The Impact of Nutrition Literacy and Neighborhood on Diet Quality in the Mexican Origin Population

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THE IMPACT OF NUTRITION LITERACY AND NEIGHBORHOOD ON DIET QUALITY IN THE MEXICAN ORIGIN POPULATION

by

Sylvia Peña, BSN, RN

A Dissertation submitted to the Faculty of the Graduate School, Marquette University, in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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ABSTRACT
THE IMPACT OF NUTRITION LITERACY AND NEIGHBORHOOD ON DIET QUALITY IN THE MEXICAN ORIGIN POPULATION

Sylvia Peña, BSN, RN
Marquette University, 2022

Introduction: Diet quality is a critical component in achieving optimal health outcomes. A poor diet can lead to various health complications including obesity, heart disease, and diabetes. Hispanic individuals have been found to have higher rates of obesity; therefore, it is critical that variables impacting diet quality be examined in this population. Available literature concerning nutrition literacy, neighborhood and diet quality have not been specific to subgroups of the Hispanic population, therefore, identifying how these factors influence the Mexican origin population is needed. The aim of this dissertation was to better understand the impact of nutrition literacy and neighborhood on diet quality in the Mexican origin population.

Methods: A descriptive, correlational design was used to examine the relationship between nutrition literacy and neighborhood and the impact on diet quality in a sample of 130 Mexican origin participants. Statistical analyses were performed using SPSS and SAS.

Results: Statistical analyses were performed with nutrition literacy, neighborhood, diet quality subscales, and demographic variables. Multiple regressions yielded statistically significant results for the diet quality subscales of total protein foods, sodium, and refined grains. Independent samples t-tests yielded significant differences in scores between immigrant generations for whole fruits, sodium, refined grains, and saturated fats. Utilizing general linear model analysis, age was significantly associated with diet quality.

Conclusion: As obesity rates in the United States continue to grow, it is important that factors leading to obesity are better understood and addressed. Due to the impact diet quality has on obesity, it is essential that we adequately understand the factors that impact diet quality. Additionally, as the United States population continues to become more diverse, it is essential that current research reflect this demographic shift. To date, there is limited information on diet quality in the Mexican origin population. Through better understanding of this concept, researchers and health care providers can better tailor dietary interventions to promote health outcomes for the Mexican origin population. Finding from this study can fill the existing gap in the literature for this topic and provide valuable insight on ways to modify future studies to ensure success with the Mexican origin population.
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Sylvia Peña, BSN, RN

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A range of health issues can arise due to a poor diet including heart disease, obesity, and diabetes (Centers for Disease Control and Prevention, 2021b). Therefore, assessment of diet quality is critical in ensuring that individuals are eating nutritious foods that help them stay at an optimal state of health (World Health Organization, 2020). With such a variety of foods available, many factors can contribute to the decisions that an individual makes when selecting food. Some influencing factors of individuals’ food choices include money, time, and nutritional information (U.S. Department of Agriculture, 2020). Considering the reasons why individuals select the foods they consume is critical to gain a better understanding of diet quality.

There is a need for further research in individuals of Mexican origin regarding diet quality, as this concept has been examined within the United States population, but very minimally with specific Hispanic subgroups. The United States has become increasingly more diverse in the last decades and health care providers are now seeing patients from many diverse backgrounds (O’Toole, Alvarado-Little, & Ledford, 2019). Therefore, it is important that health care providers better understand cultural considerations regarding diet for this subgroup, as it is the largest Hispanic subgroup in the United States with a rate of obesity at 42.2% (Burgos et al., 2005; Centers for Disease Control and Prevention, 2020). Furthermore, providers will be able to tailor interventions to meet the needs of the patients they serve to achieve better health outcomes. By narrowing the Hispanic population into subgroups, better identification of foods that individuals of Mexican origin consume, along with differences in generational status, can
be known. This knowledge is essential, as diet can vary based on nationality and generational status, and impact diet quality. This study will serve to bridge the gap in the literature regarding diet quality in the Mexican origin population.

**Background of the Problem**

Healthy People 2020 recognizes that in order to promote health in individuals, it is important that healthful diets and body weights are maintained (Office of Disease Prevention and Health Promotion, 2020). According to the *Dietary Guidelines for Americans* (U.S. Department of Health and Human Services & USDA, 2020), 74% of adults in the United States are overweight or obese. It is expected that by the year 2030, 1 in 2 adults will be obese and 1 in 4 adults will be severely obese (Ward et al., 2019). Having a healthy diet is critical in reducing the risk of a variety of health problems such as obesity (Office of Disease Prevention and Health Promotion, 2020). Therefore, as we expect that this epidemic will continue to grow in the United States in the coming years, it is important that appropriate dietary interventions are made to help reduce the incidence of obesity in the population.

An overarching goal of Healthy People 2020 is to eliminate health disparities of all groups (Office of Disease Prevention and Health Promotion, 2020). Disparities have been found to be associated with social, economic, and/or environmental disadvantage (US Department of Health and Human Services, n.d). In the United States, Hispanics have low socioeconomic status which is mirrored in education, poverty rates, and occupation (Morales, 2002). Further, higher obesity rates are found in Hispanic individuals when compared to the general population (Hammons et al., 2019). In order to
address the rising obesity rates in this population, it is important that the underlying factors that contribute to obesity, such as diet quality are addressed.

Diet quality is influenced by the food choices that are made by individuals (USDA, 2020). Having a healthy diet can be beneficial as it can protect individuals from illness later in life (World Health Organization, 2020). Healthy eating patterns are identified and outlined in the Dietary Guidelines for Americans 2020-2025 and can provide vast information on how to maintain a high-quality diet. Due to the importance that diet quality can have on an individual’s health, it is imperative that research is up to date. Further, with the changing demographics of the United States it is essential that current research reflects this demographic shift.

Hispanic Population

In 2018, 44.8 million immigrants were living in the United States, with individuals born in Mexico accounting for 25% of this group (Budiman et al., 2020). By 2025, the United States Census Bureau expects that three in ten children that live in the United States will be of Hispanic descent (Fry & Passel, 2009). In 2007, Hispanic children accounted for 22% of children in the United States under the age of 18, with 11% of children being first generation, 52% of children being second generation, and 37% of children being third generation or higher (Fry & Passel, 2009). Generational composition of Hispanic individuals living in the United States will likely continue to shift.

The Pew Hispanic Center found that fluency in the English language, parental education, poverty, and married-couple families all vary among first, second, and third
generation or higher children (Fry & Passel, 2009). The use of the Spanish language varies between generations. While 97% of Hispanic immigrant parents reported speaking Spanish to their children, only 71% of second-generation parents and 49% of third generation or higher parents spoke Spanish to their children (Lopez et al., 2018). Individuals who only speak English at home, were found to spend more money at restaurants and less money at grocery stores, while also reporting that convenience was a contributor to eating out rather than preparing meals at home (Langellier et al., 2015). In 2019, the population of Latinos in the United States was 18%, up from 16% in 2010, however, there is no specific data providing population growth for the Mexican origin subgroup (Noe-Bustamante et al., 2020).

**Mexican Origin Population**

A subgroup within the Hispanic population is the Mexican origin population, which accounts for the largest Hispanic subgroup in the United States (Noe-Bustamante, 2019; Noe-Bustamante et al., 2019). Since 2000, the population of individuals of Mexican origin increased by 76% (Noe-Bustamante et al., 2019). Various differences exist between the Hispanic population and the Mexican origin population including education and age. Educational attainment for U.S. Hispanics is 16%, while only 12% of Mexican origin individuals obtain at least a bachelor’s degree (Noe-Bustamante et al., 2019). Further, within the Mexican origin subgroup, individuals who are foreign born are less likely to obtain a bachelor’s degree, 7%, compared to their U.S. born counterparts at 17%. (Noe-Bustamante et al., 2019). The median age for the Mexican origin population
is 27 and U.S. Hispanics have a median age of 29, compared to the general U.S. population which has a median age of 38 (Noe-Bustamante et al., 2019).

Batis et al. (2011) found that overall, the Mexican population has poor diet quality. However, participants who live in urban areas of Mexico with higher socioeconomic status reported a higher intake of fruit, vegetables, and dairy (Batis et al., 2016; Perez-Tepayo et al., 2020). These findings are similar to that of the Mexican origin population living in the United States. Within the United States population, the Mexican American group has higher obesity rates than other groups (Satia-Abouta, 2003). Further, a decrease in diet quality is associated with acculturation for Mexican origin individuals living in the United States (Batis et al., 2011; Ayala et al., 2008; Perez-Escamilla, 2009).

**Generation**

The largest and fastest growing group of immigrants in the United States are Mexican born individuals (Burgos et al., 2005; Flores, 2017). Therefore, it is necessary to understand the role that generational status can have on Mexican origin individuals. For example, an increased BMI is associated with generational status as obesity risk increases with each following generation (Bates et al., 2008). Through assessment of the impact generation status has on this population, better understanding of diet quality can be achieved.

Compared to foreign-born Hispanic Americans, US born Hispanic Americans had a higher rate of obesity and a less healthy diet (Barcenas et al., 2012; Gordon-Larsen et al., 2003). Van Hook et al. (2012), found that risk of obesity increased as generational status increased. Similarly, living a sedentary lifestyle increased with generation in
Mexican origin individuals (Gordon-Larsen et al., 2003). Mexico born immigrants were found to have lower rates of morbidity and mortality compared to US born Mexican Americans (Carter-Pokras et al., 2008). Further, immigrant women who were more acculturated to US customs, had worse health behavior than less acculturated women, however, acculturation had only a small difference in men’s health behaviors (Lopez-Gonzalez et al., 2005). Higher rates of acculturation were found with individuals who had a poorer diet quality and who consume more American foods (Burgos et al., 2005; Jeffery et al., 2020). Neighborhoods that contain grocery stores with traditional Mexican food may help lessen the pressure for individuals to eat more Americanized foods (Dondero & Van Hook, 2016). Overall, many health outcomes for Hispanic immigrants become less desirable the longer that they are living in the United States.

First generation Mexican origin individuals have better diet quality than second and third generation Mexican origin individuals (Liu et al., 2012; Van Hook et al., 2012). However, other factors that can adversely impact health are worse in those who identify as first-generation Mexican origin individuals. While all three generations of Mexican origin children are at an increased likelihood of living in poverty, first generation children are the most affected as these individuals tend to live in more urban areas than subsequent generations (Burgos et al., 2005; Child Trends, 2018). Additionally, education levels are lower in first generation Mexican origin individuals (Burgos et al., 2005; Barshay, 2018).

Generational status and preferred language are both common ways used to assess acculturation (Reininger et al., 2017). Individuals with lower levels of acculturation have been found to have higher diet quality (Gorman et al., 2010). Individuals who preferred
Spanish as their primary language reported consuming more healthy foods (Reininger et al., 2017). Lower levels of acculturation were inversely related to fruit and vegetable consumption in Mexican origin individuals (Liu et al., 2012; Variyam & Aldrich, 2000). Mexican origin individuals who mainly spoke English reported increased intake of fast foods and non-homemade meals (Reininger et al., 2017) and immigrant women who were fluent in English are at an increased risk of obesity (Liu et al., 2012). Children who live in first generation households are more likely to have Spanish as the main language spoken in the home, while children of second and third generation are less likely to have Spanish be the dominant language in the home (Burgos et al., 2005; Lopez et al., 2018). Additionally, first generation Mexican origin children had less access to health care and a health care provider than second and third generation children (Van Hook et al., 2012).

Increased consumption of fruits and vegetables, and lower saturated fat and sugar was found in diets of Mexican born individuals (Reininger et al., 2017). Second generation and third generation individuals of Mexican origin consume less fruits than first generation individuals (Liu et al., 2012; Reininger et al., 2017). Obtaining further knowledge on generational differences between Mexican origin individuals living in the United States will allow for improvement of health care outcomes and better intervention strategies.

**Statement of the Problem**

As the demographics of the United States continue to change and the U.S. becomes a more diverse nation, it is important that research resembles this shift. Research on diet quality in Americans is available, however, there is a need for further research on
specific demographic groups. Evidence available regarding diet quality in the Hispanic population, is generalized to include multiple nationalities and is not specific to subgroups, such as the subgroup of individuals of Mexican origin. Conducting this research within this population is critical as obesity rates in 2019 within this population were 49.5% for men and 50.9% for women aged 20 and over (Centers for Disease Control and Prevention, 2021c). Additionally, the rate of hypertension for Mexican origin individuals was 45.1%, compared to 43.7% of their White counterparts (Centers for Disease Control and Prevention, 2021c). Further, it is important to consider the impact that one’s neighborhood and nutrition literacy have on the quality of their diet. Nutrition knowledge impacts the food that is selected (Gibbs, 2012). Therefore, it is essential that nutrition literacy be assessed to understand the extent of this influence. Additionally, the neighborhood that an individual resides in has been found to impact diet quality, as the quantity and quality of grocery stores available influences dietary intake (Moore et al., 2008). To date, there is no literature available on the impact of nutrition literacy and neighborhood on diet quality in Mexican origin individuals.

**Purpose of the Study**

The purpose of this study was to examine the impact nutrition literacy and neighborhood have on diet quality in Mexican origin individuals. The proposed research was important for this population to better understand how these factors contribute to diet quality. Studying this specific Hispanic subgroup, rather than the Hispanic population as a whole, is important as dietary intake can vary based on a variety of factors including culture, generational status, language, socioeconomic status, etc. Therefore, it is
important to acknowledge that differences exist between each Hispanic subgroup.
Furthermore, this research was important in addressing the current gap in the literature
that exists for individuals of Mexican origin and diet quality.

**Specific Aims**

The specific aims of the dissertation research include:

1. Determine the role of nutrition literacy on diet quality
2. Determine the role of neighborhood on diet quality
3. Assess differences in diet quality based on immigration generation
4. Examine the strength of the relationship between neighborhood and diet quality
5. Examine the strength of the relationship between nutrition literacy and diet quality.

**Research Questions**

The research questions for this study include:

1. What are effect sizes of relationships among nutrition literacy, neighborhood, and diet quality in a Mexican origin sample?
2. What differences are observed in diet quality between first generation and second or higher generation, Mexican origin immigrants?
3. Does nutrition literacy or neighborhood account for more of the variance in diet quality?
4. Do any other demographic variables impact the relationships with diet quality?
5. Do the demographic variables have a specific significant relationship with diet quality?
Nurses provide care for individuals from many diverse backgrounds. It is important that nurses provide culturally competent care to the patients they encounter to deliver holistic care. Additionally, nursing interventions and education provided should aim to help eliminate health disparities. Nursing practice must reflect the most up to date evidence-based practice to help meet the Healthy People 2020 goal of eliminating health disparities. Results from this study allow practitioners to have a better understanding of the factors that influence diet quality in Mexican origin individuals. These findings can aid providers in understanding, implementing, and adjusting effective strategies to improve health outcomes in this population. Additionally, findings from this study may help inform policy change to improve diet quality. For example, Darmon et al. (2014) found that implementation of policies regarding food prices may improve diet quality. Lastly, new knowledge gained from this study will help support future intervention studies related to diet quality in this Hispanic subgroup.

Definition of Terms

In order to provide clarity and consistency of the terms used throughout this dissertation, definitions are listed in alphabetical order below for ease of reference.

**Diet Quality:** Diet quality is defined as the food choices individuals make that influence their health (USDA, 2020). Food choices will be compared to the *Dietary Guidelines for Americans 2020-2025*, as these guidelines aim to provide science-based
recommendations for individuals to have a healthy, nutritious diet and are used with the Healthy Eating Index (USDHHS & USDA, 2020).

**First Generation:** An individual who is not a U.S. citizen at birth and born outside of the United States (Fry & Passel, 2009).

**Generational status:** An individual’s place of birth or that of their parents (United States Census Bureau, n.d.).

**Hispanic/Latino:** Latino and Hispanic are interchangeable within this study, referring to an individual who is of Mexican, Puerto Rican, Cuban, Central and South American origin or any other country that is Spanish speaking (Office of Budget and Management, 1997).

**Immigrant:** An individual born in another country that came to live in the United States (Budiman, 2020).

**Neighborhood:** Neighborhood is defined as the Census Block group that an individual resides in (University of Wisconsin School of Medicine Public Health, 2015).

**Nutrition Literacy:** Nutrition literacy refers to the ability of an individual to process and understand nutrition related information (Zoellner, 2009).

**Second Generation:** An individual who is a U.S. citizen at birth and also has at least one first generation parent (Fry & Passel, 2009).

**Third Generation or higher:** An individual who is a U.S. born citizen with both parents being second generation (Fry & Passel, 2009).

**Assumptions, Limitations, and Delimitations**

**Assumptions**
Assumptions for this study included that Hispanic subgroups have varying dietary intake. Research has found differences in diet quality of varying Hispanic subgroups (Colón-Ramos et al., 2009; Loria et al., 1995; Mattei et al., 2016). Further, generational status can impact diet quality. Second generation Mexican origin women were found to have poorer diet quality than first generation Mexican origin women (Variyam & Aldrich, 2000). Additionally, Mexican origin women were found to have better diet quality than Mexican origin men (Yoshida et al., 2016). An additional assumption, tied to pragmatism, is that the individual is at the main decision maker and has autonomy to select their own food. Additionally, it is assumed that participants will answer honestly. Further, because recruitment took place in the fall/winter, participants could recall different dietary intake than they would during other times of the year.

Limitations

Several limitations were identified apriori of this study. Self-selection bias was identified as a limitation as participants chose whether or not they would like to take part in the research study. This may have left out individuals who have critical knowledge to share. Further, participants who were more confident in their nutrition knowledge, may have chosen to participate over individuals who do not hold the same sentiments. Convenience sampling was used as it would not be feasible at this time to conduct a nationwide study, limiting the participants. Finally, social desirability bias may have impacted participant responses of their diet quality.

Delimitations
Three delimitations were identified for this study. First, the study was limited to individuals of Mexican origin, as this is the largest Hispanic subgroup in the United States (Burgos et al., 2005; Flores, 2017). This choice was also made because the Hispanic population is often grouped together, and generalizations are made about the population as a whole. However, it is important to acknowledge that there are differences between Hispanic subgroups. Lastly, participants were recruited in the fall and winter months to minimize the variability of fresh fruits and vegetables available between seasons.

**Conclusion**

As the demographics of the United States population continue to change, it is increasingly critical that research resembles this shift. Health care providers are tasked with helping individuals meet health outcomes and for providers to achieve this goal, they must have the most up to date information regarding diet quality to better guide their patients. To help obtain this data for providers, this study sought to identify the relationship that neighborhood and nutrition literacy play in diet quality for Mexican origin individuals.

**Summary**

In chapter one I presented a brief overview of the background and purpose of this research study. Five specific aims along with five research questions were also presented in this chapter, along with the significance to nursing research. Additionally, definitions of terms used within the following chapters were included. Lastly, assumptions,
limitations, and delimitations for this study were presented. The following chapter will include further background of diet quality, nutrition literacy, and neighborhood in individuals of Mexican origin, as well as the philosophical underpinning and theoretical framework used to guide this study.
CHAPTER II
REVIEW OF THE LITERATURE

The purpose of this study was to bridge the gap in the literature regarding diet quality in Mexican origin individuals. An in-depth literature review was conducted to better understand how neighborhood and nutrition literacy impact diet quality in individuals of Mexican origin. Diet quality is an important concept as it is influential in reducing obesity rates and future health complications. Healthy People 2020 established a goal to maintain the prevalence of obesity among adults living in the United States lower than 30.5%, however, in 2017 the rate of obesity among this population was 42.2% (Centers for Disease Control and Prevention, 2020). The population of interest for this study is the Mexican origin population, as it is important to acknowledge differences that exist between Hispanic subgroups, therefore, only individuals of Mexican origin were included in this literature review.

The Socio Ecological Model (SEM) was used as the theoretical framework to better understand the relationships between the individual and community. Additionally, the philosophical underpinning used as the foundation of this study was pragmatism.

Philosophical Underpinning

Pragmatism was the philosophical underpinning that was used for this study. William James, Charles Sanders Peirce, and John Dewey were among the first philosophers to introduce pragmatism into their work (Saunders et al., 2009; Creswell & Plano Clark, 2011). The first source of pragmatism was introduced by Charles Sanders Peirce in his 1878 paper (Atkin, n.d.; Kaushik & Walsh, 2019). Peirce began his initial
work on pragmatism in the 1870s and later reworked his pragmatism theories based on reaction to William James’ work. As a result of this there are two versions of Peirce’s pragmatism: the early pragmatism and the later pragmatism (Atkin, n.d.).

In his early work on pragmatism, Peirce introduced the pragmatic maxim that would clarify how individuals may achieve the highest level of clarity of concepts. Further, Peirce provides three grades of clarity that must be met to obtain the highest level of clarity, also known as the pragmatic maxim (Atkin, n.d.). The three grades include: (1) experience the concept, (2) provide a definition of the concept, and (3) in order to fully understand a concept, one must have encounters with the concept, provide a definition of the concept, and know what outcome to expect based on accuracy of the concept (Atkin, n.d.). Twenty years later, Peirce returned to his initial work on pragmatism and further developed it based on James’ work. The reworking of the initial pragmatism maxim led to a more sophisticated approach about concepts inclusive of subjunctive conditionals (Atkin, n.d.).

Paradigms can vary based on the assumptions of ontology and epistemology (Kaushik & Walsh, 2019; Morgan, 2014; Shah et al., 2018). The three major paradigms are constructivism, positivism, and pragmatism. The constructivist paradigm emphasizes that there are multiple realities that allow for various explanations of the same phenomenon to occur, while positivism maintains that there is only one objective reality (Patel, 2015; Shah et al., 2018). Constructivism considers the individual as being part of the social system and therefore, are influenced based on their role and place in society (Shah et al., 2018). The positivist paradigm ignores that individuals have intention, individualism, and freedom and focus is aimed at objectivity and deductive reasoning.
Pragmatism defines a concept based on how it would help the individual achieve their purpose (Kaushik & Walsh, 2019). Positivism is usually associated with quantitative research, constructivism is typically associated with qualitative research, and mixed methods research is associated with pragmatism (Kaushik & Walsh, 2019; Shah et al., 2018). However, there is no deterministic link that requires that a particular paradigm be aligned with a particular method (Morgan, 2014).

Social research can utilize the pragmatic paradigm regardless of which research method is used to conduct the study (Morgan, 2014). The pragmatic paradigm holds that there are both singular and multiple realities of truth (Kaushik & Walsh, 2019; Shah et al., 2018). Further, pragmatism focuses on answering practical, real world problems (Cohen et al., 2011). Pragmatism acknowledges that there can be both an objective reality and a subjective reality to a problem (Shah et al., 2018). In pragmatic research, the researcher remains neutral and develops no relationship with the participant and is focused on measuring participant behaviors rather than understanding the behaviors (Bryman, 2012; Shah et al., 2018). The goal of the pragmatism paradigm is to address the research question in a practical way, while also acknowledging the way that human nature and the world impacts participants.

While this study aligned with positivism in that generalization of study findings to the Mexican origin population and measurement of participants’ diet quality are goals of the research, positivism holds that measurement rather than understanding is a greater goal. This dissertation study held both measurement and understanding as equally important goals, as increased knowledge of the factors that impact diet quality is essential
to better guide future intervention studies with this population. Additionally, understanding was important as it will aid health care providers in adequately addressing variables that impact diet quality in this population to promote health outcomes.

Pragmatist epistemology holds that knowledge is based on one’s experience (Kaushik & Walsh, 2019). For example, food is often included in social settings such as get togethers, dates, or outings with friends and family. Therefore, as so much of our social environment surrounds food, dietary intake can be influenced by the social circle one belongs to and food that is consumed at events when they are with others. Therefore, while an individual may conclude that they have adequate diet quality when compared to the foods that other individuals are consuming, they may actually have poor diet quality based on the social circle that they encounter with. This aligns with pragmatic epistemology as each person’s experience is unique, yet still remains social in nature (Kaushik & Walsh, 2019; Morgan, 2014). Further, the purpose of pragmatic epistemology is to create change and knowledge that will lead to improvement (Goldkuhl, 2012; Patel, 2015). In alignment with this purpose, this study served to provide knowledge to participants regarding their diet quality with the nutrition report generated at the end of the questionnaire, which may lead to identification of areas for improvement in dietary intake. Additionally, participants were provided with the researcher’s contact information if they would like to receive aggregate-level results when the study is completed.

This philosophical underpinning influenced this dissertation study in two main ways. First, pragmatism focuses on the individual as the decision maker (Salkind, 2010). In a similar way, participants of this study were the decision maker of the foods that they
consumed. Participants must have been 19 years of age or older, which gives them the freedom to make decisions regarding the food that they eat, unlike a child who would be more dependent on foods that their parents provide for them. Second, pragmatism aims to answer practical, real world problems (Cohen et al., 2011). Similarly, this dissertation study aimed to obtain answers regarding the factors that influence diet quality. Diet quality is an important problem in the United States, as it influences various health outcomes such as diabetes and heart disease (Centers for Disease Control and Prevention, 2021b; WHO, 2020).

**Theoretical Framework**

This study is guided by the Socio-Ecological Model (SEM), originally presented as a conceptual model by Urie Bronfenbrenner in the 1970s (Bronfenbrenner, 1979; Kilanowski, 2017). Bronfenbrenner’s purpose for the SEM was to obtain a better understanding of human development (Bronfenbrenner, 1979; Kilanowski, 2017). Since Bronfenbrenner’s initial model, many adaptations of the SEM have been made to explore relationships of phenomenon including child development, physical activity, obesity, and health promotion (Fiese & Jones, 2012; Gregson et al., 2001; United States Department of Health and Human Services & U. S. Department of Agriculture, 2015; Ohri-Vachaspati et al., 2015). Gregson et al. (2001) modified the socio-ecological model for health promotion by McLeroy et al. (1988), which was used for this study.

The SEM is comprised of five levels including the individual, interpersonal, institutional/organizational, community, and social structure, policy, and systems (Gregson et al., 2001; Ohri-Vachaspati et al., 2015). At the center of the SEM is the
individual level, surrounded by the four other levels. In alignment with pragmatist
epistemology, the SEM holds the individual as the most influential level (Kaushik &
Walsh, 2019; Gregson et al., 2001). This theoretical framework was used to inform this
study by acknowledging that the individual is the most influential factor regarding diet
quality (Gregson et al., 2001). Additionally, this theoretical framework aligns with the
philosophical underpinning, pragmatism, used to guide this study as it recognizes the
individual as central because they hold knowledge based on their experiences (Kaushik &
Walsh, 2019).

**Individual**

The SEM’s constructs and the impact to the individual can vary based on
proximity to the individual level. This level is the most influential level for an individual
(Gregson et al., 2001). At the individual level, various factors can impact a person’s diet
quality. Such factors can include a person’s knowledge, beliefs, skills, and personality
traits (Golden & Earp, 2012; Gregson et al., 2001; McLeroy et al., 1988). Participants for
this study were all adults and have the autonomy to include their personal choices into
their diet, whereas children would not have the same option if meals were prepared for
them by other individuals. The individual level is often measured using surveys or
interviews to assess behavior (Gregson et al., 2001). For this study, the individual level
was measured with the Nutrition Literacy Assessment Instrument (Gibbs, 2012) to
measure nutrition literacy. Further, the Diet History Questionnaire III (National Cancer
Institute, 2020c) was used to obtain a diet history and Healthy Eating Index – 2015
(National Cancer Institute, n.d.d.) score to measure the individual’s diet quality.
Interpersonal

The Interpersonal level is the second level of the SEM. This level is the most influential to the individual, as it comprised of family, friends, and social networks who directly interact with the individual (Lee et al., 2017; Gregson et al., 2001; McLeroy et al., 1988). An individual’s dietary intake can be influenced by people in their interpersonal circle when attending gatherings that involve food. Additional factors in the interpersonal sphere can impact diet quality such as household. For example, in 2016, 64 million Americans were living in multigenerational households, with prevalence of this being higher for Hispanic and Asian American families compared to their white counterparts (Cohn & Passel, 2018).

Organization

Organization is the third sphere of the SEM. The organizational level includes public agencies, or service organizations that can influence large populations (Gregson et al., 2001). This level impacts individuals regardless of their presence or direct participation within the organization (Bronfenbrenner, 1979). For example, health requirements for grocery stores and restaurants imposed by a city health department impact an individual, regardless of their involvement in the organization. Further, many organizations have the ability to provide economic and social resources for individuals (McLeroy et al., 1988).

Community
The fourth level of the SEM is community, which refers to the built environment surrounding the individual. Community is influential of an individual’s neighborhood including green space and food availability (Ohri-Vachaspati, et al., 2015; Lee et al., 2017). For example, a school’s neighborhood environment can be influential of childhood obesity based on the amount of green space that is available for students (Ortega Hinojosa et al., 2018). Further, lack of grocery stores in a community, can negatively impact healthy eating behaviors (Reed et al., 2016). Components of the built environment within the community can influence norms, values and attitudes related to health behaviors (McLeroy et al., 1988). Therefore, examining the impact that the community sphere of the SEM has on an individual is essential in understanding influencing variables of diet quality.

Public Policy

Public Policy is the outermost level of the SEM. This level refers to local, state, and federal regulations that are in place which impact the individual (Gregson et al., 2001). Policies implemented through these types of agencies have helped in reducing health risks, such as limitation of smoking in public buildings, that could lead to chronic diseases later in life (McLeroy et al., 1988). Federal regulations may also include policies on immigration, housing, sanitation, food stamps, and state funding (Lee et al., 2017; McLeroy et al., 1988). Within the United States, 9.5 million low-income families rely on the Supplemental Nutrition Assistance Program (SNAP) for support in purchasing food (Feeding America, n.d.). While these individuals may not be personally involved in the
process of creating and implementing these policies, the regulations enacted by these entities can positively or negatively impact the individual.

**Conclusion**

An individual’s health can be affected by the interactions between the five levels of the SEM (Kilanowski, 2017). Three variable relationships inclusive of nutrition literacy, neighborhood, and diet quality were examined in this study. The variable relationships in this study can be explained with help of the SEM’s constructs, specifically, the individual and community spheres of the SEM. The variables of nutrition literacy and diet quality were at the individual level, while at the community level, neighborhood, was assessed. In addition to the SEM guiding this dissertation study, pragmatic epistemology also guided this study in a similar way. The individual plays an important role in both the philosophical underpinning and theoretical framework. Pragmatism holds the individual as being central due to the knowledge they hold based on their prior experiences (Kaushik & Walsh, 2019). Similarly, the SEM holds the individual level as reflective of the individual’s knowledge based on decisions they make (Gregson et al., 2001). This concept of the individual shared by both the SEM and pragmatism, applied to this dissertation study as it was centered around the individual and their diet quality.

**Literature Review**

Four data bases were searched for literature regarding this topic: Cumulative Index of Nursing and Allied Health Literature (CINAHL), Cochrane, Ovid, and PubMed.
Keywords used included: Diet quality, neighborhood, nutrition literacy, nutrition knowledge, Mexican, and Mexican American with search techniques including ‘or’ and ‘and’. Additionally, Mexican immigrant generation and diet quality were searched in the four databases to obtain a better understanding of how the various immigrant generations impact diet quality in this population. Inclusion criteria for the literature was limited to articles published in English, published between the year 2005 and 2021, set in the United States, and focused on adults. Exclusion criteria included any articles published prior to the year 2005, not in English, set outside of the United States, and included children. The timespan of 2005-2021 was used as the 2005, 2010, and 2015 Dietary Guidelines for Americans provided similar recommendations including the reduction of sugar and refined grain intake, and limiting dietary fat to 20-35% of calories, which were different in previous versions of the Dietary Guidelines for Americans (Mozaffarian & Ludwig, 2015). Following application of the inclusion and exclusion criteria, 30 articles were reviewed.

Of the 30 articles reviewed, 20 related to neighborhood, two related to nutrition literacy, and eight related to diet quality. Articles found were representative of various disciplines including, medicine, nursing, dieticians, psychology, physical therapy, and social work. Study designs included randomized controlled trials, cross-sectional, longitudinal, and prospective. Findings from the literature search are discussed in three categories: Diet quality, neighborhood, and nutrition literacy. Each category will provide a description of the topic prior to the review of articles found in the literature. Tables included in the literature review will include author, year, article title, objective, subjects, design, instruments, and limitations. There is limited research available regarding solely
the Mexican origin population, further establishing the need to address the gaps found in the literature.

**Diet Quality**

The USDA (2020) defines diet quality as the food choices an individual makes that influence their health. This concept can affect an individual’s life in a variety of ways, as a healthy diet can influence obesity, health, and illness. As the United States obesity epidemic continues to grow, it is increasingly important to address factors that contribute to improving obesity rates, such as diet quality. Higher rates of obesity have been found in the Hispanic population living in the United States, when compared to the general population (Hammons et al., 2019). Food selection influences diet quality and therefore, ensuring that an individual has a healthy diet can aid in preventing illness later in life (Office of Disease Prevention and Health Promotion, 2020; United States Department of Agriculture, 2020; World Health Organization, 2020). Understanding of the factors that lead to poor diet quality and good diet quality are fundamentally necessary to improve health outcomes for individuals living in the United States, particularly for the Hispanic community.

Diet quality is important for various reasons. One reason that this concept of diet quality is important is for promotion of a healthy diet and weight. Both, diet and weight, are ways that Healthy People 2020 has identified to aid in the improvement of health outcomes, as currently 74% of U.S. adults are overweight or obese (Office of Disease Prevention and Health Promotion, 2020; United States Department of Health and Human Services & U. S. Department of Agriculture, 2020). Further, chronic health issues such as
diabetes and heart disease can occur due to an unhealthy diet, making adequate assessment of diet quality essential in improving health outcomes (Centers for Disease Control and Prevention, 2021b; WHO, 2020). Due to the important and fundamental role that diet quality plays in an individual’s life and the increasing rates of obesity in the United States, it is essential that diet quality be suitably measured.

Adequate measurement of diet quality can aid health care providers identify ways to educate individuals on ways to improve their dietary intake. Currently, a variety of methods exist to help measure diet quality. Some of the most common ways to obtain a diet history to measure this concept are through the use of 24-hour recalls, food frequency questionnaires, and food records. A 24-hour recall is a structured interview between the investigator and the respondent, where all foods and beverages consumed within the last 24 hours are recorded (National Cancer Institute, n.d.a). Food frequency questionnaires collect food, beverage, and dietary supplement intake with portion sizes for either the past month or year (National Cancer Institute, n.d.b; National Cancer Institute, 2020c). When using food records to obtain diet history, respondents self-report the foods that they have consumed over the number of days specified by the investigator (National Cancer Institute, n.d.c). All of these dietary intake collection methods can then be used to calculate a Healthy Eating Index score, which provides a score for an individual’s diet quality based on their dietary intake.

The *Dietary Guidelines for Americans* are designed to help Americans consume a healthier diet (United States Department of Health and Human Services and U.S. Department of Agriculture, 2015). Every five years the *Dietary Guidelines for Americans* are updated to include the most up to date evidence on nutrition (Food and Agriculture
Organization of the United Nations, 2021). The current 9th edition of the *Dietary Guidelines 2020-2025* includes greater guidance on nutritional recommendations at different stages of life (United States Department of Agriculture, 2021; Dietary Guidelines for Americans, 2020). The *Dietary Guidelines for Americans* is used to guide the Healthy Eating Index (HEI). The HEI provides a score up to 100, based on compliance with food and beverage intake outlined in the *Dietary Guidelines for Americans* (DGA, 2020). This measurement of diet quality works through evaluation of dietary patterns compared to the recommendations in the *Dietary Guidelines for Americans*. Findings on diet quality scores using the HEI can help health care providers and researchers better implement interventions to improve health outcomes for individuals living in the United States.

Understanding the variables that influence diet quality in the Mexican origin population is needed, as dietary intake differs based on various factors including culture (Reddy & Anitha, 2015). Purposely looking at the differences between ethnic groups regarding diet quality is essential as dietary intake was found to vary by racial groups (Wang & Chen, 2012). Language barriers and access to health care have created higher health risks in Hispanic individuals (Centers for Disease Control and Prevention, 2004). However, through assessment of diet quality in the Mexican origin subgroup, factors that influence this important concept within this specific population can be better understood. Currently, evidence on the variables that influence diet quality in this population is extremely limited, however, as the United States Census Bureau (2020) predicts that the majority population of the United States will be nonwhite by 2050, it is essential that further research be done with this subgroup.
Diet Quality and the Mexican Origin Population

Results from the literature search regarding diet quality in the Mexican origin population yielded eight articles that are presented in Table 1. Of the eight studies reviewed, food frequency questionnaires were used in three of the studies (Errisuriz et al., 2019; Montez & Eschbach, 2008; Palacios et al., 2017) and 24-hour dietary recalls were used in five studies (Gregory-Mercado et al., 2007; Mattei et al., 2016; Pignotti et al., 2015; Yoshida et al., 2016; Yoshida et al., 2017). Four studies utilized reported food intake to calculate a Healthy Eating Index (HEI) score for the participants (Errisuriz et al., 2019; Pignotti et al., 2015; Yoshida et al., 2016; Yoshida et al., 2017). Participants from three of the studies where a HEI score was calculated, had low diet quality scores of 48.62, 50, and 62 and one article did not report HEI scores (Pignotti et al., 2015; Yoshida et al., 2016; Yoshida et al., 2017). One study also calculated Alternate Healthy Eating Index (AHEI) to obtain participant diet quality score based on their reported intake and found Mexican origin participants to have higher AHEI scores than other Hispanic subgroups (Mattei et al., 2016). However, diet quality was still low for Mexican origin individuals at 52.6 (Mattei et al., 2016). Two articles asked for generational status within their studies, however, findings were not presented based on generational status (Mattei et al., 2016; Montez & Eschbach, 2008).
### Table 1.
*Research Studies on Diet Quality in the Mexican Origin Population*

<table>
<thead>
<tr>
<th>Author and year</th>
<th>Title</th>
<th>Objective</th>
<th>Subjects</th>
<th>Design</th>
<th>Diet quality measurement instruments</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Errisuriz et al., 2019</td>
<td>Depression and Physical Activity Affect Diet Quality of Foreign-born Latina Women Living on the U.S.-Mexico Border</td>
<td>To (1) examine the relationship between depression and diet quality and (2) identify if physical activity moderates this relationship</td>
<td>$N = 534$</td>
<td>Cross-sectional</td>
<td>Food frequency questionnaire HEI</td>
<td>Cross-sectional Findings may not be generalizable to Latinas living in other parts of the US</td>
</tr>
<tr>
<td>Gregory-Mercado et al., 2007</td>
<td>Ethnicity and nutrient intake among Arizona wisewoman participants</td>
<td>To compare nutrient intake between uninsured Mexican American women and non-Hispanic white women</td>
<td>$N = 361$</td>
<td>Longitudinal</td>
<td>24-hour recalls</td>
<td>Self-reported dietary intake</td>
</tr>
<tr>
<td>Mattei et al., 2016</td>
<td>Diet Quality and Its Association with Cardiometabolic Risk Factors Vary by Hispanic and Latino Ethnic Groups</td>
<td>To examine diet quality and metabolic syndrome across six Hispanic and Latino backgrounds</td>
<td>$N = 12,406$</td>
<td>Cross-sectional</td>
<td>24-hour recalls Alternate HEI</td>
<td>Cross-sectional Self-reported dietary intake</td>
</tr>
<tr>
<td>Study</td>
<td>Background</td>
<td>Objective</td>
<td>Sample Size</td>
<td>Design</td>
<td>Data Collection</td>
<td>Findings/Notes</td>
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<tr>
<td>Montez &amp; Eschbach, 2008</td>
<td>Country of birth and language are uniquely associated with intakes of fat, fiber, and fruits and vegetables among Mexican-American women in the United States</td>
<td>To examine the relationship between diet, country of birth, and language acculturation among Mexican-American women</td>
<td>N = 1,245</td>
<td>Cross-sectional</td>
<td>Food frequency questionnaire</td>
<td>Cross-sectional Abbreviated version of FFQ</td>
</tr>
<tr>
<td>Palacios et al., 2017</td>
<td>Dietary Patterns in Puerto Rican and Mexican-American Breast Cancer Survivors: A Pilot Study</td>
<td>To examine diet patterns and diet quality in Mexican American and Puerto Rican breast cancer survivors</td>
<td>N = 45</td>
<td>Randomized controlled trial</td>
<td>Food frequency questionnaire</td>
<td>Cross-sectional Small sample size Different FFQs used</td>
</tr>
<tr>
<td>Pignotti et al., 2015</td>
<td>Comparison and evaluation of dietary quality between older and younger Mexican-American women</td>
<td>To examine differences in diet quality among younger and older Mexican American women</td>
<td>N = 139</td>
<td>Cross-sectional</td>
<td>24-hour recalls</td>
<td>Cross-sectional Self-reported dietary intake</td>
</tr>
<tr>
<td>Yoshida et al., 2016</td>
<td>Diet quality and its relationship with central obesity among Mexican Americans: findings from National Health and Nutrition Examination</td>
<td>To examine diet quality and its impact on central obesity in Mexican American men and women</td>
<td>N = 6847</td>
<td>Cross-sectional</td>
<td>24-hour recalls</td>
<td>Cross-sectional Social desirability bias</td>
</tr>
<tr>
<td>Study</td>
<td>Title</td>
<td>Sample Size</td>
<td>Study Design</td>
<td>Data Collection Method</td>
<td>Bias</td>
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<tr>
<td>Yoshida et al., 2017</td>
<td>Role of age and acculturation in diet quality among Mexican Americans - Findings from the National Health and Nutrition Examination Survey, 1999-2012</td>
<td>$N = 6847$</td>
<td>Cross-sectional</td>
<td>24-hour recalls</td>
<td>Cross-sectional Social desirability bias</td>
<td></td>
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</tbody>
</table>
Diet quality is a central component of an individual’s overall health. Various factors have been found to influence diet quality including depression, acculturation, physical activity, and age (Errisuriz et al., 2019; Mattei et al., 2020; Montez & Eschbach, 2008; Pignotti et al., 2015; Yoshida et al., 2017). Gregory-Mercado et al. (2007) examined the differences in diet quality between Mexican American women and non-Hispanic white women and found higher rates of obesity in Mexican American women. Further, Latina women experiencing depression had lower diet quality scores than Latina women without depression, but women who met physical activity guidelines had a higher probability of having better diet quality than those that did not (Errisuriz et al., 2019). Overall, Mexican origin individuals had higher incomes and physical activity level when compared to other Hispanic subgroups, however, they had lower educational attainment (Mattei et al., 2020).

Acculturation is often studied within this population. Acculturation includes the adaptation of values, beliefs, and customs of the new country by new immigrants and their families (Mody, 2007). Increased acculturation has been found to be inversely related with diet quality (Yoshida et al., 2017; Montez & Eschbach, 2008). Unfavorable diet quality outcomes have been found in individuals with higher acculturation. In measuring acculturation, researchers often use available acculturation scales or base acculturation dependent on the individual’s country of birth or language. Montez and Eschbach (2008) found that country of birth was a better predictor of nutritional intake than language.

When comparing diet quality in Mexican American men and Mexican American women, women were found to have better diet quality than men that was associated with
a reduced chance of obesity (Yoshida et al., 2016). Mexican American women reported higher intake of fruits, vegetables, total grains, whole grains, added fat, and calories from solid fats and added sugars when compared to Puerto Rican women (Palacios et al., 2016). Further, when comparing US-born, English-speaking women and their Mexican-born counterparts, increased language acculturation was associated with lower consumption of fruits and vegetables (Montez & Eschbach, 2008). Lastly, age was also a factor impacting diet quality score. As participant’s age increased, diet quality score also increased (Pignotti et al., 2015; Yoshida et al., 2017). Overall, English-speaking, US-born Mexican American women, are at highest risk for having poor diet quality (Montez & Eschbach, 2008).

Many studies have been conducted that examine factors that influence diet quality in the Hispanic population, however, only a few studies exclusively address individual subgroups within this population. To the author’s knowledge, only eight articles are available that address the factors that influence diet quality in the Mexican origin population. Because diet quality can vary based on an individual’s culture, it is important that subgroups of the Hispanic population be examined separately, and not as one homogenous group (Siega-Riz et al., 2019). Further, acknowledging factors that impact diet quality within individuals of Mexican origin will aid in further understanding how to adequately create interventions to support positive health outcomes. For example, Mexican-born Hispanic individuals were found to have healthier dietary intake than their US-born counterparts (Dixon et al., 2000). Additionally, the longer individuals remain in the United States, the worse their diet quality becomes (Batis et al., 2011). Due to the vast number of factors impacting Hispanic diet quality, it is essential to differentiate between
the subgroups that make up the Hispanic population and seek to obtain better understanding of how these various factors impact diet quality.

**Nutrition Literacy**

Assessment of nutrition literacy is critical in understanding an individual’s food choices and dietary behavior. Understanding individual’s food choices is essential as the obesity epidemic in the United States continues to grow. In 2018, the United States’ obesity rate for the general adult population was at 42.2% and 44.8% for Hispanic adults (Centers for Disease Control and Prevention, 2020; Centers for Disease Control and Prevention, 2021a). With obesity rates continuing to rise it is increasingly important to understand the impact that nutrition literacy has on individuals. Nutrition knowledge has the ability to impact the food selections that individuals make (Gibbs, 2012). Therefore, better understanding of nutrition literacy and how it impacts individuals’ overall diet quality is essential in improving obesity rates in the United States.

Health literacy skills are vital to navigating the health care system in the United States (Morrison et al., 2013). While many health care providers place an emphasis on health literacy and ensuring that patients are understanding the instructions given to them, it is equally important to assess nutrition literacy when addressing issues of diet quality and obesity. When the concepts of health literacy are applied specifically to nutrition, this is often referred to as nutrition literacy. Silk et al. (2008) defined nutrition literacy as an individual’s ability to obtain, process, and understand nutrition information and skills to make suitable nutrition choices. An overlap exists between nutrition literacy and food literacy, mainly regarding how food is selected (Velardo, 2015). An individual’s ability
to comprehend concepts related to nutrition is important, especially if the individual has
developed a disease that could have been prevented with adequate nutrition knowledge
(Gibbs & Chapman-Novakofski, 2013).

Currently, there are various measures available to assess nutrition literacy. Such
measures include: The Electronic Nutrition Literacy Tool (e-NutLiT; Ringland et al.,
2016), Newest Vital Sign (NVS; Weiss et al., 2005), Nutrition Literacy Assessment
Instrument (NLit; Gibbs, 2012), Nutrition Literacy Scale (NLS; Diamond, 2007),
Nutrition Literacy Items for an Elderly Japanese Population (NLQ-JP; Aihara & Minai,
2011), and Critical Nutrition Literacy Instrument (CNLI; Guttersrud et al., 2014). Of the
previously listed measures, the NLit and the NVS are both available for use in English
and in Spanish. Availability of tools in Spanish to measure nutrition literacy is critical in
obtaining better understanding of Hispanic nutrition knowledge and diet quality,
specifically in Mexican origin individuals.

Multiple components contribute to nutrition literacy. For example, the Nutrition
Literacy Assessment Instrument utilizes six subscales to measure nutrition literacy:
Nutrition and Health, Energy Sources in Food, Food Label and Numeracy, Household
Food Measurement, Food Groups, and Consumer Skills (Gibbs et al., 2018b). The
Nutrition Facts Panel (NFP) is often used as a component of nutrition literacy
measurement (Blistein & Evans, 2006; Gibbs et al., 2018b). One study found that 53% of
its participants consistently utilized NFPs when making food purchasing decisions
(Blistein & Evans, 2006). Other components of nutrition literacy include concepts such as
differentiation between nutrient-dense foods and energy-dense foods, as well as refined
grains and whole grains. Having sufficient knowledge about which types of foods should
be eaten more frequently and which should be eaten less frequently, will have an impact on an individual’s diet quality and health outcomes.

Adequate nutrition literacy can have an influence on diet quality in a variety of ways. Without knowledge of the types of foods that should be eaten, individuals may select foods that are not healthy. For example, if a health care provider informs a patient that they need to increase their intake of vegetables, but does not provide further instructions, the patient might purchase canned vegetables instead of fresh vegetables. Assessment of the patient’s nutrition literacy and understanding of the nutritional value of fresh vegetables versus canned vegetables would have been beneficial in this situation. Along with a known need for education to support nutrition literacy, there is also a need for socioeconomic interventions. Socioeconomic interventions in combination with education can help improve dietary intake and diet quality, as food insecurity is often associated with diet quality (Beydoun & Wang, 2008; Wang & Chen, 2012; Larson et al., 2020).

Nutrition literacy has been found to be a significant predictor of diet quality (Gibbs et al., 2018b). If individuals are not cognizant of the nutritional value of the foods or portion sizes that they should consume, they may not know when the foods that they are consuming may be keeping them from reaching their diet and health goals. Nutrition is a critical component in prevention of future health complications including diabetes, hypertension, and obesity (Franz et al., 1995; Sacks et al., 2001; Office of Disease Prevention and Health Promotion, n.d.). High rates of obesity exist in Mexican origin individuals living in the United States (Satia-Abouta, 2003). In one study, Hispanic participants were found to have fair nutrition knowledge, however, differentiation
between Hispanic subgroups and how the subgroups scored was not taken into account (Acheampong & Haldeman, 2013). It is important that nutrition literacy be measured in Hispanic subgroups, as this population continues to grow in the United States.

The Hispanic population has been found to have only fair nutrition knowledge when compared with other populations. Further, this population has a higher prevalence of obesity than other minority groups (Martinez, 2013). Better understanding of nutrition literacy is essential to aid in improving health outcomes for the Hispanic population living in the United States. Additionally, it is necessary to acknowledge the differences between Hispanic subgroups, rather than treating the population as one homogenous group, as diet can vary based on various factors including individual’s culture and ethnicity.

**Nutrition Literacy and the Mexican Origin Population**

Results from an extensive review of the literature yielded two articles related to nutrition literacy in the Mexican origin population that are presented in Table 2. One study was a randomized controlled trial conducted in El Paso County that included only females (Otilingam et al., 2015). The second study was a cross sectional design conducted in Los Angeles County and included a sample of 61.3% female participants and 38.7% male participants (Sharma et al., 2008). Sharma et al. (2008) found that knowledge regarding the needed servings of fruits and vegetables, beans, and water was lowest for Mexican origin individuals compared to their counterparts. Of the participants in this study, Mexican origin males had the lowest nutrition knowledge (Sharma et al., 2008). Nutrition knowledge was found to be a strong predictor of an individual’s eating
behavior, except for fruits and vegetables (Sharma et al., 2008). Education programs regarding nutrition should target women, as they have the potential to impact the entire family (Sharma et al., 2008; Wansink, 2006). Otilingam et al. (2015), implemented an intervention study with women, inclusive of workshops that provided education on nutritional choices and dietary fat modification strategies. Participants reported that learning how to read nutrition labels was the most important thing they had learned from the intervention class (Otilingam et al., 2015). This finding suggests that nutrition literacy is a valuable skill for individuals in this population to have in order to successfully modify their diet.
Table 2.  
*Research Studies on Nutrition Literacy in the Mexican Origin Population*

<table>
<thead>
<tr>
<th>Author and year</th>
<th>Title</th>
<th>Objective</th>
<th>Subjects</th>
<th>Design</th>
<th>Nutrition literacy measurement instrument</th>
<th>Limitations</th>
</tr>
</thead>
</table>
| Otilingam et al., 2015 | Buenos habitos alimenticios para una buena salud: Evaluation of a nutrition education program to improve heart health and brain health in Latinas | Evaluation of nutrition education targeting Latinas                      | $N = 100$ | Randomized controlled trial | Newest Vital Sign                          | Small sample size  
Self-report  
No long-term follow up with participants |
| Sharma et al., 2008 | Nutrition knowledge predicts eating behavior of all food groups except fruits and vegetables among adults in the Paso del Norte region: Que sabrosa vida | Assess relationship between nutrition knowledge and eating behavior       | $N = 963$ | Cross-sectional design      | QSV Guide to Healthy Living                | Did not assess portion size  
Nutrition knowledge scored as correct or incorrect, limiting understanding of overestimation or underestimation of servings |
Neighborhood

The neighborhoods that people reside in are important influencers of health. Neighborhood factors have been found to influence diet quality, problem drinking behaviors, violence, physical activity, and obesity (Espinosa de Los Monteros et al., 2008; Joseph & Vega-Lopez, 2020; Kelly et al., 2010; Lee & Ferraro, 2007; Martinez et al., 2012). The neighborhood’s built environment, including proximity to grocery stores, liquor stores, and green space, is an important contributor to this as it can have a positive or negative impact on residents of the neighborhood. Further, having high density ethnic composition of a neighborhood can impact various aspects of an individual’s health (Gerst et al., 2011; Lisabeth et al., 2010; Stroope et al., 2015).

The built environment of a neighborhood can either support or create barriers to access important health related services such as pharmacies and health clinics. Additionally, the food environment in a neighborhood is critical to accessibility of healthy food options for residents of that neighborhood. Previous research has established that the quantity and quality of food stores that residents have access to within their neighborhood impacts the food they consume, which has an effect on their diet quality (Moore et al., 2008). Understanding how neighborhood influences health is increasingly important for the Hispanic population as the United States continues to become a more diverse nation, and specifically for the Mexican American population as they are the largest Hispanic subgroup in the United States (Burgos et al., 2005; United States Census Bureau, 2020).

Assessment of the influence that neighborhood has on the Mexican origin population is essential to gain a better understanding of its impact on health. Evaluating
neighborhood characteristics such as rural and urban settings, socioeconomic status, access to grocery stores, and availability of healthy foods at stores is important in better understanding how neighborhood factors impact individuals’ diet quality. Participants in one study who were living in rural, less resource-rich neighborhoods, had better reported diets (Jilcott-Pitts et al., 2017). Individuals who were surrounded by fast food restaurants, lived in neighborhoods where there were no low-fat food options, or lived far away from supermarkets and farmers’ markets had poorer diet quality than their counterparts (Gordon-Larsen et al., 2017; Hoerster et al., 2016; Jilcott-Pitts et al., 2015; Moore et al., 2009). Therefore, greater fast-food availability, absence of healthy food, and increased price of fruits and vegetables in neighborhood stores are important components to consider when evaluating an individual’s diet quality.

While availability of healthy food options can be a barrier to eating healthy food, socioeconomic status can also have an impact on food consumed. For example, as the price of healthy food increased, participants were less likely to consume high quality diets (Kern et al., 2017). Additionally, low socioeconomic status, is associated with decreased consumption of fruits and vegetables (Ball et al., 2006; Dubowitz et al., 2008). However, Mexican American individuals that live in ethnically dense Mexican American neighborhoods with low socioeconomic status have features that counterbalance this disadvantage (Stroope et al., 2015). Therefore, obtaining a better understanding of the impact that neighborhood characteristics have on health in the Mexican origin population is essential in comprehending and addressing barriers to promote health outcomes in this population.
Neighborhood and Mexican Origin Population

Results from the literature search regarding neighborhood in the Mexican origin population yielded 20 articles, that are presented in Table 3. Barrio advantage, which suggests that individuals exhibit positive health effects when residing in high density Mexican American neighborhoods (Eschbach et al., 2004), physical activity, and older Mexican origin adults were the three most common themes regarding neighborhood (Aranda et al., 2011; Gerst et al., 2011; Joseph & Vega-Lopez, 2020; Lee & Ferraro, 2007; Martinez et al., 2012; Oluyomi et al., 2014; Salinas et al., 2018; Sheffield & Peek, 2009; Stroope et al., 2015). Additional themes related to neighborhood included acculturation, depression, diabetes, food environment, health, medication adherence, metabolic syndrome, obesity, parenting, and violence (Barnett et al., 2016; Billimek & August, 2014; Espinosa de Los Monteros et al., 2008; Gallo et al., 2012; Kelly et al., 2010; Lee, 2009; Lisabeth et al., 2010; Rote et al., 2017; Salinas et al., 2012; Stroope et al., 2017; Vaeth et al., 2016). Various measures were utilized to assess neighborhood factors including the Neighborhood Scales Questionnaire, Physical Activity and Neighborhood Environment Scale, Neighborhood Socioeconomic Status Index, Mexican Cultural Environment Inventory, Neighborhood Environment Walkability Scale, and U.S. Census data inclusive of neighborhood characteristics (Joseph & Vega-Lopez, 2020; Salinas et al., 2018; Billimek & August, 2014; Salinas et al., 2012; Martinez et al., 2012; Barnett et al., 2016).
<table>
<thead>
<tr>
<th>Author and year</th>
<th>Title</th>
<th>Objective</th>
<th>Subjects</th>
<th>Design</th>
<th>Neighborhood measurement instruments</th>
<th>Limitations</th>
</tr>
</thead>
</table>
| Aranda et al., 2011 | The protective effect of neighborhood composition on increasing frailty among older Mexican Americans: a barrio advantage? | To examine the relationship between frailty in a community sample of Mexican Americans and medical, psychosocial, and neighborhood factors | $N = 2,069$ | Longitudinal | 2000 U.S. Census | Short follow-up period
| | | | | | | Only ethnic density composition of neighborhood was examined
| | | | | | | Selection bias |
| Barnett et al., 2016 | Cultural Factors Moderating Links Between Neighborhood Disadvantage and Parenting and Coparenting Among Mexican Origin Families | To assess how the relationship between acculturation and familism buffer associations between subjective and objective neighborhood disadvantage and parenting | $N = 71$ | Cross sectional | 2010 U.S. Census | Self-reported parenting practices, familism beliefs, and coparenting cooperation |
| Billimek & August, 2014 | Costs and beliefs: understanding individual- and neighborhood-level correlates of | To examine how individual level and neighborhood level indicators influence | $N = 749$ | Cross sectional | Neighborhood Socioeconomic Status Index | Missing data
| | | | | | | Cross-sectional nature
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<td>Factors Associated with Depression Among Mexican Americans Living in U.S.-Mexico Border and Non-Border Areas</td>
<td>To examine the relationship between neighborhood disorder and depression among Mexican Americans</td>
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Neighborhood disadvantage is one of the factors that can be assessed through some of these measures. Neighborhood safety, walking environment, and social unity are all positively associated with higher physical activity levels (Joseph & Vega-Lopez, 2020; Martinez et al., 2012). Oluyomi et al. (2014) found that Mexican American individuals who live in higher walkability index neighborhoods had a higher chance of meeting physical activity guidelines. Additionally, physical activity was positively associated to the neighborhood’s built environment, specifically neighborhood safety factors (Martinez et al., 2012; Salinas et al., 2018). The influence that neighborhood has on individuals is not solely limited to physical activity, but also other aspects of health. For example, neighborhood disadvantage was associated with nonadherence to medication regimen and to reduced supported parenting in mothers with low acculturation (Barnett et al., 2016; Billimek & August, 2014). Additionally, perspectives can be influenced based on the neighborhood that individuals reside in. For example, negative attitudes on couple violence was connected to neighborhood block conditions and collective efficacy was associated with negative attitudes about violence (Kelly et al., 2010). Therefore, understanding the various implications that neighborhood has on individuals is critical to better understanding and improving health outcomes for this population.

One subgroup of this population are older Mexican origin adults, who can be impacted by neighborhood factors in various ways, both positive and negative. The association between older adult health and neighborhood has been examined in multiple studies (Aranda et al., 2011; Gerst et al., 2011; Stroope et al., 2015). Stroope et al. (2015) found that in older Mexican American men, problem drinking was associated with living
in neighborhoods with high co-ethnic density. Additionally, Mexican American women residing in these neighborhoods were found to have higher rates of depression than their male counterparts (Gerst et al., 2011; Vaeth et al., 2016). On the other hand, positive outcomes have been found in older individuals residing in high density Mexican American neighborhoods (Aranda et al., 2011; Sheffield & Peek, 2009). Further, homogeneity of ethnic neighborhood suggests a protective effect for the individuals who reside in those neighborhoods (Aranda et al., 2011). One reason for this may be the higher levels of support reported by residents of these neighborhoods (Rote et al., 2017; Stroope et al., 2017). Additionally, older individuals who live in these neighborhoods were slightly better off cognitively than individuals who lived in a less ethnic dense neighborhood (Sheffield & Peek, 2009). Neighborhood acculturation to United States customs may have a negative influence on health outcomes of the individuals residing in these areas (Yoshida et al., 2016).

Individuals who reported living in high density Mexican American neighborhoods and had less self-reported health complications and higher levels of social support (Aranda et al., 2011; Stroope et al., 2017). Lower fat intake was reported by women who reside in neighborhoods more acculturated to the US (Espinosa de Los Monteros et al., 2008). Interestingly, no significant findings were found when assessing the relationship between inflammatory markers and neighborhood SES (Gallo et al., 2012). Overall, as acculturation increases it is important to further assess variables impacting health, as higher rates of acculturation in previous studies have led to poorer health outcomes.

Neighborhoods tend to have lower socioeconomic status when it is a high Mexican American density area, however, homogeneity of ethnic neighborhood suggests
some protective effect for the individuals who reside in those neighborhoods (Aranda et al., 2011; Stroope et al., 2015). Mexican American individuals who reside in these high density communities, are less at risk for increasing frailty and have decreased chances of medical complications such as stroke, cancer, and hip fractures (Aranda et al., 2011). However, one study found a greater risk of developing diabetes, a high prevalent disease among this population, among individuals living in high Mexican American density areas (Salinas et al., 2012). Generational differences also exist among individuals living in these neighborhoods. For example, in second and third generation Mexican Americans, increased isolation was inversely related to physical health problems (Lee & Ferraro, 2007).

Mental health is also impacted based on the neighborhood that individuals reside in. Unlike physical health, living in a high density Mexican American neighborhood is not always beneficial to Mexican American individual’s mental health (Lee, 2009). The percent of Hispanic individuals living in a high ethnic density neighborhood is related to increased caregiver well-being determined by lower depressive symptoms (Rote et al., 2017). Further, for Mexican American individuals living on the border, a protective effect against depression was found among men, but not women (Vaeth et al., 2016). As Mexican American individuals move into neighborhoods that are more assimilated, there is an increased risk of cognitive decline and presentation of new health conditions (Sheffield & Peek, 2009). On the other hand, living in segregated neighborhoods is associated with anxiety in Mexican American individuals (Lee, 2009). Additional assessment of neighborhood factors is needed to obtain a better understanding of the varying findings in mental health and physical outcomes for this population.
Contributions to health of concepts such as acculturation, neighborhood ethnic density, mental health, and physical health have been studied with the Mexican origin population to understand their impact on health. Numerous aspects influence the structure of the built environment of a neighborhood, making the concept important when assessing health outcomes. For example, one study found that in Mexican American neighborhoods there is a greater number of convenience stores over supermarkets and grocery stores when compared with non-Hispanic, white neighborhoods (Lisabeth et al., 2010). The barrier of accessibility to fresh fruits and vegetables found in grocery stores can have a direct negative impact on health and diet quality, making neighborhood an essential contributor to an individual’s well-being. Overall, the built environment of a neighborhood can either aid in diminishing barriers or create barriers to achieving health outcomes in this population.

Summary

The purpose of the in-depth literature review conducted, was to aid in further understanding these variables in the Mexican origin population. Multiple points can be drawn from this literature review. First, the literature review conducted revealed a gap in the literature regarding neighborhood, nutrition literacy, and diet quality in the Mexican origin population. Second, the population of interest for this study is the Mexican origin population, however, very little literature is available regarding diet quality solely in this Hispanic subgroup. This current gap in the literature pointed toward a need for this dissertation study.
The Socio Ecological Model was used as the theoretical framework for this dissertation study. Specifically, this study aimed to address the interaction between the individual level measured by diet quality and nutrition literacy, and the community level measured by neighborhood. The SEM served as a guide for this study as it holds that the individual makes decisions based on knowledge (Gregson et al., 2001). This concept guided this research by placing the individual at the center of the dissertation study. Further, pragmatism was the philosophical underpinning used as the foundation of this study. Pragmatism also critically informed this study by placing the participant at the center, as they are the main decision maker of their dietary intake.
CHAPTER III
METHODS

Methodology

The purpose of this quantitative study was to understand the relationship among neighborhood, nutrition literacy, and diet quality in the Mexican origin population. The aims for this dissertation study included: 1) Determining the role of nutrition literacy on diet quality, 2) Determining the role of neighborhood on diet quality, 3) Assessing differences in diet quality based on immigration generation, 4) Examine the strength of the relationship between neighborhood and diet quality, and 5) Examine the strength of the relationship between nutrition literacy and diet quality. This chapter will discuss the research design, sample, and instruments that were utilized for data collection in this study.

Design

A descriptive, correlational design was used in this quantitative study to examine the relationships between nutrition literacy and neighborhood and how these concepts impact diet quality in Mexican origin individuals. The questionnaire was a one-time survey, lasting approximately 60-90 minutes. Questionnaires were provided in both English and Spanish, based on the participant’s preferred language. The Nutrition Literacy Assessment Instrument and the Diet History Questionnaire III were currently available in both English and Spanish. Additionally, translation and backtranslation of the consent document and screening questions was completed using the World Health
Organization translation method by qualified translators (World Health Organization, n.d.). Data collected from participants was de-identified and stored on a password protected laptop.

Recruitment and Setting

For this dissertation study, convenience sampling was used for the recruitment of participants. The flyer included the researcher’s contact information, inclusion criteria for the study, and a QR code and link directing participants to the study if they chose to participate. Two recruitment flyers were made, one in Spanish and the other in English. A QR code and link on the recruitment flyer redirected participants to a pre-screening survey in their selected language.

Recruitment took place both in person and online. Social media platforms such as Facebook and Instagram were used for the recruitment of participants. Facebook groups inclusive of the target population, such as the National Association of Hispanic Nurses chapter pages, were sought out by the researcher to ask permission to post recruitment flyers on their page. Additionally, a post was made on Facebook that included the recruitment flyer. In person recruitment occurred at several community sites including postings at grocery stores and flyer distribution at community events, such as parish and school events. Additionally, the researcher reached out to a local school to obtain permission to distribute recruitment flyers at parent teacher conferences.

Participants who chose to complete the questionnaire online were able to do so on Qualtrics, an online survey tool (Qualtrics, 2021). However, Garcia et al. (2017), found that research conducted in person was more successful when collecting data with
Hispanic individuals. Therefore, participants had the option of completing the questionnaire either online or in person. Participants who preferred to complete the questionnaire in person scheduled a time and location to meet with the researcher to complete the questionnaire.

Population

While there are various studies that have looked at the factors that influence diet quality in the Hispanic population, there are very few studies that solely look at specific subgroups of the Hispanic population, such as Mexican origin individuals. Of the 44.8 million immigrants residing in the United States, individuals born in Mexico account for 25% of the population (Budiman et al., 2020). Assessing diet quality within individual subgroups of the Hispanic population, rather than as one homogenous group, is important as diet quality can differ based on culture (Siega-Riz et al., 2019). Additionally, differences exist within Mexican origin Hispanics in the United States. When assessing generational status in this population, first-generation children were less likely to have seen a physician within the last year and had worse health status (Burgos et al., 2005). Compared to the United States population, Mexican origin individuals have been found to have higher rates of obesity (Satia-Abouta, 2003). Therefore, further research is needed regarding the factors that impact diet quality in individuals of Mexican origin living in the United States.

Sample
For this dissertation study, participants needed to meet the following inclusion criteria: 1) Must be at least 19 years old, 2) Self-identified as being of Mexican origin, 3) Speak and read either English and/or Spanish, and 4) To their knowledge no other members of their household have already completed the study. Exclusion criteria for this dissertation study included 1) individuals who did not self-identify as being of Mexican origin, 2) were not at least 19 years old, 3) did not speak and read either English and/or Spanish, or 4) who have another member of their household who has already completed the survey.

Using PASS 2019 (Power Analysis and Sample Size Software, 2019), a sample estimation program, a sample size of 130 participants was needed. Using this conditional power calculation method, this sample size helped achieve 80% power. Based on seven independent variables, this power detected an $R^2$ of 0.1 and alpha of 0.05. Further, the variables tested were adjusted for an additional five covariates, which yielded a combined $R^2$ of 0.05.

**Instrumentation**

Three instruments were used for data collection in this dissertation study. The three instruments included the Area Deprivation Index (University of Wisconsin School of Medicine Public Health, n.d.), Nutrition Literacy Assessment Instrument (Gibbs, 2012), and the Diet History Questionnaire III (National Cancer Institute, 2020c). User agreements for these instruments can be found in Appendix B. The Area Deprivation Index was used to obtain a neighborhood rank for the participants’ neighborhood. The Nutrition Literacy Assessment Instrument was used to obtain a nutrition literacy score
based on participants’ responses. Finally, the Diet History Questionnaire III was used to collect participants’ dietary intake from the past year and calculated a Healthy Eating Index score for diet quality.

**Area Deprivation Index**

The Area Deprivation Index (ADI) was used to obtain a neighborhood disadvantage score for participants. Within the ADI, the term neighborhood is defined based on the census block group. The ADI was originally developed in 1990 and has since been updated to the most current version, the 2019 ADI (University of Wisconsin School of Medicine Public Health, n.d.). To obtain this score from the ADI, participants provided a nine-digit zip code within the study questionnaire. The Area Deprivation Index provided rankings of neighborhoods based on factors such as education, employment, income, etc. (University of Wisconsin School of Medicine and Public Health, n.d.). Neighborhood rankings were available at both the national and state level, with ranks ranging from one to ten. A rank of one indicated a low level of disadvantage, while a rank of ten indicated the highest level of disadvantage (University of Wisconsin School of Medicine Public Health, n.d.). The ADI utilizes 5-year estimates from the U.S. Census’ American Community Survey to designate neighborhood rankings (University of Wisconsin School of Medicine and Public Health, n.d.).

This tool provided useful information on neighborhood disadvantage based on multiple indicators including education, income, employment, and housing quality (University of Wisconsin School of Medicine Public Health, n.d.). Further, the ADI provided information on area deprivation for neighborhoods all throughout the United
States, using an online interactive map (Singh, 2003; Kind et al., 2014). ADIs are not only used in the United States, but are also implemented in other countries including Australia, New Zealand, and Japan (Kurotani et al., 2019; Singh, 2003). In addition to being used in a variety of ways, reliability and validity have been established for the ADI. To establish validity, factor loadings of 17 variables were compared to county-level health outcomes of the original and updated versions of the ADI (Kind et al., 2014; Singh, 2003). To establish reliability, high internal consistency at 0.95 was found (Singh, 2003). This tool aided in assessing the relationship between neighborhood and diet quality in the Mexican origin population for this study.

**Nutrition Literacy Assessment Instrument**

Various factors play important roles in nutrition literacy. Nutrition literacy focuses specifically on health literacy related to food and refers to the ability of being able to process and understand nutrition related information (Velardo, 2015; Zoellner, 2009). To measure nutrition literacy in this study, the Nutrition Literacy Assessment Instrument (NLit) was used. The purpose of this instrument was to measure an individual’s nutrition literacy utilizing various components of nutrition. The NLit was developed by Gibbs (2012) who identified a gap in the instruments available to health care providers for the assessment of nutrition literacy.

The NLit can be used in its entirety, or it can be utilized by individual subscales. The algorithm provided at the beginning of the NLit aids providers in determining which subscales will be important for them to use, based on the concepts of nutrition literacy that they hope to measure in patients. However, based on key feedback, Gibbs (2012)
suggests that the first subscale, “Nutrition and Health”, be used at the beginning with all participants. Other subscales within the NLit assess participant understanding of portion sizes, nutrient information, macronutrients, and food groups (Gibbs, 2012). Face and content validity for the NLit were established (Gibbs, 2012). The subscales “Nutrition and Health” and “Macronutrients” achieved adequate agreement (80% agreement), while the subscales “Household Food Measurement”, “Food Label and Numeracy”, and “Food Groups” achieved good agreement (90% agreement) (Gibbs & Chapman-Novakofski, 2013). When scores for all subscales were combined, the Nutrition Literacy Assessment Instrument achieved agreement at 90%, resulting in overall good agreement (Gibbs & Chapman-Novakofski, 2013). Since the initial version of the NLit, this instrument has been revised.

The revised NLit consists of six subscales including: Nutrition and Health, Energy Sources in Food, Household Food Measurement, Food Label and Numeracy, Consumer Skills, and Food Groups (Gibbs et al., 2018b). Item Content Validity Index (ICVI) and Scale Content Validity Index (SCVI) were established for the NLit with an acceptable ICVI of 0.75 and an acceptable SCVI set at greater than or equal to 0.90 (Gibbs et al., 2017). Initially, the SCVI reported was 0.881, however, with deletion of four items and modification of various items, the SCVI increased to meet the set goal (Gibbs et al., 2017). To further measure validity and reliability of this instrument, Gibbs et al. (2018b), implemented the NLit in a sample of 429 adults with chronic disease. Further, confirmatory factor analysis was used to establish factor validity and reliability at 0.97, with test-retest reliability at 0.88 (Gibbs et al., 2018b). The NLit is comprised of 64 items and provides a nutrition literacy score from 0 to 64 (Gibbs et al., 2018b). A score less
than 44 is indicative of the likelihood of poor nutrition literacy, a score from 45 to 57 is indicative of the possibility of poor nutrition literacy, and a score greater than 58 is indicative of a likelihood of good nutrition literacy. The NLit has been used in a variety of populations and was previously translated to Spanish.

Gibbs et al. (2018a), implemented the translated NLit with 51 participants who identified Spanish as their primary language. To establish validity and reliability of the translated instrument, individuals who participated in this study were asked to complete the Nutrition Literacy Assessment Instrument in Spanish (NLit-S), along with the Short Assessment of Health Literacy-Spanish (SAHL-S), and a demographics questionnaire. Cultural adaptation of foods was completed, so that foods in the NLit-S mirrored nutritional content of foods found in the NLit. The SCVI was established at 0.96, confirming content validity of the translated instrument (Gibbs et al., 2018a). Additionally, entire reliability for the NLit-S was found at 0.994. Overall, the NLit and NLit-S, are valid and reliable instruments in measuring nutrition literacy in individuals.

**Diet History Questionnaire III and Healthy Eating Index**

Various assessment tools are available to measure diet quality. Tools to measure nutritional intake include 24-hour recalls, food frequency questionnaires, and food records. For this study, the Diet History Questionnaire III (DHQ3) was used to assess food and dietary supplement intake. The DHQ3 is a food frequency questionnaire consisting of 135 food and beverage items and 26 dietary supplement items (National Cancer Institute, 2020c). Participants reported their nutritional intake over the past year
and the DHQ3 calculated a Healthy Eating Index (HEI) score based on the foods, beverages, and supplements that participants reported having consumed.

**Healthy Eating Index**

The HEI is a measure of an individual’s diet quality and is updated every few years by the United States Department of Agriculture in collaboration with National Cancer Institute, based on published recommendations in the Dietary Guidelines for Americans (National Cancer Institute, 2020a). The HEI provides a diet quality score based on compliance with the U.S. Dietary Guidelines for Americans, which are aimed at Americans ages 2 years and older (National Cancer Institute, 2020a; National Cancer Institute, n.d.d.). The most recent version of the HEI is the HEI-2015, which is based off the 2015-2020 Dietary Guidelines for Americans (National Cancer Institute, n.d.d.; National Cancer Institute, 2021b). For this dissertation study, this most current version, the HEI-2015, was used to measure diet quality. This scoring metric is composed of thirteen categories that sum up to 100 points (National Cancer Institute, n.d.d.). The thirteen components of the HEI assess either adequacy or moderation. Components that assess adequacy include total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, and fatty acids (National Cancer Institute, n.d.d.). Components that assess moderation include refined grains, sodium, added sugars, and saturated fats (National Cancer Institute, n.d.d.).

Content validity, construct validity, and reliability have all been established for the HEI (Guenther et al., 2014; National Cancer Institute, 2020b; Reedy et al., 2018). Content validity was established for all three versions of the HEI as they adequately
reflect the recommendations of the Dietary Guidelines for Americans (National Cancer Institute, 2020b). Construct validity was established as the HEI measured well when calculating scores for different groups with known differences in diet quality, and when calculating scores for high-quality diet menus (National Cancer Institute, 2020b). Further, Pearson’s correlations of total HEI score and individual component scores, as well as principal components analysis, determined that the HEI is able to adequately assess diet quality (Guenther et al., 2014; National Cancer Institute, 2020b). To assess reliability, Cronbach’s coefficient alpha determined internal consistency, $\alpha = 0.43$, for all available versions of the HEI (Guenther et al., 2008; Guenther et al., 2014; National Cancer Institute, 2020b). Therefore, the HEI is a valid and reliable measure of diet quality.

*Diet History Questionnaire III*

The Diet History Questionnaire III (DHQ3) is a food frequency questionnaire developed from dietary recall data obtained from the National Health and Nutrition Examination Surveys (NHANES) (National Cancer Institute, 2020c). The purpose of the DHQ3 is to assess food and dietary supplement intake for individuals 19 years or older. The DHQ3 is a web-based tool that is available in both English and Spanish (National Cancer Institute, 2020c). Therefore, translation of this tool for this study was not needed. Prior versions of the DHQ instrument include the original Diet History Questionnaire (DHQ) and the Diet History Questionnaire II (DHQ2). Initially, the DHQ was a paper-based tool created by staff at the National Cancer Institute’s Division of Cancer Control and Population Sciences from reported dietary intake from the USDA’s Continuing Survey of Food Intake by Individuals (National Cancer Institute, 2021a). The DHQ2 and
DHQ3 then transitioned to using 24-hour dietary recall data from the NHANES to decide which foods should be included and what appropriate portion sizes would be (National Cancer Institute, 2021a). A validation study comparing the DHQ instrument to two other food frequency questionnaires found the DHQ to be superior in assessing nutrients when using 24-hour diet recalls as reference data (Subar et al., 2001). Moderate reliability coefficients ranging from 0.5-0.8 were found for the majority of the nutrients (Bittoni & Wilkins, 1994). The DHQ3 was created using the same methods as the DHQ, therefore, no evaluation research was completed on the DHQ3 (National Cancer Institute, 2020d).

Currently, four versions of the DHQ3 are available: past year with portion size, past year without portion size, past month with portion size, and past month without portion size (National Cancer Institute, 2020c). For this study, to obtain a comprehensive review of individual’s intake, the questionnaire version that assessed food intake for the past year with portion size was used. Dietary intake assessed in the DHQ3 included fruits, vegetables, soups, rice, meat, eggs, sweets, as well as various types of beverages and supplements. Some of the nutrients and food groups assessed within the DHQ3 included carbohydrates, carotenoids, fats, fatty acids, macronutrients, minerals, and vitamins (National Cancer Institute, 2021b). Age was a factor considered with this instrument, however, developers of the measure found that differentiating by age groups did not improve nutrient estimation (Subar et al., 2000). Using the dietary intake reported by participants on the DHQ3, a Healthy Eating Index – 2015 score was obtained from the online analysis program.

**Data Collection**
Data collection was completed through the use of Qualtrics (Qualtrics, 2021) online or in person for individuals who resided local to the researcher. The NLit and DHQ instruments have both been used in person and online, with no significant differences reported (Gibbs et al., 2018b), therefore, participants selected whether they preferred to complete the study online or in person. The first page of the online Qualtrics survey included the consent document and participants were asked to continue with the survey only if they have read and agreed to the terms of the consent document, which can be found in Appendix C. Similarly, participants who choose to complete the survey in person were first provided with the consent form. Participants were screened for eligibility with a pre-screening questionnaire, prior to beginning the study questionnaire. If participants did not meet inclusion criteria, they were redirected to an end page thanking them for their time and interest in the survey. If participants met inclusion criteria, they were redirected to a new page to begin the questionnaire. Participants completed a questionnaire consisting of demographics, nine-digit zip code, Nutrition Literacy Assessment Instrument, and the Diet History Questionnaire III. If participants needed help providing their nine-digit zip code, a link to the USPS zip code lookup website was provided to aid them in obtaining their nine-digit zip code. Upon completion of the questionnaires, participants received a $25 gift card for their time. Institutional Review Board (IRB) approval was obtained from the Marquette University Institutional Review Board. The IRB approval document can be found in Appendix A.

Data Analysis
All statistical analyses were conducted using SPSS Statistics 27 and SAS edition 9.4 (IBM Corp, 2020; SAS Institute Inc, 2013). General linear model, multiple regressions, and $t$-tests were the most appropriate statistical analyses for the data obtained from this study to answer the proposed research questions. Standard multiple regression was used as we sought to determine the ability of nutrition literacy and neighborhood to predict diet quality in a sample of 130 participants of Mexican origin.

**Conclusion**

Very few studies have assessed diet quality in Mexican origin individuals, prompting the need for further research. Using the ADI, NLit, and DHQ3, insight on the impact that one’s neighborhood and nutrition literacy have on diet quality was obtained. Utilizing both in person and virtual recruitment aided in reaching a larger population to be more representative of Mexican origin individuals living in different parts of the United States. Findings from this study will allow health care providers and researchers to better understand the factors that influence diet quality in the Mexican origin population. Lastly, knowledge gained from this study will guide future intervention studies related to diet quality in this population.
CHAPTER IV and CHAPTER V
RESULTS AND DISCUSSION

These chapters include two manuscripts. The first manuscript is titled, “Diet quality, nutrition literacy, and neighborhood in the Mexican origin population: A literature review”. This literature review serves to provide a background of current literature, as well as identifies the gap in the literature that supports the need for this study. The second manuscript titled, “Exploring the association of nutrition literacy and neighborhood on diet quality in the Mexican origin population” contains the findings of this study.
Diet quality, nutrition literacy, and neighborhood in the Mexican origin population: A literature review

Abstract

Background: Diet quality is an important aspect of an individual’s overall health. To date, there is no literature that examines the connection between diet quality and nutrition literacy, neighborhood, and the Mexican origin population. The present literature review aims to analyze recent literature regarding diet quality, nutrition literacy, and neighborhood related to the Mexican origin population.

Methods: A literature search was conducted using Cochrane, CINAHL, and PubMed. Inclusion criteria included the article being in the English language, set in the United States, adult participants, and human subjects.

Results: A total of seventeen articles related to diet quality were included. No current literature was available related to neighborhood, nutrition literacy, and diet quality in the Mexican origin population.

Discussion: Further assessment of variables that impact diet quality in the Mexican origin population living in the United States is necessary in creating interventions that aid in improving health outcomes for this population.
Introduction

High diet quality is critical in reducing the risk of future health complications (Office of Disease Prevention and Health Promotion, 2020). Higher prevalence of health risks due to language barriers and access to health care have been found in Hispanic individuals (Centers for Disease Control and Prevention, 2004). Further, Hispanic individuals have been found to have higher rates of obesity when compared to the general population (Hammons et al., 2019). Since various health issues such as diabetes and heart disease can occur due to a poor diet, assessment of diet quality is essential to promote optimal health outcomes (Centers for Disease Control and Prevention, 2021; World Health Organization, 2020).

Promotion of a healthy diet and body weight are both ways that Healthy People 2020 has identified to promote individuals’ health, as currently 74% of U.S. adults are overweight or obese (Office of Disease Prevention and Health Promotion, 2020; US Department of Health and Human Services and USDA, 2020). As the United States obesity epidemic continues to grow, it is increasingly important to address factors, such as diet, that contribute to improving obesity rates. Diet quality is influenced by the food choices that individuals make and therefore, ensuring that individuals have healthful diets can aid in preventing illness later in life (World Health Organization, 2020; USDA, 2021). Additionally, understanding the variables that influence diet quality in the Hispanic population is necessary, as dietary intake varies based on culture (Reddy & Anitha, 2015).

Currently, research on factors that influence diet quality in the Hispanic population is extremely limited, however, even less common is research solely conducted
within individual ethnicities, such as those of Mexican origin. As the majority population of the United States will be nonwhite by 2050, as projected by the U.S. Census Bureau (2021), it is essential that diet quality in the Mexican origin population be assessed. Through individual examination of diet quality in the Mexican origin subgroup, factors that influence this important concept within this population can be better understood. To the author’s knowledge, there is no literature that examines the relationship between nutrition literacy, neighborhood, the Mexican origin population, and diet quality. It is necessary that research on diet quality in this population is available, based on the important role diet quality plays on individuals’ current and future health. The purpose of this literature review was to (1) examine how nutrition literacy and neighborhood impact diet quality in the United States population, (2) describe diet quality trends in the Mexican origin population, and (3) evaluate dietary methods used to measure diet quality in the United States.

**Methods**

This paper reviews current available literature on diet quality and the Mexican origin subgroup living in the United States. The electronic databases searched include Cochrane, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and PubMed. Search terms included ‘diet quality’, ‘nutrition literacy’, ‘nutrition knowledge’, ‘Mexican’, ‘neighborhood’, and ‘area deprivation index’.

A literature review of articles published in English between 2005 and 2021 was conducted. Inclusion criteria for the studies selected included articles published in English, set in the United States, focused on adults, focused on diet quality, and the
population was Mexican origin individuals. However, no studies with this specific population were found. Therefore, studies inclusive of all ethnicities were included as they related to nutrition literacy and diet quality or neighborhood and diet quality. Exclusion criteria of studies included studies that were of non-English language, conducted outside of the United States, conducted before 2005, participants were children, and studies on animals. Articles were first screened for inclusion based on the title and abstract. If keywords and concepts were in alignment with inclusion criteria, full text articles were retrieved and assessed for inclusion criteria.

No articles were found pertaining to diet quality and nutrition literacy or diet quality and neighborhood in the Mexican origin population. Therefore, three separate searches were conducted. First, a search using the terms ‘diet quality’ and ‘Mexican’ resulted in a total of 237 articles. After review of the articles, only four articles that related to diet quality in the Mexican origin population were retrieved for inclusion in this review. The second search using terms ‘diet quality’, ‘Mexican’, ‘Hispanic’ or ‘Latino’ and ‘neighborhood’ yielded no results. A literature search omitting the terms ‘Mexican’, ‘Hispanic’, and ‘Latino’, was then conducted, which resulted in 80 results. After review of the 80 articles, seven articles that related to diet quality and neighborhood were retrieved for inclusion in this review. No results were found when ‘diet quality’, ‘Mexican’, and ‘nutrition literacy’ were searched. A literature search omitting the term ‘Mexican’ was then conducted, which resulted in 203 results. After review of the 203 results, six articles were included in the review.

Results
Seventeen total articles were retrieved for inclusion in this literature review. Of the seventeen articles, four were related to diet quality in the Mexican origin population and are summarized in Table 1. Seven articles were related to diet quality and neighborhood, and six articles were related to diet quality and nutrition literacy. Articles related to diet quality and neighborhood are summarized in Table 2 and articles related to diet quality and nutrition literacy are summarized in Table 3.

A way to assess diet quality is by obtaining a Healthy Eating Index (HEI) score. The HEI is calculated by using dietary intake reported by participants through food frequency questionnaires and 24-hour diet recalls. HEI scores range from 1-100, with 1 being the low diet quality and 100 being high diet quality. The average diet quality score for Americans when calculated using the HEI is 59 (USDA Food and Nutrition Service, 2019). Diet quality is assessed based on reported food intake by the participant and is then compared to the Dietary Guidelines for Americans to obtain the diet quality score.
<table>
<thead>
<tr>
<th>Author and year</th>
<th>Title</th>
<th>Objective</th>
<th>Subjects</th>
<th>Dietary Method</th>
<th>Results</th>
<th>Limitations</th>
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<tbody>
<tr>
<td>Montez, &amp; Eschbach, 2008</td>
<td>Country of birth and language are uniquely associated with intakes of fat, fiber, and fruits and vegetables among Mexican-American women in the United States</td>
<td>To examine the relationship between diet, country of birth, and language among Mexican American women</td>
<td>N = 1245</td>
<td>Abbreviated food frequency questionnaire</td>
<td>Increased acculturation as measured by country of birth and language use, was associated with negative diet outcomes.</td>
<td>Utilized abbreviated format of the food frequency questionnaire.</td>
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<td>Pignotti et al., 2015</td>
<td>Comparison and evaluation of dietary quality between older and younger Mexican-American women</td>
<td>To examine differences in diet quality among younger and older Mexican American women</td>
<td>N = 139</td>
<td>24-hour diet recall</td>
<td>Older women had more fruit, vegetable, beans and greens, and fiber intake than younger women</td>
<td>Only one 24-hour diet recall was collected – this is not a good representation of an individual’s usual intake</td>
</tr>
<tr>
<td>Yoshida et al., 2016</td>
<td>Diet quality and its relationship with central obesity among Mexican Americans: findings from National Health and Nutrition Examination Survey (NHANES) 1999-2012</td>
<td>To examine diet quality and its impact on central obesity in Mexican American men and women</td>
<td>N = 6847</td>
<td>24-hour diet recall</td>
<td>Women had better diet quality than men. In men, a higher diet quality score was associated with a decreased chance of central obesity.</td>
<td>Secondary data analysis</td>
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<tr>
<td>Yoshida et al., 2017</td>
<td>Role of Age and Acculturation in Diet Quality</td>
<td>To examine the relationship</td>
<td>N = 6847</td>
<td>24-hour diet recall</td>
<td>Diet quality increased as age increased. Increased</td>
<td>Secondary data analysis</td>
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<tr>
<td>Author and year</td>
<td>Title</td>
<td>Objective</td>
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<td>Drewnowski et al., 2016</td>
<td>Obesity, diet quality, physical activity, and the built environment: The need for behavioral pathways</td>
<td>To assess the relationship between built environment variables and diet and physical activity</td>
<td>N = 387</td>
<td>Food Frequency Questionnaire</td>
<td>Diet quality is not impacted by distance to food locations. Diet quality, physical activity and obesity rates were strongly correlated with neighborhood property values</td>
<td>Sample was mostly representative of females and a younger population; Self-reported diet history</td>
</tr>
<tr>
<td>Gordon-Larsen et al., 2017</td>
<td>Understanding bias in relationships between the food environment and diet quality: The Coronary Artery Risk Development in Young Adults (CARDIA) study</td>
<td>To examine the relationship between neighborhood food options and \textit{a priori} diet quality scores</td>
<td>N = 7740</td>
<td>CARDIA Diet History</td>
<td>\textit{A priori} diet quality scores increased; Availability of fast-food restaurants was associated with poorer diet quality</td>
<td>Self-reported diet history</td>
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<tr>
<td>Authors, Year</td>
<td>Title</td>
<td>Objective</td>
<td>Sample Size</td>
<td>Study Design</td>
<td>Limitations</td>
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<td>Hoerster et al., 2016</td>
<td>Diet quality is associated with mental health, social support, and neighborhood factors among Veterans</td>
<td>To examine the relationship between individual, social and physical environment and diet quality among Veterans</td>
<td>N = 653</td>
<td>Starting the Conversation</td>
<td>Absence of low-fat foods in neighborhood stores was associated with negative dietary behavior; Clinically restricted sample; Limited geographical sample</td>
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<tr>
<td>Jilcott-Pitts et al., 2015</td>
<td>Associations between neighborhood-level factors related to a healthful lifestyle and dietary intake, physical activity, and support for obesity prevention polices among rural adults</td>
<td>To assess the relationship between healthy lifestyle, dietary intake, physical activity and neighborhood-level factors</td>
<td>N = 366</td>
<td>Food Frequency Questionnaire</td>
<td>Living closer to healthy food locations and fewer perceived neighborhood barriers was associated with higher diet quality; Self-reported diet and physical activity</td>
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<tr>
<td>Jilcott-Pitts et al., 2017</td>
<td>Examining the association between intervention-related changes in diet, physical activity, and weight as moderated by the food and physical activity environments among rural, southern adults</td>
<td>To examine whether changes in diet, physical activity, and weight were moderated by food and physical environment</td>
<td>N = 249</td>
<td>Food Frequency Questionnaire</td>
<td>Participants living in rural, less-resource rich food environments had greater improvements in diet; Small sample size; Inadequate power</td>
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<td>Kern et al., 2017</td>
<td>Neighborhood prices of healthier and unhealthier foods and</td>
<td>To examine the relationship between</td>
<td>N = 2765</td>
<td>Food Frequency Questionnaire</td>
<td>As price of healthy food increases relative to unhealthy foods, the odds; Selection bias based on</td>
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</table>
associations with diet quality: Evidence from the multi-ethnic study of atherosclerosis

Neighborhood food price and diet quality

Are lower of having a higher diet quality

Proximity to supermarket

Moore et al., 2009

Fast-food consumption, diet quality, and neighborhood exposure to fast food: The multi-ethnic study of atherosclerosis

To examine relationships between consumption of fast food, diet, and neighborhood fast-food exposure

N = 5633

Food Frequency Questionnaire

As fast-food consumption increased, odds of having poor diet quality increased 2-3-fold

Nutritional quality of fast foods eaten was not assessed

<table>
<thead>
<tr>
<th>Author and year</th>
<th>Title</th>
<th>Objective</th>
<th>Subjects</th>
<th>Dietary Method</th>
<th>Results</th>
<th>Limitations</th>
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<tr>
<td>Acheampong &amp; Haldeman, 2013</td>
<td>Are nutrition knowledge, attitudes, and beliefs associated with obesity among low-income Hispanic and African American women caretakers?</td>
<td>To describe knowledge, attitudes beliefs, and self-efficacy; To examine relationships between variables and diet quality and weight status; Identify barriers to healthy eating</td>
<td>N = 364</td>
<td>Food Frequency Questionnaire</td>
<td>Hispanic participants had fair nutrition knowledge; No relationship between nutrition knowledge, attitudes, beliefs and self-efficacy and diet quality</td>
<td>Convenience sample; Diet quality assessment did not include all food groups; Secondary data collection</td>
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<td>Research Question</td>
<td>Methodology</td>
<td>Sample Size</td>
<td>Findings</td>
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<td>Beydoun &amp; Wang, 2008</td>
<td>Do nutrition knowledge and beliefs modify the association of socio-economic status on diet quality and fruit and vegetable intake, and nutrition knowledge and beliefs</td>
<td>N = 4356 24-hour recalls</td>
<td></td>
<td>Socio-economic interventions, as well as health education must both be implemented to improve diet quality</td>
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<tr>
<td>Gibbs et al., 2016</td>
<td>Assessing the nutrition literacy of parents and its relationship with child diet quality</td>
<td>N = 101 24-hour recall</td>
<td></td>
<td>Parental nutrition literacy was a significant predictor of the child’s diet quality</td>
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<td>Gibbs et al., 2018</td>
<td>The Nutrition Literacy Assessment Instrument (Nlit) is a valid and reliable measure of nutrition literacy in adults with chronic disease</td>
<td>N = 429 Food Frequency Questionnaire</td>
<td></td>
<td>Nutrition literacy was a significant predictor of diet quality; The Nlit is a reliable and valid tool to measure nutrition literacy</td>
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<tr>
<td>Larson, Laska, &amp; Neumark-</td>
<td>Food insecurity, diet quality, home food availability, and</td>
<td>N = 1518 Food Frequency Questionnaire</td>
<td></td>
<td>Poor diet quality, availability of healthy foods and fast-food</td>
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<tr>
<td>Reference</td>
<td>Study Title</td>
<td>Objective</td>
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<td>Findings/Results</td>
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<td>Sztainer, 2020</td>
<td>health risk behaviors among emerging adults: Findings from the eat 2010-2018 study</td>
<td>insecurity and diet quality, food literacy, home food availability, and health behaviors</td>
<td>N = 4356 24-hour recall</td>
<td>intake were associated with food insecurity reported diet history</td>
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<tr>
<td>Wang &amp; Chen, 2012</td>
<td>Between-group differences in nutrition- and health-related psychosocial factors among us adults and their associations with diet, exercise, and weight status</td>
<td>To examine ethnic differences in nutrition and health related psychosocial factors to diet, exercise, and weight status</td>
<td>N = 4356 24-hour recall</td>
<td>Large racial/ethnic group differences in dietary intake; Groups with higher socioeconomic status had higher diet quality scores</td>
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Mexican Origin Population

Various studies have examined factors that influence diet quality in the Hispanic population. However, few studies disaggregate Hispanic subgroups and to date, studies regarding diet quality in the Hispanic population have focused on the population as one homogenous group. It is important that subgroups of the Hispanic population be examined separately, and not as one homogenous group, as diet quality can differ based on culture (Siega-Riz et al., 2019). A total of four articles that address factors that influence diet quality in the Mexican origin population were identified.

Multiple factors related to diet quality in the Mexican origin population were examined in the four studies. These factors included age, acculturation, and sex (Montez & Eschbach, 2008; Pignotti et al., 2015; Yoshida et al., 2016; Yoshida et al., 2016). Yoshida et al. (2016) examined the relationship between diet quality and central obesity, finding that Mexican origin women had better diet quality compared to Mexican origin men, resulting in a decreased incidence of central obesity for women (Yoshida et al., 2016). Age was found to have a direct relationship with diet quality score (Pignotti et al., 2015; Yoshida et al., 2017), while increased acculturation scores were inversely related with diet quality scores (Montez & Eschbach, 2008; Yoshida et al., 2017).

Various methods exist to measure diet quality. Measures used to assess diet quality within these studies included an abbreviated food frequency questionnaire and 24-hour diet recalls. Three studies utilized a 24-hour recall and calculated Healthy Eating Index–2010 (HEI–2010) scores for the participants to obtain their diet quality score based on their reported intake (Montez & Eschbach, 2008; Yoshida et al., 2016; Yoshida et al., 2017). Participants from two of the three studies were found to have low diet quality
scores with means of 48.62 and 50 (Yoshida et al., 2016; Yoshida et al., 2017), however a study by Pignotti et al. (2015) had a mean diet quality score of 62, which is higher than the national average diet quality score for Americans of 59 (USDA Food and Nutrition Service, 2019).

**Neighborhood**

Assessment of the impact neighborhood has on diet quality is critical to better understanding factors that can negatively impact individuals’ health outcomes. However, to date there is no current literature that examines the impact neighborhood has on diet quality in the Mexican origin population. Seven articles that address the impact of neighborhood on diet quality were identified.

A variety of neighborhood level factors can have an impact on the food that is consumed by individuals residing in that neighborhood. For example, lower socioeconomic status was found to be associated with less consumption of fruits and vegetables (Ball et al., 2006; Dubowitz et al., 2008). Other neighborhood level factors that influence diet quality include the price of healthy food, compared to the price of unhealthy food. As the price of healthy food increased, participants were less likely to have a high-quality diet (Kern et al., 2017). An additional barrier to a healthy diet included living far away from supermarkets and farmers’ markets with limited healthy food options, contributing to poorer diet quality (Jilcott Pitts et al., 2015). If no options for low-fat foods in neighborhood stores were present, this was associated with less healthy dietary behaviors (Hoerster et al., 2016; Jilcott Pitts et al., 2017). Jilcott Pitts et al. (2015) found that participants living in rural areas had better dietary intake when they
lived in less-resource rich neighborhoods, however, this contrary finding may be explained by the researcher’s chosen target intervention factors, such as dietary intakes that limit assessment to specific components of diet quality. Additionally, other studies have found that participants living in neighborhoods where availability of fast-food restaurants is high, had a decreased diet quality score (Gordon-Larsen et al., 2017; Moore et al., 2009).

Methods to collect participant dietary intake in these seven studies included food frequency questionnaires and the CARDIA Diet History tool. Food frequency questionnaires were used to collect dietary intake in six of the seven articles retrieved (Drewnowski et al., 2016; Moore et al., 2009; Hoerster et al., 2016; Jilcott Pitts et al., 2017; Jilcott Pitts et al., 2015; Kern et al., 2017) and the CARDIA Diet History tool was used to collect diet intake in the seventh article (Gorden-Larsen et al., 2017).

**Nutrition Literacy**

Health literacy is important in ensuring that health care consumers understand services and make informed decisions. Nutrition is an important component of health and health literacy; however, health literacy assessments do not always focus on nutrition (Carbone & Zoellner, 2012). One current measurement tool available to assess nutrition literacy is the Nutrition Literacy Assessment Instrument (Nlit). The Nlit is a reliable and valid instrument in assessing an individual’s nutrition literacy and evaluating diet quality (Gibbs et al., 2016; Gibbs et al., 2018). To date, there is no literature that examines the impact nutrition literacy has on diet quality in the Mexican origin population. However,
six articles that address the impact of nutrition literacy on diet quality in the general population were identified.

There is a need for further research examining the differences in nutrition literacy between groups as dietary intake was found to vary by racial groups (Wang & Chen, 2012). Acheampong & Haldeman (2013) found Hispanic participants to have fair nutrition knowledge compared to their African American counterparts, however, this study did not differentiate between Hispanic subgroups. While there is a need for health education to incorporate nutrition literacy, socioeconomic interventions can be combined with education to improve diet quality, as socioeconomic status and food insecurity, have been found to be influencing factors of diet quality (Wang & Chen, 2012; Beydoun & Wang, 2008; Larson et al., 2020). While there are various methods to assess diet quality, two primary methods were in these six articles. Three of the six articles utilized food frequency questionnaires to collect participant intake (Gibbs et al., 2018; Acheampong & Haldeman, 2013; Larson et al., 2020), while three other studies used 24-hour recalls to collect participants’ diet history (Gibbs et al., 2016; Wang & Chen, 2012; Beydoun & Wang, 2008).

**Discussion**

The seventeen studies reviewed highlighted the importance of diet quality. Most studies found that older, Mexican origin, women had better diet quality than older, Mexican origin, men and younger, Mexican origin women. This finding is similar to that of the general population. One reason for this may be that older, Mexican origin women are more aware of the foods that they are consuming, and therefore, are less likely to
consume fast food and unhealthy foods. Higher diet quality scores were related to a lower risk of health issues, such as central obesity in Mexican American men and women (Yoshida et al., 2016). Further, as acculturation increased with this subgroup, diet quality decreased. In one study where acculturation was measured based on country of birth and language, country of birth was a stronger predictor in determining diet quality than language spoken by the participant (Montez & Eschbach, 2008). Additionally, language acculturation was found to be inversely related to the consumption of fruits and vegetables. Overall, a higher acculturation level was inversely related to diet quality, regardless of age group.

Neighborhood factors were found to be influential of participant’s diet quality. Type of food available to participants in their neighborhood stores had an impact on reported food consumption. While the distance to food locations (e.g., fast food restaurants, grocery stores, etc.) related to the impact on diet quality varies between studies, neighborhoods with higher property values were found to be strongly correlated with better diet quality and lower rates of obesity rates (Drewnowski et al., 2016). Additionally, greater fast-food availability, absence of healthy food and increased price of fruits and vegetables in neighborhood stores were associated with worse diet quality. Therefore, the community that an individual resides in can impact their diet quality based on their neighborhood factors.

A better understanding of nutrition literacy is critical in improving health outcomes related to diet quality in the United States population. Hispanic individuals have been found to have only fair nutrition knowledge when compared with other groups. However, to gain a better understanding of this population, it is critical to consider
subgroups differences within the Hispanic population. To adequately implement interventions that improve diet quality and health outcomes, it is necessary to understand factors, such as culture, that influence diet quality in individual Hispanic subgroups.

While health care providers focus on health literacy and ensuring that patients understand health instructions provided to them, it is equally important to assess nutrition literacy, as it is a strong predictor of diet quality (Drewnowski et al., 2016). If patients aren’t aware of the nutritional value of foods or portion size of the foods that they consume, they may not understand how the food they are consuming can negatively impact their dietary goals.

Diet quality is key to promote health and can be measured using a variety of methods that currently exist. Two common methods utilized in these articles to measure diet quality were 24-hour recalls and food frequency questionnaires. Additional dietary methods are available to assist in collection of participant diet history, however, only three types were found in this literature review. Of the seventeen studies reviewed, food frequency questionnaires were used in ten studies, 24-hour dietary recalls were used in six studies, and the CARDIA Diet History tool was used in one study. The three assessment tools are all valid methods to collect participants’ dietary intake. The CARDIA Diet History tool is a comprehensive assessment measure that is used to identify eating patterns and nutrient intake (McDonald et al., 1991). Food frequency questionnaires are composed of three main parts including list of foods, frequency of food consumption, and portion size of food consumed (Perez Rodrigo et al., 2015). Lastly, 24-hour recalls gather intake of all foods and beverages that participants consumed within 24 hours (National Cancer Institute, n.d.).
Limitations exist within this review. First, most of the studies included in this review were cross-sectional. Second, social desirability bias is a concern when collecting data on individuals’ dietary methods, as participants may overreport or underreport dietary intake. Lastly, there is minimal literature available regarding diet quality in the Mexican origin population and there is no available literature regarding neighborhood, nutrition literacy. And diet quality in the Mexican origin population.

Conclusions

This review provides a summary of current literature regarding diet quality trends in the Mexican origin population, as well as methods used to measure diet quality. Further, this review includes articles that examine the impact that nutrition literacy and neighborhood have on diet quality in the United States population. Food choices are central to determining diet quality, therefore, understanding factors that influence food choices is necessary in preventing chronic illness (World Health Organization, 2020; US Department of Health and Human Services and USDA, 2020). As the United States continues to become a more diverse nation, it is essential that research reflects this national shift. Health care providers treat patients from many diverse backgrounds; therefore, incorporation of culturally competent care is necessary to optimize outcomes (O’Toole et al., 2019). Very few studies have assessed diet quality in the Mexican origin population, prompting the need for further research. Furthermore, research pertaining to factors that influence diet quality in the Mexican origin population is needed to better understand how to tailor interventions in this population.
Acknowledgments

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Data Availability

Data sharing is not applicable to this article as no datasets were generated or analyzed during the literature review.
References


moderated by the food and physical activity environments among rural, southern adults. *Journal of the Academy of Nutrition and Dietetics, 117*(10), 1618–1627.  
https://doi.org/10.1016/j.jand.2017.04.012

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National Cancer Institute. (n.d.). 24-hour dietary recall (24hr) at a glance. [https://dietassessmentprimer.cancer.gov/profiles/recall/#:~:text=A%2024%20hour%20dietary%20recall,to%20midnight%20the%20previous%20day](https://dietassessmentprimer.cancer.gov/profiles/recall/#:~:text=A%2024%20hour%20dietary%20recall,to%20midnight%20the%20previous%20day)


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MANUSCRIPT 2

Exploring the association of nutrition literacy and neighborhood on diet quality in the Mexican origin population

Abstract

Introduction: Nutrition literacy, neighborhood and diet quality studies have not been specific to any Hispanic subgroup. The aim of this study was to better understand the impact of nutrition literacy and neighborhood on diet quality in the Mexican origin population.

Methods: This study used a descriptive, correlational design to examine the relationships between nutrition literacy and Area Deprivation Index (neighborhood rank) and their impact on diet quality in the Mexican origin population.

Results: Age was found to be a statistically significant predictor of diet quality as a whole. Statistically significant findings for the diet quality subscales of greens and beans, seafood and plant proteins, total vegetables, saturated fats, and refined grains were also found. Nutrition literacy was found to be a predictor of the diet quality subscales seafood and plant proteins, as well as total protein foods. Area Deprivation Index was a significant predictor of diet quality: refined grains. Additionally, various demographic variables were found to impact the relationships with diet quality subscales.

Conclusion: Diet quality is a critical variable in health, making it necessary to better understand influencing factors. The present study aims to close the gap in the literature regarding influencing factors of diet quality in the Mexican origin population. Findings
from this study support the need for additional intervention studies with this population on nutrition education, as well as adequacy and moderation of different food groups.

**Introduction**

Diet quality is a critical and impactful component to individuals’ health outcomes (ODPHP, 2020). Multiple health issues can arise from poor diet quality including diabetes, heart disease, and obesity; therefore, assessment of diet quality is critical in ensuring that individuals’ food choices help them maintain an optimal state of health (CDC, 2021; WHO, 2020). Alarmingly, 74% of adults are overweight or obese in the United States and it is expected that by 2030, one in every two adults will be obese and one in every four adults will be severely obese (USDHHS & USDA, 2020; Ward et al., 2019). The Dietary Guidelines for Americans (DGA) can help individuals recognize healthy eating habits and provide information on how individuals can maintain a high-quality diet. The DGA recommends kcal intake between 1,600 and 2,400 for adult women, and 2,000 to 3,000 for adult men (USDHHS & USDA, 2020). The Healthy Eating Index-2015 (HEI-2015), a measure of diet quality, provides a diet quality score based on reported dietary intake and is intended to align with dietary recommendations from the Dietary Guidelines for Americans (NCI, 2020a).

By 2050, it is projected that most of the United States population will be nonwhite, therefore, as the United States continues to become a more diverse nation, it is critical that research reflects this demographic shift to better serve patients from diverse backgrounds (O’Toole, Alvarado-Little, & Ledford, 2019; U.S. Census Bureau, 2020). According to Reddy and Anitha (2015), dietary intake varies based on one’s culture and
as a result, it is important to understand the variables influencing diet quality, specifically in the largest Hispanic subgroup, Mexican origin individuals. Hispanic individuals have been found to have higher rates of obesity when compared to the general population (Hammons et al., 2019). Therefore, it is critical that factors influencing diet quality in the Mexican origin population be assessed.

Factors related to diet quality such as age, acculturation, and sex have been studied in this population (Montez & Eschbach, 2008; Pignotti et al., 2015; Yoshida et al., 2016; Yoshida et al., 2017), however, there is a need to identify how nutrition literacy and neighborhood rank impact diet quality in this population. While the impact of nutrition literacy on diet quality has been studied, there is a need to identify the differences between groups to better serve the diverse U.S. population (Wang & Chen, 2012). Further, in the general population neighborhood factors such as proximity to grocery stores, availability of fast-food restaurants, and food prices in local stores were found to be influential of participant’s diet quality (Gordon-Larsen et al., 2017; Jilcott Pitts et al., 2015; Kern et al., 2017; Moore et al., 2009). However, these studies were not specific to any population, therefore, identifying how these factors influence the Mexican origin population is needed. The purpose of this study was to better understand diet quality in the Mexican origin population and to explore the following research questions: 1) What are effect sizes of relationships among nutrition literacy, neighborhood rank, and diet quality in a Mexican origin sample?, 2) What differences are observed in diet quality between first generation and second generation and higher Mexican origin immigrants, 3) Does nutrition literacy or neighborhood rank account for more of the variance in diet quality?, 4) Do any demographic variables impact the relationships with diet quality?
and 5) Do the demographic variables have a specific significant relationship with diet quality?

**Method**

This study utilized a descriptive, correlational design to examine the relationships between nutrition literacy and neighborhood rank and their impact on diet quality. Utilizing a sample estimation program, 130 participants were needed to achieve 80% power and alpha of 0.05. Participants were recruited throughout the United States using Qualtrics as the platform for participants to complete their survey online (Qualtrics, 2021). Convenience sampling was used for the recruitment of participants. Recruitment flyers were made available to participants in both English and Spanish. This study was approved by the Marquette University Institutional Review Board.

**Recruitment**

Recruitment was completed both in person and online, based on participant preference. Facebook and Instagram, two social media platforms, were used for the recruitment of participants. The recruitment flyer was posted on the researcher’s Facebook page and shared by other Facebook users. Facebook groups and Instagram accounts inclusive of the target population were sought out by the researcher to share the recruitment flyer. Once approval from the group’s administrator was obtained, the recruitment flyer was shared with members. Recruitment flyers were also shared at community events, grocery stores, and at a national nursing conference.

**Data Collection**
Participants were provided the consent form and screened for eligibility with a pre-screening questionnaire, prior to the study survey. If participants did not meet inclusion criteria, they were redirected to an end page thanking them for their time and interest in the survey. Inclusion criteria included participants being at least 19 years old, self-identify as being of Mexican origin living in the United States, speak and read either English and/or Spanish, and to their knowledge no other member of their household must have already participated. Participants who met inclusion criteria were redirected to the beginning of the survey to complete a one-time, two-part questionnaire lasting between 60 and 90 minutes. Participants who preferred to complete the questionnaire in person, scheduled a time to meet with the researcher to complete the questionnaire.

Three instruments were utilized for this study: Area Deprivation Index (University of Wisconsin School of Medicine Public Health, n.d.), Nutrition Literacy Assessment Instrument (Gibbs, 2012), and the Diet History Questionnaire III (NCI, 2020c). The ADI was used to obtain a neighborhood rank for the participants’ neighborhood. The ADI provides this rank based on neighborhood characteristics including education, employment, income, housing quality, etc. (University of Wisconsin School of Medicine Public Health, n.d.). The NLit was used to obtain a nutrition literacy score based on participants’ responses. This instrument is comprised of six subscales including: “Nutrition and Health”, “Household Food Measurement”, “Food Label and Numeracy”, “Energy Sources in Food”, Consumer Skills”, and “Food Groups” (Gibbs et al., 2018b). Reliability and validity of this instrument were acceptable for both the English and Spanish versions of the instrument (Gibbs et al., 2018a; Gibbs et al., 2018b). Lastly, the DHQ3 was used for participant self-reported dietary intake. The DHQ3
yielded a Healthy Eating Index – 2015 (HEI-2015) score for participants’ diet quality, based on their reported dietary intake (NCI, 2020b). The DHQ3 is a food frequency questionnaire that asked participants about their nutritional intake over the past year (NCI, 2020c).

Participants were asked to complete a demographics questionnaire, ADI, NLit, and to provide an email address. The email address provided in the Qualtrics survey was used to send participants the second part of the study questionnaire, the DHQ3. Upon completion of both parts of the questionnaire, participants were sent a $25 gift card to their provided email to thank them for their time.

Sample

A total of 408 individuals opened the survey link to begin the study. Of the 408 individuals, 110 did not complete the first part of the study and fifty-six did not meet inclusion criteria. Two hundred questionnaires were completed online and 42 were completed in person. Fraudulent activity by bots was detected after sharing the recruitment flyer on social media, which resulted in 99 entries being disqualified from inclusion. A total of 143 participants completed the first part of the study, however, only 130 participants completed the second part. Participants reported zip codes from seven different states: Arizona, California, Illinois, Texas, Virginia, Washington, and Wisconsin. Of the 130 participants, 91 identified as female and 39 identified as male. Further, 72 participants self-identified as first-generation immigrant, 44 participants self-identified as second-generation immigrant, and two participants self-identified as third-
generation immigrant. Table 1 displays additional demographic characteristics of the participants.
<table>
<thead>
<tr>
<th>Categorical Variables</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>91 (70.0)</td>
</tr>
<tr>
<td>Male</td>
<td>39 (30.0)</td>
</tr>
<tr>
<td>Immigrant Generation</td>
<td></td>
</tr>
<tr>
<td>First generation</td>
<td>72 (55.4)</td>
</tr>
<tr>
<td>Second generation</td>
<td>44 (33.8)</td>
</tr>
<tr>
<td>Third generation or higher</td>
<td>2 (1.5)</td>
</tr>
<tr>
<td>Educational Level</td>
<td></td>
</tr>
<tr>
<td>Less than a high school diploma</td>
<td>21 (16.2)</td>
</tr>
<tr>
<td>High school diploma or equivalent degree</td>
<td>38 (29.2)</td>
</tr>
<tr>
<td>Trade or vocational degree</td>
<td>4 (3.1)</td>
</tr>
<tr>
<td>Some college</td>
<td>20 (15.4)</td>
</tr>
<tr>
<td>Associate degree</td>
<td>8 (6.2)</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>26 (20.0)</td>
</tr>
<tr>
<td>Master’s degree</td>
<td>8 (6.2)</td>
</tr>
<tr>
<td>PhD or doctoral degree</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>Employment</td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>72 (55.4)</td>
</tr>
<tr>
<td>Part-time</td>
<td>10 (7.7)</td>
</tr>
<tr>
<td>Homemaker/Caregiver</td>
<td>25 (19.2)</td>
</tr>
<tr>
<td>Out of work and looking for work</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>Unable to work</td>
<td>3 (2.3)</td>
</tr>
<tr>
<td>Student</td>
<td>9 (6.9)</td>
</tr>
<tr>
<td>Retired</td>
<td>5 (3.8)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (1.5)</td>
</tr>
<tr>
<td>Language</td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>23 (17.7)</td>
</tr>
<tr>
<td>Spanish</td>
<td>64 (49.2)</td>
</tr>
<tr>
<td>Both equally spoken at home</td>
<td>41 (31.5)</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
</tr>
<tr>
<td>Single, never married</td>
<td>42 (32.3)</td>
</tr>
<tr>
<td>Married or domestic partnership</td>
<td>72 (55.4)</td>
</tr>
<tr>
<td>Widowed</td>
<td>6 (4.6)</td>
</tr>
<tr>
<td>Divorced</td>
<td>1 (0.8)</td>
</tr>
<tr>
<td>Separated</td>
<td>3 (2.3)</td>
</tr>
<tr>
<td>Neighborhood</td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>85 (65.4)</td>
</tr>
<tr>
<td>Suburban</td>
<td>30 (23.1)</td>
</tr>
<tr>
<td>Rural</td>
<td>8 (6.2)</td>
</tr>
<tr>
<td>Special Diet</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>21 (16.2)</td>
</tr>
<tr>
<td>No</td>
<td>109 (83.8)</td>
</tr>
</tbody>
</table>
Bots

Fraudulent bot activity was detected via Qualtrics surveys when recruitment flyers were shared on Facebook and Instagram. The social media posts were taken down for analysis of data received. Qualtrics security settings were enabled to help identify fraudulent responses and included fraud score, bot detection, reCAPTCHA score, and duplicate score. To differentiate between actual participants and fraudulent bots, a protocol was developed to determine inclusion of survey responses. Responses were assigned yellow or red flags depending on the Qualtrics data received. Yellow flags included responses that Qualtrics identified as a high fraud score, low reCAPTCHA score, responses provided in the same format as other responses (ex. zip code followed by a full address), reporting of calories consumed per day that were far below the pilot study calorie average of 1200, and surveys that were started at the same time as multiple other surveys but ended at different times. Red flags included responses of multiple surveys that began and ended at the same exact times, Qualtrics questionnaires completed in less than eleven minutes, conflicting answers between the first and second part of the

<table>
<thead>
<tr>
<th>Meals Prepared By</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Self</td>
<td>93 (71.5)</td>
<td></td>
</tr>
<tr>
<td>Partner/Spouse</td>
<td>17 (13.1)</td>
<td></td>
</tr>
<tr>
<td>Partner/Guardian</td>
<td>12 (9.2)</td>
<td></td>
</tr>
<tr>
<td>Meals consumed outside of the home/takeout</td>
<td>5 (3.8)</td>
<td></td>
</tr>
<tr>
<td>Outside agency</td>
<td>1 (0.8)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2 (1.5)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Continuous Variables</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>40.89</td>
<td>13.98</td>
</tr>
<tr>
<td>Income</td>
<td>64442.4</td>
<td></td>
</tr>
<tr>
<td>Children in the home</td>
<td>59622.2</td>
<td></td>
</tr>
<tr>
<td>Adults in the home</td>
<td>1.01</td>
<td>1.14</td>
</tr>
<tr>
<td></td>
<td>2.62</td>
<td>1.27</td>
</tr>
</tbody>
</table>
questionnaire, and email responses received in other languages. If a response met one of the items listed as a red flag or two of the items listed as yellow flags, it was determined to be a fraudulent response and not included in the analysis. This protocol yielded a total of 99 fraudulent responses.

**Data Analysis**

Statistical analyses were performed using SPSS Statistics 27 (IBM Corp, 2020) and SAS version 9.4 (SAS Institute Inc., 2013). Multiple regression was the most appropriate analysis, as we sought to determine relationships and effect sizes among nutrition literacy, neighborhood rank, and diet quality. General Linear Model was also used to determine if demographic variables had a significant relationship with diet quality. Independent samples \( t \)-tests were performed to identify differences observed in diet quality between first generation and second generation or higher Mexican origin immigrants.

**Results**

Table 2 presents the Pearson’s \( r \) between nutrition literacy, neighborhood rank, and diet quality, along with descriptive statistics. To answer the research questions, regression analysis for diet quality as outcome variables was performed with nutrition literacy and neighborhood rank entered as predictor variables. The results are presented in Table 3. The diet quality instrument contains 13 subscales including: total vegetables, greens and beans, total fruits, whole fruits, whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids, sodium, refined grains, saturated fats, and added sugars. Statistical analyses yielded statistically significant predictor \( (p<0.05) \) for the diet
quality subscales of total vegetables, greens and beans, total fruits, whole fruits, total protein foods, seafood and plant proteins, saturated fats, and refined grains. No violation of assumptions was detected when assessing data for multicollinearity, outliers, and normality. Additionally, kurtosis, skewness, and multicollinearity were all within acceptable ranges.

<table>
<thead>
<tr>
<th>Table 2</th>
</tr>
</thead>
</table>

### Table 2
**Descriptive Statistics and Correlations Among Variables of Interest**

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>1 (Nlit)</th>
<th>2 (ADI)</th>
<th>3 (HEI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Nutrition Literacy (Nlit)</td>
<td>130</td>
<td>49.19</td>
<td>7.76</td>
<td></td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>2. Neighborhood (ADI)</td>
<td>130</td>
<td>66.62</td>
<td>23.42</td>
<td>.029</td>
<td></td>
<td>--</td>
</tr>
<tr>
<td>3. Diet Quality (HEI)</td>
<td>130</td>
<td>63.16</td>
<td>10.00</td>
<td>.028</td>
<td>.057</td>
<td>--</td>
</tr>
</tbody>
</table>

**Research Questions 1&3: Nutrition Literacy, Neighborhood Rank, and Diet Quality**

Effect sizes for the variables of interest, nutrition literacy, neighborhood rank, and diet quality were obtained using Pearson’s \( r \). The effect size for nutrition literacy and diet quality was 0.028, neighborhood rank and diet quality was 0.057, and neighborhood rank and nutrition literacy was 0.029. Nutrition literacy and neighborhood rank did not have a significant relationship with overall diet quality. However, when examining individual subscales of diet quality, total protein foods (\( p=0.009 \)) and seafood and plant proteins (\( p=0.005 \)) were found to have relationships with nutrition literacy, while diet quality: refined grains had a relationship with neighborhood rank (\( p=0.010 \)).

**Research Question 2: Immigrant Generation Status and Diet Quality**
Independent samples $t$-tests were performed to compare the diet quality subscale scores for first generation Mexican origin immigrant participants and second generation or higher Mexican origin immigrant participants. There were significant differences in scores between first-generation and second-generation immigrants for total fruits, whole fruits, total protein foods, sodium, refined grains, and saturated fats. Table 3 presents the results of the analysis. Bonferroni corrections were completed, resulting in a $p$ level of 0.008 (Polit & Beck, 2010). After the Bonferroni adjustment, whole fruits, sodium, refined grains, and saturated fats were found to be statistically significant, $p<0.008$.

Participants who identified as first-generation immigrant had better scores on whole fruits and refined grains, but worse scores on sodium and saturated fats compared to participants who identified as second-generation or higher immigrant. Cohen’s $d$ produced a small effect size for refined grains and medium effect size for whole fruits, sodium, and saturated fats.
### Table 3

**Immigrant Generation Differences in Diet Quality and Diet Quality Subscales**

<table>
<thead>
<tr>
<th>Category</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; immigrant generation</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; or higher immigrant generation</th>
<th>Mean differences</th>
<th>95% CI</th>
<th>df</th>
<th>( t )</th>
<th>( p )</th>
<th>Cohen’s ( d )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Fruits</td>
<td>n = 72, ( M = 4.34 ), ( SD = 1.21 )</td>
<td>n = 46, ( M = 3.62 ), ( SD = 1.69 )</td>
<td>0.71</td>
<td>0.14, 1.28</td>
<td>74.15</td>
<td>2.48</td>
<td>0.015</td>
<td>0.504</td>
</tr>
<tr>
<td>Whole Fruits</td>
<td>n = 72, ( M = 4.65 ), ( SD = 0.96 )</td>
<td>n = 46, ( M = 3.88 ), ( SD = 1.70 )</td>
<td>0.76</td>
<td>0.21, 1.31</td>
<td>63.37</td>
<td>2.77</td>
<td>0.007</td>
<td>0.587</td>
</tr>
<tr>
<td>Total Protein Foods</td>
<td>n = 72, ( M = 4.20 ), ( SD = 1.15 )</td>
<td>n = 46, ( M = 4.62 ), ( SD = 0.86 )</td>
<td>-0.42</td>
<td>0.19, -0.79</td>
<td>113.03</td>
<td>-2.29</td>
<td>0.024</td>
<td>-0.405</td>
</tr>
<tr>
<td>Sodium</td>
<td>n = 72, ( M = 5.19 ), ( SD = 3.29 )</td>
<td>n = 46, ( M = 3.53 ), ( SD = 3.09 )</td>
<td>1.66</td>
<td>0.46, 2.86</td>
<td>116</td>
<td>2.74</td>
<td>0.007</td>
<td>0.517</td>
</tr>
<tr>
<td>Refined Grains</td>
<td>n = 72, ( M = 5.70 ), ( SD = 3.90 )</td>
<td>n = 46, ( M = 7.41 ), ( SD = 2.91 )</td>
<td>-1.71</td>
<td>-2.96, -0.47</td>
<td>113.08</td>
<td>-2.72</td>
<td>0.008</td>
<td>-0.482</td>
</tr>
<tr>
<td>Saturated Fats</td>
<td>n = 72, ( M = 7.45 ), ( SD = 2.55 )</td>
<td>n = 46, ( M = 6.02 ), ( SD = 2.98 )</td>
<td>1.43</td>
<td>0.41, 2.44</td>
<td>116</td>
<td>2.78</td>
<td>0.006</td>
<td>0.525</td>
</tr>
</tbody>
</table>
Research Questions 4&5: Demographic Variables and Diet Quality

General Linear Model analysis was performed to identify if demographic variables age, sex, income, immigrant generation, education, employment, marital status, special diet, and neighborhood type had a specific relationship with diet quality. Results of this statistical analysis are shown in Table 4.

Table 4
Regressions of Diet Quality Subscales and Independent Variables

<table>
<thead>
<tr>
<th>Subscale</th>
<th>R²</th>
<th>Unstandardized Estimate</th>
<th>95% CI</th>
<th>t</th>
<th>p</th>
<th>Partial eta squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.29</td>
<td>0.28</td>
<td>0.06, 0.50</td>
<td>2.54</td>
<td>0.013</td>
<td>0.08</td>
</tr>
<tr>
<td>Diet</td>
<td></td>
<td>-7.29</td>
<td>-13.54, -1.04</td>
<td>-2.32</td>
<td>0.023</td>
<td>0.07</td>
</tr>
<tr>
<td>Total Vegetables</td>
<td>0.32</td>
<td>0.03</td>
<td>0.01, 0.05</td>
<td>2.18</td>
<td>0.032</td>
<td>0.06</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>0.93</td>
<td>0.14, 1.72</td>
<td>2.36</td>
<td>0.021</td>
<td>0.08</td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td>-0.76</td>
<td>-1.48, -0.04</td>
<td>-2.11</td>
<td>0.039</td>
<td>0.06</td>
</tr>
<tr>
<td>Greens and Beans</td>
<td>0.32</td>
<td>-0.99</td>
<td>-7.96, -0.03</td>
<td>-2.05</td>
<td>0.044</td>
<td>0.06</td>
</tr>
<tr>
<td>Diet</td>
<td></td>
<td>0.89</td>
<td>0.08, 1.70</td>
<td>2.18</td>
<td>0.032</td>
<td>0.06</td>
</tr>
<tr>
<td>Neighborhood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Fruits</td>
<td>0.26</td>
<td>0.04</td>
<td>0.01, 0.07</td>
<td>2.61</td>
<td>0.011</td>
<td>0.09</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>1.41</td>
<td>0.30, 2.52</td>
<td>2.54</td>
<td>0.013</td>
<td>0.09</td>
</tr>
<tr>
<td>Whole Fruits</td>
<td>0.20</td>
<td>0.03</td>
<td>0.00, 0.06</td>
<td>2.07</td>
<td>0.042</td>
<td>0.06</td>
</tr>
<tr>
<td>Whole Grains</td>
<td>0.25</td>
<td>-1.67</td>
<td>-2.38, -0.36</td>
<td>-2.70</td>
<td>0.009</td>
<td>0.09</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Protein Foods</td>
<td>0.23</td>
<td>0.04</td>
<td>0.01, 0.07</td>
<td>2.66</td>
<td>0.009</td>
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<td>0.01, 0.14</td>
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</table>
Among Mexican origin individuals living in the United States, literature on diet quality is limited. Considering the important role that diet quality plays on health, it is critical to better understand this concept with this growing Hispanic subgroup. This study aimed to identify the relationship between nutrition literacy and neighborhood rank in a Mexican origin sample, understand differences observed in diet quality between first and second or higher Mexican origin generation immigrant, and identify any demographic variables that may impact the relationship with diet quality. To obtain diet quality scores, the HEI–2015 was used which provides scores from 0 (worse) to 100 (best). The HEI is composed of thirteen components, which assess either adequacy or moderation. Total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, and fatty acids assess adequacy (NCI, n.d.d.). Refined grains, sodium, added sugars, and saturated fats assess moderation (NCI, n.d.d.). Results of this study indicate subscales of diet quality, rather than overall diet quality, are impacted by nutrition literacy, neighborhood rank, and demographic variables.

Diet Quality

The mean HEI–2015 score for participants was 63.16, which is higher than the national average for Americans of 59 (USDA, 2020). Findings from this study suggest age and following a special diet are predictors of diet quality in Mexican origin individuals. As age increased, participants’ overall diet quality score increased, as seen in Figure 1. These results support findings from Yoshida et al. (2017), where age was also a
direct predictor of diet quality. Additionally, if participants stated that they were not on a special diet, they had worse diet quality scores compared to individuals who were not on any type of diet regimen. Some of the special diets reported included a diabetic diet, keto diet, and low carb diet.

**Figure 1**

*Age and Diet Quality*

![Scatter Plot of HEI by Age](image)

**Total Vegetables**

The diet quality subscale of total vegetables measured participants’ reported intake for adequacy, meaning that individuals obtained greater than or equal to 1.1 cups of total vegetables per 1,000 kcal (NCI, n.d.d.). The mean score for total vegetables was 4.07, which is higher than the national average of 3.3 (USDA, 2019). Similar to overall diet quality, age was found to be a significant predictor of total vegetable score. As age increased, diet quality: total vegetable score increased. Additionally, participants who
identified as homemakers, had higher diet quality: total vegetable scores. Kane et al. (2018) also assessed HEI scores, findings that homemakers had better diet quality scores compared to individuals that worked, were retired, or unemployed. Similar to overall diet quality, individuals who were not on a special diet had worse diet quality: total vegetable scores, compared to individuals who were on a special diet.

**Greens and Beans**

The greens and beans subscale also assessed participant intake for adequacy. Adequate intake of greens and beans means that participants incorporate at least 0.2 cups per 1,000 kcal of greens and beans into their diet (NCI, n.d.d.). The mean score for greens and beans was 3.9, which is higher than the national average of 3.1 (USDA, 2019). In alignment with previous subscales, individuals who were not on a special diet had worse diet quality: greens and beans scores, compared to individuals who were on a special diet. Further, individuals who lived in urban settings had better diet quality: greens and beans, than individuals who lived in rural or suburban settings. This finding is similar to findings from Jilcott-Pitts et al. (2015), which found that living closer to stores with healthy food options led to higher diet quality.

**Total Fruits and Whole Fruits**

Total Fruit adequacy was measured as consumption of greater than 0.8 cups per 1,000 kcal of total fruit, including 100% fruit juice (NCI, n.d.d.). The diet quality subscale, whole fruits, also measures adequacy of intake. Adequate intake is measured as 0.4 cup per 1,000 kcal excluding fruits consumed in juice (NCI, n.d.d.). The mean scores
for total fruits and whole fruits were 4.04 and 4.3, which are higher than the national average of 2.9 and 4.2 (USDA, 2019). Similar to prior findings with other subscales, as age increased the diet quality: total fruits and diet quality: whole fruits scores also increased. Further, individuals who had a high school diploma or equivalent had higher diet quality: total fruits score.

Whole Grains

Adequacy in the whole grain subscale was assessed by reported intake, with a goal of at least 1.5 ounces per 1,000 kcal (NCI, n.d.d.). The mean score for whole grains was 2.2, which is lower than the national average of 3 (USDA, 2019). Diet quality: whole grains scores were lower for individuals who identified as female, compared to participants that identified as male. This finding is contrary to previous studies such as Pignotti et al. (2015) and Yoshida et al. (2016), which found better diet quality in Mexican origin women compared to men. One reason for this may be that the current study assessed individual subscales rather than overall diet quality, providing more insight into specific dietary components.

Total Protein Foods

The HEI-2015, measured total protein food intake for adequacy as intake greater than 2.5 ounces per 1,000 kcal (NCI, n.d.d.). The mean score for total protein food was 4.4, which is lower than the national average of 5 (USDA, 2019). Findings from this study found nutrition literacy and neighborhood type to be predictors of diet quality: total protein foods. As participants’ nutrition literacy scores increased, diet quality: total
protein food adequacy also increased, meaning, their diet quality pertaining to total protein food intake was better. While Gibbs et al. (2016) and Gibbs et al. (2018) did not look at specific subscales of diet quality, when assessing overall diet quality, nutrition literacy was found to be a significant predictor. Diet quality: total protein foods scores were higher for individuals who lived in urban settings compared to individuals who lived in rural and suburban neighborhoods, comparable to findings from the diet quality subscale of greens and beans.

**Seafood and Plant Proteins**

Adequacy of seafood and plant proteins was assessed based on intake of at least 0.8 ounces per 1,000 kcal (NCI, n.d.d.). The mean score for seafood and plant proteins was 3.7, which is lower than the national average of 5 (USDA, 2019). Nutrition literacy and neighborhood type were found to be significant predictors of the diet quality subscale, seafood and plant proteins. As nutrition literacy scores increased, intake of seafood and plant proteins also increased. Scores for this subscale were higher for individuals who lived in urban neighborhoods compared to individuals who lived in rural or suburban neighborhoods.

**Saturated Fats**

The diet quality: saturated fats subscale assessed participant intake for moderation, with the goal being less than 8% of energy (NCI, n.d.d.). If participants had greater than 16% of energy from saturated fats, they received a score of zero for this subscale (NCI, n.d.d.). Consumption of saturated fats should be limited, as high rates of
intake can lead to an increase in total cholesterol levels (Harvard Medical School, 2019). The mean score for saturated fats was 7.1, which is higher than the national average of 5.1 (USDA, 2019). Similar to prior subscales where age was a positive predictor, age was associated with decreased intake of saturated fats such that as age increased, diet quality: saturated fats scores increased.

**Refined Grains**

The diet quality: refined grains subscale measures moderation, meaning, if more than 4.3 ounces per 1,000 kcal of refined grain intake was reported by the participant, they received a score of zero due to high intake (NCI, 2020a). The mean score for refined grains was 6.3, which is lower than the national average of 6.4 (USDA, 2019). The results of this study found neighborhood rank, education, and special diet to be significant predictors of this subscale. Findings indicate as neighborhood rank decreased, meaning if participants lived in a better ranked neighborhood according to the ADI, they had a higher score on the diet quality: refined grain subscale, meaning less refined grain consumption. Drewnowski et al. (2016) found diet quality to be strongly correlated with neighborhood property values, meaning, if individuals lived in a neighborhood with high property values, they had a higher diet quality score. Additionally, individuals who had a trade or vocational degree, associate degree or some college education scored higher on diet quality: refined grains than their counterparts. This finding resembles previous study findings such that as education level increases, diet quality increases (Hiza et al., 2012; Thiele et al., 2003). Lastly, individuals who were not on a special diet had worse diet quality: refined grains scores, compared to individuals who were on a special diet.
Immigrant Generations

An aim of this study was to identify differences in diet quality between first and second or higher Mexican origin generation immigrants. When comparing the diet quality subscale scores between these two groups, significant findings resulted for whole fruits, sodium, refined grains, and saturated fats. Overall, individuals who identified as first-generation immigrant had better scores on three of the four subscales compared to second-generation immigrant or higher participants. First-generation Mexican origin immigrants had greater mean scores ($M=4.65$) for the diet quality: whole fruits subscale, compared to second-generation or higher Mexican origin immigrants ($M=3.88$). Additionally, individuals who identified as first-generation immigrant also had better mean scores in the sodium ($M=5.19$) and saturated fats ($M=7.45$) subscales, compared to individuals who identified as second-generation or higher immigrant. These findings suggest that first-generation immigrant Mexican origin participants had better diet quality as measured by a higher intake of whole fruits and lower intake of sodium and saturated fats. However, when assessing refined grain intake participants who identified as first-generation immigrant scored worse ($M=5.70$) compared to second or higher generation immigrant participants ($M=7.41$).

Limitations

Like many studies, limitations were identified in this study. First, self-selection bias was identified as a limitation as participants chose whether to participate or not, which may have excluded individuals who have critical knowledge to share.
Additionally, individuals who were more confident in their knowledge on nutrition may have chosen to participate, over individuals who did not hold the same sentiments. Second, convenience sampling was used as it would not be feasible to recruit participants in person nationwide at this time, limiting the participants. Further, while online recruitment methods were used, this is limiting to participants that have access to the internet. Lastly, social desirability bias may have impacted participant responses of their diet quality.

**Implications for Nursing Research, Practice, and Education**

Health care providers deliver care to a diverse population. Nurses spend time educating patients on various topics, making it critical that they deliver culturally competent teaching. Nursing research, practice, and education must incorporate the most up to date evidence-based practice to eliminate health disparities. Findings from this study will help inform nursing researchers and educators on factors that influence diet quality in Mexican origin individuals, resulting in better implementation of strategies to improve health outcomes. However, there is first a need to encourage assessment by providers with this population to identify areas of need regarding diet quality. Special attention to intake of total vegetables, greens and beans, total and whole fruits, whole grains, total protein foods, seafood and plant proteins, saturated fats, and refined grains should be assessed by providers with this population. Assessment of intake of these foods will help better inform nursing intervention studies regarding adequacy and moderation. Acknowledging factors that impact diet quality with individuals who identify as being of
Mexican origin, will aid in improving nursing research, practice, and education to support positive health outcomes.

**Conclusion**

Diet quality is an influencing factor of an individual’s health, making it necessary to better understand the factors affecting it. This study aimed to close the gap in the literature regarding diet quality in the Mexican origin population. Study results indicated that while diet quality as a whole is not impacted by an individual’s neighborhood rank or nutrition literacy, subscales of diet quality are affected by these variables. Findings include the need for assessment and nutrition interventions with the Mexican origin population to promote good diet quality. Findings from this study also support the need for further research regarding moderation and adequacy of diet quality components. Additionally, next steps would include piloting the effectiveness of nutrition label education in this population to improve health outcomes.

**Declaration of Conflicting Interests**

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

Funding for this study from the National Association of Hispanic Nurses and Marquette University is gratefully acknowledged.
References


https://www.cdc.gov/chronicdisease/resources/publications/factsheets/nutrition.htm


https://doi.org/10.1186/s12889-016-3798-y


https://doi.org/10.1007/s10903-017-0678-1


https://epi.grants.cancer.gov/hei/developing.html

National Cancer Institute (NCI). (2020b). *Diet History Questionnaire II: Calculating Healthy Eating Index (HEI) scores using diet*calc* output.*
National Cancer Institute (NCI). (2020c). *Diet History Questionnaire III.*

https://epi.grants.cancer.gov/dhq3/


https://doi.org/10.1017/S1368980014003085


https://doi.org/10.13005/bpj/757


https://www.census.gov/data/tables/2017/demo/poproj/2017-summary-tables.html


University of Wisconsin School of Medicine Public Health. (n.d.). 2015 Area Deprivation Index v2.0. https://www.neighborhoodatlas.medicine.wisc.edu/


https://www.who.int/news-room/fact-sheets/detail/healthy-diet

https://doi.org/10.1017/S1368980016003190


https://doi.org/10.5888/pcd14.170004
Conclusion

Diet quality is a critical component to overall health, as the foods that individuals consume can lead to health complications. The aim of this study was to close the gap in the literature regarding diet quality, nutrition literacy, and neighborhood in the Mexican origin population. Findings from this study support the need for further research in addressing specific subscales of diet in this population. While results from this study detect Mexican origin individuals to have higher diet quality scores when compared to the general population, there is a need to address the areas of diet quality that were worse than the general population. Overall, addressing factors that influence diet quality can aid in improving health outcomes within this population.
BIBLIOGRAPHY


Batis, C., Aburto, T. C., Sánchez-Pimienta, T. G., Pedraza, L. S., & Rivera, J. A. (2016). Adherence to dietary recommendations for food group intakes is low in the
Mexican population. The Journal of Nutrition, 146(9), 1897S-1906S. https://doi.org/10.3945/jn.115.219626


ecological model as a framework for evaluating nutrition education and social marketing programs with low-income audiences. *Journal of Nutrition Education*, 33, S4-S15. [https://doi.org/10.1016/S1499-4046(06)60065-1](https://doi.org/10.1016/S1499-4046(06)60065-1)


environment play a role? *Journal of Immigrant and Minority Health, 16*(2), 244-255. [https://doi.org/10.1007/s10903-012-9724-1](https://doi.org/10.1007/s10903-012-9724-1)


Power Analysis and Sample Size Software. (2019). NCSS.  
https://www.ncss.com/software/pass


https://doi.org/10.13005/bpj/757

https://doi.org/10.14574/ojrnhc.v16i1.379

https://doi.org/10.1016/j.jand.2018.05.019

https://doi.org/10.1017/S1368980016003311

https://doi.org/10.1111/1747-0080.12271

https://doi.org/10.1177/0898264317707141

https://doi.org/10.1056/NEJM200101043440101


United States Department of Health and Human Services (n.d.). *HHS action plan to reduce racial and ethnic health disparities: A nation free of disparities in health and health care.*

http://health.gov/dietaryguidelines/2015/guidelines/


University of Wisconsin School of Medicine Public Health. (n.d.). *2015 Area Deprivation Index v2.0.*
https://www.neighborhoodatlas.medicine.wisc.edu/

https://doi.org/10.1007/s10903-015-0236-7

https://doi.org/10.1016/j.socscimed.2011.10.007


https://doi.org/10.1016/j.jneb.2015.04.328

https://doi.org/10.1016/j.jand.2011.12.003

https://doi.org/10.1016/j.jada.2006.07.023


Appendix A

Institutional Review Board Documentation

Date: 03/22/2021
HR-3806
Principal Investigator: Dr. Marilyn Frenn
Student Principal Investigator: Sylvia Pena
Department: Nursing
Study Title: The Impact of Neighborhood and Nutrition Literacy on Diet Quality in the Mexican American Population: A Pilot Study

<table>
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<th>New Study Approval</th>
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<td>☑ This protocol has been determined to be Exempt under category #2 as governed by 45 CFR 46.104(d) on 03/22/2021.</td>
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<td>☐ This protocol has been approved as minimal risk under Expedited category # as governed by 45 CFR 46.110 on [DATE].</td>
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<tr>
<td>☐ This protocol has been reviewed by the Institutional Review Board on [date] and approved as:</td>
</tr>
<tr>
<td>☐ Minimal risk</td>
</tr>
<tr>
<td>☐ Greater than minimal risk</td>
</tr>
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Please note that in-person research cannot be initiated until in-person research resumes and must follow the MU research ramp-up plan.

<table>
<thead>
<tr>
<th>Consent</th>
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<tr>
<td>☑ Please use the final version of the exempt information sheet or consent form submitted with this protocol in Kuali. Contact the IRB office if you have questions about which document you should be using.</td>
</tr>
<tr>
<td>☐ The IRB approved informed consent form can be found in the approved Kuali protocol. Make sure to download and use the stamped copies of this form when enrolling research participants. Each research participant should receive a copy of the consent form.</td>
</tr>
<tr>
<td>☐ This study has been approved for waiver of documentation of consent under 45 CFR 46.117(c)(1) or (2) of (3). Please use the approved consent information sheet with your participants.</td>
</tr>
<tr>
<td>☐ This study has been approved for alteration or waiving of consent under 45 CFR 46.116(d).</td>
</tr>
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<table>
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<th>Study specific notifications</th>
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<tr>
<td>☐ The IRB approved recruitment materials can be found in the approved Kuali protocol. Use stamped copies of these documents for recruitment purposes.</td>
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<td>☐ This study involves students collecting data through surveys- please review the MU Questionnaire/Survey Procedures: <a href="http://www.marquette.edu/osd/policies/survey_procedure.shtml">http://www.marquette.edu/osd/policies/survey_procedure.shtml</a></td>
</tr>
<tr>
<td>☐ This study involves recruitment emails for online surveys to be sent to 100 or more Marquette students, faculty or staff. Please review the website of the Online Survey Review Group: <a href="http://www.marquette.edu/onlinesurveys/">http://www.marquette.edu/onlinesurveys/</a></td>
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</table>
August 30, 2021

Dr. Marilyn Frenn
Cc: Sylvia Pena

College of Nursing

The amendment you submitted for your protocol number HR-3806, titled, “The Impact of Nutrition Literacy and Neighborhood on Diet Quality in the Mexican Origin Population” received approval on 08/30/2021, from a member of the Marquette University Institutional Review Board.

This amendment approves the following:
- Update study title
- Increase number of subjects to 130
- Revise study aims
- Revise data collection methods to include in-person
- Updated recruitment material;
- Updated consent to reflect changes;
- Updated Protocol to reflect changes

□ Any public advertising of this project requires prior IRB approval.

□ Any future changes to this protocol must be reviewed and approved by the IRB before being initiated, except when necessary to eliminate apparent immediate hazards to the human subjects.

□ The principal investigator is responsible for ensuring that all study staff receive appropriate training in the ethical guidelines of conducting human subjects research.

□ If there are any adverse events or deviations from the approved protocol, please notify the Marquette University IRB immediately.

□ An IRB Final Report Form must be submitted once this research project is complete. The form should be submitted in a timely fashion and must be received no later than the protocol expiration date.

Contact the IRB office if you have any further questions. Thank you for your cooperation and best wishes for a successful project.

Sincerely,
Appendix B

Instrument Permissions

Area Deprivation Index

Online tool accessed via https://www.neighborhoodatlas.medicine.wisc.edu/

Terms of Use:


AND

University of Wisconsin School of Medicine and Public Health. *(specify year)* Area Deprivation Index *(specify version).* Downloaded from https://www.neighborhoodatlas.medicine.wisc.edu/ *(date)*

You may not otherwise use the names, logos, symbols, images, or other identifying marks (“Marks”) of the University of Wisconsin-Madison, University of Wisconsin School of Medicine and Public Health, or Neighborhood Atlas in any publicity, advertising, or news release without prior written approval of the University of Wisconsin-Madison.

You further acknowledge that except as prohibited by law, any Data delivered or accessed from www.neighborhoodatlas.medicine.wisc.edu is understood to be provided “AS IS.” UNIVERSITY OF WISCONSIN-MADISON MAKES NO REPRESENTATIONS AND EXTENDS NO WARRANTIES OF ANY KIND, EITHER EXPRESSED OR IMPLIED. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR THAT THE USE OF THE DATA WILL NOT INFRINGE ANY PATENT, COPYRIGHT, TRADEMARK, OR OTHER PROPRIETARY RIGHTS.

You are responsible for any and all damages and liability associated with your use of the Data. TO THE FULLEST EXTENT PERMITTED BY LAW, YOU HEREBY WAIVE ANY AND ALL CLAIMS OF ANY KIND OR DESCRIPTION AGAINST THE BOARD OF REGENTS OF THE UNIVERSITY OF WISCONSIN SYSTEM, AND ITS OFFICERS, EMPLOYEES, AND AGENTS, ARISING OUT OF OR IN CONNECTION WITH YOUR USE OF THE DATA AND ANY DECISIONS YOU MAY MAKE AS A RESULT OF USING THE DATA. TO THE FULLEST EXTENT PERMITTED BY LAW, IN NO EVENT SHALL THE BOARD OF REGENTS OF THE UNIVERSITY OF WISCONSIN SYSTEM, OR ITS OFFICERS OR EMPLOYEES OR AGENTS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, RELIANCE, OR CONSEQUENTIAL DAMAGES OR ATTORNEYS’ FEES HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY WHETHER IN CONTRACT, STRICT LIABILITY, TORT OR OTHERWISE ARISING IN ANY WAY OUT OF THE USE OF THE DATA EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE OR IF SUCH DAMAGES WERE FORESEEABLE. SOME JURISDICTIONS DO NOT ALLOW CERTAIN LIMITATIONS OF LIABILITY, SO SOME OR ALL OF THE ABOVE LIMITATIONS OF LIABILITY MAY NOT APPLY TO YOU.

Diet History Questionnaire III
Online tool accessed via https://www.dhq3.org/
User agreement:

DHQ3 Researcher Agreement

Electronic Certification (E-Certification) and Agreement for use of the Diet History Questionnaire III Web-based System ("DHQ3") and Transfer of Data

Epidemiology and Genomics Research Program Division of Cancer Control and Population Sciences National Cancer Institute

DEFINITIONS:

NCI: Epidemiology and Genomics Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, National Institutes of Health (NIH), an agency of the United States Public Health Service (PHS) within the Department of Health and Human Services (DHHS)

RESEARCHER: An organization, as represented by its academic, clinical, or private researchers conducting observational studies with human subjects. “RESEARCHER” may also include academic, clinical, or private individuals who conduct observational studies with human subjects under their own legal authority independent of an employer or parent organization for research, treatment or education purposes.

DATA: De-identified human dietary intake data collected by the NCI under auspices of NCI’s DHQ3 system and resulting calculations. “DATA” does not mean the DHQ3 system database, associated databases, or software used to create and run the DHQ3 system.

RECITALS:

WHEREAS, the NCI has constructed a research tool in the form of a DHQ3 computerized interview and database, and this database is intended to assist RESEARCHER and human subjects under the RESEARCHER’s supervision with management of DATA associated with those human subjects; and

WHEREAS, the RESEARCHER intends to direct human subjects under RESEARCHER’s supervision to submit dietary intake data to the DHQ3 database; and,

WHEREAS, the NCI wishes the RESEARCHER to have access to DATA describing the human subjects under RESEARCHER’s supervision;

In consideration of the above, the RESEARCHER and NCI agree to the following:

1. The RESEARCHER will be responsible for directing human subjects under its supervision to submit DATA to the NCI. NCI will store the DATA in NCI’s DHQ3 database. NCI will maintain the DATA in the absence of identifying information; however, NCI will have the right to assign a unique alphanumeric username tag to records describing individual human subjects. NCI shall ensure that the nature of such tag will prevent NCI from determining human subject identities. The RESEARCHER, but not NCI, will retain the crosswalk for mapping the tag to identify individual human subjects under RESEARCHER’s supervision. NCI will not have access to the crosswalk. NCI will not communicate with any human subjects providing DATA.
2. DATA submitted to the NCI is the property of the NCI for distribution purposes and shall be made available as a service to research, academic and clinical communities.

3. The DATA will be used only for research, clinical and academic purposes. THIS DATA WILL NOT BE USED BY NCI TO TREAT OR DIAGNOSE HUMAN SUBJECTS. In the event that:

   (a) a party to this agreement is able to deduce the identity of an individual human subject whose information is a component of the DATA;

   And,

   (b) the human subject is not being supervised by or under care of the party,

then that party agrees it will not attempt to identify or contact such human subject and, furthermore, will notify the other party of its ability to make such identification.

4. Neither NCI nor RESEARCHER will use the DATA unless it has obtained all appropriate clearances to use the DATA, including but not limited to clearance by an Institutional Review Board or equivalent governing body. The use and handling of the DATA by either party will be performed in compliance with all applicable statutes and regulations.

5. The RESEARCHER may redistribute DATA to third parties for research, clinical, and academic purposes under conditions of use no less restrictive than those of this Agreement.

6. The RESEARCHER agrees to acknowledge the source of the DATA in any publications reporting use of it.

7. NCI shall have the right to conduct quality assurance measures of the DATA including, but not limited to, reviews of system logic, evaluation of missing DATA, and summary statistics based on DATA across the entire system. No evaluation of, or publication based on, a single registered study will be performed by NCI. The NCI represents that its role in managing the DATA shall be primarily archival, and that the NCI will not conduct investigative activities with the DATA.

8. Any DATA delivered pursuant to this Agreement is understood to be experimental in nature. THE NCI MAKES NO REPRESENTATIONS AND EXTENDS NO WARRANTIES OF ANY KIND, EITHER EXPRESSED OR IMPLIED. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR THAT THE USE OF THE DATA WILL NOT INFRINGE ANY PATENT, COPYRIGHT, TRADEMARK, OR OTHER PROPRIETARY RIGHTS.

9. No indemnification for any loss, claim, damage, or liability is intended or provided by any party under this agreement. Each party shall be liable for any loss, claim damage, or liability that said party incurs as a result of said party's activities under this agreement, except that the NCI, as an agency of the United States, assumes liability only to the extent as provided under the Federal Tort Claims Act (28 U.S.C. Chapter 171). If the RESEARCHER is a component of or an agency of a State government then RESEARCHER assumes liability only to the extent authorized under the laws of the State or Commonwealth.

10. RESEARCHER agrees not to claim, infer, or imply endorsement of the RESEARCHER by the NCI and by the Government of the United States of America.

11. Upon request by the NCI, the RESEARCHER will perform any of the following as directed by the NCI (a) immediately cease use of the DATA; (b) dispose of DATA provided by the NCI that is in the RESEARCHER's possession.

Any false or misleading statements made, presented, or submitted to the Government, including any relevant omissions, under this Agreement are subject to all applicable civil and criminal statutes including Federal statutes 31 U.S.C. §§ 3801-3812 (civil liability) and 18 U.S.C. § 1001 (criminal liability including fine(s) and/or imprisonment).

By accepting the terms of this agreement, the RESEARCHER certifies that the information submitted by the RESEARCHER is true, complete and accurate to the best of RESEARCHER's knowledge. The person accepting the terms of this agreement for the RESEARCHER has the requisite power and authority to accept the terms of this Agreement.
Nutrition Literacy Assessment Instrument

Terms of Service: Authorized researchers at the University of Kansas Medical Center may access de-identified data including age, gender, education, ethnicity, race, and zip code collected from the NLit App. KUMC researchers will not have access to directly identifying information (e.g., names, addresses, etc), and no individual will be identified in any resulting publication.
Appendix C

MARQUETTE UNIVERSITY
AGREEMENT OF CONSENT FOR RESEARCH PARTICIPANTS
The Impact of Nutrition Literacy and Neighborhood on Diet Quality in the Mexican Origin Population
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You have been invited to participate in this research study. Before you agree to participate, it is important that you read and understand the following information. Participation is completely voluntary. Please ask questions about anything you do not understand before deciding whether or not to participate.

PURPOSE:
• The purpose of this research study is to better understand how neighborhood and nutrition literacy impact diet quality.
• You will be one of approximately 130 participants in this research study.

PROCEDURES:
• The research will be conducted online through a Qualtrics survey and the Diet History Questionnaire III survey or in person, based on participant preference. Email address will need to be provided for subjects to receive a login to complete the Diet History Questionnaire III portion of the study.
• Participants who are interested will fill out a screening questionnaire to assess eligibility. If participants meet inclusion criteria, they will be directed to the study questionnaire. If subjects do not meet the inclusion criteria, they will be redirected to an end page thanking them for their time and interest in the study.
• Topics that will be covered in the questionnaire include nutrition literacy and food frequency.
• The Diet History Questionnaire III will ask you to report how often various foods have been eaten and how often you have consumed various beverages, including alcoholic beverages. Underage subjects will be able to skip those questions that do not apply.
• At the end of the Diet History Questionnaire III, participants will receive their nutrition report results based on their reported food intake.
• Notes may be recorded by the researcher about any issues and comments people make to help interpret the data and plan for future research, these notes will not be linked to participant responses.
• If fraudulent activity is detected, participants will be disqualified from the study and the incentive will not be provided.

DURATION:
• Your participation will consist of a one time, 60-90 minute online questionnaire.

RISKS:
• The risks associated with participation in this study are no greater than you would experience in everyday life.
• Collection of data and survey responses using the internet involves the same risks that a person would encounter in everyday use of the internet, such as hacking, or information being unintentionally seen by others.

BENEFITS:
• Benefits of participation to participants in this study include becoming more aware of diet quality concepts including personal nutrition report from the Diet History Questionnaire III.
• Benefits to society include health care providers and researchers becoming more informed on influencing variables of diet quality, as well as utilizing findings from this study to create appropriate interventions to improve diet quality in the Mexican origin population.

CONFIDENTIALITY:
• Data collected in this study will be kept confidential
• All your data will be assigned an arbitrary code number rather than using your name or other information that could identify you as an individual.
• Data downloaded from Qualtrics and the Diet History Questionnaire III will be password protected.
• The data/samples collected in this study will not be used or distributed for future research even if they have been deidentified
• When the results of the study are published, you will not be identified by name.
• Direct quotes will not be used in reports or publications.
• The data will be destroyed by shredding paper documents and deleting electronic files three years after the completion of the study.
• Although your responses will be deleted from the survey provider website on completion of the study, your data may exist on backups or server logs beyond the timeframe of this research project.
• Your research records may be inspected by the Marquette University Institutional Review Board or its designees and (as allowable by law) state and federal agencies.

COMPENSATION:
• Compensation will be distributed upon completion of all components of the study. A $25 gift card will be distributed in person or through email, based on how the participant completed the study.

VOLUNTARY NATURE OF PARTICIPATION:
• Participating in this study is completely voluntary and you may withdraw from the study and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.
• Data obtained from participants that withdraw from the study will be destroyed.
• You may skip any questions you do not wish to answer.
• Your decision to participate or not will not impact your relationship with the investigators or Marquette University.

ALTERNATIVES TO PARTICIPATION:
• There are no known alternatives other than to not participate in this study.

CONTACT INFORMATION:
• If you have any questions about this research project, you can contact Sylvia Pena at sylvia.pena@marquette.edu or (414) 485-5270.
• If you have questions or concerns about your rights as a research participant, you can contact Marquette University’s Office of Research Compliance at (414) 288-7570.

I HAVE HAD THE OPPORTUNITY TO READ THIS CONSENT FORM, ASK QUESTIONS ABOUT THE RESEARCH PROJECT AND AM PREPARED TO PARTICIPATE IN THIS PROJECT.

____________________________________________
(Printed Name of Participant)

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(Signature of Participant) Date

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(Printed Name of Individual Obtaining Consent)

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(Signature of Individual Obtaining Consent) Date