in cities) as they have 'high-quality.' For this study, we consider our population centers as the point of reference rather than the individual. Findings from the Designed for Disease study (2008) indicate that, for California, obesity and diabetes prevalence was highest among adults with the highest number of 'low-quality' foods near their homes. When comparing high and low RFEI's, there was a 20% difference in obesity prevalence and 23% diabetes prevalence among individuals from RFEI 5.0 versus 3.0. In California, there appears to be a significant relationship between the availability of 'low-quality' foods and diabetes risk factors.

### Accessibility Measures

To assess good access, we used "drive-time areas" tool (ESRI, 2017). A 0.5-mile and 1.0-mile walking distance buffer was created from the center of each targeted site. By comparing the resources visually that are available within the standard definition of good access (0.5 and 1.0 miles) to what is available only by car or bus, we can better understand the challenges of access for each neighborhood population.

## Results

### Database Accuracy

In comparing existing GIS databases to visual assessments to analyze city resources, we found consistently inaccurate GIS representation for available retailers. While only one large retailer within the Jurupa community boundary was missing from the database, there were significant discrepancies in small/convenience retailers and in fast food locations. It is to be noted that strict comparisons between the databases cannot be made because it is unclear how points within the existing databases were categorized. Nevertheless, generalizations regarding the content of the existing archival and current visual databases and their comparability are possible.

### Resource Analysis

Visual assessments of current status indicated a deleterious ratio of 15 convenience or fast food outlets for every affordable high-nutrition supermarket, greatly exceeding the ratio of 5:1 found previously to predict higher rates of obesity and diabetes (Designed for Disease, 2008). If the standard of acceptable food outlets is relaxed to include rank=4 stores, the ratio is still 10:1, ten convenience or fast food outlets for every reasonably healthy and affordable grocery store. Figures 3-7A show through maps, the challenges of food access for these population centers of Jurupa Valley. Only the two sites in eastern Jurupa, Eddie Dee Smith Senior Center, and Ina Arbuckle are considered to have good access to food as defined by this and other papers. While this area had the best food availability for high-quality food, the ratio of low- to

high-quality food was 13:3, or >4:1, indicating a risk for obesity (Figure 8). As seen in Table 2, the archival databases greatly underestimated the environmental threat to proper nutrition.

Notable from Figures 3-6, when using the USDA definition of good access, only one site, Ina Arbuckle Elementary School, had a supermarket within 0.5-miles walking distance. Its neighbor, Eddie Dee Smith Senior Center, shared some of that walking distance and did have a supermarket within 1.0-mile walking distance. The sites on the West side of Jurupa, Country Village, and Troth Elementary did not have a supermarket within 0.5-1.0-miles. When the definition was liberalized to include local markets that carried fresh foods (rank=4), Troth Elementary did have one store ranked 4, but Country Village had only retailers of poor quality or that did not accept SNAP as a form of payment. Of the twelve stores that were considered as a good access by the USDA (ranked 5 in our analysis), only three were within the Jurupa community boundary and only one within a 1-mile walk of any of our population loci. From the 63 grocery retailers identified, 47 stores accepted SNAP, including convenience stores, liquor stores, small corner stores, in addition to larger businesses such as 99 cent or dollar-stores and large grocery retailers. Fast food density can be found in Figure7, although some areas of high density exist within the community boundary, the areas of highest fast-food density lie outside of community boundaries, within the area of influence.

STORE-TYPE BY RANK	DATABASE	VISUAL	DUPLICATE
5	5	12	5
4	7	6	1
3	4	2	0
2	11	2	2
FAST FOOD	29	171	
RFEI ACTUAL:			
RATIO:	5:40	12:173	
	1:8	>1:15	
RFEI *EXPANDED DEFINITION			
ACTUAL:			
RATIO:	12:40	18:173	
	~1:3	~1:10	
*RFEI considers low-quality food outlets of convenience and fast food locations compared to grocery stores. This expanded definition for Jurupa also includes smaller stores that carry a variety of fresh foods and accept government food assistance programs (SNAP); these stores are rank 4 in the study methods.			

### Conclusion & Discussion

In determining the food resources in Jurupa Valley, GIS database analysis did not provide a complete or accurate list of retail food locations. Through targeted visual assessment, we found that although Jurupa Valley had numerous SNAP-eligible retail locations, most of them were small stores rather than full-service grocery markets. We additionally found that only three of eleven large stores were located within the community boundaries of Jurupa and often at inconvenient distances from neighborhood population centers. We found as well that there was a deleterious ratio of grocery stores to convenience/fast food locations. These results highlight the dynamic between access and availability; residents have access to many affordable foods through SNAP retailers, but there is a low availability of high-quality food retail establishments.

Our assessment was limited by existing business database information as well as the lack of community-level population data.

Windshield surveys provided a clearer depiction of the nutrition landscape. Jurupa Valley visual assessment, along the travelled routes, revealed nearly six-times the number of fast food restaurants as were identified via database analysis. Using only database results, one may be led to believe erroneously that the RFEI is only 3:1 when a visual count provides a REFI estimate of 10:1 (Table 2). Even with limited community-level data for Jurupa Valley, analysis shows a concentration of low-end food retail establishments and few good-quality markets. The California Health Policy Research Center, in 2008, published findings that obesity prevalence is highest for California adults who have the most fast-food restaurants and convenience stores near their homes relative to grocery stores and produce vendors. They found a similar pattern with the highest prevalence of diabetes among adults living in the same low-grocery, high-convenience food areas. Future assessments in Jurupa and other cities will benefit from thorough visual assessment and business database use when building resource maps.

Future assessments should include a survey of community members' use of retailers, access to vehicles and public transportation, and perceived access to and affordability of local food resources. According to Zallman, Ibekwe, Thompson, Ross-Degnan, & Oken, 2014, mapping community resources can have implications for improving population health management by care providers but is challenged by low health literacy levels. Using GIS enabled mapping to collect user responses via touchscreen may negate some or all of the issues of literacy. In 2003, Giles-Corti, Macintyre, Clarkson, Pikora, & Donovan, found that the perception of not having a shop within walking distance almost doubled the odds of obesity. In joining this newly developed

resource with the community assessed, in 2017, Fiechtner et al., found that providing a resource map to parents of overweight or obese children, improved their resource empowerment by .25 points. Providing user-friendly and interactive maps that display community resources via application, website, and/or print will provide a valuable service to residents by highlighting accessible food locations that may otherwise go unnoticed. Our research supports that GIS provides a meaningful representation of spatial variation in community resources and is limited by the quality of the data available (Charreire et al., 2010).

This study was conducted in the context of a project to assess the feasibility of community-based screenings to identify people at high risk for type 2 diabetes and recruit them into evidence-based interventions to prevent progression to disease. The long-term success of such programs depends on participants' having the means to accomplish and sustain changes in dietary behavior consistent with risk reduction. Living in a community where the challenges to change are great, where access to nutritious and less calorie-dense diets is low and not affordable might substantially reduce the effects of such programs. Identifying where environmental challenges exist might permit more personalized and environmentally sensitive interventions to help guide participants past, current environmental obstacles to access food resources more supportive of risk reduction goals. Identification of nutrition landscape hotspots might also support environmental interventions through intelligent city planning to create urban environments that are more supportive of population health in all communities.

## Limitations and Future Directions

The gap between archival data represented in the GIS analysis and currently valid data acquired by direct observation may be particular to newer areas. If so, the implication may be that, archival data alone as available for GIS analysis may not be sufficient to guide development, implementation, and targeting of public and population health programs. If low-quality convenience stores and fast-food restaurants are generally underrepresented in archival data as was the case in this study, then GIS data alone as a guide to environmental resources should be considered with caution.

The findings from this study were used to inform program development and translational research for diabetes prevention in Pomona, California. In assessing the nutrition environment for Pomona, we allocated resources towards collecting observational data of the resource environment, collected through visual assessment. Refinement of these and other methodological contributions are described in the chapters that follow.

Additionally, we learned that forming partnerships that allow for the collection of community-level screening data would be helpful for use in compiling a community demographic and health profile for comparison to environmental findings; for example, in Jurupa, we discovered an extensive network of faith-based institutions. Early outreach in Pomona included partnering with city council members, city employees, local non-profit groups with community and health focus, and religious leaders. The findings in Jurupa Valley were applied early and often to the next project for diabetes prevention in Southern California.



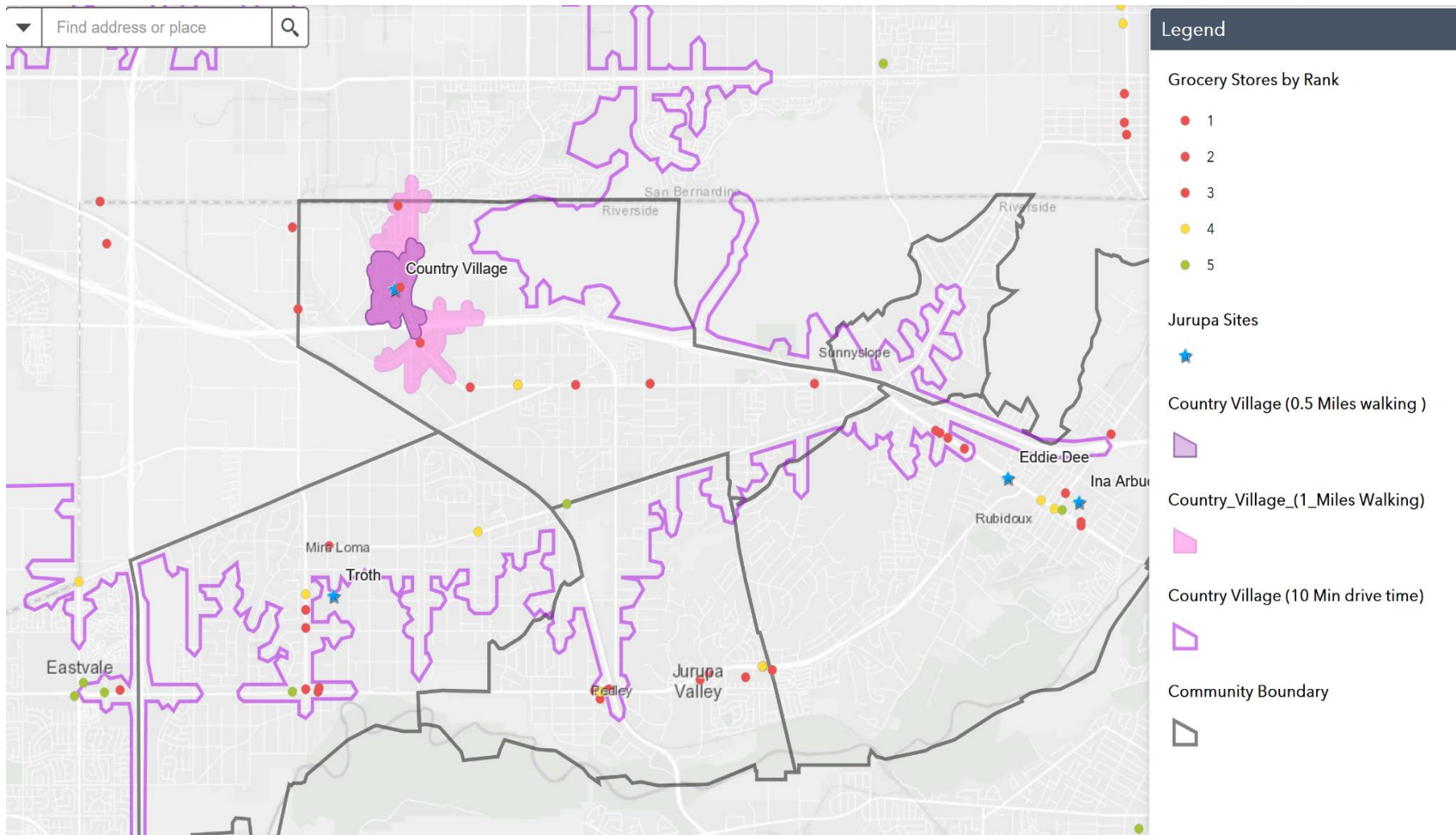


Figure 3: Country Village area nutrition resource map shows only low- to moderate-quality stores, only low-quality (rank 1-3) in the 0.5- and 1.0 mile radius of this population center. There are high-quality establishments both within and outside of the Jurupa border, seen the South-West of the map; there is a resource-rich center in the neighboring city of Eastvale, across the 15-freeway.

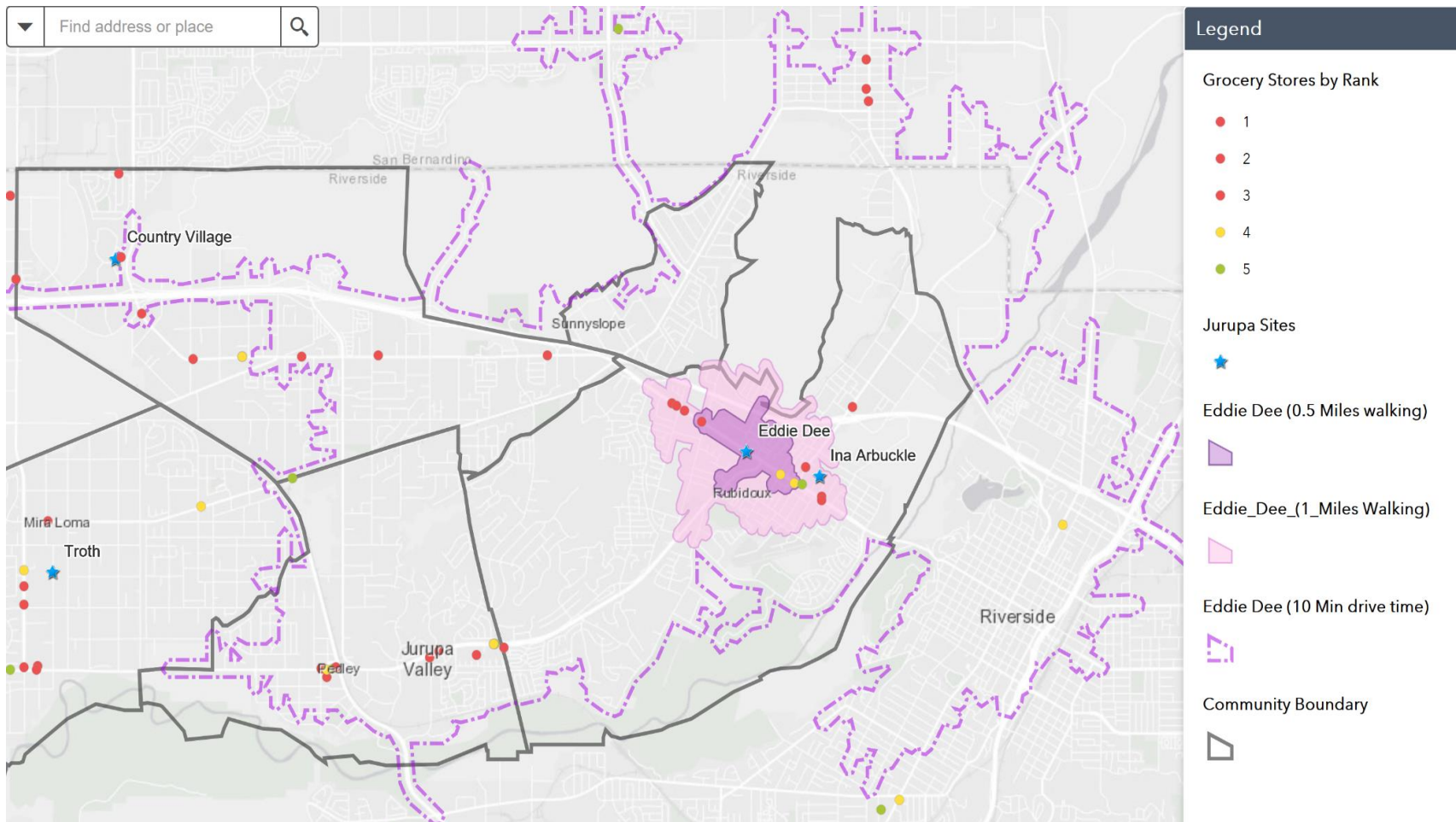


Figure 4: Eddie Dee Smith area nutrition resource map includes both low- and moderate-quality retail establishments in the 0.5-mile radius, with an additional high-quality (rank 5) store just at the edge of the 1.0-mile walk radius. There is one other high-quality establishment, seen outside of the Jurupa border, to the North, just within the 10-minute driving radius, but in the neighboring county of San Bernardino, across the 60-freeway.

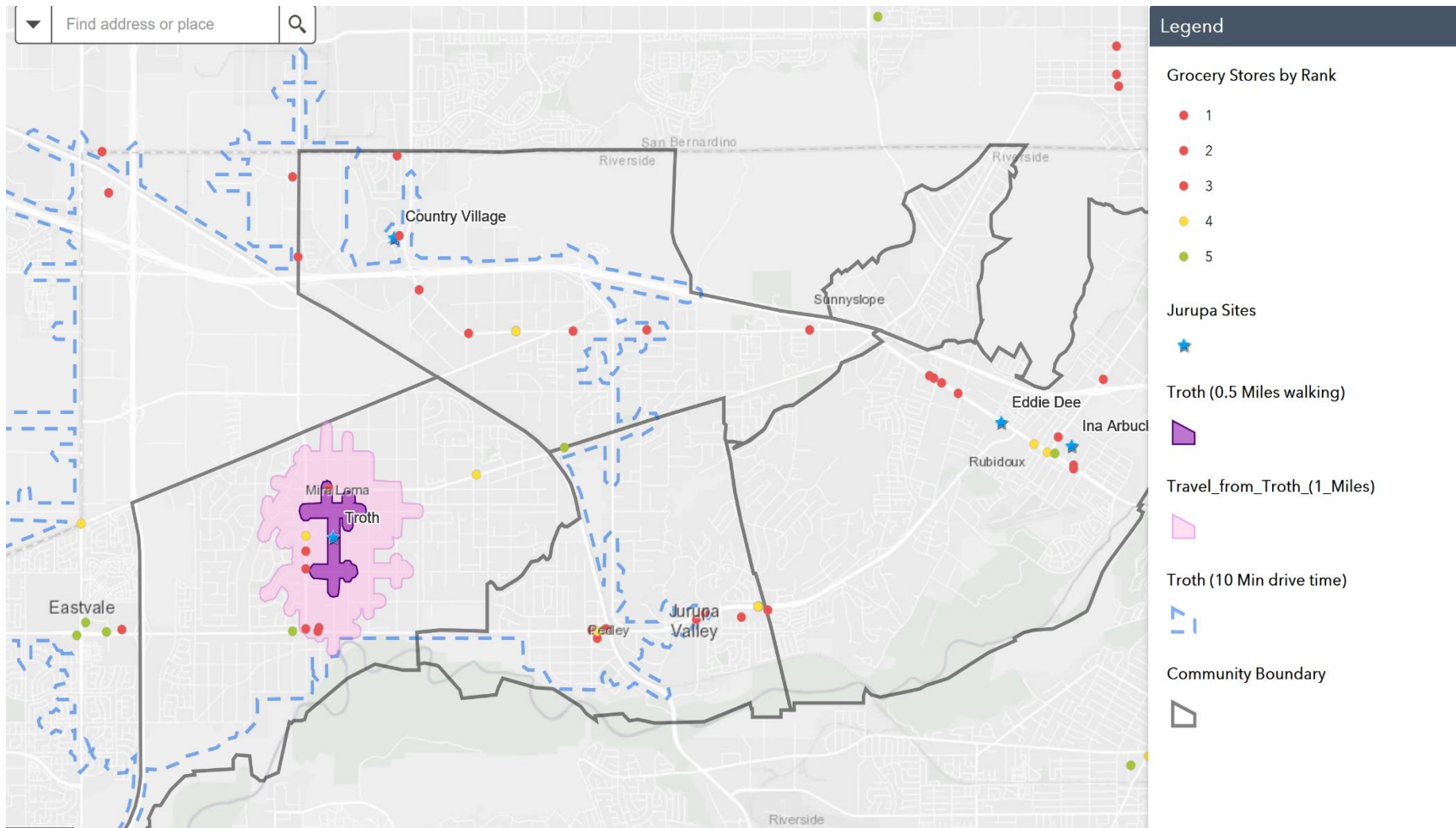


Figure 5: Troth Elementary School area nutrition resource map shows only low-quality (rank 1-3) retailers in the 0.5-mile radius, and both low- and moderate-quality retailers in the 1.0-mile radius. The nearest high-quality (rank 5) retailers is just outside of the 1.0-mile radius. A rich area of high-quality establishments can be seen outside of the Jurupa border but within a 10-minute drive from Troth Elementary, in the city of Eastvale, across the 15-freeway.

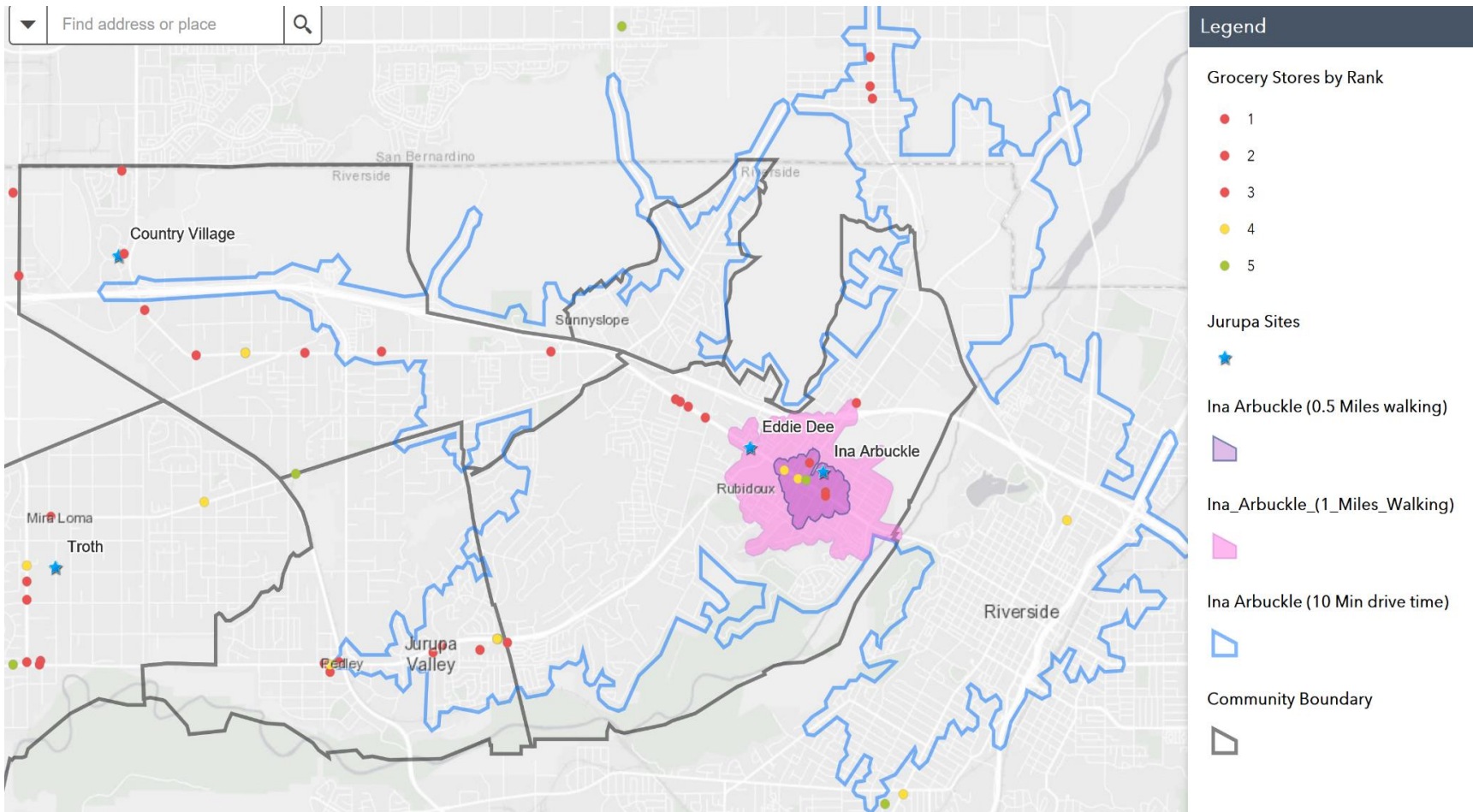


Figure 6: Ina Arbuckle Elementary School area nutrition resource map showing the most nutrition-density of the population loci. Within 0.5-miles of this location is a high-quality (rank 5) and 2 moderate-quality retailers, along with low-quality retailers within both 0.5- and 1.0-mile walking. There are no other identified high-quality stores identified within the 10-mile driving radius.

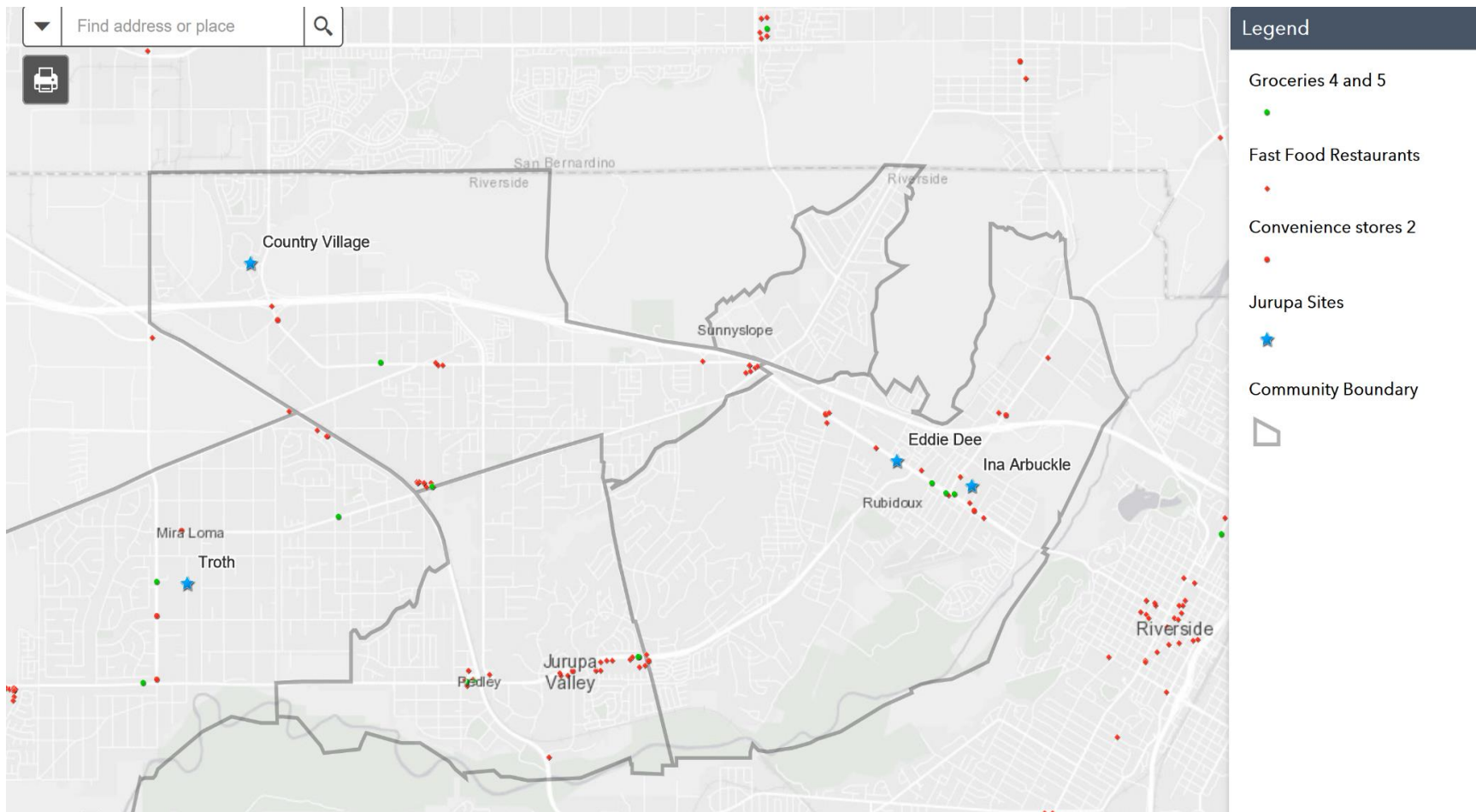


Figure 7: Jurupa with identified Low- and High-Quality Food retailers (red and green dots, respectively), showing the clear abundance of lower quality establishment and small number of higher-quality stores. \*using an expanded definition of higher-quality to include both large grocery stores and smaller retailers with a variety of fresh foods who also accept government assistance benefits (SNAP).

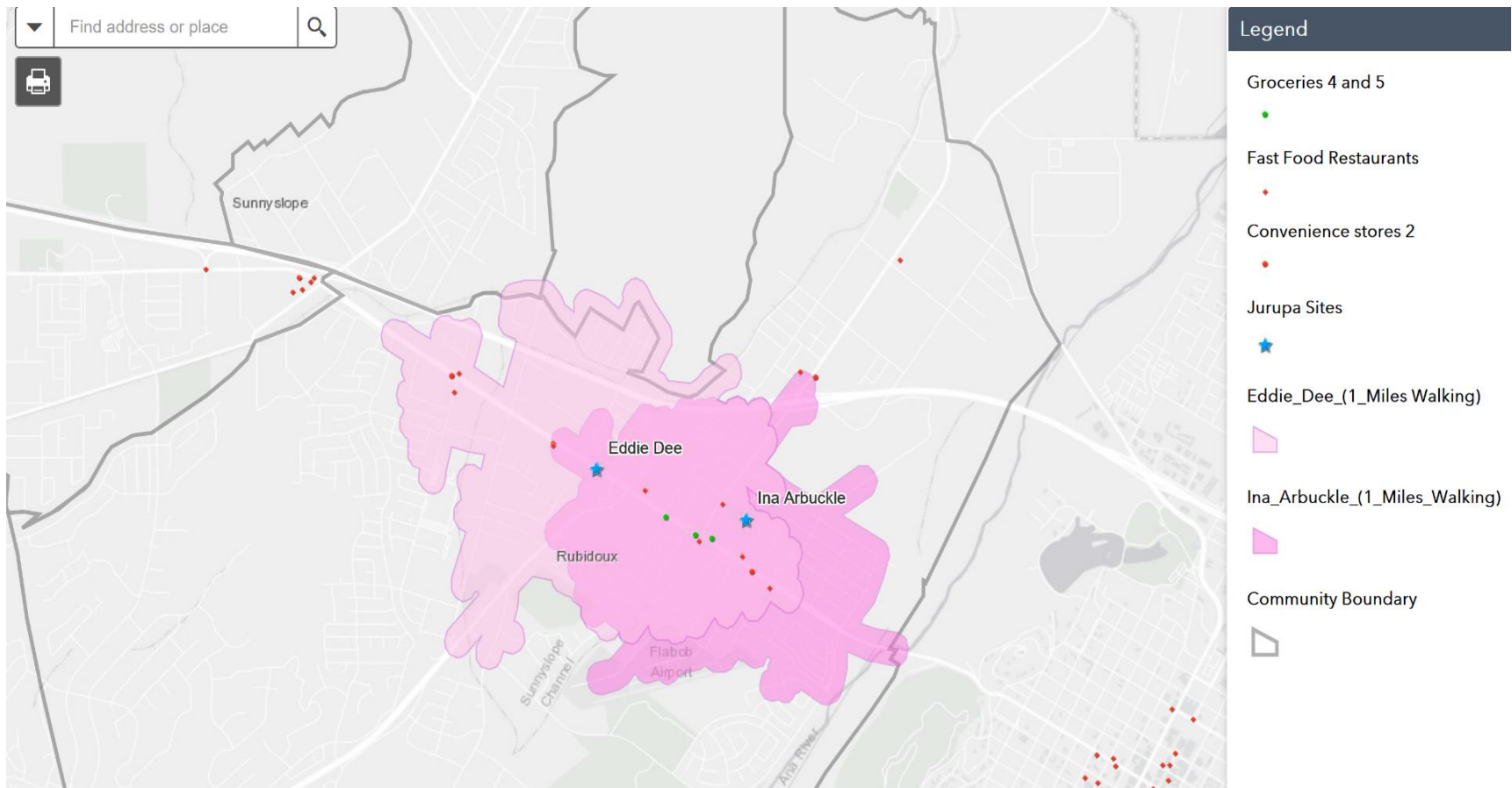


Figure 8: Highlighted area of Jurupa surrounding Inia Arbuckle Elementary, found to be the population loci with the most high- and moderate-quality food retailers. Although there is access to good-quality food, the ratio of low- to high-quality (using our expanded definition), is still harmful, at 13:3, or >4:1)

## CHAPTER IV

### Developmental Study 2.

#### Exploration of Methodology for Adaptation and Implementation of a Measure of the Nutrition Retail Environment in a Predominately Hispanic, Low-SES, Community

This developmental study established a method for adapting and improving an existing nutrition environment measurement tool (NEMS) and suggested new considerations for the definition of “good” environment. The Nutrition Environment Measurement Survey for Stores (NEMS) was adapted to capture both access and availability measures of import to our population. Findings suggest good interrater reliability of the edited version from some subcategories of scores using Spearman’s Rho correlation coefficient: Total Overall  $\rho(6) = .824$  to  $.886$ ,  $p = .019$  to  $.044$ ; while Access and Price scores did not have statistically significant correlation coefficients,  $\rho(6) .182$ ,  $p = .730$ ;  $\rho(6) .603$ ,  $p = .205$ , respectively. The results surrounding store quality support previous research that finds an abundance of convenience stores and many fewer Grocery stores in minority and lower SES communities. Adding to the existing body of work, there may be considerable variability among independent local store types that are not accounted for when all of these are categorized together.

#### Introduction

This study is a sub-study of Stopping Diabetes in Its Tracks (SDIT), a large three-year trial focusing on prevention of obesity and type 2 diabetes (T2DM) through an integrated three-pronged approach involving community, hospital and clinical settings. The goal of the study is to

establish a system of sustainable preventative and health care services to reduce T2DM in the city of Pomona, CA. SDIT includes population screenings in each system and interventions to reduce risk for those found to have lab values indicative of prediabetes or diabetes.

The current study used a cross-sectional survey design to assess indicators of the retail nutrition environment in a selected sub-region of Pomona, CA. The purpose of the present study was to determine to what extent adaptation and implementation of a more explicit measure of nutrition environment within retail food stores challenge accepted definition of retail food quality which considers only high- and low-quality variations.

## Methods

### *Glossary of Terms*

NEMS-SDIT – Nutrition Environment Measure of Stores, Stopping Diabetes in Its Tracks

RFEI – Retail Food Environment Index

NAICS - North American Industrial Classification System

Enumeration – Method for assigning six-digit numeric codes (ID numbers) to survey stores

Classification – Classifying stores by NAICS numbers

### Demographics

The study was carried out in the city of Pomona, California which is a suburb of Los Angeles that was incorporated on January 6, 1888 and becoming a charter City in 1911. Pomona is currently the seventh largest city in Los Angeles County and has over 151,000 residents, (“About Pomona,” n.d.). The city covers 22.95 square miles with a population density of 6,494.3 per square mile, as of 2010 (US Census, 2019a). As of the April 1, 2018 Census information, Pomona’s population was 152,361 people, a 2.2% increase from the 2010 census. Pomona is composed of greater than 70% Hispanic followed by less than 12% White, and less than 10%



American Indian, Asian/Pacific Islander, Black non-Hispanic, or multi-racial. These numbers represent a much larger percentage of the population identifying as Hispanic and much lower percentage of White non-Hispanic, when compared to the whole of Los Angeles County, (Table 3). Compared to Los Angeles County, Pomona has higher home ownership, more people reporting that English is not the primary language at home, 22% more persons identifying as Hispanic, and the number of residents 25 years or older without at least a high school degree is almost 10% higher when compared to the County as a whole.

	POMONA	LA COUNTY	SDIT SURVEY (WHERE ABLE)
POPULATION ESTIMATE	152,361	10,105,518	146
POPULATION GROWTH (APRIL 2010-JULY 2013)	2.2%	2.9%	
PEOPLE 25 OR OLDER WITHOUT AT LEAST A HIGH SCHOOL DEGREE	31.5%	21.8%	
FOREIGN BORN PERSONS (2013-2017)	34.1%	31.4%	
PERSONS LIVING BELOW POVERTY LEVEL (2013-2017)	20.7%	14.9%	
HOMEOWNERSHIP RATE (2009-2013)	52.6%	45.9%	
PERSONS PER HOUSEHOLD (2013-2017)	3.79	3.01	
MEAN TRAVEL TIME TO WORK (2013-2017)	30.2 MINUTES	30.9 MINUTES	
LANGUAGE OTHER THAN ENGLISH SPOKEN AT HOME	65.9%	56.6%	
<u>POPULATION BY RACE/ETHNICITY</u>	PERCENT	PERCENT	PERCENT
AMERICAN INDIAN/NATIVE ALASKAN, ALONE	1.9	1.4	.7
ASIAN, PACIFIC ISLANDER, NON-HISPANIC	9.9	15.8	4.7
BLACK, NON-HISPANIC	6.3	9.0	2
HISPANIC	70.6	48.6	70.5
MULTI-RACIAL	4.1	3.1	4.7
WHITE, NON-HISPANIC	11.7	26.1	15.7

## NEMS Survey Tool Adaptation

The Nutrition Environment Measure Survey (NEMS) is an observational measure to assess the community and consumer nutrition environments in food outlets, specifically stores, corner stores, and restaurants (Glanz, et al., 2007). Development and testing of the original NEMS tool development published in 2007 found high interrater (kappa 0.84-1.00) and test-retest (kappa, .44-1.00) reliability in showing differences across store types. In the 12 years since its debut, the tool has been used or cited in 61 articles and has been adapted for use in many of these instances, to fit the needs of the study community or population (Lo, Minaker, Chan, Hrgetic, Mah, & Cook, 2016; Lo et al., 2016; Bureau of Sociological Research, n.d.; CHILE, 2008; Yale Rudd Center, n.d.). For the city of Pomona, the following adaptations were made, taking into consideration our population demographics and potential challenges to access/accommodation, and having referenced successful adaptations previously mentioned, (Caspi et al., 2012b, Cannuscio et al., 2013, Byrne, 2019).

After careful consideration of time, feasibility, and study population, the existing NEMS survey was edited to capture aspects of the retail food environment that are culturally relevant to the Pomona, CA community. The edits described in detail below consist of expanded store variety and measures of accessibility on the survey cover page, edits to the types of foods surveyed in produce, protein, grains, and drinks, as well as measures of convenience and processed foods. The following factors were added to the cover page of the NEMS survey tool: a detailed variety of food retail options including drug stores, independent stores (other than convenience stores), ethnic and general or discount stores, as well as distinguishing among

convenience-store types. As well, measures of access and accommodation were included (Figure 8):

- WIC store certification
- Food Stamp store certification
- Cleanliness of premises
- Presence of a usable and safe sidewalk
- Outdoor lighting, bus stop within one block
- Hispanic food section or options,
- Hours of operation

Changes made to the fresh produce segment reflect the top five-each fruits and vegetables from national surveys and the top five-each fruits and vegetables from surveys of Hispanic food preference for a total of 20 fruits and vegetables. Although fresh produce is a preferred, when possible, fresh-frozen and canned fruits and vegetables can be affordable and less perishable option, these were added to the NEMS-SDIT.

For protein, in addition to ground beef, chicken, canned tuna, and beans were included.

For the grains segment, rice, pasta, and tortillas were added; these culturally acceptable foods may be purchased more frequently than loaf bread. In addition to cereal, we measured hot cereal and availability of plain quick-cooking oats.

For beverages we included only diet soda, juice drinks, aguas frescas, tea and coffee, dairy-alternatives, as well as 6-packs of water.

The last additions were made in consideration of busy lifestyle and options for good-quality convenience items. For this, we measured availability of prepared/Ready-To-Eat (RTE) foods, partially prepared foods (take and bake foods, pre-marinated meats), and compared prices with light alternatives as available.

Another unique feature of the NEMS SDIT is the classification of healthy versus unhealthy varieties within each segment, and comparison of prices for the standard versus healthy alternative. A few items were deleted from the measure for our purposes, in consideration of time, the above additions, and the perceived quality of the following: hot dogs, frozen dinner, baked goods, chips. We did not collect specific prices for foods, only compared prices within a category for a single store. Examples can be found below; the full survey is found in Appendix 1.

Click to write the question text

	Certified	Not Certified	Unknown (no signage displayed)
WIC Store Certification	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SNAP (EBT/Food Stamps) Certification	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**General impression of cleanliness of premises:**

Acceptable

Unacceptable

Comments

**Does this location have:**  
(choose all that apply)

Off-street parking

Bus Stop within 1 block

Safe/accessible sidewalk (not blocked, or broken - making it difficult to navigate)

Outside lighting

Hispanic food section or options

Comments

**Figure 9: Sample of NEMS-SDIT Cover Page Questions**

Identification and Classification of Stores for Survey

Prior to collecting survey data, a reference list from which to work was compiled and used to guide the route for surveyors; I used *ReferenceUSA* (2019). *ReferenceUSA* is a database,

accessible through academic institutions and private fee-for-service interactions that boasts access to information from 57 million U.S. businesses, 16 million verified and 41 million unverified because they are verified weekly. “Every day, new businesses open, existing businesses change locations and eventually some businesses close—because of this, the database must be continually maintained to keep the information up-to-date. [They] also phone-verify every record annually, making more than 24 million calls a year,” (ReferenceUSA 2019). *ReferenceUSA* uses the classification categories from North American Industrial Classification System (NAICS) numbers. “The North American Industry Classification System (NAICS) was developed under the direction and guidance of the Office of Management and Budget (OMB) as the standard for use by Federal statistical agencies in classifying business establishments for the collection, tabulation, presentation, and analysis of statistical data describing the U.S. economy. Use of the standard provides uniformity and comparability in the presentation of these statistical data,” (U.S. Census Bureau, 2018). NAICS numbers are self-selected by businesses as part of their licensing and taxation procedures. When selecting business classification there is an opportunity to include multiple classification codes which are then ordered, presumably, related to relevancy. For our purposes we considered those locations that listed food, grocery, market, or beverage in the description of the classification code.

Researchers used the NAICS website to identify the NAICS sectors and categories of interest for food-related businesses. The NAICS includes several sectors, each covering businesses of a specific type, for instance, Sector 11 is described as Agricultural, Forestry, Fishing, and Hunting and 22 is Utilities. Each sector, regardless of description, was inspected by the researcher for possible business-types of interest (retail-food locations). When further

investigation was warranted, codes were searched using the *ReferenceUSA* database for more specific business information. The following sectors are included in the final data aggregation for stores of interest, related to their likelihood of being accessed by community members to purchase food.

Sectors 44-45 are *Retail Trade*, further search through ReferenceUSA, yields 101 results for Pomona CA, including all subcategories below, search results will be included in the final business search:

- 445 Food and Beverage Stores
- 4451 Grocery Stores
  - 445110 Supermarket
  - 445120 Convenience Store
- 4452 Specialty Food Stores
  - 445220 Fish and Seafood Market
  - 445210 Meat Market
- 4453 Beer, Wine, and Liquor Stores

The final category under this sector is 45421 is *vending machine operators*, yielded 1 result which was not a store and was excluded. Sector 446 is *Health and Personal Care Stores*, search using *ReferenceUSA*, yields 61 results including 22 sites with Pharmacy/Drugs in the title, excluded from the list were NAICS primary and secondary codes (Health) Supplement Stores that included no other food-related codes. In a review of store names these were supplement, vitamin, health-related retailers, not grocery or convenience stores. Classification code 446110, Pharmacies, were included if they were a large national retailer known to also sell food products (Walgreens, CVS, Rite Aid, Sav-on).

The next sector: 447, is Gasoline Stations, further categorized into classifications 447110-447190, Gasoline Stations with Convenience Stores and Other Gasoline Stations. Search using Reference USA yielded 43 results for Pomona. Duplicates, identified by address, were deleted

along with electronic charging stations which do not have associated stores. Sector 452 are General Merchandise Stores including Warehouse Clubs and Supercenters, search using ReferenceUSA yielded 47 results. Specific codes of interest are 452210 Department store and 452319 General Merchandise, which included businesses such as Target, 99c only stores, and other multi-purpose store types. The business-types above, unless otherwise specified, are included in the final aggregation of potential stores related to their likelihood of serving the community as a food retailer.

#### *Exclusions from Final Data Aggregation*

The following were investigated for inclusions: Sector 11 business titles included farming, production, and trapping, not retail providers and was not included in final business search. Sectors 21, 22, 21 and 31-33 are also found to be unrelated to retail food providers and were excluded. Additional cursory and detailed searches of business types and resulting business names, from NAICS and *ReferenceUSA* respectively are conducted for Sectors 48-49, Sectors 51, 52, 53, 54, 55, 56, which are found to be unrelated and excluded from the final search. Sector 61, Educational Services, includes schools and universities, not food purchasing locations for the general public. A search of sector 62, Health Care and Social Assistance, includes subcategories of 6242 Community Food and Housing, and Emergency and Other Relief Services and 624210 community food services, search using *ReferenceUSA*, yields zero results in Pomona, CA. Sector 81 called Other Services (except Public Administration), and a search reveals no businesses of interest; 8131 Religious organizations, yields 121 results, while, Sector 92, Public Administration, results for which none had a food-retailer related code as primary or secondary NAICS. Curiously,

none of these public assistance, community food, other services resulted in any information about food banks, each of these categories is excluded.

The next sector of interest is 42, Wholesale Trade. Further investigation of business names was conducted using *ReferenceUSA* and resulting codes including food products are 4244 Grocery and Related Product Merchant Wholesalers: 424410-424490. Name search yielded twelve results, these were not accessible to the general public and were excluded from the final aggregation. Subcategory 4245 is Farm Product Raw Material Merchant Wholesalers: 424510, 424520, 424590, which yielded zero results within Pomona. Next is 4248 Beer, Wine, and Distilled Alcoholic Beverage Merchant Wholesalers, which revealed two results for Pomona, neither are retail establishments accessible by the public and they were excluded from the final search.

Using the ReferenceUSA database and the NAICS codes identified earlier, results for Pomona, CA were gathered. Each code category generated a code and location specific spreadsheet, each including between 2 and 101 retailers for a total of 266 retailers identified with a Pomona, CA address. These retailers were narrowed by business name and type to exclude small pharmacies, disease/condition-specific stores such as vision centers, cannabis businesses, through web search if a business was a distribution center, not open to the public (Sodexo, Meat or Beverage Distribution), it was excluded, as well as department stores known for carrying predominately non-food items (Ross Dress For Less). Further exclusions were made if the address of the business of interest was not in the final Environmental Scan area, described in Chapter IV. Results yielded 77 database-identified locations of interest within the survey area.



## Store Classification/Enumeration for NEMS Scans

An environmental Scan was performed in the survey area using ArcGIS Survey123 generated application, detailed procedures in Chapter V (page63). Upon completion of environmental scan in areas of interest, cross-reference for duplicates, changes of name or business-type, possible business closures were noted and, following identified “main streets” of thoroughfare and identified businesses of interest. Businesses from the database plus those identified through the environmental scan were added to a main spreadsheet, separated by category as either Grocery, convenience/liquor, discount/department, small/independent grocery, ethnic/specialty, or drug stores. Each location was assigned a six-digit number for identification. The first two numbers are store-type categories as follows: Grocery = 01, Convenience/Liquor = 02, Small/Independent Store = 03, Drug Store = 04, Chain General Store = 05, Ethnic Store = 06, Other = 07. After initial enumeration, further subcategories were used to parcel out store-types within the convenience/liquor category. Methodology for new numbers within the 02 category are as follows: Convenience (by name, known classification, from Reference USA) – no gas station connected remains =02, Gas with Convenience (by name in Reference USA database, that includes both a gas station and indicates a store) = 08, Gas (by name in Reference USA database, name is gas company with no further information indicating a convenience store) = 09, Liquor (by name = liquor, wine, beer in the name) = 10. For all categories, if unclear or unable to determine using name, NAICS primary categorization was used to determine categorization. For locations without NAICS (not in database) information discovered on visual assessment based on inclusion criteria above was used to select category.

More details about determination of store-type includes that initially, stores were categorized based on modified pre-existing categories from the NEMS development: Chain Grocery/Supermarkets, Convenience/Liquor stores, Small/Independent Stores, Drug stores, Chain/General/Discount Stores, Ethnic/Specialty stores. Chain Grocery Stores/Supermarkets were regional or national chain stores such as Vons, Stater Bros, Cardenas, or Ralphs. Convenience/Liquor stores are stores that may or may not be connected to a gas station, that are not classified as large grocery stores and offer many convenience items or are primarily focused on selling beverages and convenience foods. Drug stores included large nationally recognized chain pharmacy stores that also sell general items such as household supplies and food items, examples include Rite Aid, Walgreens, and CVS. Chain/General/Discount Stores included both national or local stores whose name included a 99c or \$1 store, and/or general stores that also sell food items, examples are 99c Only, Target, and K-mart stores. Small/Independent stores include local (not chain) stores that have names that imply food being the primary product being sold, as compared to a general store, and included stores with the local 'Alta Dena Dairy' certification, stores with 'market' in the name but not liquor, the word 'nutrition' or 'food' in the name. Ethnic/Specialty stores are local stores that included 'meat, Carniceria, Pescadera, Panaderia' or a specific location/ethnic food group 'Jamaican, Mexicana' in the name.

The second set of numbers are a four-digit store ID based on address, by street. The master list of stores is separated into different and distinct spreadsheet pages, by street. For example, all stores with a Garey Avenue address versus those on Holt Avenue. The list was then ordered by North/South or East/West and addresses are ordered numerically. For example, 123

North Garey, then 125 North Garey, not 123 North Garey, 123 South Garey. Ordering the list by geographic (North/South) address first, then numerical address allowed for easy flow of surveys while in the field. ID numbers were assigned 0001, 0002, etc., from the top to the bottom of each spreadsheet, numbers are continuous, and assignments were made from Garey Street, Holt Avenue, Mission Avenue, then Indian Hill Boulevard. The order of streets from Garey to Indian Hill was not significant but reflected our workflow, following the progress of the environmental scan.

#### Areas of the City Selected for Survey

ESRI ArcGIS desktop and webAppBuilder, maps were created for aggregation of environmental data. Initial maps included layers for ReferenceUSA (2019) database information for business codes identified using the NAICS numbers. For Pomona we reviewed the rich body of data that was being collected during diabetes screening events; as well, the city of Pomona gives public access to their general plan and GIS zoning districts. Through thorough review of existing data, four the corridors described below were chosen as the concentration of our visual assessment.

In researching the city of Pomona we reviewed the General Plan in which the Garey Avenue corridor is described as a ‘commercial corridor,’ as well, Holt Avenue and Mission Boulevard corridors both ‘commercial,’ and in historic areas, serving as “main street” configuration, with retail, commercial, and residential parcels (City of Pomona 2014 General Plan Update). The City of Pomona website map found on the city’s website identifies Garey Corridor, Mission Avenue and Holt Boulevard, as Urban Neighborhood, Transit-Oriented Neighborhood:

Neighborhood, Workplace District and District Edge, and identifies numerous Activity Centers along these routes (General Plan & Zoning, n.d.). These city-provided data sources along with the information being collected at screenings indicated the Garey Corridor, Mission Boulevard, Holt Avenue, and Indian Hill were concentrated centers of activity where a variety of stores could be surveyed.

### Rater Training and Quality Control

Before performing community environmental surveys, staff were trained on the NEMS survey and the mobile access system for data collection. Raters were college educated research volunteers with or without prior research experience, each 'set' of raters included at least one student with nutrition training, either a current undergraduate nutrition student or a graduate of a local undergraduate nutrition program. The lead researcher completed the full self-paced Store and Restaurant NEMS training course provided by the NEMS research team at University of Pennsylvania. Subsequent data-collector training took place over 2-hours and included all survey sections with examples and testing of knowledge throughout. Training materials were adapted from the NEMS online training materials (Honeycut, Davis, Clawson, & Glanz, 2010). In addition to this training, all raters had open access to a mock survey for practice and the lead researcher was available via text or phone call during all rating sessions. To assess interrater reliability, duplicate stores surveys were carried out for approximately 10% of the surveyed. Duplicated surveys were completed no more than 24-hours apart to minimize differences in product displays from day to day.

## Data Collection

The final step in completing surveys included assignment of stores using those in close geographical proximity on the same day. Survey sessions lasted from two to five hours covering approximately four to ten stores per session, carried out by a single surveyor at a time. 5-10% of store locations were assigned to a second surveyor to be completed within 24 hours of the initial survey, for interrater reliability. In completing surveys along parts of the route, independent survey completion was deemed to be safe and reasonable. As the survey progressed to parts of the city that included neighborhoods with indications of lower safety, as perceived by surveyors, the surveys were completed in teams of two surveyors to assure safety of the research staff. Surveyors attended a two-hour training before starting surveys and participated in sample survey questions to clarify procedures. During survey days, the surveyors were able to contact the lead researcher with any questions, concerns, or comments. Before each agreed-upon survey day, the staff was contacted via email with a list of locations for survey (field tracking form), electronic letter to the store manager, copies of the training material, and practice survey. Paper copies of the letter to store manager were provided to each staff member as needed (appendix 2). At the end of each survey period, the staff member would send completed tracking sheet to lead researcher for tracking on the master list. A tracking methodology was employed throughout, to update store findings in terms of refusals, location changes, etc. For example, database entries were entered using plain black text, if the same location was identified via environmental scan, the text was edited to green; versus blue and italics stores were found only via the environmental scan and not available in the database. Bold was used to indicate a question about a location including possible closures, name changes, or duplicates, to be verified

in the field at the time of store survey. After attempts to visit a location, if the location was permanently closed, changed business-type, or was not the business-type as expected from database or environmental scan, it was stricken out and a survey was not completed. If the business-type or name changed, but fell under the scope of interest for the survey, a survey was completed with all pertinent information change added to the tracking form; for example, if a Liquor store called ABC liquor was on the tracking list but upon arrival the name is XYZ liquor, the store was surveyed and a name change indicated (appendix 3). Finally, if a store refused survey, they were listed in red. When survey staff encountered a store that was closed during normal business hours or the staff on duty was not able to provide access for a survey the store was skipped and a re-attempt was made to visit each location. If a second attempt was unsuccessful the store was turned red and a note about inability to gain access was made in the master list.

For ease of access, NEMS SDIT was collected via mobile device (telephone), using Qualtrics<sup>XM</sup> software, which also generated the downloadable data for analysis (Qualtrics, Provo, UT). Survey questions were entered into the Qualtrics software and password protected for use only by approved research staff. Using the app-based survey was generally a time saver; however, if a researcher used the “back” button on the phone rather than the one in the app, the survey would not be accessible, and all progress was lost. These partial surveys were automatically sent as incomplete to the database. Data was reviewed by the lead researcher and any incomplete surveys or duplicate surveys of the same store by the same staff were deleted. Final survey data were downloaded into SPSS compatible files for analysis.

## Data Analysis Methods

All analysis and hypothesis testing were conducted in SPSS 25 (IBM corp., 2017) based on 62 total individual store surveys. Twelve stores (six duplicates and their six pairs) were analyzed for interrater reliability. Spearman's rank-order correlations ( $\rho$ ) were completed to determine the relationship of NEMS scores between raters. For differences between stores, Kruskal Wallis Test, a non-parametric analysis approach alternative for the one-way analysis of variance, for all store-type categories and all NEMS Scores sub-categories was used to detect statistically significant differences in group comparisons.

## **Results**

A total of 68 stores were surveyed, six surveys were duplicate. Descriptive statistics for stores surveyed can be found in Table 4. Of the 62 total stores, five were grocery, eleven Independent, three chain pharmacies, eight chain, general, or discount stores, seven ethnic/specialty, and 28 total of all convenience-type stores (study-defined convenience, gas with convenience store, gas alone, and liquor stores). Grocery stores represented only 8% of stores while convenience stores provided 45.2% of retail food environment.

There was strong interrater reliability for scores for Total overall Spearman's  $\rho(6) = .829$ ,  $p = .042$ ; Quality  $\rho(6) = .824$ ,  $p = .044$ , Availability  $\rho(6) = .886$ ,  $p = .019$ ; while Access and Price scores did not have statistically significant correlation coefficients,  $\rho(6) = .182$ ,  $p = .730$ ;  $\rho(6) = .603$ ,  $p = .205$ , respectively.

Kruskal Wallis Test, a one-way analysis of variance for nonparametric data, was employed to compare differences across all store-type categories and all NEMS Scores sub-categories. Results table 5 below shows there was a statistically significant difference between groups for four of the five NEMS sub-category and total overall scores X2 (8),  $p=.000-.004$ , with the exclusion of total Access score X2(8), 8.249,  $p= .410$ .

	FREQUENCY	PERCENT (%)
GROCERY	5	8.1
CONVENIENCE	9	14.5
INDEPENDENT	11	17.7
PHARMACY	3	4.8
CHAN/GENERAL	8	12.9
ETHNIC	7	11.3
GAS/CONVENIENCE	4	6.5
GAS	8	12.9
LIQUOR	7	11.3
TOTAL	62	100.0

	ACCESS	AVAILABILITY	PRICE	QUALITY	OVERALL
<b>KRUSKAL-WALLIS H</b>	8.249	34.035	21.498	25.842	32.593
<b>DF</b>	8	8	8	8	8
<b>ASYMP. SIG.</b>	.410	.000	.006	.001	.000
<b>A. KRUSKAL WALLIS TEST</b>					
<b>B. GROUPING VARIABLE: CATEGORY</b>					

Additional nonparametric testing was performed to identify difference in means between groups. Kruskal-Wallis test for store-type categories (convenience-only) on total NEMS scores; Convenience-only including study defined: Convenience store (without gas station), Gas station Convenience Stores, Gas Stations not self-identified as convenience stores, and Liquor Stores.



There was a statistically significant difference in NEMS Scores for Availability ( $p=.049$ ) and a borderline significant difference in Quality( $p=.052$ ), between convenience store types, while there was not a statistically significant difference in all NEMS sub-category scores for Access ( $p=.538$ ), Price ( $p=.061$ ), or Overall ( $p=.078$ ) or overall score between convenience store-types,  $X^2(3)$ .

<b>TABLE 6: KRUSKAL-WALLTEST STATISTICS<sup>A,B</sup></b>					
<b>CONVENIENCE-TYPE ON SCORE SUB-CATEGORIES</b>					
	ACCESS	AVAILABILITY	PRICE	QUALITY	OVERALL
<b>KRUSKAL-WALLIS H</b>	2.170	7.856	7.372	7.729	6.809
<b>DF</b>	3	3	3	3	3
<b>ASYMP. SIG.</b>	.538	<b>.049</b>	.061	<b>.052</b>	.078
<b>A. KRUSKAL WALLIS TEST</b>					
<b>B. GROUPING VARIABLE: CATEGORY</b>					

When the Liquor store sub-type of Convenience stores was removed from the analysis, Kruskal-Wallis on all NEMS sub-category and total scores, found that there was not a statistically significant difference in NEMS scores between the remaining store types  $X^2(2)$ ,  $p=.063-.409$ .

<b>TABLE 7: KRUSKAL-WALLTEST STATISTICS<sup>A,B</sup></b>					
<b>ONLY GAS AND CONVENIENCE STORES ON SCORE SUB-CATEGORIES</b>					
	ACCESS	AVAILABILITY	PRICE	QUALITY	OVERALL
<b>KRUSKAL-WALLIS H</b>	1.788	3.239	5.445	5.523	3.894
<b>DF</b>	2	2	2	2	2
<b>ASYMP. SIG.</b>	.409	.198	.066	.063	.143
<b>A. KRUSKAL WALLIS TEST</b>					
<b>B. GROUPING VARIABLE: NEWCATEGORY</b>					

Kruskal-Wallis test for store-type categories (excluding Convenience) and all NEMS sub-category and total scores. Including study defined: Grocery, Independent, National Pharmacy, Chain/General Store, and Ethnic Stores. There was not a statistically significant difference in NEMS scores for Access ( $p=.213$ ) or Price ( $p=.431$ ) between NON-convenience store-types, X2 (4); however, there was a statistically significant difference in NEMS scores for Availability ( $p=.024$ ), Quality ( $p=.024$ ), and Overall score ( $p=.028$ ).

TABLE 8: KRUSKAL-WALLTEST STATISTICS <sup>A,B</sup> EXCLUDING CONVENIENCE-TYPE STORES ON SCORE SUB-CATEGORIES					
	ACCESS	AVAILABILITY	PRICE	QUALITY	OVERALL
KRUSKAL-WALLIS H	5.823	11.206	3.819	11.192	10.841
DF	4	4	4	4	4
ASYMP. SIG.	.213	<b>.024</b>	.431	<b>.024</b>	<b>.028</b>
A. KRUSKAL WALLIS TEST					
B. GROUPING VARIABLE: CATEGORY					

There was not a statistically significant difference in NEMS scores for Access ( $p=.314$ ) between all non-Grocery store-types, X2 (4); however there was a statistically significant difference in NEMS scores for Availability ( $p=.001$ ), Price ( $p=.004$ ), Quality ( $p=.002$ ), and Overall score ( $p=.001$ ). Indicating that even without large grocery stores, there are differences between the remaining store-types.

TABLE 9: KRUSKAL-WALLTEST STATISTICS <sup>A,B</sup> EXCLUDING GROCERY STORES ON SCORE SUB-CATEGORIES					
	ACCESS	AVAILABILITY	PRICE	QUALITY	OVERALL
KRUSKAL-WALLIS H	8.210	25.553	20.604	22.797	24.503
DF	7	7	7	7	7
ASYMP. SIG.	.314	<b>.001</b>	<b>.004</b>	<b>.002</b>	<b>.001</b>
A. KRUSKAL WALLIS TEST					

After a review of mean scores for each subcategory of NEMS scores, there appeared to be three store-types that had the highest mean scores for Availability, Quality, and Price. Kruskal-Wallis test for store-type categories Grocery, Independent Market, and Ethnic Stores on all NEMS sub-category scores (Table 10). There was only a statistically significant difference in NEMS scores for Availability ( $p=.035$ ) but there was not a statistically significant difference in NEMS scores for Access ( $p=.184$ ), Price ( $p=.332$ ), Quality ( $p=.832$ ), and Overall score ( $p=.087$ ), X<sup>2</sup> (2).

TABLE 10: KRUSKAL-WALLTEST STATISTICS <sup>A,B</sup> GROCERY, INDEPENDENT, & ETHNIC STORES ON SCORE SUB-CATEGORIES					
	ACCESS	AVAILABILITY	PRICE	QUALITY	OVERALL
KRUSKAL-WALLIS H	3.399	6.726	2.207	.368	4.875
DF	2	2	2	2	2
ASYMP. SIG.	.183	<b>.035</b>	.332	.832	.087
A. KRUSKAL WALLIS TEST					
B. GROUPING VARIABLE: CATEGORY					

Using the USDA definition of access, large grocery stores, supermarkets, and supercenters that are eligible for SNAP are high-quality or “good.” Additionally, convenience stores are considered low-quality by the standards of research found in our literature review. According to these pilot results, Grocery, Independent Market, and Ethnic Food could be considered together to be high-quality or at least higher quality in that they provide overall, price, access, and quality scores in the modified NEMS survey that are not statistically different. Furthermore, all sub-types of convenience stores including independent locations, those associated with a gas station, and liquor stores can be considered together. By typically accepted standards, the surveyed area contained five large grocery stores and 21 convenience stores, 4.2

low-quality retailers for each high-quality. Using these study results we find 23 higher quality retailers (Grocery, Independent, and Ethnic food stores) and 28 low-quality retailers, 1.2 low-quality retailers for each of higher quality. These indicate the possibility of a much higher overall quality of the nutrition retail environment in Pomona.

<b>STORE-TYPE</b>	<b>POMONA</b>	<b>SURVEY AREA</b>	<b>% of POMONA</b>
GROCERY	11	5	45.45
CONVENIENCE	19	9	47.36
LIQUOR	18	7	38.88
GAS STATION	36	12	33.33
PHARMACY	9	3	33.33
OTHER	39	26	66.66
TOTAL	132	62	46.96

## **Discussion & Conclusion**

### *Representativeness of Data*

After selection of stores that are likely to serve as retail-food locations (Grocery, Convenience, Large Pharmacy, General/Discount, and Specialty stores), a total of 132 stores were identified, 92 of which fell within the area of interest (69.69%). Not counting stores that had closed and survey refusals by management, 62 surveys were completed. This means that approximately 47% of all potential food stores in Pomona were surveyed. Presented in Table 11 is a comparison of stores surveyed to those in greater Pomona. The total number of retail food outlets of interest surveyed represent nearly 50% of greater Pomona supporting the conclusion that food access analysis was generally representative of the food offerings to residents within the city. The representation of subcategories of stores are also presented in Table 10, between one-third (gas stations and pharmacies) and two-thirds (other) stores from each category was

surveyed for this study. These findings are consistent with the abundance of convenience stores and many fewer numbers of grocery stores reported for minority and lower SES communities elsewhere.

### *Variability within Categories*

Among the stores surveyed were nine general stores and seven ethnic stores. Defining these as non-grocery stores (as they would be using the USDA definition), may underrepresent the nutrition quality of the environment. Our findings suggest that there is considerable variability in quality, price, access, and availability between convenience stores and traditional grocery stores and aligns with previous research that finds high ethnic-minority areas are served by networks of smaller stores. Use of NEMS survey to better define the food environment will provide a more accurate reflection of resources. The current study adapted the NEMS and the two measures with the most challenges for interrater reliability were price and access. An identified challenge was finding two same-type/size items for price comparison (such as two cans of the same type of fruit but one with and one without added sugar). At smaller stores it was common to have a variety of canned foods, but no suitable comparison-pair for pricing information. Access measures included signage for WIC and SNAP certification, in the future, if no signs are present, asking staff may provide more accurate information.

Interesting to note, presented in table 5, 30 of the originally identified 91 stores were not surveyed (32.9%) because 17 locations (18.6%) were permanently closed, no longer a business of interest, or we were not able to locate (one location was seemingly still in business but closed on two separate visit attempts for surveys), 13 locations (14.2%) refused to participate.

STORE-TYPE BY TYPE* (N)	CLOSED N (%)	REFUSED N (%)
GROCERY (5)	0 (0)	0 (0)
CONVENIENCE (8)	0 (0)	0 (0)
INDEPENDENT (18)	4 (4.3)	3 (3.2)
PHARMACY (3)	0 (0)	0 (0)
CHAIN/GENERAL (11)	1 (1.0)	1 (1.0)
ETHNIC (14)	6 (6.5)	1 (1.0)
GAS/CONVENIENCE (7)	2 (2.1)	0 (0)
GAS (8)	2 (2.1)	2 (2.1)
LIQUOR (13)	2 (2.1)	6 (6.5)
ALL STORE TYPES (91)	17 (18.6)	13 (14.2)

The highest refusal rate was among liquor stores, six stores (6.5%), and some feedback provided included not participating in research, not feeling they are selling food, and being uncomfortable with the quality of food being provided at their location.

While not a formal part of the study, some store owners offered feedback about the challenges of selling fresh food including customer preference for unhealthy, high fat, sugar and salt foods, inability to recover cost for unsold perishable fresh fruits and vegetables, and licensing restrictions surrounding the sale of packaged ready-to-eat (RTE) foods such as sandwiches.

Future research would benefit from collection of data surrounding the perceptions of both the consumer and the provider in these retail locations. Comparison of perceptions along with information about food regulations could provide insight into a mechanism behind the quality, or lack thereof, in some retail establishments.

## Limitations and Future Directions

Results from this study indicate that having detailed information about the accessibility, quality, availability, and price for food retail locations does indicate more categories of stores than previously accepted. A significant limitation was low interrater reliability for newly developed measures. For future studies more development and testing for measures of access, price, and a measure for processed versus whole foods is indicated. Additionally, if able, researchers may benefit from reaching out directly to store owners, managers, or the local business association before beginning surveys. Although overall acceptance of the survey within stores was good, providing advanced notice and gaining permission may make the process easier at the store-level.

**TABLE 13**

**SUMMARY OF NEMS SCORES BY STORE TYPE (ALL CONVENIENCE-TYPE CONSIDERED TOGETHER)**

CATEGORY		ACCESS	AVAILABILITY	PRICE	QUALITY	OVERALL
GROCERY	MEAN	5.80	68.5000	5.00	12.60	91.9000
	N	5	5	5	5	5
	STD. DEVIATION	1.095	4.30116	3.536	7.765	10.21274
	GROUPED MEDIAN	5.80	67.5000	6.00	15.00	93.5000
	MINIMUM	5	64.50	0	0	75.50
	MAXIMUM	7	75.50	9	20	102.50
CONVENIENCE (ALL-TYPE)	MEAN	5.54	21.3036	1.39	1.36	29.5893
	N	28	28	28	28	28
	STD. DEVIATION	1.347	8.57385	1.315	2.248	10.28781
	GROUPED MEDIAN	5.56	21.3750	1.17	.61	30.1250
	MINIMUM	2	8.00	-1	0	13.00
	MAXIMUM	8	37.50	4	10	48.50
INDEPENDENT	MEAN	6.18	45.9091	4.36	10.18	66.6364
	N	11	11	11	11	11
	STD. DEVIATION	.603	18.72073	3.264	8.681	28.63616
	GROUPED MEDIAN	6.20	45.5000	3.00	9.00	67.5000
	MINIMUM	5	19.00	1	0	25.00
	MAXIMUM	7	78.25	10	21	108.25
PHARMACY	MEAN	4.33	33.6667	4.33	.00	42.3333
	N	3	3	3	3	3
	STD. DEVIATION	2.517	10.61053	1.155	.000	12.00347
	GROUPED MEDIAN	4.00	30.5000	4.33	.00	39.5000
	MINIMUM	2	25.00	3	0	32.00
	MAXIMUM	7	45.50	5	0	55.50
CHAIN/GENERAL	MEAN	5.50	34.0313	3.00	1.75	44.2813
	N	8	8	8	8	8
	STD. DEVIATION	.535	8.42237	2.828	3.412	13.85862
	GROUPED MEDIAN	5.50	32.3333	2.50	.67	39.3333
	MINIMUM	5	26.00	0	0	33.00
	MAXIMUM	6	50.25	9	10	75.25
ETHNIC	MEAN	5.29	41.7143	2.43	10.00	59.4286
	N	7	7	7	7	7
	STD. DEVIATION	1.113	20.52155	2.149	7.280	28.82299
	GROUPED MEDIAN	5.25	40.2500	2.33	11.00	61.2500
	MINIMUM	4	13.00	0	0	20.00
	MAXIMUM	7	69.25	6	18	99.25
TOTAL	MEAN	5.58	34.0202	2.68	4.79	47.0685
	N	62	62	62	62	62
	STD. DEVIATION	1.209	18.66609	2.572	6.797	26.27316
	GROUPED MEDIAN	5.63	29.6667	1.93	1.10	37.3333
	MINIMUM	2	8.00	-1	0	13.00
	MAXIMUM	8	78.25	10	21	108.25



## CHAPTER V:

### Developmental Study 3

#### **Development of a Methodology for accurately assessing the Retail Food Environment of a Predominately Hispanic, Low-SES Community**

This developmental study established a method for visual environmental assessment that, when compared to database analysis, was significantly more accurate (88%). When comparing stores of high- and low-quality, findings supported previous indications that people shopping in the geographic areas studied were at elevated risk relative to the nutrition environment. We conclude that systematic visual scan is likely to yield the most accurate depiction of food quality in the retail food environment. A hotspot analysis of dietary behavior relating health outcomes to NEMS scores (food quality in nearby food stores) did not produce reliable outcomes. It could be that a larger sample of individuals and/or stores might yield more interpretable results. More likely, geospatial hotspot analysis might not be sufficiently sensitive to the complex social mechanisms that influence food purchases. Assumptions in hotspot analysis about the spatial proximity of individuals as a behavioral determinant may not be valid in the current milieu where contact with neighbors is often limited. Direct associations between store proximity scores and dietary behavior and its disease-risk sequelae might be a more sensitive approach; one that might be further enhanced by assessment of individual social interactions (e.g., networks) as mediating or moderating mechanisms.

## Introduction

For three decades, GIS technology has been used to analyze and compare food environments to health statistics (Caspi, Sorensen, Subramanian, & Kawachi, 2012b). Dietary intake is recognized as a complex behavior of multi-factorial origin, whereby individual and environmental factors interact to influence what people eat (Black et al., 2014; Foresight, 2007, Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008). Areas with little or no provision of healthy foods are believed to contribute to disparities in diet-related conditions such as obesity and diabetes, particularly in the United States (US) (Larson, Story, & Nelson, 2009; Walker, Keane, & Burke, 2010). It has been established that relationships found using database queries are only as good as the data being accessed. In assessing the nutrition-related environment of Pomona, verifying database accuracy, in addition to comparing food-retailer types, densities, and proximity to neighborhoods is essential. Consumer nutrition environment within stores, particularly regarding availability, quality, and price, also reveal disparities and associates with dietary intake (Horowitz, Colson, Hebert, & Lancaster, 2004). Further research found significantly lower availability of five foods recommended for people with diabetes in less-affluent and ethnic minority neighborhoods, and findings of lower availability of healthful foods in low-income and high-minority neighborhoods were replicated (Glanz, Sallis, Salens, & Frank, 2007).

The purposes of this study are 1) to develop a methodology for accurately assessing retail food resources in a defined geographic area and 2) determining whether visual assessments of food outlets using the food quality measure better predicts indicators of dietary health risk than a GIS-dependent database analysis of food resources. Exploratory geospatial analysis of nutrition measures to dietary quality and cardiovascular risk indicators was also performed.

**Methods** (methods only related to this study are presented here)

### GIS Data collection

#### *Preparation for Assessment Route Selection*

ESRI ArcGIS desktop and webAppBuilder, maps were created for aggregation of environmental data. Initial maps included layers for ReferenceUSA (2019) database information for business codes identified using the North American Industrial Classification System (NAICS) numbers. To quantify community places of interest, layers were added to the map which included the city boundary, current locations for community screenings, items of interest as identified through the Life Space Analysis (LSA) of screening participants, food banks, churches, parks, and other identified points of interest.

#### *Life Space Analysis*

The final question of the screening survey is “Do you live, work, go to school, go to church, shop, or frequently do other things in Pomona? If “yes” they are directed to the next section. Using ArcGIS map collector or a paper map, participants are asked to look at a map of Pomona and make or mark with a happy face, a positive place in the community (Figure 8) they are also asked to describe what the place is (e.g. a laundromat, a park, a library, etc.). The same procedure is followed for a negative place, to indicate grocery and household shopping, restaurants frequented, and other places of interests within the city. Additional information collected during screening includes home address. all participant data remained anonymous.

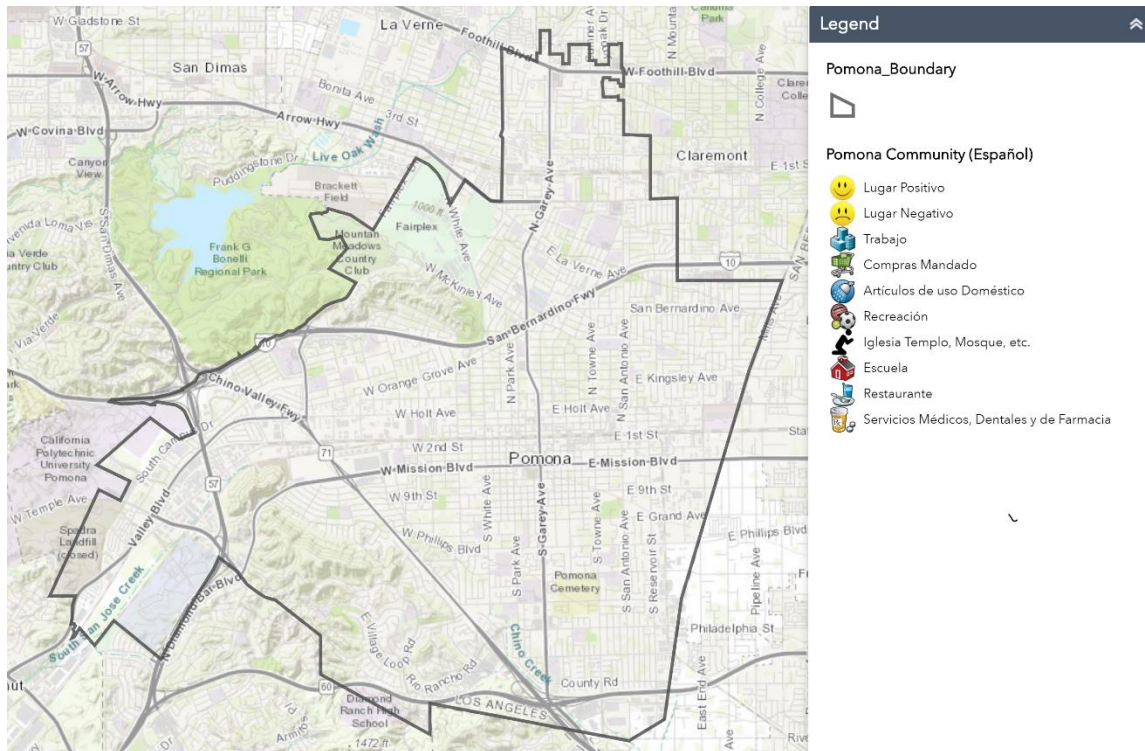


Figure 10: Life-Space Map Collector in Spanish

To develop a strategy for selecting retail food outlets, we reviewed the rich body of data on both personal and ecological factors collected during diabetes screening events, as well as the city’s GIS depiction of zoning districts and the general city development plan. Through careful review of existing data (both participant and city), we selected specific corridors containing the highest concentrations of resident-proximal retail outlets for visual assessment. As we shall see, the selection process yielded almost half of the city’s food outlet resources which we then proceeded to assess for food quality. These retail corridors selected are described below.

In researching the city of Pomona we reviewed the General Plan in which the corridors of Garey Avenue, Holt Avenue, and Mission Boulevard are described as commercial in addition to serving as the main street configuration with retail, commercial, and residential parcels (City of Pomona 2014 General Plan Update).

The decided upon approach for Pomona took into consideration the wealth of data that had already been collected from community members, input from research staff with detailed knowledge of city structure and planning, and database information. Drive-time areas were created using the Analysis>Use Proximity>Create Drive-Time Areas, features of ArcGIS (ESRI, 2017). The resultant maps included large areas that were outside of Pomona were commercial-use (Pomona Fairplex) or had minimal identified points-of-interest. The additional analysis included "Find Point Clusters," Analysis>Analyze Patterns>Find Point Clusters (ESRI, n.d.). These clusters included points-of-interest as identified by screening participants using the LSA map during screening. In comparing the generated clusters with database density of businesses of interest and excluding clusters of non-food points of interest (churches, schools), a more obvious route appeared.

After layering the points of interest collected by research participants and comparing those with businesses of interest, and considering the main corridor of the city of Pomona, four major streets which includes two West-East and two North-South significant transportation routes, and spans the entire width of Pomona in two location and near the entire length of the city, were chosen. The initial pilot scans were to take place in the main corridor of Pomona, at the intersections of Garey Avenue, Holt Avenue, and Mission Boulevard.

#### *Visual Assessment Route*

An exploratory implementation of windshield survey methodology used previously in Jurupa Valley (Chapter III) proved inadequate for the expanded purposes of this study. Results indicated that neither images nor location detail for GIS markers was of the quality or accuracy

needed for the project. This corridor was reexamined in a second pilot session, and timing and accuracy were noted. Considering time and staffing constraints as well as the areas identified in mapping, the final defined area included 1400 N. Garey Avenue to 2300 S. Garey Avenue (3 miles), 2000 W. Holt Avenue to 1600 E. Holt Avenue (4 miles), 1600 W. Mission Boulevard to 1799 E. Mission Boulevard (3.4 miles), and 500 Indian Hill Boulevard to 1851 Indian Hill Boulevard (1.05 miles). For a total of 11.45 linear miles of the main corridor of central Pomona, surrounding City Hall, and spanning the city in all directions N, S, E, and W.

#### *Visual Assessment Completion*

Food-related environmental scans of this main corridor of Pomona were completed over the weeks of July, August, and September 2019. Teams of two or more researchers scanned agreed-upon stretches of the identified scan area, always on a schedule, and with knowledge of the research staff, improving the safety of staff. Initial scans were completed by individuals, and in some areas of interest, it was decided that teams would improve the safety of the research staff. Additional precautions included scanning early in the morning before the streets were busy with community members, and, as needed, staff would approach store staff to explain the study and its purpose. Using our research version of Survey123 each research volunteer would log location of points of interest, specifically stores including grocery stores of any size, corner stores, convenience stores, gas stations with food stores, discount or general stores, specialty stores such as Carniceria or meat markets, as well as all types of restaurants, fast food, sit-down, and fast-casual. In addition to adding the location and name to the application map, the surveyor would add photos, including signage, advertisements, and store locations to either side of the

retail establishment of interest. At the end of each survey period, research staff would review data for completeness of entry and send the data through the system. From this data, map layers of points of interest were created, which could be compared to the database identified points of interest.

Several classes of data are reported in this study. These include data collected from individual screening participants as well as environmental data and data on the interaction of individuals with the environment, i.e., ecological data.

#### Screening participant selection

Individual data from screening participants used in this study include only respondents who completed the full survey and Life-Space Analysis (LSA) mapping activity. As of October 18, 2019, 146 persons ages 18 and above were screened for in community settings for diabetes risks in the community and had complete data. Survey questions included items assessing health beliefs, intake of specific foods, physical activity, neighborhood safety, anxiety, depression, stress, and demographic data. Screenings occurred at multiple sites in the city of Pomona, California: Pomona Farmers Market, N=47; Pomona Valley Hospital Medical Center Community Events, N=17; Pomona High School, N=12; Jesus Es La Roca, N=21; Lion's Club School of Extended Educational Options, N=11; Lion's Club Event at Fremont Elementary, N=12; Veteran's Expo event at Pomona Fairplex, N=16; Beta Food Pantry, N=1; and Urban Mission, N=9. Among these participants, 68 (46.6%) were Pomona residents, the next highest portion was from neighboring city, Ontario, with 13 (8.9%), followed by another neighboring city, Claremont with

five (3.4%), while 38 other cities residents were represented in numbers fewer than five (.7-2.7%).

In addition to demographic information, four questions from the 37-question survey were used in this study (Appendix 1). Each question attempted to identify an aspect of nutrition choice behavior that indicates research-supported diet quality and predicts health outcomes. Participants' home location was identified from the dashboard at the screenings. De-identified data were used for all analyses and results interpretation.

#### Participant Survey Procedures

*(Only procedures inclusive to this sub-study are included)*

Data were collected using the screening questionnaire developed for and implemented during screening events for *Stopping Diabetes in Its Tracks* (SDIT). Multiple SDIT screenings were held each month, at selected sites in the Pomona community, the population surveyed are Pomona community members in that they were utilizing Pomona resources, but may not be Pomona residents; approximately 80% of the participants resided within the boundaries of Pomona and the rest came from adjacent to or nearby municipalities. Screening sites included but were not limited to, local schools, the Farmer's Market, community centers, and the Pomona Fairplex, alongside other health-related events. The SDIT is a collaboration of an integrated set of community, clinic, and hospital interventions to prevent and control T2DM in the Pomona Community (PHFE, 2017). Unique to these health screenings, during which Point-of-Care (POC) blood assays were used to determine non-fasting blood glucose, hemoglobin A1C, and lipids, as well as anthropometric data, was the gathering of data using maps. De-identified data were used



for all analyses and results interpretation. Exact addresses were not used, while the nearest cross-street served as a proxy for 'home' address, instead.

## Participant Measures

### *Dietary Behaviors*

Four items on food consumption were based on overall diet quality measures presented earlier in this proposal. Questions were adapted from the California Health Interview Survey 2016, Adult Questionnaire Version 2.8. They were edited to provide ranges for selection rather than free-response, and some questions were compiled to stay within a short total screening time limitation. Questions asked include (1) how often do you eat fresh or canned fruits or vegetables? (do not include fruit juice, bionicos, white potatoes, or elote) (1 = less than 1/week, 2 = once a week, 3 = 2-3 times a week, 4 = 4-6 times a week, 5 = once a day, 6 = 2 or more per day), (2) How much juice or sugar-sweetened beverages do you drink on most days such as tea, soda, etc? (including juice-drinks and agua fresca) (1 = I don't drink juice or sodas (Including juice-drinks) or sugar-sweetened soda, tea, or other beverages, 2 = 1-2 cups, cans, or small bottles or drink boxes per day 3 = 3 or more cups cans, small bottles or drinks per day) (3) Now think about the past week. In the past 7 days, how many times did you eat fast food such as McDonald's, KFC, Panda Express, or Taco Bell? (including from street vendors, carts, or concessions as well as drive-through) (1 = 0, 2 = 1, 3 = 2-3, 4 = 4-6, 5 = once each day, 6 = more than once each day) (4) How often do you eat meals that are cooked at home? (including meals prepared at home and taken to work, school, or eaten outside of the home) (1 = less than 1 each

week, 2 = once a week, 3 = 2-3 times a week, 4 = 4-6 times a week, 5 = once a day, 6 = 2 or more times per day (Appendix 5).

### *Anthropometric Data*

Adopting protocols developed from the National Health and Nutrition Examination Survey (NHANES, 2017) and modified for the China Seven Cities Study (Johnson et al., 2006) and Diabetes Free Riverside (Projects: Diabetes Free Riverside, n.d.) measures of height and weight were collected using a portable electronic scale and stadiometer, with subjects wearing light clothes and thin socks or barefoot. Body weight was measured in kilograms. Height was recorded to the nearest 0.1 centimeters. Body mass index (BMI), weight in kilograms divided by height in meters squared) was used to quantify overweight and obesity status, waist circumference, measured twice to the nearest centimeter, midway between the rib cage and the superior border of the iliac crest using a flexible tape with the participant in a standing position at the end of gentle expiration ( Felicitas et al., 2015).

### *Blood Assays*

After obtaining consent for screening, a small sample of blood was collected from a finger-stick by a trained staff member for point-of-care analysis (cite). Biological data collected included total cholesterol mg/dL, HDL cholesterol mg/dL, Triglycerides mg/dL, LDL mg/dL mg/dL, non-HDL, TC/HDL ratio, and HbA1C percentage. Data were exported into IBM SPSS Software Version 25 for the analysis.

## Data Analysis

Descriptive statistics (mean, standard deviation, and percentage) were calculated using SPSS 25 (IBM corp., 2017), to reflect the background characteristics of the sample. Using ArcGIS Desktop 10.6 and ArcGIS Pro 2.4 (ESRI, 2017; ESRI, 2019), maps were created using the data collected via environmental scan, database analysis, and community screening of participants. Within ArcGIS software, weighted features were analyzed using the Getis-Ord  $G_i^*$  statistic to identify hot and cold spots.

## **Results**

### *Database and Environmental Scan Accuracy*

Analysis of GIS database records indicated 75 stores of interest, while environmental scans revealed only 72 stores of interest within the target area. After reconciling duplicate listings, both sources together revealed 91 retail food stores of interest. Upon verifying database findings with environmental assessment findings, only 62.5% of all locations were correctly identified through both database and visual assessment; database revealed only 2 (2.1%) stores not identified through visual assessment, and the environmental assessment added an additional 16 (17.5%) locations; 17 (18.6%) stores identified through the database were either found to have a new name, different current business type, or were permanently closed for business; one location had been demolished (Table 14). The most significant discrepancies were found in independent and ethnic/specialty store categories. Compared to stores identified by the database alone, the environmental scan provided 88% more and accurate stores for assessment. Our findings confirm that, even without including fast food locations, there was an increased risk

of obesity and diabetes in our target area (Table 15). Previous research in California found a 20% difference in obesity prevalence and 23% diabetes prevalence among individuals from RFEI 5.0 versus 3.0; our target area RFEI is at least 5.0. Regardless of data source, this corridor of Pomona was also at risk, related to the environment, for chronic illness. Important to note had only verified database locations been used, a risk value of 5.0 would be calculated for RFEI, rather than the more accurate >6.0 found after environmental scan. Figure 9 shows the NEMS overall scores plotted by address. This image reflects the lack of access to high-scoring stores in areas of Pomona as well as the variation of scores outside of non-traditional grocery stores.

**TABLE 14: STORES BY CATEGORY AND SOURCE**

STORE-TYPE (N)	DATABASE	ENVI. SCAN	BOTH	ERROR*
GROCERY (5)	-	-	5	
INDEPENDENT (18)	-	3	11	4
PHARMACY (3)	-	-	3	
CHAIN/GENERAL (11)	1	3	6	1
ETHNIC (14)	-	3	5	6
CONVENIENCE (8)	-	2	6	
GAS/CONVENIENCE (7)	1	1	2	2
GAS (8)	-	2	7	2
LIQUOR (13)	-	1	10	2
<b>ALL STORE TYPES (91)</b>	<b>2</b>	<b>16</b>	<b>56</b>	<b>17</b>
*FOUND UNDER WRONG NAME OR BUSINESS-TYPE IN THE DATABASE OR PERMANENTLY CLOSED				

**TABLE 15: RFEI CALCULATION BY SOURCE, ALONG ENVIRONMENTAL SCAN ROUTE**

STORE-TYPE (N)	DATABASE	ENVIRONMENTAL SCAN	DATABASE BEFORE VERIFICATION
ALL-TYPE CONVENIENCE*	26	31	32
GROCERY	5	5	5
RFEI (STORE ONLY) **	>5.0	>6.0	>6.0

\*CONVENIENCE STORES: STAND-ALONE, GAS STATION, LIQUOR

\*\*RFEI TYPICALLY INCLUDES BOTH CONVENIENCE STORES AND FAST-FOOD RESTAURANTS

### *Hot Spot Analysis*

Hot Spot analysis revealed largely non-statistically significant hot or cold spots for the stores surveyed. Some exceptions are as follows: For overall scores and Quality, one hot spot for 90% and one for 95% confidence was found for each, on Mission Boulevard, West of Garey Avenue (Figure 11) for access scores, hot spots for the 90% confidence are found on Indian Hill Boulevard, approaching the Claremont border, and West of Garey Avenue, on Holt Boulevard (Figure 12); a cold spot for Total Price was found on Garey Avenue, South of Mission (Figure 11).

A series of hot spots using participant survey results provided interesting clusters of intake data; for frequency of eating meals at home analysis revealed several 95% confidence hot spots near the corridor of interest, close to Mission Boulevard and Holt Avenue, but hot spots at 95% confidence along Alvarado street and another North of West Orange Grove Avenue in Northwest Pomona (Figure 13). A similar pattern was seen for the frequency of consumption of fruits and vegetables (Figure 14), with more hot spots near Mission Boulevard, Holt Avenue, and north of West Orange Grove Avenue. A final interesting result among participants was a cluster of cold spots (relatively low) BMI results in the neighborhood on Pomona nearing the Claremont Border to the north (Figure 15).

### *Participant Characteristics*

A description of available general characteristics is summarized in Table 16. Survey participants reflected the makeup of Pomona in that they predominately identified themselves as Hispanic/Latino (70.5%), additionally, more than 50% have an annual household income of less than \$50,000, more than 60% of screened participants were 50 years of age or older, and

more than 60% were female. Results for select dietary quality indicators found median score for fruit and vegetable consumption was 4.00 (4 = 4-6 (fruits/vegetables per week), median sugar-sweetened beverage intake 2.0 (2 = 1-2 SSBs per day), median fast food consumption over last seven days 2.00(2 = 1 time), and median home-cooked meals frequency = 5 (5 = one meal per day) (Table 17). Cardiometabolic indicators (Table 18) reveal more than 70% of surveyed participants were overweight or obese, 50% had borderline or high triglycerides, and cholesterol, nearly 40% are at high risk using American Diabetes Association risk scoring, and 43% had HgbA1c levels that indicated pre-diabetes or diabetes. 1 time), and median home-cooked meals frequency = 5 (5 = one meal per day) (Table 17).

**TABLE 16: POPULATION STATISTICS FOR SURVEY PARTICIPANTS**

VARIABLE	N (%)
	146 (100)
<b>AGE GROUP</b>	
18-29	11 (7.7)
30-39	23 (15.7)
40-49	25 (17.1)
50-59	46 (31.5)
60-69	28 (19.1)
>69	13 (8.9)
<b>GENDER</b>	
MALE (1)	51 (34.9)
FEMALE (2)	94 (64.4)
TRANSGENDER (3)	1 (.7)
<b>RACE/ETHNICITY</b>	
AMERICAN INDIAN/NATIVE ALASKAN	1 (.7)
ASIAN, PACIFIC ISLANDER, NON-HISPANIC	7 (4.7)
BLACK, NON-HISPANIC	3 (2)
HISPANIC	103 (70.5)
MULTI-RACIAL	7 (4.7)
WHITE, NON-HISPANIC	23 (15.7)
<b>INCOME</b>	
<\$25,000 (1)	42 (28.8)
\$25,000-<\$50,000 (2)	42 (28.8)
\$50,001-<\$75,000 (3)	14 (9.6)
\$75,001-<\$100,000 (4)	11 (7.5)
\$100,001-<\$150,000 (5)	6 (6.8)
MORE THAN \$150,000 (6)	10 (6.8)
DON'T KNOW/NOT SURE (7)	17 (11.6)
DECLINE TO ANSWER (8)	4 (2.7)
<b>MARITAL STATUS</b>	
MARRIED	71 (48.6)
LIVING WITH A PARTNER	9 (6.2)
WIDOWED	5 (3.4)
DIVORCED	16 (11)
SEPARATED	6 (4.1)
NEVER MARRIED	39 (26.7)
<b>EDUCATION</b>	
UP TO HIGH SCHOOL GRADUATE	82 (56.3)
1-4 YEARS OF COLLEGE	50 (34.2)
1-4 YEARS OF GRADUATE SCHOOL	12 (8.2)

VARIABLE	N (%)	MEDIAN	SD
<b>FRUIT/VEGETABLE CONSUMPTION FREQUENCY</b>		4.00	1.321
<1 PER WEEK (1)	7 (4.8)		
ONCE PER WEEK (2)	7 (4.8)		
2-3 TIMES PER WEEK (3)	41 (28.1)		
4-6 TIMES PER WEEK (4)	36 (24.7)		
ONCE PER DAY (5)	33 (22.6)		
2 OR MORE PER DAY (6)	22 (15.1)		
<b>SUGAR SWEETENED BEVERAGE FREQUENCY</b>		2.00	.629
NONE (1)	71 (48.6)		
1-2 PER DAY (2)	64 (43.8)		
3 OR MORE PER DAY (3)	11 (7.5)		
<b>FAST FOOD CONSUMPTION FREQUENCY IN LAST 7 DAYS</b>		2.00	1
0 (1)	49 (33.6)		
1 (2)	44 (30.1)		
2-3 (3)	43 (29.5)		
4-6 (4)	7 (4.8)		
ONCE PER DAY (5)	3 (2.1)		
MORE THAN ONCE EACH DAY (6)	0 (0)		
<b>HOME-COOKED MEALS FREQUENCY PER WEEK</b>		5.00	1.277
LESS THAN 1 PER WEEK (1)	2 (1.4)		
ONCE PER WEEK (2)	6 (4.1)		
2-3 PER WEEK (3)	19 (13)		
4-6 PER WEEK (4)	38 (26)		
ONCE PER DAY (5)	28 (19.2)		
2 OR MORE PER DAY (6)	53 (36.3)		



TABLE 18: CARDIOMETABOLIC INDICATORS						
	Frequency	Percent	Minimum	Maximum	Median	SD
<b>HGBA1C LEVEL</b>			4.3	13.5	5.6	1.77
NORMAL	81	55.5				
PRE-DIABETES	39	26.7				
DIABETES	24	16.4				
<b>ADA RISK SCORE</b>			0	8	4.0	1.6
LOW	84	57.5				
HIGH	58	39.7				
<b>TOTAL CHOLESTEROL</b>			100	570	203.5	54.12
DESIRABLE	59	40.4				
BORDERLINE	45	30.8				
HIGH	28	19.2				
<b>TRIGLYCERIDES</b>			45	650	175	110.38
DESIRABLE	57	39.0				
BORDERLINE	25	17.1				
HIGH	48	32.9				
VERY HIGH	2	1.4				
<b>BODY MASS INDEX (BMI)</b>			19.1	55.87	30.16	6.02
LOW	1	.7				
NORMAL	3	20.5				
OVERWEIGHT	45	30.8				
OBESE	67	45.9				
<b>WAIST CIRCUMFERENCE</b>			39	161.5	106.84	16.79

### *Participant Dietary Quality Indicators*

Dietary purchase and intake behaviors and how those interact with the environment are complex. Using GIS analysis revealed some unusual characteristics of SDIT screening participants in relation to their environment. Survey participants indicated that the majority consumed more home-cooked meals and less fast food in the prior week, many (48.6%) reported not drinking sugar-sweetened beverages, and greater than 50% of those surveyed ate fruits or vegetables at least four times per week, which indicated they may be better than statewide numbers reported by the CDC in 2017; which found that, of surveyed California residents, between 19.9-46% of adults consumed less than one vegetable per day and 29.7-33% of adults consumed less than one fruit per day ( CDC, n.d.). As previous research indicated that obesity and diabetes were more prevalent in individuals who consumed SSB's (Chapter II, page 15), Cramer's V was applied to this data after transformation into two dichotomous variables. In a comparison of No SSB's versus any SSB's and normal weight versus overweight or obese, there was a significant small association (Phi: .206,  $p = .044$ ). When the same statistical analysis was applied to SSB's and ADA risk score (below five=no risk, five or higher= yes risk) and separately to HgbA1c (5.6 or lower = no DM, 5.7 or higher= Yes DM), there was no significant correlation to SSB intake and DM risk in this population.

	Value	Approximate Significance
<b>Cramer's V</b>	.206	.044

## Discussion & Conclusion

### *Database Analysis*

In Pomona, as in Jurupa, database analysis one cannot accurately represented the current retail nutrition environment. Our findings support previous indications that our target area was at risk related to the nutrition environment, although the RFEI score was higher after a more thorough assessment. Visual scans of areas of interest are likely to yield the most accurate depiction of the retail food environment. Findings suggest that in areas where a visual scan is possible, that database analysis may not be necessary and may hinder progress by providing business information that is inaccurate. By using GIS-enabled mobile applications, collecting targeted, precise, and customizable business information, in the field and in real-time, will enhance the precision of environmental research.

### *Spatial Dietary Indicators*

Study participants appeared to have relatively better eating habits than expected with regard to home-cooked meals and produce intake even in areas of high risk and low supermarket availability. The smaller stores, some of which had moderate to high overall NEMS scores (Figure 9) and were likely to carry fresh items that could be used for home cooking rather than convenience items only. This may have positively impacted dietary behavior.

### *Spatial Health Indicators*

Hot spot analysis of BMI provided an interesting pattern of low BMI in northern Pomona, near the San Dimas border. There are no store-quality data (NEMS scores) for this region that

was not part of the target area for this analysis. A different region to the north, for which we do have NEMS scores shows an abundance of green/large circles indicating numerous locations that carry a variety of healthful and fresh foods. Residents of these two areas (both in northern Pomona, have easy access to the neighboring cities of San Dimas, and Claremont, both of which have fewer socio-economic challenges, reflected in their census data. San Dimas and Claremont respectfully have 94.2% and 92.9% high-school graduate or higher, compared to Pomona at 31.5%, and each has just 8.5% poverty while Pomona reports 20.7% (Table 8), (US Census, 2019b).

### **Limitations and Future Directions**

These findings support the conclusion that the new methodologies developed are of higher quality than their forebears and are clearly superior to classical GIS approaches for assessing ecological considerations relative to dietary risk behavior. As with any cross-sectional study, we cannot establish any causal relationships, and we have to be careful about generalizing to other populations and environmental circumstances. The sample self-selected to participate in diabetes risk screenings no doubt influencing to some extent the results in ways that are unknowable. An additional challenge to interpretation was the small sample of both participants for survey data (146 persons) and the sample of stores assessed which likely did not reflect the full array of food retail resources utilized by participants.

Future studies would benefit from data collection that covered a broader swath of the city and nearby shopping areas and that included data from a more truly random sample of community members.

GIS analysis for health has been used to identify spatial relationships between diseases and environmental factors, but unlike infectious disease, chronic illness is complex and often develops over years of exposure and is influenced by social and environmental factors that themselves are changing over time. In a 2019 publication that reviews geospatial science and point-of-care testing, author Kost makes recommendations for GIS application in public health. This review indicates that the focus of GIS analysis has been on infectious disease and emergency intervention including medical emergencies and natural disasters, not on chronic disease and risk factors (Kost, 2019). Methods for spatial analysis developed for the former may not be appropriate to the latter. The lack of clear and significant findings for health-related to environmental factors using GIS analysis in Chapter V of this research may indicate a process that is not entirely spatial. An assumption of hot spot analysis is that the people found in hot or cold clusters are likely to have the same exposures; this makes the most sense in terms of infectious disease and natural disasters. For chronic illness, the process is not simple contact or proximity but may have a social component that is complicated by technology and a social network outside of the neighborhood. Understanding the social network of community members could provide clarification about the mechanism (or lack of geospatial relationship) in chronic disease development.



Figure 11: Plotted NEMS Overall Scores for target area; larger/green circles indicated highest overall score and best availability, access, price, and quality while small/red circles are lowest overall quality



Figure 12. Hot Spot Analysis for NEMS Quality and Overall scores: Orange spot indicates 90% confidence for a cluster of high scores (hot spot), yellow are not significant

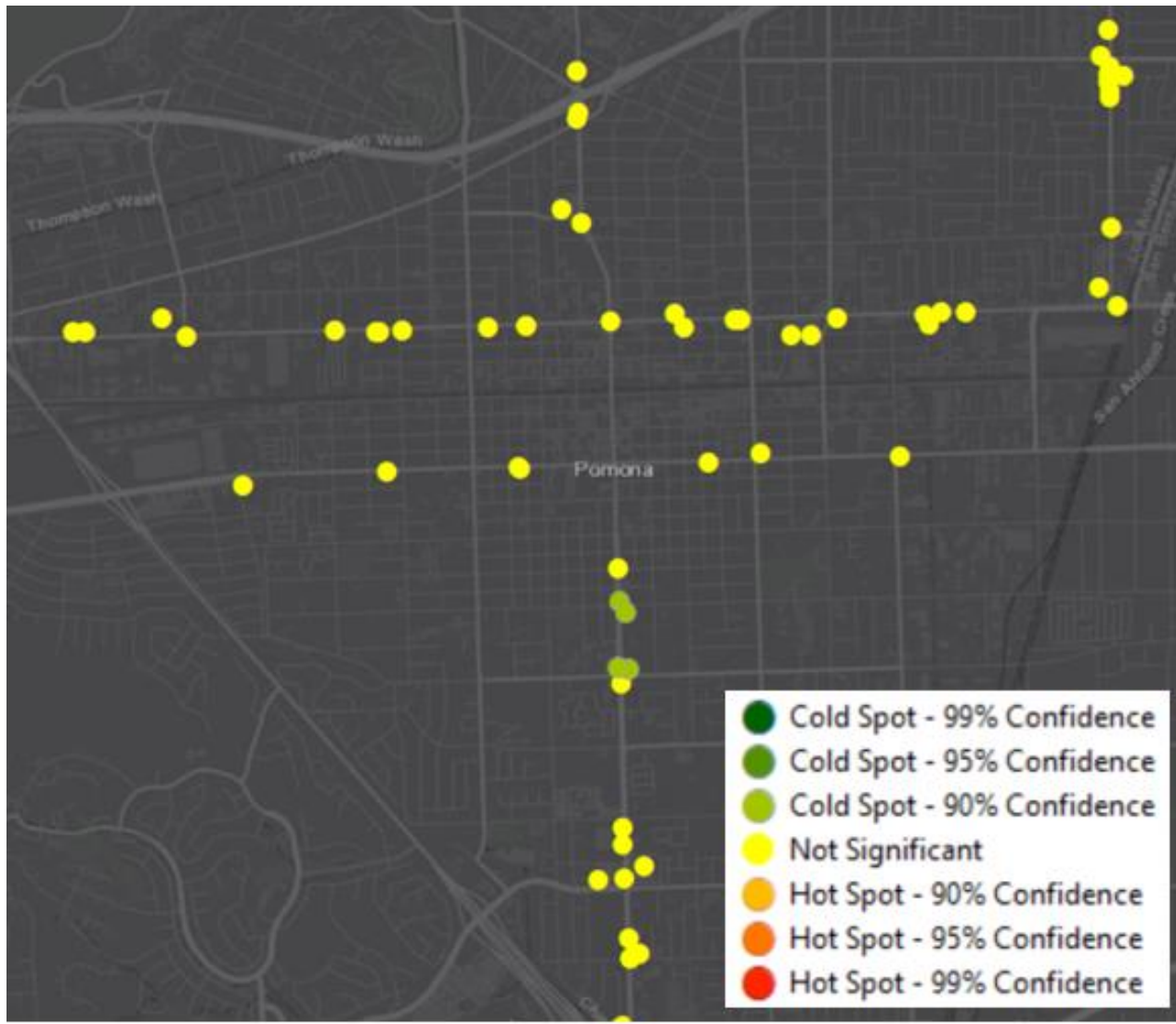


Figure 13. Hot Spot Analysis of Total Price NEMS Scores, light green circles indicate a 90% confidence cold spot (low prices) while yellow indicate not significant.



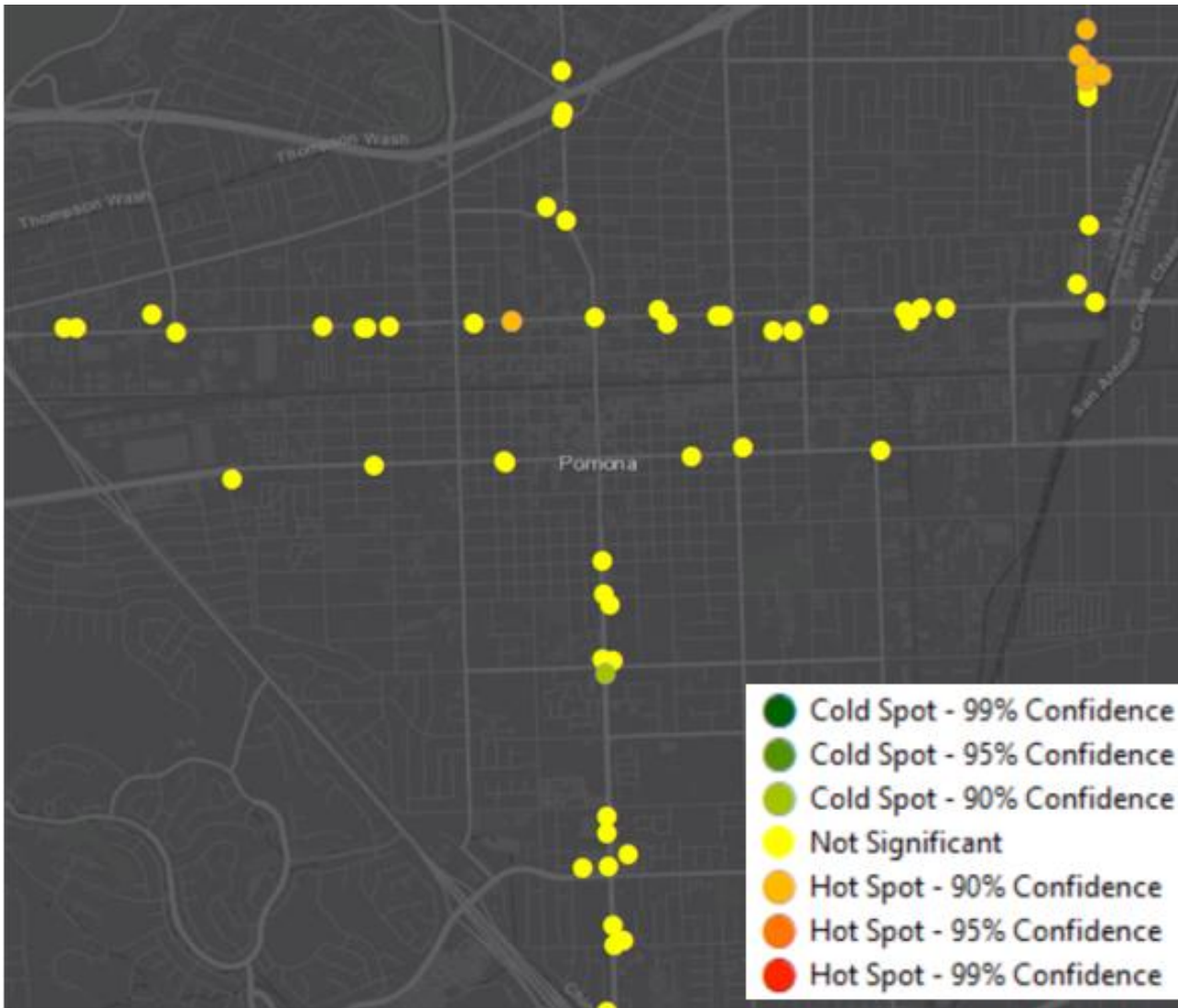


Figure 14. Hot Spot Analysis of Access NEMS Scores, light orange spot indicates 90% of a hot spot (high score) for access, while green spot is a 90% cold spot (low score) for access; yellow are not significant.

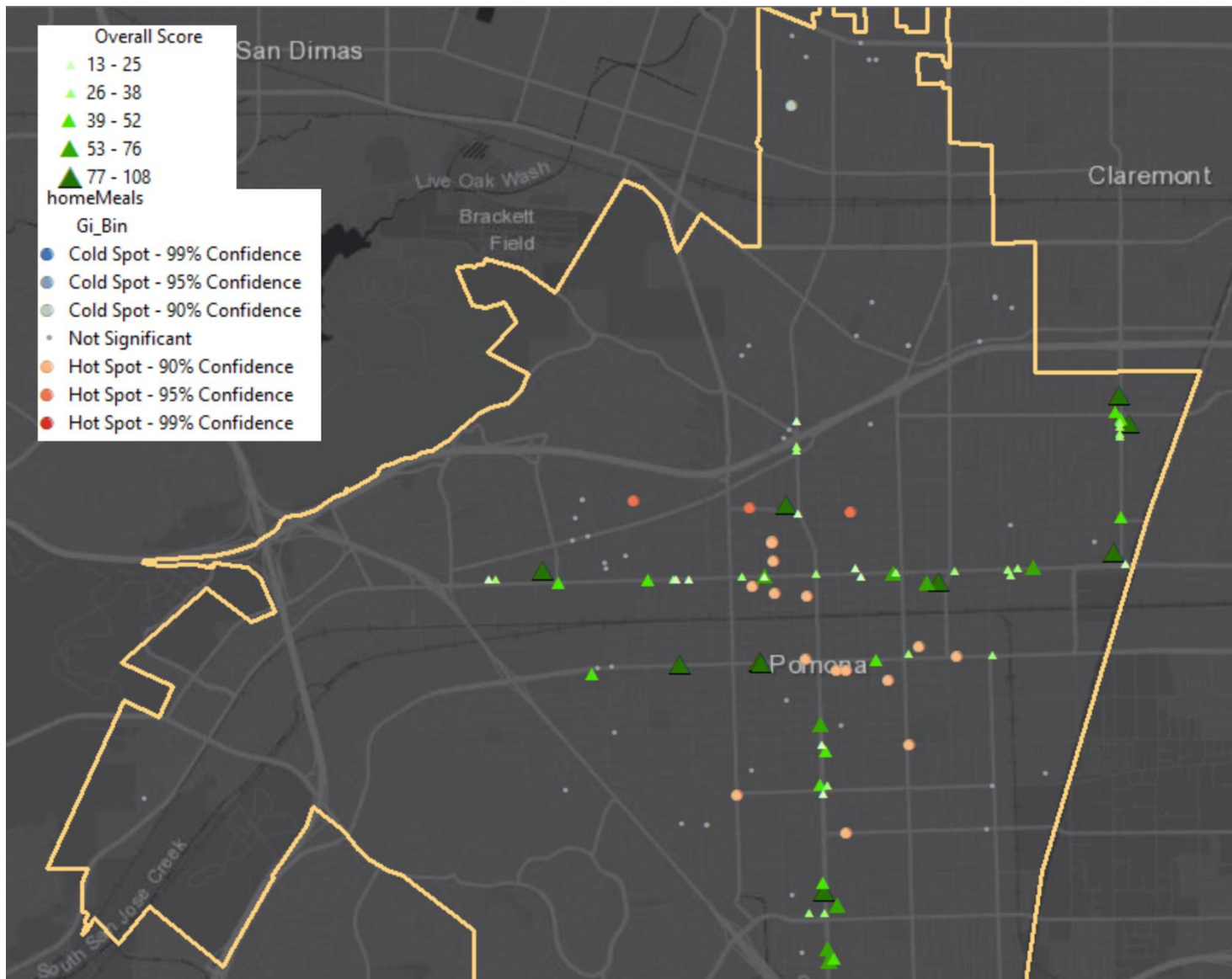


Figure 15: Hot Spots for frequency of home meals consumed per week with NEMS total scores. Dark green triangles are highest scores for overall NEMS (highest quality) and orange/red circles indicate hot spots (high geospatial frequency within the sample and near this location) of meals consumed at home.

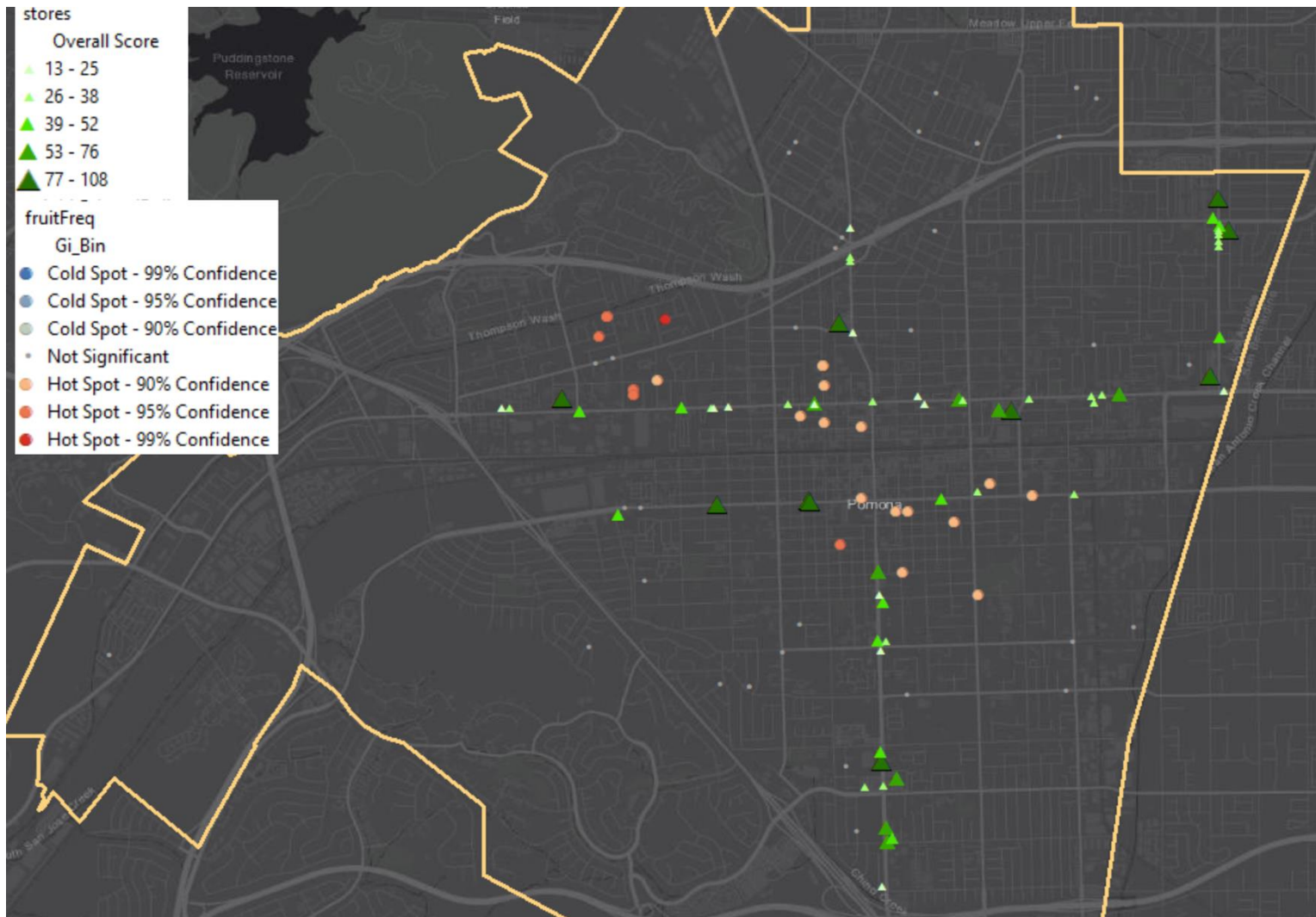


Figure 16: Hot Spot Analysis of Frequency of intake of Fruits and Vegetables with Total NEMS scores. Dark green triangles are highest scores for overall NEMS (highest quality) and orange/red circles indicate hot spots (high geospatial frequency within the sample and near this location) of fruit and vegetable intake.

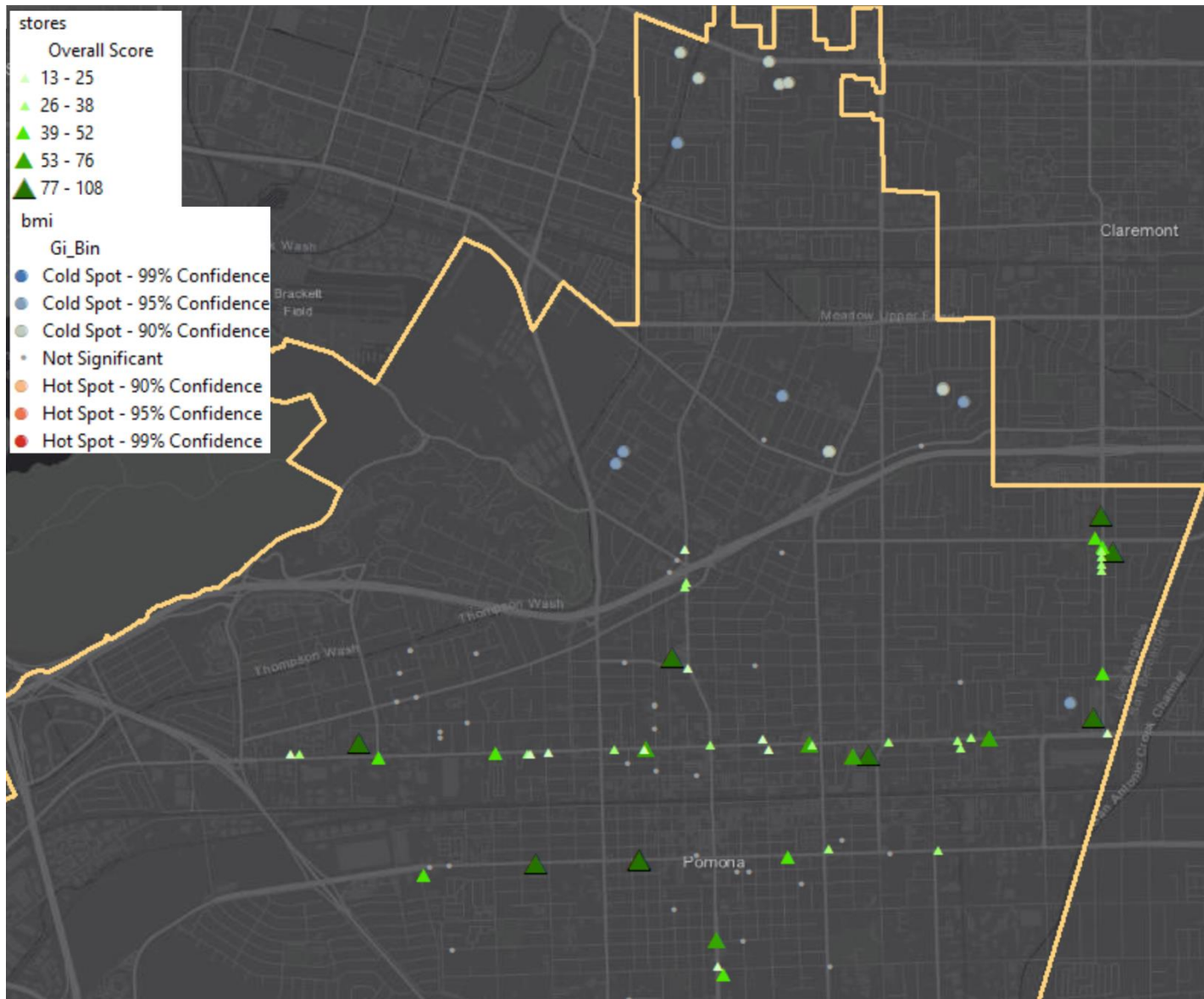


Figure 17: Hot Spot Results for BMI with Total NEMS score. Dark green triangles are highest scores for overall NEMS (highest quality) and blue circles indicate cold spots (high geospatial frequency within the sample and near this location) of lower BMI's within the sample.

## CHAPTER VI:

### DISCUSSION OF THE STUDIES IN AGGREGATE

The three studies in this research examined approaches to and utility of different data collection methods for GIS analysis of food environments (GIS database, windshield survey, walking survey, modified NEMS) as compared to historically accepted methods. Study two customized an existing measure of nutrition environment for use in a predominately Hispanic, low-SES population. To best understand the ecology of food behaviors, there needs to be an accurate understanding of local resources and a detailed knowledge of food availability in terms of fresh, accessible, affordable, culturally appropriate, and high-quality healthful options. The findings of this collection have important implications for understanding the complexities of the food environment and lay the foundation for further investigation of population-level ecological interaction with the food environment.

These findings support earlier research, which concludes that GIS database analysis is limited by the accuracy of the data for the purposes at hand. In study one which employed a windshield survey methodology for GIS data collection, stark differences were found between the accuracy of the database and visual assessments. In addition to the results in Chapter III, database analysis of archival information was markedly inaccurate compared to a direct count of available food local resources using a walking assessment. In Chapter V, two locations were found by GIS only, while 16 additional sites were found by visual assessment; moreover, 17 sites initially identified through database analysis were obsolete for our purposes or permanently closed. If resources permit, a direct count of community points of interest, preferably using a

GIS-enabled application, provides an accurate and more complete report of the retail food environment.

After adapting a nutrition environment measure for this study population, measures of food quality and availability showed high interrater reliability despite edits to the original format. Results for the modified NEMS-SDIT tool were mixed, with poor interrater reliability found for price and access scores. Price and access subcategories had the lowest total possible points possible making even small variations from one reviewer to the next significantly different.

This dissertation challenged currently accepted *definitions of good access*, which included large grocery stores, superstores, and big-box stores, would change if more sensitive measures of the retail food environment were utilized. The study reported in Chapter IV found that large stores were consistently the highest scoring for NEMS-SDIT, but that smaller neighborhood stores, including ethnic specialty and chain general stores, are providing non-traditional and proximal points of access to healthy, affordable, and culturally preferred food options. As well, the results indicate that all convenience-type stores (categorized separately as stand-alone, gas-stations, and liquor stores) are not statistically different in the quality of food offerings and provide, as previously suggested, low-quality foods.

An exploration of cardiometabolic risk factors by hot spot analysis revealed primarily non-significant results. There was a cold spot in BMI found in the northernmost part of Pomona, near the border with San Dimas, an area for which we have no NEMS data. A different region that borders the northern city of Claremont was assessed using NEMS, and further inspection found an abundance of green/large circles for overall NEMS scores (Figure 11), which indicates numerous locations for Pomona residents to purchase a variety of healthful and fresh foods. Of

note in this region and likely in the northern Pomona BMI cold-spot, nearby residents have easy access to the neighboring cities of San Dimas and Claremont, both of these cities have fewer socio-economic challenges which are reflected in their census data.

Additional analysis revealed that this population engaged in certain relatively healthy behaviors regarding produce intake and home-cooked meals, both, individual indicators of overall diet quality (page 17). GIS hot spot analysis for the individuals engaged in these healthy behaviors showed patterns of higher intake near one of the moderate NEMS score locations rather than a traditional supermarket. This seeming paradox could be related to the types of participants being recruited, those more focused on health, and self-selecting for screening. It also supports prior research that minority neighborhoods are often served by smaller, more local food retailers (Zenk et al., 2005; D'Angelo et al., 2011).

Hotspot analysis, while useful for some purposes, may not be sensitive to the social mechanisms by which proximity of one person to another might promote transmission of behavior. Our own preliminary analyses (not reporting here) find very low levels of interaction, Communication, and participation in neighborhood activities. This trend in American communities has been widely observed (Putman, 2001). Consequently, contagion of risk behavior may operate in channels other than neighborhood proximity. In future research, we will consider other analytic approaches relative to food outlet proximity, social network channels, and risk behavior.

In exploring data for these studies, correlations using Spearman's rho were used to assess any relationship between sugar-sweetened beverage intake and T2DM risk factors. The correlation matrix can be found in Table 20 and reveals that the only significant correlations are

between SSB and weight (rho: .179,  $p = .330$  and BMI (rho: .166,  $p = .047$ ), no significant correlations were found between SSB's and HgbA1c, non-fasting Blood Glucose, or Waist Circumference.

The aggregate findings of this dissertation have important implications for community-based lifestyle interventions for prevention and management of T2DM. Although studies one and three support previous research that finds many more convenience food outlets than grocery stores in these predominately Hispanic and low-income areas, study two suggests that more variety and quality within the food environment may exist. For community-based programs a deep understanding of the retail nutrition environment should include a thorough, real-time, assessment of retail food establishments. Additionally, a measure such as NEMS, when applied to a population specific cultural needs, will provide more accurate and varied results than simple categorization (grocery versus convenience stores only). If time is available and access is permitted, participants would benefit from knowledge about stores with an affordable variety of fresh foods. On a larger scale, if implemented in a majority of stores, scores could be used as motivation for grass-roots efforts to make changes to the food environment, to encourage shop owners to make changes, or to influence local retail food regulations.



TABLE 20. CORRELATION MATRIX FOR SSB'S AND T2DM RISK FACTORS

			Weight	BMI	HgbA1c	WC	BG	SSB
SPEARMAN'S RHO	Weight	Correlation Coefficient	1.000	.806**	.216*	.813**	.147	<b>.179*</b>
		Sig. (2-tailed)	.	.000	.010	.000	.098	<b>.033</b>
		N	142	142	140	140	128	142
	BMI	Correlation Coefficient	.806**	1.000	.312**	.813**	.239**	<b>.166*</b>
		Sig. (2-tailed)	.000	.	.000	.000	.006	<b>.047</b>
		N	142	143	141	140	129	143
	HgbA1c	Correlation Coefficient	.216*	.312**	1.000	.412**	.601**	.005
		Sig. (2-tailed)	.010	.000	.	.000	.000	.951
		N	140	141	144	138	129	144
	WC	Correlation Coefficient	.813**	.813**	.412**	1.000	.219*	.085
		Sig. (2-tailed)	.000	.000	.000	.	.014	.319
		N	140	140	138	140	126	140
	Non-fasting BG	Correlation Coefficient	.147	.239**	.601**	.219*	1.000	.059
		Sig. (2-tailed)	.098	.006	.000	.014	.	.500
		N	128	129	129	126	131	131
	SSB's	Correlation Coefficient	<b>.179*</b>	<b>.166*</b>	.005	.085	.059	1.000
		Sig. (2-tailed)	<b>.033</b>	<b>.047</b>	.951	.319	.500	.
		N	142	143	144	140	131	146
** . CORRELATION IS SIGNIFICANT AT THE 0.01 LEVEL (2-TAILED).								
* . CORRELATION IS SIGNIFICANT AT THE 0.05 LEVEL (2-TAILED).								

## Limitations

The limitations to the set of studies presented in this dissertation include 1) data collection for environmental scan and nutrition measures target area is in a predominately needy area 2) small sample size of participant data 3) only select dietary quality questions are used as a proxy of overall dietary quality 4) limited generalizability and 5) Inability to infer causality.

### *Limited to Target Area*

The environmental scan focused on a particularly at-risk and high retail volume corridor of Pomona and may not reflect the resources most near or most frequently used by Pomona community members. As pointed out by Cannuscio et al. (2013), although many people shop at larger retail establishments, not always the closest to home, the most economically disadvantaged are more likely to prefer small specialty stores, (Zenk et al., 2005; D'Angelo et al., 2011).

### *Small Participant Sample Size*

At the time of this analysis, 177 participants had been screened in the community, 146 with complete survey and LSA data for analysis. The general belief is that the larger the sample, the more powerful the test, having too small a sample increases the likelihood of a Type II error, (Hinkle, Wiersma, Jurs, 1998; Farber & Fonseca, 2014), failing to reject the null hypothesis when it is false. GIS Hot Spot analysis uses optimized settings to determine the attributes of the nearest neighbor for hot and cold spot  $G_i^*$  statistic (ESRI, 2018). Having more data points (screening participants) would likely increase the number of statistically significant points on our

maps. Additionally, a sample of stores from all parts of Pomona and within a distance of the border in neighboring cities may provide insight into shopping locations outside of the arbitrary city border.

#### *Select Dietary Quality Questions*

Four questions to assess the quality of food intake were adapted from the California Health Interview Survey 2016, Adult Questionnaire Version 2.8: fresh fruit and vegetable intake, sugar-sweetened beverage (SSB) intake, fast food intake frequency, and home meals frequency. They were edited to provide ranges for selection rather than free-response, and some questions were compiled to stay within a short total screening time limitation. The correlations among the items were low, ranging from rho: .01 to rho: .32 (see Table 21 below), suggesting a multi-dimensional representation of food intake quality.

			SSB	Fast Food	Fruit & Veg	Home Meals
Spearman's rho	SSB	Correlation Coefficient	1.000	.125	.212*	.178*
		Sig. (2-tailed)	.	.133	.010	.032
		N	146	146	146	146
	Fast Food	Correlation Coefficient	.125	1.000	.213**	.322**
		Sig. (2-tailed)	.133	.	.010	.000
		N	146	146	146	146
	Fruit & Vegetable	Correlation Coefficient	.212*	.213**	1.000	.259**
		Sig. (2-tailed)	.010	.010	.	.002
		N	146	146	146	146
	Home Meals	Correlation Coefficient	.178*	.322**	.259**	1.000
		Sig. (2-tailed)	.032	.000	.002	.
		N	146	146	146	146
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

We reasoned that a sum score would represent at least crudely a rounded picture of food consumption quality. These food quality estimates may be limited by several factors including 1) unknown representativeness of nutrient and total caloric intake, and 2) a relatively small number of participants (N=146), but the findings are supported by the review of literature on pages 15-17. We do not suggest that our food intake measure advances methodology in that domain; rather, the measure was adopted as an efficient holistic approach to approximate quality of food intake. As widely discussed, all existing food intake measures suffer from significant validity, sensitivity, and reliability limitations. Researchers have been collecting dietary intake data for more than 30 years, yet serious issues with under and over-reporting have been

identified and, when corrected, influence the strength of the relationship between dietary factors and disease (Ioannidis 2013, Rhee et al., 2014, Mendez 2015). Food intake measurement should be a significant area for future methodological development.

### *Limited Generalizability*

Generalizability is commonly cited as a limitation of the research. As these studies take place in Pomona, CA, a predominately Hispanic and low SES community, the results can be generalized to other populations only with caution. As part of a sub-study from Stopping Diabetes in Its Tracks, a large multi-institutional grant-funded study which focusses on detection, prevention, and lifestyle management of type 2 diabetes, it is no exception. As data collection is coming from diabetes screenings, the sample population's results may limit the generalizability to only persons who are seeking health information.

### *Inability to Infer Causal Relationship*

Exploratory study I is a cross-sectional study which limits inferred causality, a longitudinal study would give a better understanding of the causal relationship and provide insight to the appropriate means for intervention (Thomas, Nelson, & Silverman, 2005).

## **Future Directions & Implications**

Despite the limitations of this dissertation, there are some important implications. These studies provide insight into neighborhood and food quality factors that may influence dietary choices in a predominately Hispanic and low-SES city. Obesity and diabetes remain a growing

issue among adolescents and adults and are strongly associated with other chronic diseases. Lifestyle factors, including diet, are leading contributors to weight gain and, in turn, the risk for obesity; and the environment is considered a predictor of food choice and diet quality. The methods explored here offer insight into the quality of the nutrition environment within the city limits of Pomona and suggest additions to future investigation, which could improve the strength of associations, improvement in approach to make the best use of time and resources, and considerations when selecting target areas for further investigation. Future directions, utilizing these findings are discussed in further detail below.

#### *Larger Sample Size*

Sample size is a limitation of both exploratory studies in this dissertation. Increasing sample of surveyed participants will improve the ability to find significant associations on mapped features such as BMI and dietary intake. Additionally, a survey of more stores in regions beyond the initial target area may reveal different or solidify existing patterns of NEMS scores by neighborhood or other associated factors.

#### *Community member data expansion*

Missing from these studies is an assessment of the nutrition environment as perceived by the residents. Use of NEMS perceived nutrition environment tool, or another assessment tool for perception would provide insight into subjective food environment measures to consider with the store quality obtained through an objective measure.

Currently, GIS data was collected only within a select target area of high-risk Pomona, expansion of the study area to cover a broader sample of Pomona, into surrounding cities (the

area of influence for many residents that live near borders) would provide an expanded view of the nutrition environment. Additionally, this study assumes that the area of influence for each resident is proximal to their home, in a future study, allowing each participant to identify, on a GIS-enabled map, their neighborhood boundaries, may provide insight about how this region and residents define their neighborhood.

Future research might include expanded measurement of participant food shopping and consumption behaviors. Shopping questionnaires may include information about major or large shopping trips, smaller-supplemental shopping, and frequency of visiting different store types; for example, going to a large market or supercenter for large purchases on a weekly basis and relying on smaller stores for specialty shopping or to purchase only a few items between large shopping trips. An expanding possibility also includes online shopping and delivery; future assessments of nutritional environment influence would benefit from measurement of location and frequency of grocery shopping online for pick-up or delivery. Aside from shopping indicators, when time and resources permit, more broad measures of dietary intake and quality would be helpful. They are not without their issues, but the use of a food frequency questionnaire or screener will provide a more detailed picture of overall dietary quality (Ioannidis, 2013; Rhee, Sampson, Cho, Hughes, Hu, & Willett, 2015; Mendez, 2015).

#### *Expansion of sample*

1. The current sample of participant data are from individuals who self-selected to participate in health risk screening for diabetes. A more generalizable sample would expand outside of the current population, aimed to screen more of the general

population. As this is part of the larger study, SDIT, which includes clinic and hospital in addition to the community portion, one approach to expansion is to include hospital and clinic participation in the mapping portion of the screening questionnaire. These participants have not self-selected to attend screening events but are local community members seeking medical services at a local clinic or a Pomona Valley Hospital Medical Center.

2. The focus of these studies was on the retail nutrition environment and included only locations that were likely to see groceries or items that may be purchased for further preparation at home and/or to be consumed at home. NEMS also has a tool for measuring the restaurant nutrition environment and includes measures of food items as well as the information environment in terms of the healthfulness of the food items being advertised on special or seasonal signage and menus. As four of every ten food dollars are spent on food prepared outside of the home (Goldsmith, 2013), adding this information is important to understanding the whole nutrition environment.

*How can the findings contribute to community-based risk reduction interventions?*

Participant data for these studies was collected as part of the screenings in the SDIT project. Part of this project's purpose is to identify prediabetes in the community and to enroll eligible participants in diabetes prevention intervention. The evidence-based prevention programs provided in the community are the second iteration of the Diabetes Prevention Program (DPP), called Prevent T2. Understanding both the nutrition environment



and food purchase behaviors, coaches for these classes can incorporate findings into class topics about barriers to healthful food choices and options for better food choices.

### *Depression, Anxiety, and Stress Measures*

Many psychological factors may influence food choice and consumption behaviors, emotional eating is often precipitated by anger, depression, anxiety, boredom, loneliness and stress (Ganley, 1989; Frayn, M. & Knauper, B., 2018). Emotional eating is associated with obesity, weight gain, and difficulty in weight loss. In future studies, analysis of depression, anxiety, and stress through the DASS-21 questionnaire may provide insight into the influence mental health has on shopping and eating choices in our population.

### *Population health*

With an expanded survey and scores to provide a more nuanced picture of the whole retail food environment within Pomona, there will be a body of evidence to advocate for policy change. Additionally, having surveyed all retail food stores and restaurants, community members, and influential leaders can encourage retailers to make changes that reflect community desires and may lead to improved health outcomes. In Iowa, the department of health in Cerro Gordo County has used the NEMS-R (restaurant) to survey every restaurant located in the county and used this information to inform the public and encourage retailers to provide foods that would score higher in terms of nutritional quality (NEMS, n.d.). They even developed an application so that consumers can look-up restaurant scores when making decisions about dining out.

### *Information Environment*

During the application-based data collection phase for the environmental assessment, data collectors took between one and four photos of locations of interest. For retail food locations, these photos included the storefront, businesses to either side and advertisements. In 2012 the Federal Trade Commission (FTC) reported that the U.S. food industry spends close to \$10 billion per year on food marketing and advertising, with nearly \$1.8 billion targeting children. Most of the money is spent on advertising for unhealthy foods that are high in fat, salt, and sugar, including packaged and highly processed foods. In this 2012 account, the FTC reported \$800 million for snack foods, \$3.5 billion for beverages, and more than \$3 billion for restaurants and fast food (FTC, 2012). Assessment of available advertising in and around the homes of our participants, and in the areas in and around frequented shopping centers could be an important influence on purchase behavior, and we will not have access to person-specific TV or social-media advertising exposure.

### **Conclusion**

Challenges with the use of database data include self-identified NAICS numbers by store owners/managers, which eliminates the possibility for uniformity in identification. Although database information states to be updated regularly, there were significant errors in reporting business data for this area and these business types. When resources allow, and area of interest is of manageable size, a physical count of points-of-interest is preferential to database analysis for assessing the nutrition environment.

Visual assessment of the overall NEMS scores of food retailers and their disbursement throughout the target area of Pomona, there are undeniable differences in the availability of high quality, healthy food options. The edits made to NEMS for this research showed good reliability for three of five measures, and further research needs to be done to improve the reliability and accuracy of the price and accessibility measures, in addition to more thorough training. GIS statistical analysis of patterns of data for participants indicated that there are participants and areas where there are, comparably, better intake behaviors. Analysis indicated areas of high home meal frequency and high fruit and vegetable intake, and a specific area of cold (low) BMI within the surveyed population.

The use of more specific measures of nutrition environment is likely to lead to more wholly understanding the retail nutrition environment of neighborhoods and cities served by many smaller and independently owned stores.

Although the methodologies and findings of this series of studies do provide insight into the retail food environment and its relationship to food intake and health, there is more research that must be done to better understand the geospatial relationship of health behaviors and chronic disease development.

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## APPENDIX 1

### NEMS-S SDIT SURVEY (QUALTRICS)

## NEM-S - SDIT FINAL

Start of Block: Cover Page

C1 Store ID:

\_\_\_\_\_

Q108 Surveyor ID (email address)

\_\_\_\_\_

C2 Date (mm/dd/yy)

\_\_\_\_\_

C3 Start Time (hh:mm AM/PM)

\_\_\_\_\_

C4 Store Type

Grocery Store (Smart and Final, Vons, Stater Bros) (1)

Convenience Store (with or without gas station) (2)

Small/Independent Store (3)

Drug Store (4)

Chain General Store (Target, 99c store, etc.) (5)

Liquor Store (6)

Other (7) \_\_\_\_\_

-----

C5 Secondary Store Type (if 'other' or small/independent store)

- Not Applicable (1)
  - Ethnic food store (specialty, carniceria, panaderia) (2)
  - Corner Store/Bodega (3)
  - Big box stores (Sam's Club, Costco, etc) (4)
- 

C6 Is this store type different from the store type in the tracking form?

- Yes (1)
  - No (2)
  - Comment/Business Name (3) \_\_\_\_\_
- 

C7 Number of cash registers

- 1 (1)
  - 2 (2)
  - 3+ (3)
- 

C8 Click to write the question text

	Certified (1)	Not Certified (2)	Unknown (no signage displayed) (3)
WIC Store Certification (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SNAP (EBT/Food Stamps) Certification (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

C9 General impression of cleanliness of premises:

Acceptable (1)

Unacceptable (2)

Comments (3) \_\_\_\_\_

---

C10 Does this location have:  
(choose all that apply)

Off-street parking (1)

Bus Stop within 1 block (2)

Safe/accessible sidewalk (not blocked, or broken - making it difficult to navigate) (3)

Outside lighting (4)

Hispanic food section or options (5)

Comments (6) \_\_\_\_\_

---

C11 Hours of operation:

hh:mm - hh:mm (note if open different times for different days).

Example 8:00AM - 6:00PM M-F, 9:00AM-6:00PM Sat, 8:00AM-12:00PM Sun

\_\_\_\_\_

---

C12 General Comments:

\_\_\_\_\_

End of Block: Cover Page

---

Start of Block: Fresh Fruit

1 Are fresh fruits available?

Yes (1)

No (2)

Comments (3) \_\_\_\_\_

*Skip To: End of Block If Are fresh fruits available? = No*

2 Complete table for each fruit listed:

	Available		Quality	
	Yes (1)	No (2)	Acceptable (1)	Unacceptable (2)
Banana (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Apple (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Orange (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Melon (any variety) (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Berries (any variety) (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Papaya (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lemon/Lime (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Mango (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pineapple (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Plantain (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3 Total kinds (not varieties) of fresh fruits available:  
(ex. naval orange, fuju apple, red delicious apple = 2 kinds: oranges and apples

1-4 (1)

5-9 (2)

10 or more (3)

End of Block: Fresh Fruit

---

Start of Block: Fresh Vegetables

4 Are fresh vegetables available?

Yes (1)

No (2)

Comments (3) \_\_\_\_\_

*Skip To: End of Block If Are fresh vegetables available? = No*

---

5 Complete table for each fruit listed:

	Available		Quality	
	Yes (1)	No (2)	Acceptable (1)	Unacceptable (2)

Carrots (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Broccoli (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tomatoes (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Peppers (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lettuce (green leaf) (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Avocado (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Corn (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sweet Potato (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Squash/zucchini (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tomatillos (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

---

6 Total kinds (not varieties) of fresh vegetables available:  
(ex. roma tomatoes, hot house tomatoes, red bell peppers, = 2 kinds: tomatoes and peppers

- 1-4 (1)
- 5-9 (2)
- 10 or more (3)

End of Block: Fresh Vegetables

---

Start of Block: Fresh Produce Alternatives

7 Are frozen fruits available?

Yes (1)

No (2)

Comments (3) \_\_\_\_\_

---

8 Total kinds of frozen fruits (without added sugar) available:

0 (1)

1-2 (2)

3 or more (3)

---

9 Are frozen vegetables available?

Yes (1)

No (2)

Comments (3) \_\_\_\_\_

---

10 Total kinds of frozen vegetables (without sauce/added fat) available?

0 (1)

1-2 (2)

3 or more (3)

---

11 **Shelf space for frozen foods:**

How much shelf space is dedicated to fresh-frozen (no sugar, sauce, fat added) fruits and vegetables, and RAW meat, compared to all other frozen foods (meals, ice cream, pizza, etc.)?

- 50% or more freezer space is fresh-frozen food (1)
  - Less than 50% of freezer space is fresh frozen food (2)
  - N/A (no freezer section) (3)
- 

12 Are canned fruits available?

- Yes (1)
  - No (2)
  - Comment (3) \_\_\_\_\_
- 

13 Total kinds of canned fruits (in 100% juice or water) are available?

- 0 (1)
  - 1-2 (2)
  - 3 or more (3)
- 

14 Price:

Canned in 100% juice/water vs. canned in heavy syrup?

- More (1)
  - Less (2)
  - Equal (3)
  - N/A (4)
-



Q109 Are canned vegetables available?

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

---

Q110 Total kinds of canned vegetables (without sauce \*salt okay) are available?

0 (1)

1-2 (2)

3 or more (3)

---

Q111 Price:

Canned vegetables with only added salt vs. canned vegetables with sauce or flavoring?

More (1)

Less (2)

Equal (3)

N/A (4)

End of Block: Fresh Produce Alternatives

---

Start of Block: Meat & Meat Alternatives

15 Is ground beef available?

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

---

Skip To: 18 If Is ground beef available? = No

16 Is lean (at least 90% lean) ground beef available?

Yes (1)

No (2)

---

17 Price:

lean (at least 90% lean) ground beef vs. less lean (85% or 80% lean) ground beef

More (1)

Less (2)

Equal (3)

NA (4)

---

18 Is fresh or frozen chicken available?

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

*Skip To: 21 If Is fresh or frozen chicken available? = No*

---

19 Is boneless, skinless chicken breast available?

Yes (1)

No (2)

---

20 Price:

boneless, skinless chicken breast vs. less lean options (skin-on breast, thighs, wings, bone-in breast)

More (1)

Less (2)

Equal (3)

NA (4)

---

21 Is canned tuna available?

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

*Skip To: 24 If Is canned tuna available? = No*

---

22 Is canned solid white tuna in WATER available?

Yes (1)

No (2)

---

23 Price:

Canned tuna packed in water vs. canned tuna packed in oil

More (1)

Less (2)

Equal (3)

NA (4)

---

24 Are beans/legumes available?  
(not green beans - look for whole dried or any variety of canned beans like black, pinto, refried, etc).

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

*Skip To: 27 If Are beans/legumes available? (not green beans - look for whole dried or any variety of canned be... = No*

---

25 Are canned whole beans available?  
(not seasoned, barbecue, or baked beans)

Yes (1)

No (2)

---

26 Price:  
canned whole beans vs. canned refried or baked/barbecue beans

More (1)

Less (2)

Equal (3)

NA (4)

---

27 Are dried whole beans available?

Yes (1)

No (2)

---

28 **Shelf space for canned vegetables:**

How much shelf space is dedicated to fresh canned fruits, vegetables, and whole beans (compared to soups, sauces, fruits in syrup, etc?)

- 50% or more shelf-space is fresh canned fruits, vegetables or whole beans without sauce (1)
- Less than 50% of shelf space is fresh canned fruits, vegetables, or whole beans without sauce (2)
- N/A (3)

End of Block: Meat & Meat Alternatives

---

Start of Block: Grains

29 Is loaf bread available?

- Yes (1)
- No (2)
- Comment (3) \_\_\_\_\_

*Skip To: 33 If Is loaf bread available? = No*

---

30 Is 100% whole wheat/grain bread available?

- Yes (1)
  - No (2)
- 

31 Price:

100% whole wheat/grain bread vs. white bread?

- More (1)
  - Less (2)
  - Equal (3)
  - NA (4)
-

32 Total number different 100% whole wheat/grain loaf breads?

- 0 (1)
  - 1-3 (2)
  - 3 or more (3)
- 

33 Are tortillas available?

- Yes (1)
  - No (2)
  - Comment (3) \_\_\_\_\_
- 

*Skip To: 37 If Are tortillas available? = No*

---

34 Are whole wheat tortillas available? (3g of fiber or more per serving)

- Yes (1)
  - No (2)
- 

35 Price:  
whole wheat tortilla (3g of fiber or more per serving) vs. refined/white flour tortillas

- More (1)
  - Less (2)
  - Equal (3)
  - NA (4)
-

36 Are corn tortillas available?

Yes (1)

No (2)

---

37 Is uncooked rice available?

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

*Skip To: 40 If Is uncooked rice available? = No*

---

38 Is brown whole grain rice available?

Yes (1)

No (2)

---

39 Price:  
brown rice vs. refined rice

More (1)

Less (2)

Equal (3)

NA (4)

---

40 Is pasta available?

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

---

41 is 100% whole wheat pasta available?

Yes (1)

No (2)

NA (3)

---

42 Price:

100% whole wheat pasta vs. white/enriched pasta?

More (1)

Less (2)

Equal (3)

NA (4)

---

43 Is boxed cereal available?

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

---

*Skip To: 47 If Is boxed cereal available? = No*

---



44 Are "healthy" (100% whole with less than 7g sugar per serving) boxed cereals available?

Yes (1)

No (2)

---

45 Price:

"healthy" boxed cereal vs. other boxed cereals

More (1)

Less (2)

Equal (3)

NA (4)

---

46 Total number of different "healthy" (100% whole grain with less than 7g sugar) boxed cereals available?

0 (1)

1-2 (2)

3 or more (3)

---

47 Is hot cereal available?

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

*Skip To: End of Block If Is hot cereal available? = No*

---

48 Are plain quick/instant oats available?

Yes (1)

No (2)

49 Price:

plain quick/instant oats vs. sugar added/flavor varieties (ex. apple-cinnamon, berries and cream, etc)

More (1)

Less (2)

Equal (3)

NA (4)

End of Block: Grains

Start of Block: Dairy and Dairy Alternatives

50 Is there milk available?

Yes (1)

No (2)

Comments (3) \_\_\_\_\_

Skip To: End of Block if Is there milk available? = No

51 Mark availability of each of the following:

	Pint		Quart		Half Gallon		Gallon	
	Yes (1)	No (2)	Yes (1)	No (2)	Yes (1)	No (2)	Yes (1)	No (2)

Skim (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1% (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2% (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Whole (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

52 **Shelf space for milk:** *(only complete if skim/1% is available)*  
 How much shelf space is dedicated to skim/1% milk compared to 2%/whole milk?

- 50% or more shelved milk is skim/1% (1)
- Less than 50% or more shelved milk is skim/1% (2)
- NA (3)

53 Is non-dairy milk available?  
 (soy, almond, rice, cashew, etc)

- Yes (1)
- No (2)
- Comment (3) \_\_\_\_\_

54  
 Are plain or light versions available?

- Yes (1)
- No (2)
- NA (3)

---

55 Price:  
plain or light dairy alternatives vs flavored/sugar added varieties

More (1)

Less (2)

Equal (3)

NA (4)

End of Block: Dairy and Dairy Alternatives

---

Start of Block: Prepared Foods

56 Are prepared foods available (such as fully cooked chicken, meat, or sides)?

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

*Skip To: 59 If Are prepared foods available (such as fully cooked chicken, meat, or sides)? = No*

---

57 Are there any modified options such as "light, low-fat, low salt/sodium"? OR baked chicken, un-dressed salads, fresh vegetables?

Yes (1)

No (2)

---

58 Price:  
Light, baked, un-dressed versions vs. regular (those with added salt/fat) varieties

- More (1)
  - Less (2)
  - Equal (3)
  - NA (4)
- 

59 Are pre-marinated/seasoned meats such as carne asada, pollo, or other prepared (uncooked) meats available?

- Yes (1)
  - No (2)
  - Comment (3) \_\_\_\_\_
- 

*Skip To: 62 If Are pre-marinated/seasoned meats such as carne asada, pollo, or other prepared (uncooked) meats a... = No*

---

60 Are there any modified options such as low-salt?

- Yes (1)
  - No (2)
- 

61 Price:  
low-salt/sodium vs. regular varieties?

- More (1)
  - Less (2)
  - Equal (3)
  - NA (4)
-

62 Are any agua frescas available?  
(such as horchata, jamaica, pina, etc).

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

*Skip To: End of Block If Are any agua frescas available? (such as horchata, jamaica, pina, etc). = No*

---

63 Are any modified options such as 'no added sugar' available?

Yes (1)

No (2)

64 Price:  
no added sugar vs. regular varieties?

More (1)

Less (2)

Equal (3)

NA (4)

End of Block: Prepared Foods

---

Start of Block: Beverages & Snacks

65 Are canned or bottled soda/carbonated drinks available? (soda)

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

---

66 Are zero calorie (light/diet) varieties available?

Yes (1)

No (2)

Comments: (3) \_\_\_\_\_

---

67 Price:

Zero calorie (light/diet) versions vs. regular/sugar added varieties?

More (1)

Less (2)

Equal (3)

NA (4)

---

68 Is bottled water available?  
(at least 6-pack)

Yes (1)

No (2)

---

69 **Shelf space for sugar-sweetened beverage:** *(only complete if water and/or unsweetened versions available)*

How much shelf space is dedicated to water or low/no-calorie options compared to sugar-sweetened options?

50% or more shelved beverages is water or low/no-calorie options (1)

Less than 50% or more shelved beverages is water or low/no-calorie options (2)

N/A (3)

---

70 Is bottled juice/fruit drinks available?  
(64oz, half gallon)

Yes (1)

No (2)

Comment (other sizes?) (3) \_\_\_\_\_

---

71 Is 100% juice available?

Yes (1)

No (2)

---

72 Price:  
100% juice vs. "juice drink" varieties?

More (1)

Less (2)

Equal (3)

NA (4)

---

73 Is bottled or fountain coffee or tea available?

Yes (1)

No (2)

Comment (3) \_\_\_\_\_

---



74 Are unsweetened options available?

Yes (1)

No (2)

---

75 Price:  
unsweetened vs. sugar-added varieties

More (1)

Less (2)

Equal (3)

NA (4)

End of Block: Beverages & Snacks

---

Start of Block: End Time

C13 End Time:  
(hh:mm AM/PM)

---

End of Block: End Time

---

## APPENDIX 2

### LETTER TO STORE MANAGERS



Date 8/23/2019

Dear Manager:

Our research group at Claremont Graduate University, as part of a community project called “Stopping Diabetes in its’ Tracks,” is visiting stores that sell food (not restaurants) in your area to measure the food sources that people in neighborhoods have available to them. Members of our project team are visiting stores to look at certain things such as the packaged food, fruit, vegetables, and meat.

We are **not** inspectors or evaluators, nor are we connected with your competitors. As researchers, we follow strict rules to protect any information we collect. We assign an identification (ID) number to your store, and only the study staff will see your individual information, this will not be released or published. Information about your store will be combined with others before it is shared outside, and the name of your store will not be used.

Your participation in this study is voluntary. Participation or non-participation will not affect your relationship with Claremont Graduate University or any of its faculty, students, or staff in any way. You are not waiving any legal claims or rights.

If you have any questions about the project, please feel free to ask them at any time. You are also welcomed to call the number listed below to obtain additional information.

Thank you for allowing us to spend a few minutes in your store, recording this information. Please feel free to ask us any questions. Your participation is voluntary, and you may inform us at any time if you do not wish to participate. If you have questions or concerns, please contact me at ###-###-####.

Best regards,

Emily Kiresich, MS, MPH, PhD(ABD), RD

Student, Researcher

Claremont Graduate University





## APPENDIX 4

### NEMS-SDIT SCORING METHODOLOGY

Item	Availability of Healthier It	Avail Total Points	Price	Price Total Points	Quality	Quality Total Points
Fresh Fruit	Available YES = 1 NO = 0	1				
	1 point per variety	10	[no points]		1 point per variety	10
	Total kinds available: 1-4 kinds = 1 points 5-9 kinds = 2 points 10+ kinds = 3 points	3				
Fresh Vegetable	Available YES = 1 NO = 0	1				
	1 point per variety	10	[no points]		One point per variety	10
	Total kinds available: 1-4 kinds = 1 points 5-9 kinds = 2 points 10+ kinds = 3 points	3				
Frozen Fruits	YES frozen fruit = 1 pts 0 without added sugar = 1-2 without added sugar = 3+ without added sugar =	3	[no points]		[no points]	
Frozen Vegetables	YES frozen vegetables = 1 0 without sauce = 0 pts 1-2 without sauce = 1 pts 3+ without sauce = 2 pts	3	[no points]		[no points]	
Frozen Shelf Space					>50% + fresh-frozen = 1 <50% = 0	1
Canned Fruits	YES canned fruit = 1 pts 0 in 100% juice = 0 pts 1-2 in 100% juice = 1 pts 3+ in 100% juice = 2 pts	3	Lower price for 100% juice = 2pts Equal pricing = 1pts Higher for 100% juice = -1 pts	2	[no points]	
Canned Vegetables	YES canned vegetables = 0 without sauce = 0 pts 1-2 without sauce = 1 pts 3+ without sauce = 2 pts	3	Lower price for plain = 2pts Equal pricing = 1pts Higher for plain = -1 pts	2	[no points]	
Ground Beef	YES = 1 90% Lean = 1 pts	2	Lower for lean meat = 2 pts Equal pricing = 1 pts Higher for Lean Meat = -1 pts	2	[no points]	
Chicken Fresh/frozen	YES = 1 boneless, skinless breast	2	Lower for bone/skinless breast = Equal pricing = 1 pts Higher for bone/skinless breast =	2	[no points]	
Tuna	YES = 1 pts Albacore in water = 1pts	2	Lower for in Water = 2 pts Equal pricing = 1 pts Higher for in Water = -1 pts	2	[no points]	
Beans	YES Beans = 1 pts Whole/unseasoned = 1pt YES dried whole beans =	3	Lower for whole beans = 2pts Equal price whole/refried = 1 pts More for whole beans = -1 pts	2	[no points]	
Frozen Shelf Space					>50% + fresh-canned <50% = 0	1
Bread	Loaf bread avail = 1 Whole grain avail = 1 0 100% Whole Grain = 0p	5	Lower for 100% Whole Grain = 2 Equal pricing = 1 pts Higher for 100% Whole Grain = -	2	[no points]	

	1-2 100% Whole Grain = 2 3+ 100% Whole Grain = 2					
Tortillas	YES = 1 pts Whole Wheat = 1 Corn Tortilla = 1	3	Lower for Whole Wheat (vs white) = 2 pts Equal pricing = 1 pts. Higher for Whole Wheat = -1 pts.	2	[no points]	
Rice (uncooked)	YES = 1 Brown Rice = 1 pts	2	Lower for brown rice = 2 pts Equal pricing = 1 pts Higher for brown rice = -1 pts	2	[no points]	
Pasta	YES = 1 pts whole wheat pasta = 1pt	2	Lower for whole wheat = 2 pts Equal pricing = 1 pts Higher for whole wheat = -1 pts	2	[no points]	
Cold Cereal	Boxed Yes = 1 Healthy Cereal yes = 1 0 Healthy cereals = 0 pts 1-2 Healthy cereals = 1pt 3+ Healthy cereals = 2 pts	5	Lower for healthy cereals = 2 pts Equal pricing = 1 pts Higher for healthy cereals = -1 pt	2	[no points]	
Hot Cereal	YES = 1 plain (no sugar) oats = 1	2	Lower for plain varieties = 2 pts Equal pricing = 1 pts Higher for plain varieties = -1 pts	2	[no points]	
Milk	YES = 1  .25 pts Each size pint, quart, ½ gal, and gal for each fat-level non-fat, 1%, 2%, Whole =	5	Lower for lowest-fat = 2 pts Same for both (lowest/highest) = 1 pt Higher for lowest-fat = -1 pts	2	[no points]	
Milk Shelf Space					>50% + 1% fat/fat-free = 1 <50% = 0	1
Milk Alternative	YES = 1 Plain/Light = 1 pts	2	Lower for plain/light = 2 pts Equal pricing = 1 pts Higher for plain/light = -1 pts	2	[no points]	
Prepared Foods	YES = 1 Light versions = 1	2	Lower for modified/light = 2 pts Equal pricing = 1 pts Higher for plain/light = -1 pts	2		
Pre-marinated	YES = 1 Modified version = 1	2	Lower for modified/light = 2 pts Equal pricing = 1 pts Higher for plain/light = -1 pts	2		
Agua-Fresca	YES = 1 Light version = 1	2	Lower for light = 2 pts Equal pricing = 1 pts Higher for light = -1 pts	2		
Carbonated	YES = 1 Light/diet = 1	2	Lower for Zero calorie/Diet = 2 pts Equal pricing = 1 pts Higher for Zero calorie/Diet = -1 pts	2	[no points]	
Water	YES 6-pack water = 1 pts	1			[no points]	
Bottled drink Space					>50% water, low-calorie = 1 <50% = 0	1
Juice	YES 64-oz fruit juice/drink = 1 100% juice = 1 pts	2	Lower for 100% juice = 2 pts Equal pricing = 1 pts Higher for 100% juice = -1 pts	2	[no points]	
Caffeinated	YES = 1 Unsweetened avail = 1	2	Lower for plain = 2 pts Equal pricing = 1 pts Higher for plain/unsweetened = -1 pts	2		
<b>Possible Availability Points</b>		<b>88</b>	<b>Possible Pricing Points</b>	<b>40</b>	<b>Possible Quality Points</b>	<b>20/24</b>

Item	Accessibility Measure	Accessibility Points
Accepts Gvmt Aid	WIC certification: YES = 1 No/no sign = 0  EBT/Food Stamps: YES = 1 No/no sign = 0	2
Cleanliness	Acceptable = 1 Unacceptable = 0	1
Features	Off-Street Parking = 1 Bus Stop within 1 block = 1 Safe/accessible sidewalk = 1 Outside lighting = 1 Hispanic Foods Section = 1	5
Food-Related/Hispanic	Tortillas available = 1 Beans Available = 1 Rice Avail = 1 Prepared food = 1 Partially Prepared food = 1	5
<b>Possible Access Points</b>		<b>8/13</b>

Total Overall Score possible = 8+88+40+24 = 160

APPENDIX 5

COMMUNITY SCREENING SURVEY

Instructions: For each question below, please circle or check the best answer for you, unless you are instructed to answer all that apply.

**1.** How old are you?

a. \_\_\_\_\_

**2.** How would you describe yourself? (circle one)

- a. Male
- b. Female
- c. Transgender
- d. Do not identify as female, male or transgender

**3.** Please tell me which one or more of the following you would use to describe yourself.

(Circle all that apply)

- a. American Indian or Alaskan Native
- b. Asian/Chinese/Japanese/Korean/Filipino
- c. Black/African American
- d. Hispanic/Latino
- e. White/Caucasian
- f. Native Hawaiian or Other Pacific Islander
- g. Middle Eastern
- h. Other
- i. Do Not Know

**4.** What is your current marital status?

- a. Married
- b. Living with a partner
- c. Widowed
- d. Divorced
- e. Separated
- f. Never married

**5.** Diabetes is a disease resulting in high blood sugar (glucose) levels in the blood. Has a doctor ever told you that you have any of the following?

- a. Diabetes Type 1
- b. Diabetes Type 2
- c. Gestational diabetes (women only)
- d. Another type (specify) \_\_\_\_\_
- e. Diabetes type unknown
- f. None



- 6.** If you answered "Type 2" on type of diabetes, then:  
Were you told/diagnosed within the last 12 months?
- Yes
  - No
  - Don't know
- 7.** Do you have a mother, father, sister, or brother with diabetes?
- Yes
  - No
- 8.** Have you ever been diagnosed with any of the following diseases? (Circle all that apply)
- High blood pressure (hypertension)
  - Coronary heart disease
  - Stroke
  - Asthma
  - COPD (chronic obstructive pulmonary disease (lung disease))
  - Arthritis
  - Depression
  - Cancer
  - I have not been diagnosed with any of these diseases
- 9. What is the highest grade (or year) of school you have completed? (Check one.)**
- Elementary/Middle School: \_\_01 \_\_02 \_\_03 \_\_04 \_\_05 \_\_06 \_\_07\_\_08
  - High School: \_\_09 \_\_10 \_\_11 \_\_12
  - College/Junior College: \_\_1 \_\_2 \_\_3 \_\_4
  - Graduate School: \_\_1 \_\_2 \_\_3 \_\_4+
- 10.** How many people are currently living in your household, including yourself? \_\_\_\_
- Of these people, how many are children less than 18 years old? \_\_\_\_
- 11.** Which of these categories best describes your total combined family income for your household for the past 12 months? This should include income (before taxes) from all sources, wages, rent from properties, social security, disability and/or veteran's benefits, unemployment benefits, workman's compensation, help from relatives (including child payments and alimony), and so on.
- less than \$25,000 (1)
  - \$25,000-<\$50,000 (2)
  - \$50,001-<\$75,000 (3)
  - \$75,001-<\$100,000 (4)
  - \$100,001-<\$150,000 (5)
  - more than \$150,000 (6)

- g. Don't Know/Not sure (77)
- h. Decline to respond (-9)

**12. Have you smoked at least 100 cigarettes in your entire life? (5 packs= 100 cigarettes)**

- a. Yes
- b. No
- c. Don't know
- d. Decline to respond

**13. How long has it been since you last smoked a cigarette, even one or two puffs?**

- e. Less than 1 month ago
- f. 1 to 6 months ago
- g. 6 to 12 months ago
- h. 1 to 5 years ago
- i. 5 years ago or more
- j. Never smoked regularly
- k. Don't Know/Not sure
- l. Decline to respond

**(If you currently smoke, please answer the following question)**

**A. How soon after you wake up do you smoke your first cigarette?**

- i. Within 5 minutes
- ii. 6 to 30 minutes
- iii. 31 to 60 minutes
- iv. After 60 minutes

**14. Think about the past seven days. On how many of those days were you in a room, car or truck with someone who was smoking?**

- a. 0 days
- b. 1 day
- c. 2 days
- d. 3 days
- e. 4 days
- f. 5 days
- g. 6 days
- h. 7 days (everyday)
- i. I don't know

**15. On average, how many days in a week do you walk for at least 30 minutes per day? (Please include walking for transportation and other activity)**

- a. None
- b. 1 day
- c. 2 days

- d. 3 days
- e. 4 days
- f. 5 days
- g. 6 days
- h. 7 days

**16. On average, how many days in a week do you do activities that make you breathe hard or sweat for at least 20 minutes per day? (Included can be work, home or other activities)**

- a. None
- b. 1 day
- c. 2 days
- d. 3 days
- e. 4 days
- f. 5 days
- g. 6 days
- h. 7 days

**17. On average, how many days a week do you do activities at home, work, or elsewhere that might improve your muscle strength, such as lifting weights, carrying or moving heavy loads?**

- a. None
- b. 1 day
- c. 2 days
- d. 3 days
- e. 4 days
- f. 5 days
- g. 6 days
- h. 7 days

**18. How often do you eat fresh or canned fruit or vegetables? (Do not include fruit juice, bionicos, white potatoes, or elote).**

- a. Less than 1/week
- b. Once a week
- c. 2-3 times a week
- d. 4-6 times a week
- e. Once a day
- f. 2 or more times per day

**19. How much juice or sugar-sweetened beverages do you drink most days such as tea, soda, etc.? (including juice-drinks and agua fresca)**

- a. I don't drink juice or sodas (including juice-drinks) or sugar-sweetened soda, tea, or other beverages.
- b. 1 – 2 cups, cans, small bottles or drink boxes per day
- c. 3 or more cups, cans, small bottles or drink boxes per day

**20. Now think about the past week. In the past 7 days, how many times did you eat fast food, such as McDonald's, KFC, Panda Express, or Taco Bell? (including from street vendors, carts, or concessions, as well as drive-through)**

- a. 0
- b. 1
- c. 2-3
- d. 4-6
- e. once each day
- f. more than once each day (or more numbers)

**21. How often do you eat meals that are cooked at home? (including meals prepared at home and taken to work, school, or eaten outside of the home)**

- a. Less than 1 each week
- b. Once a week
- c. 2-3 times a week
- d. 4-6 times a week
- e. Once a day
- f. 2 or more times per day

**22. How confident are you that you can prevent getting diabetes?**

1	2	3	4	5
Not at all Confident	Little Confidence	neither	Somewhat Confident	Very Confident

**23. How confident are you that you could make healthy changes in your lifestyle?**

1	2	3	4	5
Not at all Confident	Little Confidence	neither	Somewhat Confident	Very Confident

**24. Diabetes can be prevented:**

1	2	3	4	5
Strongly Disagree	Disagree	Neither or Not sure	Agree	Strongly Agree

**25. Whether or not someone gets diabetes is a matter of fate:**

1	2	3	4	5
Strongly Disagree	Disagree	Neither or Not sure	Agree	Strongly Agree

**26. If a free diabetes or prediabetes prevention program were available, would you be interested in participating?**

- a. Yes
- b. No

**(If no, answer the following question)**

**A. Why would you not be interested in a program? (Check all that apply)**

- i. I do not have the time
- ii. It is not that important to me to prevent diabetes or pre-diabetes
- iii. I do not think these kinds of programs work
- iv. I have to be at home to take care of my family
- v. Transportation is hard for me
- vi. Other: \_\_\_\_\_

**27. One's feelings are often related to one's health. Please answer the following.**

For each statement below, please circle the number in the column that best represents how you have been feeling in the last week.

Statement	Did not apply to me at all	Applied to me to some degree	Applied to me a considerable degree	Applied to me very much
1. I found it hard to relax.	0	1	2	3
2. I was aware of dryness of my mouth	0	1	2	3
3. I couldn't seem to experience any positive feelings at all	0	1	2	3
4. I sometimes breathe fast or have trouble breathing in even when not exercising	0	1	2	3
5. I found it hard to make myself do things.	0	1	2	3
6. I tended to over-react to situations	0	1	2	3

7. I experienced trembling (eg, in the hands)	0	1	2	3
8. I felt that I was using a lot of nervous energy	0	1	2	3
9. I worried about situations where I might panic or do something to embarrass myself.	0	1	2	3
10. I felt that I had nothing to look forward to	0	1	2	3
11. I found myself getting upset or disturbed	0	1	2	3
12. I find it hard to unwind	0	1	2	3
13. I felt down-hearted and blue	0	1	2	3
14. I was irritated or impatient with anything that got in my way	0	1	2	3
15. I felt I was close to panic	0	1	2	3
16. I was unable to get interested or excited about doing anything	0	1	2	3
17. I felt I wasn't worth much as a person	0	1	2	3
18. I felt that I was rather touchy	0	1	2	3
19. I felt my heart pounding or missing a beat even when I was not exercising or working hard	0	1	2	3
20. I felt scared without any good reason.	0	1	2	3
21. I felt that life was meaningless	0	1	2	3

**28. Which of these statements best describes your neighborhood?**

- a. Most people keep to themselves and don't talk or visit much with the other people who live here.
- b. Some people keep to themselves, but others talk or visit a lot with the other people who live here.
- c. Most people talk or visit a lot with the other people who live here.

**29. How many of your neighbors do you know well enough to visit or call on?**

- a. None
- b. 1 or 2
- c. 3 or more
- d. I have no neighbors

**30. How involved are you in your neighborhood?**

- a. not at all
- b. a little bit
- c. somewhat
- d. very much

**31. In general, how do you feel about your neighborhood?**

- a. very bad
- b. fairly bad
- c. fairly good
- d. very good

**32. How satisfied are you with the police protection around your neighborhood?**

- a. very satisfied
- b. somewhat satisfied
- c. somewhat dissatisfied
- d. very dissatisfied

**33. How often are there problems with muggings, burglaries, assaults, or anything else like that around your neighborhood?**

- a. hardly ever
- b. not too often
- c. fairly often
- d. very often

**34. Do you have a cell phone?**

- a. Yes
- b. No

(If yes, answer the following three questions)

**A. Can you use your cell phone to send and receive text messages?**

- i. Yes, I sometimes use it to send and receive text messages
- ii. Yes, but I don't use it for text messaging
- iii. No

**B. Can you use your phone to access the internet?**

- i. Yes, I sometimes use it for the internet
- ii. Yes, but I don't use it for the internet
- iii. No

**C. Can you use apps on your phone?**

- i. Yes, I sometimes use apps
- ii. Yes, but I don't use apps
- iii. No

**35. How did you hear about our screenings?**

- b. I heard about it from a friend or relative
- c. Facebook
- d. Instagram
- e. Twitter
- f. Some other place on the internet
- g. Flyer
- h. Pomona Community farmers market
- i. School
- j. Church
- k. None (9)
- l. Other: \_\_\_\_\_

**36. Do you live, work, go to school, go to church, shop, or frequently do other things in Pomona?**

- a. Yes
- b. No

(If yes, please answer NEXT QUESTION)

**37. Look at the map of Pomona with a marker of your current location.**

Please draw a happy face 😊 on a positive place in your community.

Describe what this place is (e.g. a laundromat, a park, a library, etc.)

---

**How often do you go to this place?**

- a. Less than 1X a week
- b. 1X a week
- c. 2X a week
- d. 3X a week
- e. 4X a week
- f. 5X a week
- g. I do not go to this place

Please draw a sad face ☹️ on a negative place in your community. Describe what this place is (e.g. a park, an alleyway, liquor store etc.).

---



**How often do you go to this place?**

- a. Less than 1X a week
- b. 1X a week
- c. 2X a week
- d. 3X a week
- e. 4X a week
- f. 5X a week
- g. I do not go to this place

**Do you work in Pomona?**

- a. Yes (please place a marker where you work)
- b. No

**Do you shop for groceries in Pomona?**

- a. Yes (please place a marker where you shop for groceries)
- b. No

**Do you shop for household goods in Pomona?**

- a. Yes (please place a marker where you shop for household goods)
- b. No

**Do you eat at restaurants in Pomona?**

- a. Yes (please place a marker on the restaurant where you eat)
- b. No

**Do you or your children go to school in Pomona?**

- a. Yes (please place a marker where you or your child go to school)
- b. No

**Do you play or recreate in Pomona?**

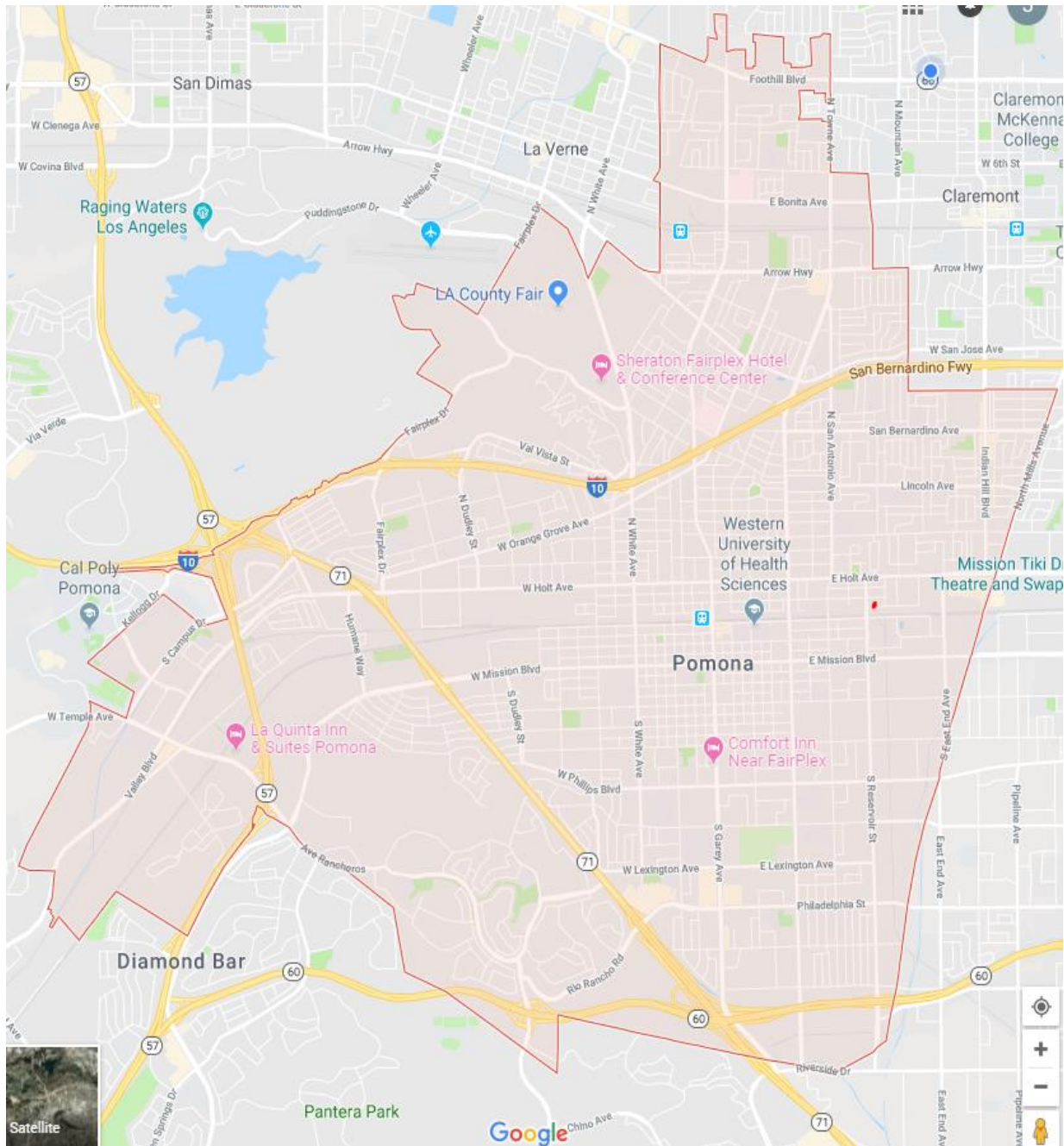
- a. Yes (please place a marker where you play or recreate)
- b. No

**Do you worship in Pomona?**

- a. Yes (place a marker where you worship)
- b. No

**Do you receive medical, dental, and pharmacy services in Pomona?**

- a. Yes (place a marker where you receive services)
- b. No



## APPENDIX 6

### SDIT SCREENING CONSENT FORM

**INTERVENTION PROGRAM IN THE COMMUNITY:  
NATIONAL DIABETES PREVENTION PROGRAM (DPP)  
CONSENT FORM FOR PARTICIPATION IN RESEARCH ACTIVITIES  
STUDY TITLE: "Stopping Diabetes in its Tracks"**

STUDY LEADERSHIP. You are being asked to participate in a research study led by Pomona Valley Hospital Medical Center (PVHMC), the Community Translational Research Institute (CTRI), PVHMC Family Center, Park Tree Community Health Center (PCHC), Claremont Graduate University (CGU), and Heluna Health.

SPONSORSHIP. This study is being funded by the UniHealth Foundation and the Pomona Valley Hospital Foundation, non-profit philanthropic organizations whose mission it is to support and facilitate activities that significantly improve the health and well-being of individuals and communities within its service area.

PURPOSE. The purpose of this study is to invite eligible participants to attend our 10-month National Diabetes Prevention Program (DPP), in-person or online.

ELIGIBILITY. To be in this study, you must be:

1. Adult 18 years old or older
2. If you are a woman, you must NOT be pregnant
3. Be able to read this form and provide consent to take part in this study
4. Hemoglobin A1c (HbA1C) level between 5.7-6.4% (prediabetes)
5. BMI  $\geq$ 25 (overweight or obese)

INTERVENTION PARTICIPATION. You will be asked to attend the 10-month long program in the following structure:

- 16 Weekly classes (4 months)
- 6 monthly classes (6 months)

During the study you will also, from time to time, be asked to complete short online surveys, we will ask you about:

1. Health information (e.g. diet, physical activity, smoking status, stress, depression, etc.)
2. Utilization questions (i.e. use of community resources, social support, etc.)
3. Barriers to success

In addition to short online surveys, we will take the following measurements:

1. Weight (weekly during each class)
2. Height (beginning and at the end of the program)
3. Waist and hip measurements (beginning and at the end of the program)

4. Blood pressure (beginning and at the end of the program)
5. Blood sugar levels (HbA1C) (beginning and at the end of the program)
6. Lipid panels (beginning and at the end of the program)

RISKS OF PARTICIPATION. There are some risks from participating in this study. The risks include the following:

1. From the online survey, you may feel uncomfortable or offended by some of the questions.
2. During the course of this intervention program, you could feel tired or uncomfortable participating in the classes.
3. From the other measurements, you could feel discomfort when taking weight, height, waist and hip circumference, blood pressure, sugar levels, and lipid levels.
4. Every reasonable step will be taken to protect your personal information (i.e. name, birth date, address, etc.); however, there is a small chance that a data breach could occur and that your personal information will be exposed.

BENEFITS OF PARTICIPATION. We do expect the intervention program to benefit you personally, by giving you accurate measures of your height, weight, waist circumference, blood pressure, and blood sugar levels. This intervention program may also benefit you by giving helping you develop and maintain a healthy lifestyle.

This intervention program will benefit the researcher(s) by providing data on health outcomes of participants in the program. This will help us understand the advantages of the program (in-person vs. online).

COMPENSATION/COSTS. There is no direct compensation to you for participating in this intervention program. For taking part in this intervention program, you will be giving class materials, and a lifestyle coach will be available to help you in the program.

There are no costs to you for participating in this intervention program. If you receive information where you may need to seek out a physician, you will be responsible for costs not related to the study.

VOLUNTARY PARTICIPATION. Your participation in this study is completely voluntary. You may stop or withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled. Your decision whether or not to participate will have no effect on your current or future connection with anyone at PVHMC, PVHMC Family Center, PCHC, CGU, CTRI and Heluna Health.

CONFIDENTIALITY. Your individual privacy will be protected in all papers, books, talks, posts, or stories resulting from this study. We may share the data we collect with other researchers, regulatory agencies, UniHealth Foundation, and the Institutional Review Board (IRB) may also have access, but we will not reveal your identity with it. In order to protect the confidentiality of your responses, we will store your data in password-protected files and will be reporting group averages and group statistics. Your information will be kept as confidential as possible to the extent allowable by law. While members of the research team will know your personal

information, we will not disclose it or make it possible for anyone outside the research team to learn it.

FURTHER INFORMATION. If you have any questions or concerns about the study or your rights as a research participant, believe you have been harmed by participating in this study, would like to offer input or would like additional information about this study, please contact:

**Lena Plent, MSN, RN.**

Pomona Valley Hospital Medical  
Center  
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Pomona, CA 91767  
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**C. Anderson Johnson, PhD.**

Community Translational Research  
Institute  
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The Institutional Review Board (IRB) has approved this project to ensure regulatory requirements of the study are adhered to. You may contact the IRB at Pomona Valley Hospital Medical Center with any questions or issues at (909) 865-9692. A copy of this form will be given to you.

CONSENT. Your signature below means that you have read the information on this form, that someone has answered any and all questions you may have about this study, and you voluntarily agree to participate in this intervention program.

Signature of Participant \_\_\_\_\_ Date \_\_\_\_\_

Printed Name of Participant \_\_\_\_\_

Signature of Person Obtaining Consent \_\_\_\_\_ Date \_\_\_\_\_

Printed Name of Person Obtaining Consent \_\_\_\_\_