

2018

## The Effect Of Neighborhood Characteristics And Acculturation On Vegetable Intake Among U.S. Hispanics

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THE EFFECT OF NEIGHBORHOOD CHARACTERISTICS AND ACCULTURATION ON  
VEGETABLE INTAKE AMONG U.S. HISPANICS

by

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Bachelor of Science  
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Submitted in Partial Fulfillment of the Requirements

For the Degree of Master of Science in Public Health in

Health Promotion, Education, and Behavior

The Norman J. Arnold School of Public Health

University of South Carolina

2018

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## ABSTRACT

The growing prevalence of chronic disease among the U.S. Hispanic population has drawn increasing attention to modifiable behaviors such as diet in an effort to curb the burden of disease among this population. While factors affecting dietary intake among U.S. Hispanics have been largely studied, this study broadens the scope of existing analyses from examining the role of individual-level factors, including acculturation, to also include environmental factors such as neighborhood ethnic composition. Multilevel mixed modeling was employed to test the interaction of individual acculturation with neighborhood ethnic composition to predict vegetable intake among a sample of U.S. Hispanics. Individuals who participated in a cross-sectional survey were linked with census-tract level data for where they lived. The study sample consisted of 851 Hispanic individuals of Mexican, Puerto Rican, or Cuban origin and included 671 census tracts, as proxies for neighborhoods, with data regarding the proportion of Hispanics residing within each census tract. No significant interactions were observed between acculturation and neighborhood ethnic composition to predict vegetable intake. These results emerged from a unique sample not previously examined and suggest avenues for future research to continue disentangling the complex process of acculturation, neighborhood contributions to the acculturative process, and dietary quality overall. This information is critical for the development of effective health promotion strategies for Hispanics in the U.S.

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# CHAPTER 1

## INTRODUCTION

### 1.1 SUMMARY OF THE RESEARCH

This thesis will address the role of neighborhood ethnic composition on the relationship between acculturation and vegetable intake among Hispanics in the United States. Hispanics comprise a significant portion of the total United States population and are projected to undergo rapid growth in coming decades. They are also facing a disproportionate burden of chronic disease. These diseases are significantly influenced by both genetic and environmental factors. Because genetic factors are largely unchangeable, it is important for health professionals to understand and address environmental, and other more malleable factors such as diet, in order to best mitigate the detrimental effects of chronic disease for this population. It has been found that acculturation into U.S. culture is associated with a decrease in dietary quality, including a lower consumption of vegetables but there is limited research dedicated to explaining this association. By examining the effects of neighborhood context on the relationship between acculturation and vegetable intake among a sample of the three largest U.S. Hispanic subgroups (Mexicans, Puerto Ricans, and Cubans) this thesis will expand our ability to develop more effective interventions to increase vegetable intake and thus improve Hispanic health overall.

## 1.2 INTRODUCTION TO THE RESARCH

Chronic disease is on the rise among the rapidly growing U.S. Hispanic population (Livingston, Minushkin & Cohn, 2008). As Hispanics comprise 17.8% of the U.S. population (U.S. Census Bureau, 2016), addressing this mounting health concern is vital to achieving optimal health and well-being for the nation as a whole. A quality diet consisting, in part, of a daily intake of 2.5 cups of vegetables or more has been associated with a reduction in the risk of diabetes (Van-Duyn & Pivonka, 2000; Li et al., 2014), cardiovascular disease (Hung et al., 2004), and chronic liver disease (Fan & Cao, 2013) and, thus, has been recommended for the prevention and control of chronic disease (U.S. Department of Health and Human Services & U.S. Department of Agriculture, 2015). Currently, Hispanics are consuming far less than the recommended amount of daily vegetables (U.S. Department of Health and Human Services Office of Diseases Prevention and Health Promotion, n.d.). In order to improve health interventions aimed toward increasing vegetable consumption among Hispanics in the U.S., it is important to first understand the mechanisms that influence low intake of vegetables among U.S. Hispanics. Cost, taste, and quality of available produce have been extensively examined as factors that influence vegetable intake, but the influence of acculturation as a possible factor in decreased vegetable intake is less understood.

Although variously defined, acculturation is generally understood to be the process through which individuals or groups adopt and adapt as they transition from living in one culture to living within a new culture. For instance, when an individual from Mexico immigrates to the United States, they undergo a process of cultural exchange between their culture of origin and their new host culture. Most studies

examining the effects of acculturation on dietary intake have concluded that acculturation has a negative influence on vegetable intake. According to the existing literature, acculturation and dietary quality have an inverse relationship among Hispanics in the U.S. (Chavez, Sha, Persky & Pestano-Binghay, 1994; Dubowitz, Smith-Warner, Acevedo-Garcia, Subramanian & Peterson, 2007; Duffey et al., 2008; Dixon, Guendelman & Abrams, 1995; Lopez-Cepero, Jimenez, Lemon, Palacios & Rosal, 2017; Sundquist and Winkleby, 2000; Montez & Esbach, 2008; Zhang et al., 2015). However, across the literature, acculturation is defined and operationalized in a variety of ways creating space for further research to continue clarifying this relationship. In addition, health studies involving Hispanics often treat Hispanics as a single monolithic group, when, in reality, they possess immense diversity across and even within ethnic subgroups, which may influence patterns of vegetable intake. This thesis will complement the existing literature by yielding an examination of the relationship between acculturation and vegetable intake across the three largest Hispanic ethnic subgroups in the U.S.: Puerto Ricans, Mexicans, and Cubans.

Furthermore, most acculturation studies focus only on an individual level and do not account for environmental factors that may play a significant role in influencing the relationship between acculturation and vegetable intake. There is a small body of research that is beginning to examine the potential effects of environmental variables, including a variety of neighborhood characteristics, on the relationship between acculturation and dietary intake. These variables are of interest due to significant residential separation by race and ethnicity that exists in the U.S. (Araido-Lanza, Armbrister, Flórez & Aguirre, 2006) and associated studies indicating that neighborhood

context influences a range of health outcomes, even after adjusting for individual-level variables (Abraido-Lanza, Echeverria & Florez, 2016). This thesis will add to the small but growing body of literature on acculturation and diet that looks beyond the individual to analyze environmental factors such as the ethnic composition of neighborhoods to further our understanding of the complex reality of dietary acculturation in the U.S. among Hispanics. There is a need to investigate these associations further, as studies analyzing all three of these variables in conjunction are few and have yielded results with limited generalizability. The potential knowledge this study will yield is increasingly important as the Hispanic population continues to undergo rapid growth (Colby & Ortman, 2015; Stepler & Brown, 2016) accompanied by a simultaneously increasing prevalence of chronic disease and related risk factors (Dominguez et al., 2015), both of which are directly affected by individual diet (Willett et al., 2006).

This study aimed to investigate the potential moderating effects of the proportion of Hispanic residents residing within a census tract on the relationship between acculturation and vegetable intake among a sample comprised of Puerto Ricans, Cubans, or Mexicans living in the U.S. Here, the terms “ethnicity” and “ethnic” will be used to refer to these three subgroups. The study will be guided by the social ecological model and will analyze individual-level and community-level data to address the following research questions: Does the proportion of Hispanics residing within a census tract influence the relationship between acculturation and vegetable intake among U.S. Hispanics? Do these relationships function differently among Puerto Ricans, Cubans, or Mexicans?



These answers are critical for the development of effective and comprehensive health programs directed toward improving the diet and well-being of Hispanics in the U.S.

### 1.3 PREVIEW OF THE THESIS CHAPTERS

The next section, Chapter 2, consists of a literature review that summarizes relevant background information about the study population. It also provides context for the proposed study by summarizing the existing literature on Hispanic acculturation in the U.S. and its effects on vegetable intake, as well as neighborhood characteristics and their effects on acculturation and vegetable intake. Chapter 2 is followed by a detailed description of the study methodology in Chapter 3. Chapter 4 is the manuscript to be submitted to Public Health Nutrition and Chapter 5 contains a detailed analysis of the study findings, how they relate to previous findings, and what can be done to further address these questions in the future.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 INTRODUCTION

This study examines the effects of neighborhood ethnic composition on the interaction between acculturation and vegetable intake among Hispanics in the U.S. This chapter will begin by providing an overview of the current state of health for Hispanics in the U.S. to provide context for the problem addressed by this study. Following the overview, there is a brief description of acculturation and acculturation measures to lead into a review of the literature addressing the current knowledge on acculturation and vegetable intake among Hispanics. The section ends with a summary and discussion of the existing body of research that examine the effects of neighborhood ethnic composition on acculturation and vegetable intake among Hispanics in the U.S.

#### 2.2. OVERVIEW OF HISPANIC HEALTH IN THE UNITED STATES

##### 2.2.a DEMOGRAPHICS

Hispanics in the U.S. are the largest minority groups, comprising 18.1% (approximately 55.9 million; U.S. Census Bureau, 2017) of the total U.S. population, which is up from 6.5% in 1980 (Stepler & Brown, 2016). In coming decades, it is projected that more than one out of every four Americans will be Hispanic by 2060 (Colby & Ortman, 2015). Hispanics are also currently the youngest major racial/ethnic

group in the U.S. with a median age of 28 overall and 18 among U.S.-born Hispanics (Stepler & Brown, 2016; Patten, 2016).

Although research studies involving Hispanic subjects often regard Hispanics as a single monolithic subgroup of the U.S. population, there is significant diversity by race, ethnicity, educational attainment, and English proficiency.

Here, only data regarding Mexicans, Puerto Ricans, and Cubans (referred to here as “Hispanic ethnic subgroups”) will be presented, as they are the three largest Hispanic subgroups in the U.S. and the three Hispanic subgroups represented in this study.

Mexicans comprise nearly two-thirds (63.9%) of the total U.S. Hispanic population, followed by Puerto Ricans (9.5%), and Cubans (3.7%; U.S. Census Bureau, 2015). These subgroups are concentrated in distinct geographic regions across the United States.

Mexicans are primarily located in the west with 61% of the total U.S. Mexican population residing in California and Texas and 11% in Los Angeles County (Motel & Patten, 2012). One out of two Puerto Ricans in the U.S. resides in the northeast (Cohn, Patten & Lopez, 2014) with 6% in Bronx County, NY (Motel & Patten, 2012), although the northeastern concentration has dispersed in recent years to other regions of the country (Cohn, Patten & Lopez, 2014). Additionally, the population of Puerto Ricans on the island has been, and will continue to be, on a steady decline with migration rates and low birth rates outpacing population growth (Cohn, Patten & Lopez, 2014) in addition to the recent effects of Hurricane Maria on migration. At the time of the study, approximately 3.4 million Puerto Ricans inhabited the island (Cohn, Patten & Lopez, 2014). Cubans in the U.S. are the most concentrated subgroup with nearly half (48%)

residing in Miami-Dade County, FL and two out of three (67%) living in Florida (Motel & Patten, 2012).

Other demographics across which these subgroups differ include age, educational attainment, and English proficiency. Cubans are among the oldest U.S. Hispanics with a median age of 40.6 years, as compared to 26.2 and 28.9 among Mexicans and Puerto Ricans, respectively (Dominguez et al., 2015). Among those aged 25 or older, approximately 30% of Puerto Ricans, 29% of Cubans, and 26% of Mexicans have a high school-level education or less and among those 25 or older with a Bachelor's degree or higher, Cubans (24%) outpace both Puerto Ricans (16%) and Mexicans (9%; Motel & Patten, 2012). Among U.S. Hispanics aged five or older, Puerto Ricans have the highest English proficiency (82%), followed by Mexicans (64%) and Cubans (58%; Motel & Patten, 2012).

## 2.2.b BURDEN OF DISEASE AMONG HISPANICS IN THE UNITED STATES

Due to the large and rapidly growing Hispanic population, it is important for public health professionals to address and understand the health challenges faced by this population in order to create effective policies and interventions to reduce these burdens. Health professionals have been limited in these efforts by a general lack of specialized health data to compare trends across and within ethnic subgroups of the Hispanic population. More specifically, the shortage of data extends to data regarding the incidence and prevalence of specific diseases, such as cardiovascular disease and diabetes, within specific subgroups of the Hispanic population, as defined by variables such as Hispanic ethnicity, national origin, race, or degree of acculturation (Tienda et al., 2006). This deficit of subgroup health data can be attributed to several factors. First, a

vast majority of studies treat Hispanics as a singular group. Secondly, many studies examine trends only among Mexican Americans, who comprise, by far, the majority of Hispanics in the U.S. (63.9%; U.S. Census Bureau, 2015) but do not serve as a true proxy to represent the diversity of the Hispanic population in the U.S. as a whole. As a result of these limitations, when more specific descriptive data by Hispanic ethnic subgroup were unavailable, data below were reported for Hispanics generally.

#### 2.2.b.i OVERALL MORTALITY AND MORBIDITY

The top five leading causes of death among Hispanics are cancer, heart disease, accidents, chronic liver disease and cirrhosis, and type 2 diabetes (Heron, 2016). Below are more specific data regarding the prevalence and incidence of cancer, heart disease, type 2 diabetes, and chronic liver disease/cirrhosis among Hispanic ethnic subgroups, as these four diseases have been specifically linked to dietary intake.

#### 2.2.b.ii CANCER

Cancer is the primary leading cause of death among Hispanics in the U.S. and, in conjunction with heart disease (the second leading cause), accounts for 41% of all deaths among Hispanics (Heron, 2016; Dominguez et al., 2015). However, significant differences exist across Hispanic ethnic subgroups. Puerto Ricans have higher age-adjusted death rates from cancer (140.8 per 100,000) than Mexicans (123.8) or Cubans (130.7) but lower than non-Hispanic whites (169.7; Dominguez et al., 2015).

Hispanics overall have a 49% lower reported prevalence of cancer than non-Hispanic whites (Dominguez et al., 2015). Furthermore, among Hispanics, marked differences in disease prevalence have been identified across Hispanic ethnic subgroups.

For example, 3.5% of Puerto Ricans have cancer, as compared to 1.9% of Mexicans and 1.5% of Cubans (Dominguez et al., 2015).

#### 2.2.b.iii HEART DISEASE

Data indicate that the burden of heart disease, the second leading cause of death among U.S. Hispanics, is not consistently distributed across all ethnic subgroups. Puerto Ricans have the highest death rate due to heart disease (171.5 per 100,000) when compared to Cubans (153.9) or Mexicans (129.2; Dominguez et al., 2015).

There is a lower reported prevalence (4.9%) of heart disease among all Hispanics compared to non-Hispanic whites (7.5%; Dominguez et al., 2015). The prevalence of heart disease among Puerto Ricans is approximately 8.8%, which again surpasses the prevalence of disease among Mexicans and Cubans (4.7% among both groups; Dominguez et al., 2015).

Hypertension is a significant risk factor of heart disease. Recent statistics indicate that approximately 16.8% of Hispanics have hypertension and, of those, approximately two-thirds (67.7%) also have uncontrolled hypertension (Dominguez et al., 2015). More specifically, 17.5% of Mexicans have hypertension but 72.4% do not have it controlled (Dominguez et al., 2015). No recent data were available regarding Puerto Ricans or Cubans.

#### 2.2.b.iv TYPE 2 DIABETES

Cubans have the lowest mortality rate from diabetes (19.6 deaths per 100,000 population) among the three Hispanic ethnic subgroups (Dominguez et al., 2015). This death rate is comparable to that among non-Hispanic whites (18.7; Dominguez et al., 2015). Mexicans (33.8) and Puerto Ricans (33.7) have similar death rates to each other,

but these rates are higher than the rate among Hispanics overall (28.3) and among non-Hispanic whites (18.7; Dominguez et al., 2015, Table 2). These statistics indicate that Mexicans and Puerto Ricans are almost twice as likely to die from diabetes as non-Hispanic whites (Dominguez et al., 2015).

Hispanics have an estimated 133% higher prevalence of type 2 diabetes than non-Hispanic whites (Dominguez et al., 2015). The only data available by national origin subgroup suggests that Mexicans have a higher prevalence of diabetes (15.3%) than Hispanics overall (14.0%), which is more than two times that of non-Hispanic whites (Dominguez et al., 2015).

#### 2.2.b.v CHRONIC LIVER DISEASE AND CIRRHOSIS

Chronic liver disease and cirrhosis are also responsible for a higher death rate among Hispanics (14.8 deaths per 100,000) than non-Hispanic whites (10.0; Dominguez et al. 2015). Among Puerto Ricans, Mexicans, and Cubans, the death rates to chronic liver disease and cirrhosis are highest for Puerto Ricans (18.1 per 100,000) and Mexicans (14.1), which are both more than twice the rate among Cubans (6.5; Dominguez et al., 2015). The most prevalent chronic liver disease among Hispanics is nonalcoholic fatty liver disease (NAFLD).

#### 2.2.b.vi OBESITY

The prevalence of obesity among U.S. Hispanic adults (39.9%) is higher than that of non-Hispanic whites (34.5%; Dominguez et al., 2015). Approximately 42.4% of Mexicans are obese, which is higher than Hispanics overall and non-Hispanic whites (Dominguez et al., 2015). No data obesity prevalence data were available for Puerto Ricans or Cubans.

### 2.2.c.vii SUMMARY

As evidenced by the above review of demographic and health data, Hispanic subgroups have a diverse representation across the U.S. in terms of age, general concentration of residence, and burden of disease. These differences highlight the need for a shift toward a more comprehensive approach that broadens the scope of Hispanic health research, and thereby health interventions, to be more inclusive and mindful of these differences.

### 2.3 VEGETABLE CONSUMPTION AND PREVENTION

In order to reduce the burden of chronic disease present in this population, significant public health efforts over the last several decades have been aimed toward improving the diet of Hispanics in the United States, as dietary intake is a significant modifiable determinant of health (United States Department of Health and Human Services, & The U.S. Department of Agriculture, 2015; World Health Organization, 2017). For the prevention and self-management of chronic disease individuals are typically advised to maintain healthful diets consisting of adequate vegetable intake, among other recommended foods, and to engage in regular physical activity.

This study focuses on the vegetable-intake aspect of dietary quality among U.S. Hispanics. Daily consumption of a variety of vegetables is recommended for adults because of the protective effects of vegetables on health for the prevention and control of chronic diseases (Van-Duyn & Pivonka, 2000), as well as risk factors for many chronic diseases (Ledoux, Hingle & Baranowski, 2011). Consumption of leafy greens, in particular, has been found to reduce the risk of cardiovascular disease (Hung et al., 2004) and type 2 diabetes (Li et al., 2014; Carter, Gray, Troughton, Khunti & Davies, 2010).



High consumption of plant protein has also been associated with lower cardiovascular mortality, especially among individuals with at least one lifestyle-related risk factor for cardiovascular disease (Song et al., 2016).

Associations between cancer risk and mortality with vegetable intake are not as clear. Oyeboade and colleagues (2014) found fruit and vegetable consumption to be associated with reduced cancer risk, while Giovannucci (2002) found that a higher intake of folate, which is a nutrient found in fruits and vegetables, was associated with a lowered risk of colorectal cancer (Giovannucci, 2002). However, while Leenders et al. (2015) did observe lower risk of colorectal cancer with higher fruit and vegetable consumption, there was no consistent association when fruit and vegetable consumption were assessed separately. Similarly, Wang et al. (2014) did not find a significant association between higher consumption of fruits and vegetables and cancer mortality.

Non-alcoholic fatty liver disease (NAFLD) is the most common cause of liver disease among Hispanics and increases the risk of cirrhosis, the fourth leading cause of death among Hispanics. Dietary patterns consisting of higher consumption of fatty foods and lower consumption of fruits and vegetables have been associated with an increase in prevalence of NAFLD (Fan & Cao, 2013) which makes addressing diet of particular importance for its prevention and treatment. Although no direct links between vegetable consumption and liver disease prevention or treatment have been established, it has been found that individuals who undergo significant weight loss via dietary and other behavioral changes experience an amelioration of hepatic steatosis (fatty liver; Fan & Cao, 2013; Zelber-Sagi, Ratziu & Oren, 2011). This condition, if left untreated, can be

detrimental to health and is often accompanied by comorbidities such as diabetes, hypertension, and obesity (Fan & Cao, 2013).

There is also evidence to suggest that vegetable intake aids in the prevention of additional weight gain and promotion of weight loss among overweight and obese adults. An increase of fruit and vegetable consumption has been associated with reduced adiposity (fatty tissue) among overweight or obese adults (Ledoux, Hingle and Baranowski, 2011) and general weight loss (Sartorelli, Franco & Cardoso, 2008; Svendsen, Blomhoff, Holme & Tonstad, 2007).

### 2.3.a. TRENDS IN VEGETABLE CONSUMPTION

The recommended minimum daily intake of vegetables per day for adult women is 2.5 cups and for adult men, 3.0 cups (United States Department of Health and Human Services, & The U.S. Department of Agriculture, 2015), but the latest data available indicate that mean daily intake among all U.S. adults aged 19 and older is only 0.86 cups (United States Department of Health and Human Services, & The U.S. Department of Agriculture, 2015). Mean daily vegetable intake among Hispanics (0.79 cups) is almost equivalent to that of non-Hispanic whites (0.77 cups) and higher than among non-Hispanic blacks (0.66 cups); however, vegetable intake among Hispanics is nonetheless well below the recommended 2.5 or 3.0 cups per day for women and men, respectively (Healthy People, 2020).

There are several potential explanations for why Americans, and more specifically Hispanics, consume less than the recommended amount of vegetables. Individual and neighborhood socioeconomic status have both been found to be strongly associated with low vegetable consumption (Dubowitz et al., 2008; Storey & Anderson,

2014) and have led researchers to hypothesize that poverty and food insecurity hinder the regular consumption of fruits and vegetables (Kaiser et al. 2003). Furthermore, qualitative studies among Hispanic immigrants in the U.S. have found that changes in the availability, quality, and taste of fresh produce, in addition to shifts in income and long work hours may decrease vegetable consumption post-immigration (Gray et al., 2005; Cason, 2006). As discussed in more detail below, existing evidence indicates that acculturation is inversely associated with vegetable intake, however, acculturation is a complex process that is not only difficult to operationalize but is also influenced by a number of potentially confounding variables such as age, income, education, and movement from rural to urban areas (Pérez-Escamilla & Putnik, 2007). Thus, it is difficult to clearly disentangle the exact relationship between acculturation and vegetable intake and few studies have attempted to examine the specific attributes of acculturation that may have the most significant impact on health behaviors such as vegetable intake (Allen et al., 2014). These relationships deserve further investigation, as their understanding may be critical to developing effective programs and policy interventions to promote improvements in dietary quality among U.S. Hispanics.

## 2.4 DEFINITIONS AND MEASURES OF ACCULTURATION AMONG U.S.

### HISPANICS

Acculturation is generally understood to be a dynamic process by which individuals or groups undergo varying degrees of adaptation to the many aspects of a new host culture. Relatedly, dietary acculturation is the process of adopting the dietary practices of a host country or culture (Satia-Abouta et al., 2002). There are varying perspectives across the literature on the mechanisms through which the process of acculturation takes

place as well as its influence on health outcomes. Due to the multiple conceptualizations of acculturation employed in health research, operationalization also differs and a variety of measures have been employed across nutrition studies involving Hispanics.

Acculturation scales can be unidimensional, measuring one domain of acculturation, or bidimensional (sometimes also referred to as multidimensional) which measures two or more domains. The term “dimension” refers to the number of domains of acculturation (i.e. language preference, or ethnic identity) that are measured by independently-scored subscales of an acculturation scale (Furr, 2011). Acculturation scales are also classified in terms of their directionality. Directionality describes the manner in which two cultural orientations are assessed. In terms of acculturation scales, the directionality refers to whether a scale is conceptualized linearly or orthogonally. In these scales, two cultural orientations can be measured dependently, represented by a single linear scale, or independently as two independent, perpendicular linear scales that comprise one orthogonal scale. The different attributes of common acculturation scales are described in more detail in the following sections.

To highlight the discrepancies across the literature in terms of acculturation measures, Thomson and Hoffman-Goetz (2009) found in their review of acculturation measures used in public health research among Hispanic populations in the U.S., that almost half of the studies examined did not include a definition of acculturation, and, of those that did, 27% cited a bidimensional definition (encompassing two domains of acculturation) while employing a unidimensional measure (measuring only one domain) of acculturation, exemplifying the discrepancies that exist even within singular studies. This measurement

inconsistency may be attributed to irregularities across the literature regarding the association between acculturation and health outcomes therefore limiting generalizability.

#### 2.4.a LINEAR MEASURES OF ACCULTURATION

Unidirectional, or linear, definitions of acculturation, as first developed by Park and Miller (1921), describe acculturation as a linear process through which gains in cultural orientation made toward the host culture are accompanied by equivalent losses in the culture of origin. In other words, as ties with a new culture are strengthened, they are offset by reductions in ties with the previous culture. This means that one can only strongly identify with one culture at a time.

Linear measurements of acculturation reflect the linear definition and measure a person's orientation toward their culture of origin and their host culture together on a single scale, wherein identifying with one culture is inversely related to one's identification with the other culture. One example of this type of measurement is the original Acculturation Scale for Mexican Americans (ARSMA, or ARSMA-I; Cuellar, Harris & Jasso, 1980). The scale consists of four independently-scored subscales including (1) language familiarity, usage, and preference, (2) ethnic identity and generation, (3) reading, writing and cultural exposure and (4) ethnic interaction, for a total of 20 items (Cuellar, Harris & Jasso, 1980). Based on these subscale scores, the ARSMA classifies each individual on a continuum of acculturation into one of five categories: very Mexican, Mexican-oriented bicultural, true bicultural, Anglo (non-Hispanic European American)-oriented bicultural, and very Anglicized (Cuellar, Harris & Jasso, 1980). The ARSMA can be administered in both English and Spanish and was originally developed for use among Mexican-Americans, but it has been adapted

successfully for use among Puerto Ricans (Wiley et al., 2014), El Salvadorans, and Cubans (Jimenez et al., 2010). Another example of a linear scale is the 12-item Short Acculturation Scale for Hispanics (SASH), which was developed by Marín et al. (1987). The SASH is multidimensional as it includes three cultural domains: language use (English or Spanish), media, and social interactions with people from Hispanic versus non-Hispanic White ethnic groups. This scale was developed in the U.S. primarily among Cubans, Mexicans, and “other Hispanics,” most of whom were Central American (Marín et al., 1987).

The development of ARSMA and other unidimensional instruments were progress toward a more robust measure of acculturation that better reflected more complex definitions of acculturation, but their use has been limited by classification of individuals on a continuum of less-acculturated (strong Mexican-orientation) to more-acculturated (strong Anglo-orientation). These predetermined potential outcomes imply a linear process that has been criticized as being an overly-simplified operationalization of the actual progression of acculturation. Another commonly cited flaw of this unidirectional measurement, is that individuals with strong cultural orientations for both their original and new host cultures, as well as those that do not identify strongly with either, fall in the middle of the scales and are both classified as bicultural, which is an inaccurate characterization of those that do not identify with either culture (Cuellar, Arnold & Gonzales, 1995; Flannery, Reise and Yu, 2001; Thomson & Hoffman-Goetz, 2009). These limitations are addressed by orthogonal measures of acculturation, discussed in the following section.

#### 2.4.b ORTHOGONAL MEASURES OF ACCULTURATION

Orthogonal definitions of acculturation view the culture of origin and host culture as two conceptually independent cultural orientations (Thomson & Hoffman-Goetz, 2009; Flannery, Reside & Yu, 2001). This conceptualization of acculturation began with the work of psychologist John Berry who described acculturation as a process in which the maintenance of the culture of origin and the development of relationships with the host culture occur separately and independently of one another (Berry, 1980; Thomson & Hoffman-Goetz, 2009). This conceptualization has allowed for more acculturation classifications than unidimensional interpretations provided and was the foundation upon which Cuellar, Arnold and Maldonado (1995) modified the original ARSMA to develop the ARSMA-II. Berry's (1980) orthogonal conceptualization has become the more accepted view of the acculturation process, as it allows for researchers to classify individuals that hold strong affiliations with one culture, two cultures, or neither their host culture or culture of origin.

When graphically displayed, Berry's conceptualization places orientation toward the host culture on the x-axis and the culture of origin on the y-axis forming four quadrants for each of the four potential acculturation outcomes: integration, assimilation, marginalization, and separation (Berry, 1980). Integration (quadrant I) describes individuals who acquire strong behavioral and attitudinal associations with their new host culture while retaining those with their culture of origin (Berry, 1980). Assimilation (quadrant II), refers to individuals who have almost entirely abandoned the attitudes and behaviors associated with their culture of origin while simultaneously adopting those of the host culture (Berry, 1980). Marginalization (quadrant III), describes a psychological

state in which an individual loses his or her original cultural identification while adopting that of the host culture that subsequently does not fully accept said individual (Berry, 1980). Lastly, separation (quadrant IV) describes individuals who reject the host culture and choose to retain only the beliefs, practices and values of their culture of origin (Berry, 1980). The ARSMA-II conceptualization is based on Berry's (1980) interpretation of acculturation and categorizes individuals into five categories: high integrated bicultural, Mexican oriented bicultural, low integrated bicultural, assimilated bicultural, and unclassified, which have sub-classifications of 17 possible bicultural typologies (Cuellar, Arnold & Maldonado, 1995). The ARSMA-II is also multidimensional in that it assesses the domains of (1) language use and preference, (2) ethnic identification and classification, (3) cultural heritage and ethnic behaviors, and (4) ethnic interaction in individually-scored subscales (Cuellar, Arnold & Maldonado, 1995).

Another example of an orthogonal measure of acculturation is the 12-item Bidimensional Acculturation Scale (BAS) by Marín and Gamba (1996). This scale consists of three subscales covering the domains of: language use, linguistic proficiency, electronic media and celebrations (Marín & Gamba, 1996).

The primary advantage of orthogonal scales over linear scales is their ability to accurately categorize individuals that are bicultural in addition to individuals that do not identify with either culture.

#### 2.4.c PROXY MEASURES OF ACCULTURATION

Many studies have used proxy measures of acculturation like birth country, language use, number of years spent in the U.S., or generational status in the U.S. (Ayala, Baquero & Klinger, 2008; Pérez-Escamilla & Putnik, 2007). In general, proxy measures



consist of a single item and therefore tend to be more efficient and economical, especially for large-scale surveys and in clinical settings where assessments need to be short. More in-depth measures of acculturation contain significantly more items and thus take longer to administer. Additionally, many studies of acculturation have examined secondary data that were not collected for the purposes measuring acculturation and have therefore relied on proxy measures.

Although proxy measures have practical benefits, they have several limitations. They lack the ability to measure the nuances of the acculturative process and are varied in their ability to predict individuals' scores on longer, more in-depth, acculturation measures (Thomson & Hoffman-Goetz; 2009). Thomson and Hoffman-Goetz (2009) conducted a systematic review of studies that employed a multitude of proxy measures of acculturation and found correlations with acculturation scales, including the ARSMA, ranging from 0.17-0.76. The use of proxy measures may result in misleading outcomes because they fail to consider other factors (Thomson & Hoffman-Goetz, 2009). An example of this would be an individual who was born in a Latin American country and who has only resided among and interacted with their own ethnic community post-immigration to the U.S., even after several decades. This individual would be categorized as being less acculturated according to proxy measures of birth country or language use/proficiency. On the other hand, the proxy measures of years lived in the U.S. would classify this individual as being more acculturated, which may not be as accurate because he or she may not have adopted the majority culture of the new host country. This exemplifies the need for more comprehensive measures of acculturation in research and

even calls into question the need for environmental variables such as neighborhood characteristics.

This study used the ARSMA-II as a measure of acculturation as it is among the three most well researched and validated acculturation measures, in addition to the original ARSMA and the BAS (Wallace, Pomery, Latimer, Martinez & Salovay, 2010). Of these three scales, the ARSMA-II and the BAS are the only orthogonal measures and, of those, the ARSMA-II encompasses a broader range of domains.

## 2.5 STUDIES ON HISPANIC ACCULTURATION AND DIET

In the most recent systematic review of the literature analyzing the association between acculturation and diet among Hispanics in the U.S., Ayala and colleagues (2013) found that regardless of the operationalization of acculturation used, being less acculturated was associated with more healthful levels of nutrient consumption, including more fruit, vegetables, and beans. As a result, the relationship between acculturation and dietary intake, especially among Hispanics, has been an important focus of research in recent years. However, results are mixed among the many studies conducted since the 1980s aimed at understanding the relationship of acculturation with diet and other health-related outcomes among Hispanics in the U.S. Comprehensive reviews of the literature on the relationship between acculturation and diet exclusively among Hispanics in the U.S. have concluded that much of the significant variation in the findings across studies could be attributed to the inconsistencies in the way that acculturation was being measured (Ayala, Baquero & Klinger, 2008; Pérez-Escamilla & Putnik, 2007; Thomson & Hoffman-Goetz, 2009). The following section organizes existing literature on Hispanic diet and acculturation by the type of acculturation measure employed in the study.

## 2.5.a NUTRITION STUDIES INVOLVING LINEAR MEASURES OF ACCULTURATION

Studies involving linear measures of acculturation have indicated that dietary quality overall, specifically vegetable intake, is positively associated with acculturation. Kaiser Permanente conducted a study in San Francisco among Hispanics, those who used Spanish more than English, based on a 5-item language use-focused acculturation scale, were 1.5 times more likely to eat beans than Hispanics who used English more than Spanish (Otero-Sabogal et al., 1995). Intake was assessed using food frequency items from the National Health Interview Survey (Otero-Sabogal et al., 1995). Bermudez, Falcon and Tucker (2000) analyzed cross-sectional data from the Massachusetts Hispanic Elders Study for both Hispanics (Puerto Ricans, Dominicans, and other Hispanics) and non-Hispanics and found that Hispanics with ARSMA scores indicative of a stronger Anglo-orientation than Hispanic orientation, had similar dietary habits to non-Hispanic whites, i.e. higher intake from simple sugars and less intake from complex carbohydrates (beans, whole grains, and vegetables). Additionally, a stronger Anglo-orientation was associated with a lower intake from complex carbohydrates when compared to those with a stronger Hispanic-orientation (Bermudez, Falcon & Tucker, 2000). Neuhouser and colleagues (2004) found comparable results among a Mexican population in Washington State in a baseline assessment for a community-randomized cancer prevention trial to assess the associations of diet with acculturation. Overall, Hispanics with high Anglo-orientation scores, determined by an adapted four-item ARSMA scale, consumed close to half a serving less of vegetables than those with a stronger Mexican-orientation ( $p < 0.05$ ; Neuhouser et al., 2004).

## 2.5.b NUTRITION STUDIES INVOLVING ORTHOGONAL MEASURES OF ACCULTURATION AMONG HISPANICS

There is only one known study to have examined acculturation and vegetable intake while employing a multidimensional measure of acculturation. Matias, Stoecklin-Marois, Tancredi, and Schenker (2013) sought to further explore the relationship of acculturation and vegetable intake by incorporating the use of several types of acculturation measures and comparing their associations with fruit and vegetable (F&V) intake. The associations between F&V intake and acculturation changed based on the measure of acculturation employed (Matias et al., 2013). Acculturation level (as determined by ARSMA II) and age at immigration were not associated with fruit and vegetable intake, however, respondents born in Central America had higher odds of F&V consumption when compared to U.S.-born counterparts, and surprisingly, longer residence in the U.S. which was presumably indicative of stronger Anglo-oriented acculturation (and therefore lower F&V consumption) was positively associated with fruit and vegetable consumption (Matias et al, 2013).

## 2.5.c NUTRITION STUDIES INVOLVING PROXY MEASURES OF ACCULTURATION AMONG HISPANICS

Several studies have employed the use of proxy measures to approximate acculturation including nativity, language use, generational status, and length of U.S. residence and have found an inverse relationship between acculturation into the Anglo-American culture and vegetable intake.

Birth country was used by Dixon, Sundquist, and Winkleby (2000), Duffy and colleagues (2008), and Montez and Esbach (2008) as a proxy for acculturation where

those born in the U.S. were assumed to be more oriented to the U.S. mainstream culture than their foreign-born counterparts. Dixon, Sundquist and Winkleby (2000) studied the energy, nutrient, and food intake of a sample of Mexican-Americans using data from NHANES III and found that participants born in Mexico were more likely to have a higher intake of fruits, vegetables, grains and legumes than their U.S.-born counterparts. These findings were supported by Duffey and colleagues (2008) who also utilized NHANES data collected among Mexicans and other Hispanic adults and found that being born in the U.S. was associated with a lower percentage of consumption of legumes, fruits and vegetables. Lastly, Montez and Esbach (2008) also found that Mexican-born women consumed more grams of daily fiber ( $p < 0.01$ ) when compared to U.S.-born Mexican women. Women with an increased comfort with English also had lower vegetable intake (Montez & Eschbach, 2008).

Generational status has also been used as a proxy for acculturation under the supposition that acculturation increases with generation status. Using this proxy measure, first-generation Mexican American women consumed significantly more protein, carbohydrates, cholesterol, vitamins A and C, folic acid, calcium and iron than second-generation (more acculturated) Mexican women (Guendelman & Abrams, 1995).

Lastly, length of residence in the U.S. has been used as a proxy for acculturation whereby more years of residence in the U.S. is representative of higher acculturation to mainstream Anglo-American culture. Chavez, Sha, Persky, and Pestano-Binghay (1994) examined the effect of length of residence in the U.S. on food group intake among Mexican and Puerto Rican women and found that the consumption of vitamin A-rich and vitamin C-rich fruits and vegetables among Mexican women was inversely related to

length of U.S. residence, even after controlling for education and ethnicity (Chavez, Sha, Persky & Pestano-Binghay, 1994). In another study among Hispanic women, foreign-born women who had lived in the U.S. fewer than four years consumed 2.5 more servings of fruits and vegetables than U.S.-born women (Dubowitz, Smith-Warner, Acevedo-Garcia, Subramanian & Peterson, 2007). Lastly, in a comparison of dietary quality between Puerto Rican adults living in Massachusetts or Puerto Rico, vegetable intake was significantly lower among Puerto Ricans living in Massachusetts compared with those on the island (Lopez-Cepero, Jimenez, Lemon, Palacios & Rosal, 2017). Diet quality was assessed using the Multicultural Food Frequency Questionnaire, which researchers modified for use among the Puerto Rican study sample (Lopez-Cepero, Jimenez, Lemon, Palacios & Rosal, 2017).

## 2.6 THE POTENTIAL INFLUENCE OF NEIGHBORHOOD ETHNIC COMPOSITION ON THE RELATIONSHIP BETWEEN ACCULTURATION AND VEGETABLE INTAKE

Most of the published studies that have examined the influence of acculturation on vegetable intake have used exclusively individual-level measures of behaviors, attitudes, acculturation, and sociodemographic characteristics. However, there is an emerging body of research that focuses more widely beyond the individual to observe the effects of environmental factors on this relationship. Generally, it has been found that neighborhood context influences a range of health outcomes after adjusting for individual-level variables (Abraido-Lanza, Echeverria & Florez, 2016). The effects of neighborhood characteristics on the relationship between acculturation and vegetable intake have not yet been extensively studied but existing findings suggest a need for

further investigation. Hispanics who move to neighborhoods in the United States where residents predominantly match their culture of origin are shielded to varying extents from exposure to mainstream Anglo-American culture. Because of this, neighborhood ethnic composition may possess a significant role in the acculturative process, but its potential effects have been largely overlooked in dietary acculturation research thus far (Abraido-Lanza, 2006). This assertion is supported by Pérez-Escamilla and Putnik (2009), who criticize linear acculturation scales in particular for their inherent assumption that the acculturative process ultimately ends with the adoption of the mainstream White, or Anglo-American culture. As they assert, this may not be true of the acculturative process for individuals in areas of the United States where the dominant host culture is not the mainstream Anglo-American culture. Much less is known about this progression for Hispanics living in neighborhoods where the majority of residents are Hispanic. In these communities, it may even be that acculturation occurs in the reverse of the expected direction, wherein Anglo-Americans adopt the Hispanic culture (Pérez-Escamilla & Putnik, 2007). Satia-Abouta, Patterson, Neuhouser, and Elder (2002) referred to these areas where the majority culture is that of an ethnic minority as “ethnic enclaves,” and posited that immigrants who immigrate into areas with high densities of non-White individuals may experience acculturation more slowly or with outcomes not described by existing models.

Neighborhood ethnic segmentation is common in the United States as nearly half of all Hispanics in the U.S. reside in the top 10 metropolitan areas alone (Motel & Patten, 2012). This pattern has been attributed to a preference among Hispanics immigrants for residing in areas with a high proportion of Hispanics in order to ease adjustment to living

in the U.S. (Acevedo-Garcia et al., 2003). Therefore, understanding the potential effects of neighborhood ethnic composition on the relationship between acculturation and vegetable intake is important especially among U.S. Hispanics. Further, these effects should be examined within specific subgroups of the Hispanic population, such as Mexicans, Puerto Ricans, and Cubans.

## 2.9 STUDIES ON THE EFFECTS OF NEIGHBORHOOD CHARACTERISTICS ON DIET AMONG U.S. HISPANICS

There are limited data on the effects of neighborhood characteristics on dietary acculturation. Existing data indicate that the proportion of Hispanic residents within a census tract is positively associated with vegetable consumption among Hispanic adults (Dubowitz et al., 2008, Park et al., 2011). Dubowitz et al. (2008) also found that living in a neighborhood with a higher proportion of foreign-born individuals was associated with a higher fruit and vegetable intake among low-income, post-partum women, including Hispanic women. Moreover, for each 10-percentage point increase in the foreign-born proportion within a census tract, there was an average increase of 0.2 daily servings of fruits and vegetables (Dubowitz et al., 2008). Park et al. (2011) observed that adherence to a healthy dietary pattern consisting, in part, of a high vegetable intake, was strongly predicted by the proportion of linguistically isolated households, defined as a household in which all persons 14 or older speak a language other than English and none speaks English “very well” within a given census tract (Siegel, Martin & Bruno, 2001). Similarly, Zhang et al. (2015) identified that the proportion of foreign-born individuals was associated with a lower predicted probability of “unhealthy dietary behaviors” defined as zero servings of fruit and vegetables a day and eating fast food at least once



per week. In contrast, the opposite relationship between neighborhood ethnic composition and dietary intake was observed by Reyes-Ortiz et al. (2009) among Mexicans in the U.S., where a negative association was observed between proportion of Mexicans within a census tract and the consumption of carrots, spinach/greens, broccoli, melons and other fruits and vegetables. However, the proportion of Mexican residents was positively associated with more ethnically traditional foods, such as corn products, tomatoes, red chili peppers, beans, lentils and garbanzos (Reyes-Ortiz et al. 2009).

Some researchers have hypothesized that the apparent protective effects of residing in an area of high-Hispanic density may be due to local businesses in these areas catering to the diets of immigrants due to high demand, making it easier for individuals in these areas to consume familiar fruits and vegetables from their cultures of origin, which may have an effect on vegetable intake (Osypuk et al., 2009). Furthermore, neighborhoods with concentrations of residents who share the same culture and language may provide greater access to culturally appropriate health and nutrition services, healthy and more affordable foods, or other material goods through social networks which would otherwise be significantly more difficult to access (Berkman et al., 2000).

More research is needed to understand if, how, and the extent to which, neighborhood characteristics affect the relationship between acculturation and vegetable intake among Hispanics and Hispanic ethnic subgroups both in a wider context and using more robust measures of acculturation like the ARSMA-II. Among the four studies cited above, ethnic composition of the Hispanic samples varied. One consisted of Mexicans and Puerto Ricans (Park et al., 2011), another of only Mexicans (Reyes-Ortiz et al., 2009), and the last two of general Hispanic ethnicity (Dubowitz et al., 2008; Zhang et al.,

2015). Hispanics are not a homogenous group and investigating country of origin or Hispanic ethnic subgroup in this context may have yielded more specific or even different results.

Furthermore, three of the four studies were conducted among individuals in large metropolitan areas: Los Angeles, Boston and New York City (Zhang et al., 2015; Dubowitz et al., 2008; Park et al., 2011) which limits the generalizability of results. Reyes-Ortiz et al. (2009), whose results contrasted those of the other studies in finding a positive association between neighborhood ethnic density and vegetable intake, was the only study employing a national sample.

Lastly, none of these studies used a measure of acculturation beyond proxies. Reyes-Ortiz et al. (2009) utilized Hispanic ethnic composition as a proxy for contextual acculturation while Dubowitz et al. (2008), Zhang et al. (2015), and Park et al. (2011) all utilized several proxy measures (nativity, duration of residence in the U.S., and language spoken at home) in their analyses to approximate individual acculturation in their samples, likely due to their use of existing datasets not originally intended to measure acculturation.

These conflicting findings encourage future studies to analyze these relationships with national samples and more robust measures of acculturation in order to better understand the impacts of neighborhood ethnic composition on acculturation and vegetable intake.

## 2.10 CONTRIBUTION OF THE STUDY TO THE LITERATURE

The goal of the present study was to assess whether neighborhood ethnic composition plays a role in the relationship between acculturation and vegetable intake among Hispanics in the U.S. and, more specifically, among the three largest Hispanic subgroups: Mexicans, Puerto Ricans, and Cubans.

This information contributes to the literature focused on acculturation and vegetable intake because it includes a robust, multidimensional measure of acculturation, the ARSMA-II, as well as a large sample of the three largest U.S. ethnic subgroups of Hispanics. This study moves beyond the examination of individual-level factors to assess the independent and potentially interactive effects of community-level characteristics which have remained largely unstudied. Understanding larger-scale variables like neighborhood characteristics that are potentially protective against the negative impacts of dietary acculturation will be crucial for designing appropriate, culturally specific, and effective interventions that promote and preserve healthier diets. This is especially important among Hispanic populations in the U.S., which will continue to grow in the coming decades and that are already experiencing a high prevalence of chronic disease and associated risk factors. This study has one specific aim: to determine the extent to which the proportion of Hispanic residents within census tracts interacts with acculturation to predict vegetable intake among U.S. Hispanics overall and within three ethnic subgroups, Mexicans, Puerto Ricans, and Cubans.

**Hypothesis:** It was predicted that Hispanic density would moderate the relationship between acculturation and vegetable intake, such that the relationship between having a Hispanic cultural orientation and vegetable consumption would be stronger among Hispanic participants living in census tracts with higher Hispanic density than those living in census tracts with lower Hispanic density. This relationship was also tested within each of the three Hispanic subgroups.

## 2.11 CONCEPTUAL MODEL

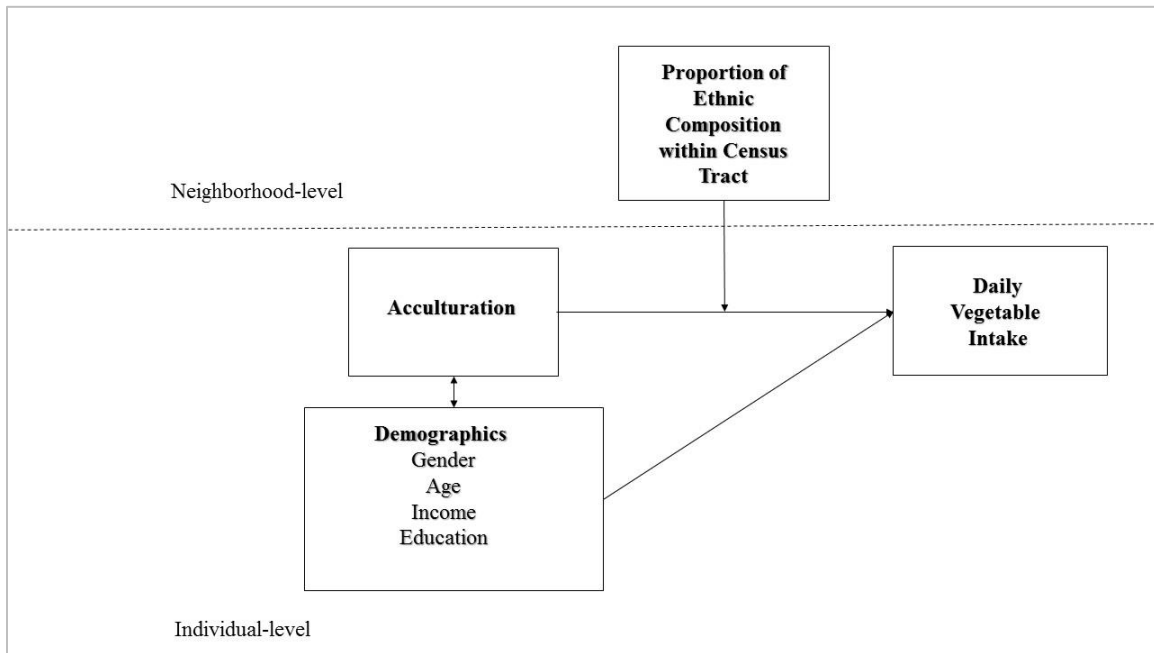


Figure 2.1 The conceptual model of the study. “Proportion of Ethnic Composition” refers to overall proportion of Hispanics within a census tract as well as the proportion of Mexicans, Puerto Ricans, and Cubans, within census tracts, assessed in independent subgroup analyses.

## CHAPTER 3

### METHODS

#### 3.1 STUDY POPULATION

Participants in this study were drawn from a study funded by the National Cancer Institute which focused on improving the validity of survey data by minimizing the effects of acquiescence, or the tendency to systematically agree with survey items, among Hispanic telephone survey respondents. In order to be eligible to participate in the parent study, respondents had to be 18-90 years of age, reside in the mainland U.S. or Puerto Rico, and self-identify as Mexican, Mexican-American, Cuban, Cuban American, or Puerto Rican. Participants also had to be classified as “acquiescers,” as determined by a 20-item acquiescence response style (ARS) screener. Respondents were selected for the parent study using lists of landline and cell telephone numbers purchased from a commercial sampling vendor. Data for the current study were obtained from the 913 participants who completed a telephone survey as part of the parent study.

#### 3.2 DATA COLLECTION

Computer assisted telephone interviewing (CATI) was conducted by bilingual interviewers who administered the parent study survey during the period of May-November 2016. The survey was available for completion in English or Spanish, according to each respondent’s preference. The survey content was translated by external trained and certified bilingual translators and reviewed for accuracy by bilingual study

team members. Two different interviewing techniques, standardized interviewing and conversational interviewing, were employed by the interviewers as part of an experiment conducted in the parent study. Respondents were randomly assigned one of the two techniques. The survey took approximately 45 minutes to administer. Thirty-dollar gift cards were mailed to participants who completed the survey. Procedures for the proposed study have been approved by the University of South Carolina Internal Review Board.

### 3.3 MEASURES

#### 3.3.a VEGETABLE INTAKE (DEPENDENT VARIABLE)

Daily intake of vegetable consumption was estimated employing a six-item Food Frequency Questionnaire (FFQ) adapted from the National Health and Nutrition Examination Survey (NHANES) 2009-2010 Dietary Screener (Centers for Disease Control and Prevention, 2010). The six items measured vegetable intake and included specific questions about the intake of leafy greens, fried potatoes (excluded from analysis), legumes and other beans, raw tomato sauce, cooked tomato sauce, and other vegetables not previously mentioned. These items were adapted for use with the Puerto Rican, Mexican, and Cuban study participants by adding culturally relevant examples of some foods, such as jicama and tomatillos, and, when appropriate, using words for vegetables that were more familiar within each ethnic group for the Spanish version of the questionnaire (See Appendix B).

The construction of this variable followed guidelines from the National Cancer Institute Division of Cancer Control and Population Sciences for scoring the 2009-2010 NHANES dietary screener (National Cancer Institute, 2016). For analysis, the equivalents of total vegetable intake, without fried potatoes, were estimated in mean cups

per day. Respondents had the option of reporting intake of each food item in terms of daily, weekly, or monthly consumption (i.e. "...three times per week"). Quantities reported as weekly or monthly were divided by 7 or 30, respectively, to obtain a daily frequency ( $N_k$ ) for each type of vegetable assessed. The FFQ items yielded the frequency of consumption for each food item, so median portion size estimates ( $P_k$ ) were applied in order to estimate cup equivalents. Because the original FFQ was slightly altered for this study, the median portion estimates publicly available online were not applicable to these data. Instead they were obtained with direct assistance from the National Cancer Institute (NCI) and calculated based upon NHANES 2009-2010 24-hr dietary recall data and adapted for the FFQ employed in this study (U.S. Department of Agriculture and the U.S. Department of Health and Human Services, 2015). The portion estimates were age- and sex-specific. Resulting cup equivalents for each of the six vegetable items in the FFQ were multiplied by sex-specific regression coefficients, also obtained from the NCI, to more accurately reflect the relationship between the FFQ estimate and the gold-standard, 24-hr dietary recalls.

The calculated cup equivalents for each vegetable item were added together to calculate the total estimated daily vegetable intake for each respondent using the following formula:

$$E(\text{Vegetables}) = b_0 + b_5 N_{FG5} P_5 + b_6 N_{FG6} P_6 + b_8 N_{FG8} P_8 + b_{11} N_{FG11} P_{11} + b_9 N_{FG9} P_9$$

In this formula, E is the expected value,  $N_{FGK}$  is the daily frequency of intake for that food group,  $P_k$  is the sex-age specific portion size estimate for that group, and  $b_k$  is the sex-specific estimated regression coefficient for each term. Regression coefficients specific to the Hispanic sample overall and Mexicans, respectively. Coefficients and

median portion vegetable intake frequencies and distributions were examined to identify outliers. The threshold for extreme values was set at 10 cups per day. All observations above 10 were recoded as 10.

### 3.3.b ACCULTURATION (INDEPENDENT VARIABLE)

Acculturation was measured using a version of ARSMA-II that was modified for use among Puerto Ricans and Cubans by tailoring the survey items to the respondent's Hispanic ethnicity. For example, an original ARSMA-II item, "I associate with Mexicans and/or Mexican Americans" was altered to read "How often do you socialize with (Mexicans/Cubans/Puerto Ricans)?" This 27-item scale consisted of two subscales. One measured orientation toward an individual's Hispanic ethnic group of origin (15 items;  $\alpha=.79$ ), and one assessed orientation toward Anglo-American culture (12 items;  $\alpha=.87$ ). Each subscale included the four original ARSMA and ARSMA-II domains: language use preference, ethnic identity and classification, cultural heritage and ethnic behaviors, and ethnic interaction (Cuellar, Arnold & Maldonado, 1995). The slightly adapted version of the ARSMA-II used in the present study can be found in Appendix A. Scores for both four-point subscales were used to measure the strength of individuals' orientation to each culture, higher scores indicating a stronger orientation and vice versa.

### 3.3.c ETHNIC COMPOSITION WITHIN CENSUS TRACTS

Tracts are defined by the U.S. Census Bureau (2010) as "small, relatively permanent statistical subdivisions of a county" ranging between 1,200 and 8,000 inhabitants based on the population density of the area. Tract-level census data were obtained via the American FactFinder from the American Community Survey (ACS) 5-year estimates (United States Census Bureau, 2015). Variables of interest included the



proportion of total Hispanics within each tract and the proportion of residents within each tract from each of the targeted Hispanic ethnic subgroups (Mexicans, Puerto Ricans, and Cubans) which were modeled as continuous variables (Dubowitz et al., 2008; Park et al., 2011). The proportion of Hispanic speakers within tracts was also of interest. These data were collected over a 60-month period between 2011-2015 (U.S. Census Bureau, n.d.). Of the total sample of 913 participants, the sample was reduced to 851 after geocoding due to missing addresses or P.O. Boxes, both of which could not be geocoded.

Eight hundred and fifty-one full addresses from the U.S. and Puerto Rico were geocoded, or converted to geographic coordinates, using ArcGIS® 10.5.1 by Environmental Systems Research Institute, Inc. (Esri; Copyright © 2017, Redlands, CA). Geocoded addresses were matched with corresponding tract identifiers (unique codes assigned to each individual tract), and tract-level attributes including: proportion Hispanic, proportion Mexican, proportion Cuban, proportion Puerto Rican, and proportion Spanish speakers. The data merge resulted in individual-level as well as census tract-level attributes for each participant.

### 3.3.d SOCIODEMOGRAPHIC VARIABLES (COVARIATES)

Individual-level covariates included age, gender, and education, as these variables have been previously found to influence vegetable intake (Roos et al., 1998; Dubowitz et al., 2008). Age may affect individuals' ability to prepare vegetables for themselves, and as a result, older adults may consume fewer vegetables than younger adults. Because of strong gender roles in the Hispanic population, gender may also influence vegetable consumption as women are potentially more likely to cook for themselves and their families. Although they may not be cooking vegetables exclusively, it may increase the

probability of vegetable consumption. Education may also be associated with vegetable intake because of the knowledge obtained via education about the benefits of vegetable consumption. While knowledge may not be sufficient for engaging in vegetable consumption, educational attainment may affect vegetable intake. Household income is known to influence individual food choices, thereby affecting vegetable consumption, but income was not included in the final models although it was considered in analysis. It had significant missing observations and no significant effect on the models.

### 3.4 STATISTICAL ANALYSIS

First, descriptive statistics for the individual-level and tract-level variables of interest and covariates were computed to describe the study sample. Spearman and Pearson correlations and Chi square tests were also conducted to examine the potential for multicollinearity among the variables. It was found that the proportion of Hispanics within census tracts and the proportion of Spanish speakers in tracts were highly correlated ( $r=0.97$ ,  $p<0.001$ ) and thus only the proportion of Hispanic residents was examined in the models. In order to control for the nesting of participants with census tracts, hierarchical linear mixed modeling was employed to test the study hypotheses using the following general model:

$$Y_{ij} = \beta_0 + \beta_1 Z_{ij} + \beta_2 X_{ij} + \beta_3 X_{ij} \times Z_{ij} + a_j + \epsilon_{ij},$$

In this model,  $Y_{ij}$  is the (possibly transformed) vegetable intake measure for subject  $i$  in census tract  $j$ .  $X_{ij}$  is the proportion Hispanic measure,  $Z_{ij}$  is the acculturation measure, and  $\epsilon_{ij} \sim N(0, \sigma^2)$  is the measurement error term. This model has census tract random effects denoted by  $a_j$ , for the census tract  $j$ . The random effects are assumed to have normal distributions with variance  $\sigma_a^2$  and  $\sigma_b^2$ , respectively. The main hypothesis of

interest is the test for  $\beta_3$  indicating whether there is an interaction between the proportion of Hispanic residents within tracts and acculturation on vegetable intake. This model does not include the control variables or other independent variables.

Analyses were first conducted on the entire study population. Subsequent stratified analyses were conducted for each of the three ethnic groups in the sample: Mexicans, Puerto Ricans, and Cubans. Additional hypotheses were tested according to the same pattern of this model. Analyses were conducted using the PROC MIXED procedure using SAS 9.4 software (SAS Institute Inc., Cary, NC, USA).

## CHAPTER 4

### ASSESSING THE INTERACTION OF ACCULTURATION AND NEIGHBORHOOD ETHNIC COMPOSITION IN PREDICTING VEGETABLE INTAKE AMONG U.S. HISPANICS<sup>1</sup>

#### 4.1 ABSTRACT

**Objective** This study employed multilevel mixed modeling to test the interaction between individual acculturation and neighborhood ethnic composition when predicting vegetable intake among a sample of U.S. Hispanics.

**Design** Individual results of a cross-sectional survey were linked with census-tract level data for each respondent's residence.

**Setting** The sample was drawn from across the U.S. and Puerto Rico and included 671 census tracts.

**Subjects** A sample of 851 Hispanic individuals of Mexican, Puerto Rican, or Cuban origin living in the U.S or Puerto Rico. Individual data included age, sex, ethnicity, educational attainment, acculturation and vegetable intake. Neighborhood data included the proportion of Hispanics within the census tracts where respondents lived.

**Results** No significant interactions were observed between individual acculturation, ethnic composition, and vegetable intake. No significant main effect was found for the tract-level variable.

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<sup>1</sup> Mesa, A., Davis, R., McLain, A., Peterson, K., Thrasher, J. To be submitted to Public Health Nutrition

**Conclusions** These results emerged from a unique sample not previously examined in similar literature and largely contradicted expectations based on previous findings. This raises new questions and avenues for further research to disentangle the complex process of acculturation, neighborhood contributions to the acculturative process, and dietary quality overall in order to work toward more effective health promotion strategies for Hispanics in the U.S.

**Keywords:** Hispanic nutrition; acculturation; vegetable consumption; multilevel study

## 4.2 INTRODUCTION

### *Overview of the Hispanic population and burden of disease*

Hispanics in the United States (U.S.) are among the largest and most rapidly growing ethnic minorities, comprising 17.4% of the total U.S. population, up from 6.5% in 1980 (Colby & Ortman, 2015). Within the next four decades it is expected that the Hispanic population will nearly double (Vespa, Armstrong & Medina, 2018) and more than one in four Americans will be Hispanic (Colby & Ortman, 2015). This rapid population increase has been accompanied by a sharp increase in chronic disease among Hispanics (Livingston, Minushkin & Cohn, 2008). Among the top ten leading causes of death for Hispanics are cancer, heart disease, type 2 diabetes, chronic liver disease and cirrhosis (Dominguez et al. 2015). Addressing these mounting health concerns is vital to achieving optimal health and well-being for the nation as a whole.

Significant public health efforts over the last several decades have aimed to improve diet and health among Hispanics, as dietary intake is a significant modifiable

determinant of health (United States Department of Health and Human Services, & The U.S. Department of Agriculture, 2015; World Health Organization, 2017). For the prevention and self-management of chronic disease, individuals are typically advised to maintain healthful diets consisting of adequate vegetable intake, among other recommended foods, and to engage in regular physical activity. A quality diet that includes the daily recommended intake of vegetables has been associated with a reduced risk of diabetes (Van-Duyn & Pivonka, 2000; Li et al., 2014; Carter, Gray, Troughton, Khunti & Davies, 2010), cardiovascular disease (Hung et al., 2004), obesity (Ledoux, Hingle & Baranowski, 2011), chronic liver disease and cirrhosis (Fan & Cao, 2013; Zelber-Sagi, Ratziu & Oren, 2011).

The recommended minimum daily intake of vegetables per day for adult women is 2.5 cups, and 3.0 cups for adult men 3.0 cups (United States Department of Health and Human Services & The United States Department of Agriculture, 2015). Although vegetable consumption (0.79 cups) among Hispanics is almost equivalent to that among non-Hispanic whites (0.77 cups) and higher than among non-Hispanic blacks (0.66 cups), vegetable intake among Hispanics is nonetheless well below the recommended daily vegetable intake (Healthy People, 2020).

#### *Acculturation and vegetable consumption*

A number of studies have examined the influence of acculturation on vegetable consumption among Hispanics. Due to its complexity as a concept, acculturation has been variously defined and operationalized throughout the scientific literature (Cuellar & Maldonado, 1995; Thomson & Hoffman-Goetz, 2009). Acculturation is generally understood to be a dynamic process by which individuals or groups of different cultures

come into continuous contact resulting in the alteration of their original cultural patterns (Cuellar & Maldonado, 1995; Redfield, Linton & Herskovits, 1936). Studies similar to the present study have used single-item proxy measures (e.g. birth country or years in the U.S.) to assess acculturation (Dubowitz et al., 2008; Park et al., 2011; Reyes-Ortiz et al., 2009; Zhang et al., 2015), which do not capture important nuances that more comprehensive acculturation measures assess (Thomson & Hoffman-Goetz, 2009). Furthermore, linear measures, such as the ARSMA (Cuellar, Harris & Jasso, 1980), measure acculturation on a single linear continuum whereby gains toward one cultural orientation equal equivalent losses toward the other, effectively failing to accurately capture bicultural individuals and individuals that do not align strongly with either culture. Thus, it is important to keep the limitations of these measures in mind as the results of studies utilizing these measures may produce misleading results.

Acculturation among Hispanics into the mainstream Anglo-American culture has generally been found to be inversely associated with vegetable intake (Ayala, Baquero & Klinger, 2008; Bermudez, Falcon & Tucker, 2000; Chavez, Sha, Persky & Pestano-Binghay; Dubowitz, Smith-Warner, Acevedo-Garcia, Subramanian & Peterson, 2007; Duffy et al., 2008; Dixon, Sundquist & Winkleby, 2000; Guedelman & Abrams, 1995; Montez and Esbach, 2008; Neuhouser et al., 2004; Otero-Sabogal et al., 1995; Pérez-Escamilla & Putnik, 2007). Most of these studies have used exclusively individual-level measures of behaviors, attitudes, acculturation, and sociodemographic characteristics. However, there is an emerging body of research that focuses more widely on the effects of environmental factors on health outcomes and behaviors, like neighborhood ethnic composition.

### *Vegetable Intake and neighborhood ethnic composition*

Hispanics who move to, or were raised in, neighborhoods in the United States where residents predominantly match their culture of origin may be shielded to varying extents from exposure to mainstream Anglo-American culture. Neighborhood segmentation by ethnicity is common in the United States, as nearly half of all Hispanics in the U.S. reside in the top 10 metropolitan areas alone (Motel & Patten, 2012). This pattern has been attributed to a preference among immigrant Hispanics for residing in areas with a high proportion of Hispanics in order to ease adjustment to living in the U.S. (Acevedo-Garcia et al., 2003).

Some researchers have hypothesized that the apparent protective effects of residing in an area of high-Hispanic density may be due to local businesses in these areas catering to the diets of immigrants due to high demand, making it easier for individuals in these areas to consume and prepare familiar fruits and vegetables from their cultures of origin, which may have a protective effect on vegetable intake (Hampl & Sass, 2001; Osypuk et al., 2009; Strolla, Gans & Risica, 2006). Furthermore, neighborhoods with concentrations of residents who share the same culture and language may provide greater access to culturally appropriate health and nutrition services, healthy and more affordable foods, or other material goods through social networks which would otherwise be significantly more difficult to access (Berkman et al., 2000). For these reasons, ethnic composition could have a potential slowing effect on the acculturative process thereby interacting with the relationship between acculturation and vegetable intake.

Neighborhood context influences a range of health outcomes after adjusting for individual-level variables (Abraido-Lanza, Echeverria & Florez, 2016). Yet only a few



studies have examined the effects of neighborhood characteristics, specifically neighborhood ethnic composition, on vegetable intake among Hispanics. Existing data indicate that the proportion of Hispanic residents within a census tract (Dubowitz et al., 2008, Park et al., 2011) and the proportion of foreign-born individuals within tracts (Zhang et al., 2015) are positively associated with vegetable consumption among Hispanic adults. More specifically, Zhang and colleagues (2015) identified a significant interaction between neighborhood immigrant composition and linguistic acculturation on frequent consumption of fast food such that individuals with higher percentages of immigrants experienced stronger protective effects against negative dietary behaviors. By contrast, Reyes-Ortiz et al. (2009) found a negative association between proportion of Mexicans within a census tract and the consumption of carrots, spinach/greens, broccoli, melons and other fruits and vegetables among Mexicans in the U.S.; however, a positive association was found with more ethnically traditional foods, such as corn products, tomatoes, red chili peppers, and beans (Reyes-Ortiz et al. 2009). Reyes-Ortiz et al. (2009), whose results contrasted with those of the other studies in finding a positive association between neighborhood ethnic density and the consumption of specific classes of vegetables, was also the only study that employed a national sample and exemplifies the need to further investigate these relationships among diverse samples.

More research is needed to understand if, how, and the extent to which, neighborhood characteristics affect the relationship between acculturation and vegetable intake among Hispanics. This information is vital for the development of health interventions that consider both environmental and individual factors that influence vegetable consumption among Hispanics in the U.S. Existing studies that examine these

interactions have been limited in their geographic scope, with samples based only in large metropolitan areas and in the measures of acculturation that were primarily proxy measures which have limited generalizability.

The goal of the current study was to examine whether neighborhood ethnic composition, specifically the proportion of Hispanics residing within census tracts (Hispanic density), interacts with acculturation to predict vegetable intake among U.S. Hispanics overall, as well as within the three major ethnic Hispanic subgroups in the US (Mexicans, Puerto Ricans, and Cubans). We predicted that neighborhood density of Hispanics would moderate the relationship between acculturation and vegetable intake, such that a stronger relationship between having a Hispanic cultural orientation and vegetable consumption would be found among Hispanic participants living in census tracts with higher Hispanic density than among those living in census tracts with lower Hispanic density. This relationship was also tested within each of the three Hispanic subgroups.

## 4.3 METHODS

### 4.3.a STUDY SAMPLE

Study data were obtained from a parent study focused on improving the validity of survey data by minimizing the effects of acquiescence, or the tendency to systematically agree with Likert-formatted survey items, among Hispanic telephone survey respondents. Participants were recruited by randomly selecting numbers from a purchased sample of landline and cellular telephone numbers targeting individuals with telephone numbers associated with addresses in the U.S. or Puerto Rico, no more than 12 years of education, and a household income of \$25,000 or less. Eligible participants had

to be 18-90 years of age, reside in the mainland U.S. or Puerto Rico, and self-identify as Mexican, Mexican-American, Cuban, Cuban American, or Puerto Rican. Study participants all classified as “acquiescers” as a requirement of the parent study, which meant that they provided an illogical pattern of responses to Likert-formatted, disagree-agree responses scales on an acquiescence screener.

#### 4.3.b DATA COLLECTION

Data were collected via computer assisted telephone interviewing with bilingual interviewers conducting the interviews in English or Spanish according to the preference of the respondent. All participants provided informed consent to all eligible recruited respondents and incentives were mailed to all participants who completed the survey. Study procedures were reviewed and approved by the University of South Carolina Institutional Review Board.

Two different interviewing techniques were employed in the study: standardized and conversational. Respondents were randomly assigned to different interviewing conditions as part of an experiment pertinent to the parent study. The average interview duration was approximately 45 minutes.

#### 4.3.c MEASURES

##### 4.3.c.i VEGETABLE INTAKE

Vegetable intake was estimated utilizing a slightly adapted version of a six-item Food Frequency Questionnaire (FFQ) from the National Health and Nutrition Examination Survey (NHANES) 2009-2010 Dietary Screener (Centers for Disease Control and Prevention, 2010). The six items measured the frequency of eating leafy greens, fried potatoes, legumes and beans, raw tomato sauce, cooked tomato sauce, and

other vegetables not previously mentioned. Fried potatoes were included in the FFQ to improve data accuracy but excluded when estimating vegetable intake. The NHANES vegetable intake FFQ was adapted to be more culturally appropriate based on data obtained while pretesting the FFQ in 31 cognitive interviews with Mexican, Puerto Rican, and Cuban adults. Culturally relevant examples of some foods, such as jicama for the category of “other vegetables” and tomatillos for the category of “raw tomato sauce,” were added to the FFQ and, when appropriate, words for vegetables that were more familiar within each ethnic group for the Spanish version of the questionnaire were used. For example, a minor adjustment to the legume item included utilizing the term “frijoles negros” among Mexican respondents and “arvejas verdes” among Puerto Rican respondents).

Daily frequency of consumption was calculated for all five items and converted to estimate total daily vegetable intake in cups using age and sex-specific portion size estimates and regression coefficients. These values were based on NHANES 2009-2010 24-hr dietary recall data (National Cancer Institute, 2016). The estimated cup values for each food item were summed to calculate overall consumption. The threshold for extreme values was set at ten cups of vegetables per day. All values of consumption frequency above ten were replaced with ten.

#### 4.3.c.ii ACCULTURATION

Acculturation was measured using an adapted version of the ARSMA-II (Cuellar, Arnold & Maldonado, 1995). This scale was originally developed for use among Mexicans and Mexican Americans but has been adapted successfully in studies for use among Puerto Ricans (Wiley et al., 2014), El Salvadorans, and Cubans (Jimenez et al.,

2010). For the purpose of this study, the text of individual items was modified for use among Puerto Ricans and Cubans. For example, an original ARSMA-II item, “I associate with Mexicans and/or Mexican Americans” was adapted to read “How often do you socialize with (Mexicans/Cubans/Puerto Ricans)?” This measure was comprised of two subscales: Hispanic cultural orientation (15 items;  $\alpha=.79$ ) and Anglo-American or non-Hispanic White orientation (12 items,  $\alpha=.87$ ). Each subscale included the original domains of the ARSMA-II: language use preference, ethnic identity and classification, cultural heritage and ethnic behaviors, and ethnic interaction (Cuellar, Arnold & Maldonado, 1995). A higher score on each four-point subscale indicated a stronger orientation toward that cultural orientation. The two subscales were used in analysis and treated as continuous variables rather than the categorical version of ARSMA-II due to the predominance of highly Hispanic-oriented individuals in the sample.

#### 4.3.c.iii PROPORTION OF HISPANIC RESIDENTS WITHIN CENSUS TRACTS

Census tracts where participants lived were used to approximate “neighborhoods” and are defined by the U.S. Census Bureau as “small, relatively permanent statistical subdivisions of a county” ranging in population between 1,200 and 8,000 inhabitants based on population density (United States Census Bureau, 2010). Tract-level census data from the American Community Survey (ACS) 5-year estimates were obtained via the American FactFinder (ACS, 2015). Tract-level variables of interest included the proportion of Hispanics within each U.S. census tract and the proportion of residents within tracts from each of the targeted Hispanic ethnic subgroups: Mexican, Puerto Rican, and Cuban.

#### 4.3.c.iv SOCIODEMOGRAPHICS

Sociodemographic variables included age, gender, annual household income, and educational attainment. All were self-reported. Annual household income and educational attainment were measured categorically whereby annual income was grouped into intervals of \$20,000 and educational attainment included the options of “less than 7<sup>th</sup> grade,” “7<sup>th</sup> through 12<sup>th</sup> grade, no diploma,” “high school graduate or equivalent,” “some college or technical/vocational school,” “4-year college degree,” and “graduate degree.” Adaptations to these items were made based on the titles used for varying levels of educational attainment in the country of origin of each respondent, for example “college preparatory graduate,” among respondents educated in Mexico “high school graduate,” among respondents educated in the U.S. or Puerto Rico, or “pre-university graduate” among respondents educated in Cuba.

#### 4.3.d STATISTICAL ANALYSES

Respondent addresses, which were obtained in order to mail post-survey incentives, were deidentified and geocoded across the U.S. and Puerto Rico using ArcGIS® 10.5.1 by Environmental Systems Research Institute, Inc. (Esri; Copyright © 2017, Redlands, CA). Of the total study sample (n=913), the analytic sample size was reduced to 851 due to missing addresses or P.O. Box addresses for which census tracts could not be accurately identified. The final data set comprised of individual and corresponding tract-level attributes was created in ArcGIS via two layer joins. First, a spatial join was performed to place each respondent within the boundaries of pre-determined tract boundaries. Secondly, the attributes (proportion Hispanic, etc.) of that tract were associated with the individuals residing within those tracts.

Potential multicollinearity among predictors was assessed and a determination was made to exclude the proportion of Spanish speakers within tracts in the analysis because of the high correlation of this variable with the proportion of Hispanic residents in each census tract ( $r=0.97$ ,  $p<0.001$ ). Income was excluded from the final analytic models because of a higher quantity of missing data. Hierarchical linear mixed modeling was employed to account for the nesting of respondents within tracts and to test the potential interactions between the proportion of Hispanic residents within tracts and acculturation to predict vegetable intake using the following model:

$$Y_{ij} = \beta_0 + \beta_1 Z_{ij} + \beta_2 X_{ij} + \beta_3 X_{ij} \times Z_{ij} + a_j + \epsilon_{ij},$$

In this model,  $Y_{ij}$  is the (possibly transformed) vegetable intake measure for subject  $i$  in census tract  $j$ .  $X_{ij}$  is the proportion Hispanic measure,  $Z_{ij}$  is the acculturation measure, and  $\epsilon_{ij} \sim N(0, \sigma^2)$  is the measurement error term. This model has census tract random effects denoted by  $a_j$ , for the census tract  $j$ . The random effects are assumed to have normal distributions with variance  $\sigma_a^2$  and  $\sigma_b^2$ , respectively. The main hypothesis of interest is the test for  $\beta_3$ , which indicates whether there was an interaction between the proportion of Hispanic residents in a census tract and individual acculturation on vegetable intake. Analyses were conducted using the PROC MIXED procedure using SAS 9.4 software (SAS Institute Inc., Cary, NC, USA).

#### 4.4 RESULTS

A summary of the overall analytic sample, ethnic group subsamples, and census tract-level descriptors can be found in Table 4.1. Approximately one-third of the sample

came from each of the three ethnic groups: Mexican (36%), Puerto Rican (30%), and Cuban (34%). Notably, most study participants were female (80%) and older ( $M=64.8$ ). The sample was also of lower socioeconomic status with 71% reporting an annual household income under \$20,000 and 53% not having graduated from high school.

Some differences were observed across the ethnic subgroups. Cubans had the oldest mean age ( $M=74.2$ ) of the three subgroups, followed by Puerto Ricans ( $M=62.2$ ), and Mexicans ( $M=58.10$ ). The Cuban subsample also had the highest percentage (81.5%) of respondents with annual income below \$20,000, as compared to Mexicans (63.5%) and Puerto Ricans (70.8%). However, Mexicans had the highest percentage of respondents with less than a 7<sup>th</sup> grade education (43.5%) when compared with Puerto Ricans (20.8%) and Cubans (15.1%). The percentage of women was consistent across the three subgroups.

Overall and within subgroups, participants had a stronger orientation to Hispanic culture than non-Hispanic White culture. Estimated daily vegetable intake for women ( $M=2.1$  cups) was just under the recommended intake for women of 2.5 cups, while intake for men (3.1 cups) was slightly above the recommendation of 3.0 cups for men (United States Department of Health and Human Services, & The U.S. Department of Agriculture, 2015). These intake patterns were consistent across subgroups.

The mean percent of Hispanic residents within census tracts ( $M=76%$ ) and Spanish speakers within census tracts ( $M=64%$ ) were high due to the nature of the sampling strategy employed.

In the main model using data from the entire sample and regressing vegetable intake on study variables, the hypothesized interaction between acculturation and the



proportion of Hispanic residents within census tracts was not statistically significant (Table 4.2, Model 1). Significant associations were observed for both gender and education. Males had significantly higher vegetable intake than females ( $p < 0.0001$ ). Furthermore, respondents with less than 7<sup>th</sup> grade education had higher vegetable consumption when compared to higher levels of educational attainment, with the exception of those with a graduate degree. These associations were significant ( $p < 0.05$ ) for 7<sup>th</sup> through 12<sup>th</sup> grade with no diploma, some college or technical/vocational school, and 4-year college degree. Although income was excluded from the final models, models that included income indicated that income was not a significant predictor of vegetable intake (data not shown).

Then vegetable intake was regressed on study variables after stratifying the data by ethnic subgroup. There interaction between both acculturation variables and the proportion of Hispanic residents within census tracts was not statistically significant in any model (Table 2, Models 2-4). Among Mexican and Puerto Rican respondents (Models 2 and 3), the associations between education and vegetable intake were nonsignificant. Cuban respondents (Model 4) with less than a 7<sup>th</sup> grade education had higher vegetable intake than those with higher educational attainment. These associations were significant for 7<sup>th</sup> through 12<sup>th</sup> with no diploma, some college or technical/vocational school and 4-year degree, when compared to respondents with less than a 7<sup>th</sup> grade education ( $p < 0.05$ ). The effects of age on vegetable intake were nonsignificant across models.

Similar additional models (results not shown) were run to test the interaction of acculturation with the proportion of Hispanic residents in tracts including acculturation as

a single, four-level categorical variable rather than two continuous subscales that grouped individuals into one of four possible categories: “more Hispanic,” “high bicultural,” “low bicultural,” or “more non-Hispanic White.” Use of this variable did not change the pattern of results presented above.

Tract-level predictors explained a negligible amount (<1%) of the variance in vegetable intake across all model (1-4) with the interaction terms. Individual factors accounted for most of the variation explained by the models (between 16% - 24%).

Examining the main effects of the variables of interest without the interaction terms, similar results are observed (see Table 4.3). In the overall model (Model 5), non-Hispanic White cultural orientation was significantly predictive of vegetable intake, with an increase in vegetable intake as orientation toward the non-Hispanic White culture increased. The other variables of interest, acculturation toward the Hispanic culture and the proportion of Hispanic residents within tracts, were both non-significant predictors of vegetable intake in Model 5 and within stratified analytic models of ethnic subgroups in Models 6-8.

In Model 5, gender was again a significant predictor, with males consuming significantly more vegetables than females. This was also true within all three ethnic subsamples represented in Models 6-8. Certain levels of educational attainment were significant predictors only in Model 5, among the overall sample, and Model 8, among the Cuban subsample specifically among “7<sup>th</sup> through 12<sup>th</sup> grade with no diploma,” “some college or tech/vocational school,” and “4-year college degree” with intake among these three levels of educational attainment being significantly lower than among respondents with less than a 7<sup>th</sup> grade education.

Table 4.1. Description of the Study Sample

	Total		Mexican		Puerto Rican		Cuban	
	(n=851)	SD	(n=304)	SD	(n=259)	SD	(n=288)	SD
<b>Age in years (M)</b>	64.80	15.37	58.10	15.56	62.15	14.00	74.2	11.21
<b>Gender (% female)</b>	80.02		81.91		78.38		79.51	
<b>Education (%):</b>								
Less than 7th grade	27.07		43.52		20.78		15.05	
7th through 12th grade, no diploma	25.75		26.91		21.57		28.32	
High school graduate or equivalent	22.99		18.94		25.88		24.73	
Some college or technical/vocational school	12.22		5.65		14.12		17.56	
4-year college degree	8.26		3.99		11.37		10.04	
Graduate degree	3.71		1.00		6.27		4.30	
<b>Annual household income (%):</b>								
Less than \$20,000	71.43		63.52		70.79		81.46	
\$20,000-\$39,999	19.66		25.00		20.30		12.68	
\$40,000-\$59,999	6.14		7.79		5.45		4.88	
\$60,000-\$99,999	2.00		2.87		2.48		0.49	
\$100,000 or greater	0.76		0.41		0.99		0.49	
<b>Ethnic subgroup (%):</b>								
Mexican	35.72							
Puerto Rican	30.43							
Cuban	33.84							
<b>Acculturation†:</b>								
Acculturation NHW ( <i>M</i> )	2.05	0.60	2.0	0.61	2.10	0.60	2.07	0.58
Acculturation Hispanic ( <i>M</i> )	3.37	0.38	3.28	0.42	3.46	0.32	3.40	0.37
<b>Vegetable Intake per day (cups)</b>	2.28	1.18	2.36	1.46	2.28	0.93	2.31	1.34
<b>Percent Hispanic within census tracts (<i>M</i>)</b>	75.59	27.78	66.87	27.56	78.87	30.05	81.84	23.29
Percent Mexican within census tracts ( <i>M</i> )			58.93	29.43				
Percent Puerto Rican within census tracts ( <i>M</i> )					67.39	37.55		
Percent Cuban within census tracts ( <i>M</i> )							51.96	25.65
<b>Percent Spanish speakers within census tracts (<i>M</i>)</b>	63.65		51.07		67.76		73.22	

SD, standard deviation

M, mean

NHW, non-Hispanic White

†This value was based on a four-point scale

Table 4.2 Hierarchical linear mixed models, predicting log-transformed daily vegetable intake in cups, with interaction terms

	Model 1 – Overall		Model 2 - Mexican		Model 3 – PR		Model 4 Cuban	
	Estimates	SE	Estimates	SE	Estimates	SE	Estimates	SE
Intercept	0.8114	0.459	1.2276	0.8549	0.3586	0.8660	1.4945	0.9038
<b>Individual level</b>								
Age	-0.0002	0.0011	0.0006	0.0020	0.0017	0.0018	0.0026	0.0026
Gender								
Male	Ref		Ref		Ref		Ref	
Female	-0.3656***	0.0389	-0.6221**	0.0810	-0.2780*	0.0612	-0.3348***	0.0717
Ethnicity								
Cuban	Ref		-	-	-	-	-	-
Puerto Rican	-0.0032	0.0422	-	-	-	-	-	-
Mexican	-0.0255	0.0451	-	-	-	-	-	-
Education								
Less than 7 <sup>th</sup> grade	Ref		Ref		Ref	α	Ref	
7 <sup>th</sup> through 12 <sup>th</sup> grade, no diploma	-0.1225*	0.0442	0.0638	0.0820	-0.0017	0.0800	-0.2209*	0.0913
High school graduate or equivalent	-0.0198	0.0473	0.1726	0.0955	-0.0016	0.0761	-0.0900	0.0943
Some college or tech/vocational school	-0.1333*	0.0587	0.2446	0.1468	-0.0597	0.0887	-0.2842*	0.1049
4-year college degree	-0.1541*	0.0654	0.0643	0.1754	-0.1033	0.0957	-0.2657*	0.1177
Graduate degree	0.0439	0.0889	0.2831	0.3140	0.0794	0.1197	-0.0718	0.1557
Acculturation								
Hispanic	0.0063	0.1129	-0.1412	0.2220	0.0248	0.2167	0.0271	0.2022
Non-Hispanic White	0.1081	0.0785	0.1771	0.1515	0.1570	0.1215	-0.1100	0.1707
<b>Tract level</b>								
Proportion Hispanic in tract	0.0018	0.0060	-0.0024	0.0121	0.0082	0.0105	-0.0063	0.0114
<b>Cross level interactions</b>								
Acculturation Hispanic * Proportion	-0.00001	0.0015	0.0029	0.0031	-0.0012	0.0027	<0.00001	0.0026
Hispanic in tract								
Acculturation NHW * Proportion Hispanic	-0.0004	0.0010	-0.0037	0.0021	-0.0014	0.0015	0.0030	0.0020
in tract								
ICC	0.0748		0.1010		-		0.0808	

SE, standard error

Ref, referent group

NHW, non-Hispanic White

ICC, Intraclass correlation

\*p < .05. \*\*p < .005. \*\*\*p < .0001.

Table 4.3 Hierarchical linear mixed models predicting log-transformed vegetable intake in cups, main effects

	<b>Model 1 – Overall (n=832)</b>		<b>Model 2 – Mexican (n=299)</b>		<b>Model 3 – PR (n=255)</b>		<b>Model 4 – Cuban (n=278)</b>	
	Estimates	SE	Estimates	SE	Estimates	SE	Estimates	SE
Intercept	0.8992***	0.2048	1.0038**	0.3507	0.9114*	0.3615	0.9582	0.3857*
<b>Individual level</b>								
Age	-0.0001	0.0011	0.0012	0.0020	0.0017	0.0018	-0.0029	0.0026
Gender								
Male	Ref	-	Ref	-	Ref	-	Ref	-
Female	-0.3660***	0.0389	-0.6166**	0.0815	-0.2781	0.0611	-0.3276**	0.0714
Ethnicity								
Cuban	Ref	-	-	-	-	-	-	-
Puerto Rican	-0.0016	0.0419	-	-	-	-	-	-
Mexican	-0.0248	0.0450	-	-	-	-	-	-
Education								
Less than 7 <sup>th</sup> grade	Ref	-	Ref	-	Ref	-	Ref	-
7 <sup>th</sup> through 12 <sup>th</sup> grade, no diploma	-0.1208**	0.0440	0.0770	0.0822	-0.0031	0.0795	-0.2387*	0.0906
High school graduate or equivalent	-0.0177	0.0469	0.1929	0.0957	0.0005	0.0753	-0.1069	0.0937
Some college or tech/vocational school	-0.1322*	0.0585	0.2390	0.1475	-0.0596	0.0883	-0.3026**	0.1042
4-year college degree	-0.1534*	0.0652	0.0421	0.1759	-0.1061	0.0940	-0.2743*	0.1177
Graduate degree	0.0430	0.0888	0.2228	0.3139	0.0695	0.1185	-0.0834	0.1554
Acculturation								
Hispanic	-0.0028	0.0435	0.0747	0.0763	-0.0668	0.0847	0.0367	0.0820
Non-Hispanic White	0.0797*	0.0302	-0.0748	0.0671	0.0477	0.0476	0.1295*	0.0554
<b>Tract-level</b>								
Proportion Hispanic in tract	0.0005	0.0006	-0.0005	0.0011	0.0011	0.0009	0.0003	0.0013

PR, Puerto Rican

SE, standard error

Ref, referent group

NHW, non-Hispanic White

\*p &lt; .05. \*\*p &lt; .005. \*\*\*p &lt; .0001.

#### 4.5 DISCUSSION

In this study, the main and interaction effects of acculturation and the proportion of Hispanic residents within census tracts were examined to predict vegetable intake among an ethnically diverse sample of Hispanics from across the U.S. It was hypothesized that the proportion of Hispanic residents within a census tract would interact with acculturation to further explain the associations previously noted in the literature of vegetable intake decreasing as orientation toward the Anglo-American culture strengthens. However, contrary to hypothesized outcomes, no significant interactions were detected between acculturation and the proportion of Hispanic residents within census tracts to predict vegetable intake.

In terms of the role of Hispanic density within census tracts, existing studies have posited that living in neighborhoods where the ethnic majority is an ethnic minority may slow the acculturative process since the majority culture is not necessarily the assumed White Anglo-American culture (Abraido-Lanza, 2006; Pérez-Escamilla and Putnik, 2007). Businesses in high density Hispanic neighborhoods may be incentivized to provide culturally traditional foods, including familiar vegetables, by popular demand (Osypuk et al., 2009). The formation of social networks in these areas via shared culture and language may also facilitate access to resources and familiar foods (Berkman et al., 2000). However, in the overall model (1) and across subgroup models (2-4), most of the variance was explained by individual variables, an insignificant amount of the variance was explained by the inclusion of the proportion of Hispanic residents within census tracts. These findings may be attributable to a lack of variation in Hispanic density within census tracts due to the nature of the sampling techniques employed.

The main effects of both acculturation variables and the proportion of Hispanic residents in tracts demonstrated slightly different outcomes than in the models including the interaction terms. In the overall model (Model 5), orientation toward the non-Hispanic White orientation was significantly predictive of vegetable intake with a stronger orientation resulting in higher vegetable intake. These findings contradict previous findings that found a negative association between Anglo cultural orientation and vegetable intake (Ayala, Baquero & Klinger, 2008; Bermudez, Falcon & Tucker, 2000; Chavez, Sha, Persky & Pestano-Binghay; Dubowitz, Smith-Warner, Acevedo-Garcia, Subramanian & Peterson, 2007; Duffy et al., 2008; Dixon, Sundquist & Winkleby, 2000; Guedelman & Abrams, 1995; Montez and Esbach, 2008; Neuhouser et al., 2004; Otero-Sabogal et al., 1995; Pérez-Escamilla & Putnik, 2007). This was also observed among the Cuban subsample (Model 8), but not among the Mexican and Puerto Rican subsamples (Models 6 and 7, respectively). Therefore, it may have been the Cuban subsample largely driving the significance of the non-Hispanic White acculturation variable in the overall model (Model 5).

These unexpected results indicating that stronger Anglo-orientation is associated with increased vegetable intake in the overall sample and among the Cuban subsample, specifically, may have been due to the nature of the sample, which had a strong Hispanic cultural orientation overall, creating limited variability, and, on average, higher vegetable intake than expected according to previous findings. Another significant difference between the present study and previous studies which may, at least partially, explain differences in findings, is the measure of acculturation employed. Among the studies that have generally examined the relationship between acculturation and vegetable intake, the

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Higher vegetable intake was also observed among individuals with less than a 7<sup>th</sup> grade education when compared with those of higher educational attainment, with the exception of those with a graduate degree. Of the subgroups, Cubans exhibited the same directionality of significant associations indicating a decrease in vegetable intake as educational attainment increased, even among graduate degree holders, suggesting that the significance in the overall model may have been driven by effects from the Cuban subgroups. These findings conflict with previous positive associations between educational attainment and fruit and vegetable intake (Dubowitz et al. 2008). Again, associations identified in previous studies may have been driven by fruit consumption rather than vegetable consumption. Another possibility is that the Cuban sample in this study was of a significantly older age profile which may reduce the normally observed positive associations of educational attainment and vegetable intake. Associations between educational attainment and vegetable intake among Mexicans and Puerto Ricans were nonsignificant.

As the Hispanic population continues to grow in the United States, it is accompanied by an increase in the prevalence of chronic disease and an urgent need to address the mounting health burdens of this population (Colby & Ortman, 2015; Livingston, Minushkin & Cohn, 2008). Healthful nutrition, specifically consisting of an adequate consumption of vegetables, is vital to the prevention and management of chronic disease (Carter, Gray, Troughton, Khunti & Davies, 2010; Fan & Cao, 2013; Hung et al., 2004; Ledoux, Hingle & Baranowski, 2011; Li et al., 2014; Van-Duyn & Pivonka, 2000; Zelber-Sagi, Ratziu & Oren, 2011). On average, Hispanics have been

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The sampling strategy employed targeted high-density Hispanic areas limiting variability in the acculturation variable and in the proportion of Hispanic residents within census tracts. Additionally, the sample was overwhelmingly comprised of older female respondents with lower income and educational attainment. These features of the sample may limit the generalizability of the findings to other Hispanic populations. Furthermore, as with all self-reported data, measures of vegetable intake and acculturation may have been influenced by social desirability leading respondents to report inflated estimates of vegetable consumption.

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by representing the three largest Hispanic subgroups equally and obtaining a sample from across the United States and Puerto Rico, rather than a single metropolitan area.

However, due to the inconsistencies in the results of this study with previous findings, there is a need to perform further research inclusive of samples with a greater variation of acculturation, assessed with more robust measures of acculturation, and census tracts with a greater variation of Hispanic density to further understand the relationship of these variables. This knowledge is vital for the creation of more comprehensive and effective health interventions that serve to curb the rapid rise of chronic disease currently burdening the U.S. Hispanic population, by increasing vegetable intake.

#### 4.6 REFERENCES

- Abraído-Lanza, A. F., Armbrister, A. N., Flórez, K. R., & Aguirre, A. N. (2006).  
Toward a theory-driven model of acculturation in public health research.  
*American Journal of Public Health, 96*(8), 1342–1346.  
<https://doi.org/10.2105/AJPH.2005.064980>
- Acevedo-Garcia, D., Lochner, K. A., Osypuk, T. L., & Subramanian, S. V. (2003).  
Future Directions in Residential Segregation and Health Research: A Multilevel  
Approach. *American Journal of Public Health, 93*(2), 215–221.
- Ayala, G. X., Baquero, B., & Klinger, S. (2008). A Systematic Review of the  
Relationship between Acculturation and Diet among Latinos in the United  
States: Implications for Future Research. *Journal of the American Dietetic  
Association, 108*(8), 1330–1344. <https://doi.org/10.1016/j.jada.2008.05.009>
- Berkman, L., Glass, T., Brissette, I., Seeman, T. (2000). From social integration to  
health: Durkheim in the new millennium. *Social Science & Medicine, 51*(6), 843-  
857.
- Bermudez, O. L. I., Falcón, L. M., & Tucker, K. L. (2000). Intake and food sources  
of macronutrients among older Hispanic adults: Association with ethnicity  
acculturation, and length of residence in the United States. *Journal of the  
American Dietetic Association, 100*(6), 665–673. [https://doi.org/10.1016/S0002-  
8223\(00\)00195-4](https://doi.org/10.1016/S0002-8223(00)00195-4)
- Carter, P., Gray, L. J., Troughton, J., Khunti, K., & Davies, M. J. (2010). Fruit and  
vegetable intake and incidence of type 2 diabetes mellitus: systematic review  
and meta-analysis. *BMJ (Clinical Research Ed.), 341*, 4229.

- Centers for Disease Control and Prevention. (2010). National Center for Health Statistics National Health and Nutrition Examination Survey Dietary Screener. *Department of Health and Human Services*. Retrieved from: [https://epi.grants.cancer.gov/nhanes/dietscreen/nhanes\\_dtq\\_en.pdf](https://epi.grants.cancer.gov/nhanes/dietscreen/nhanes_dtq_en.pdf)
- Chávez, N., Sha, L., Persky, V., Langenberg, P., & Pestano-Binghay, E. (1994). Effect of length of U.S. residence on food group intake in Mexican and Puerto Rican women. *Journal of Nutrition Education, 26*(2), 79–86. [https://doi.org/10.1016/S0022-3182\(12\)81075-2](https://doi.org/10.1016/S0022-3182(12)81075-2)
- Colby, S. L., & Ortman, J. M. (2015). Projections of the size and composition of the U.S. population: 2014 to 2060. *Current Population Reports*, (P25-1143). Retrieved from <https://pdfs.semanticscholar.org/09c9/ad858a60f9be2d6966ebd0bc267af5a76321.pdf>
- Cuellar, I., Arnold, B., & Maldonado, R. (1995). Acculturation rating scale for Mexican Americans-II: A Revision of the original ARSMA scale. *Hispanic Journal of Behavioral Sciences, 17*(3), 275–304.
- Cuellar, I., Harris, L., & Jasso, R. (1980). An acculturation scale for Mexican American normal and clinical populations. *Hispanic Journal of Behavioral Sciences, 2*(3), 199-217.
- Dixon, L. B., Sundquist, J., & Winkleby, M. (2000). Differences in energy, nutrient, and food intakes in a US sample of Mexican-American women and men: Findings from the third National Health and Nutrition Examination Survey, 1988–1994. *American Journal of Epidemiology, 152*(6), 548–557. <https://doi.org/10.1093/aje/152.6.548>

- Dominguez, K., Penman-Aguilar, A., Chang, M.-H., Moonesinghe, R., Castellanos, T., Rodriguez-Lainz, A., & Shieber, R. (2015). Vital signs: Leading causes of death, prevalence of diseases and risk factors, and use of health services among Hispanics in the United States -- 2009-2013. *Morbidity and Mortality Weekly Report No. 64*(17), 469–478. Centers for Disease Control and Prevention. Retrieved from <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6417a5.htm>
- Dubowitz, T., Heron, M., Bird, C. E., Lurie, N., Finch, B. K., Basurto-Dávila, R., ... Escarce, J. J. (2008). Neighborhood socioeconomic status and fruit and vegetable intake among whites, blacks, and Mexican Americans in the United States. *The American Journal of Clinical Nutrition*, *87*(6), 1883–1891.
- Dubowitz, T., Smith-Warner, S. A., Acevedo-Garcia, D., Subramanian, S. V., & Peterson, K. E. (2007). Nativity and duration of time in the United States: differences in fruit and vegetable intake among low-income postpartum women. *American Journal of Public Health*, *97*(10), 1787–1790. <https://doi.org/10.2105/AJPH.2005.074856>
- Duffey, K. J., Gordon-Larsen, P., Ayala, G. X., & Popkin, B. M. (2008). Birthplace is associated with more adverse dietary profiles for US-born than for foreign-born Hispanic adults. *The Journal of Nutrition*, *138*(12), 2428–2435. <https://doi.org/10.3945/jn.108.097105>
- Environmental Systems Research Institute Copyright © 2017. *ArcGIS® 10.5.1*. Redlands, CA.

- Fan, J.-G., & Cao, H.-X. (2013). Role of diet and nutritional management in non-alcoholic fatty liver disease. *Journal of Gastroenterology and Hepatology*, 28(S4), 81–87. <https://doi.org/10.1111/jgh.12244>
- Guendelman, S., & Abrams, B. (1995). Dietary intake among Mexican-American women: generational differences and a comparison with white non-Hispanic women. *American Journal of Public Health*, 85(1), 20–25.
- HAMPL, J. S., & SASS, S. (2001). Focus groups indicate that vegetable and fruit consumption by food stamp-eligible Hispanics is affected by children and unfamiliarity with non-traditional foods. *Journal of the American Dietetic Association*, 101(6), 685–687. [https://doi.org/10.1016/S0002-8223\(01\)00171-7](https://doi.org/10.1016/S0002-8223(01)00171-7)
- Healthy People 2020. (n.d.). Search the data. Retrieved May 2, 2017, from <https://www.healthypeople.gov/2020/data-search/Search-the-Data#objid=4939;hdisp=1>.
- Hung, H.-C., Joshipura, K. J., Jiang, R., Hu, F. B., Hunter, D., Smith-Warner, S. A., ... Willett, W. C. (2004). Fruit and Vegetable Intake and Risk of Major Chronic Disease. *JNCI Journal of the National Cancer Institute*, 96(21), 1577–1584. <https://doi.org/10.1093/jnci/djh296>
- Ledoux, T. A., Hingle, M. D., & Baranowski, T. (2011). Relationship of fruit and vegetable intake with adiposity: a systematic review. *Obesity Reviews*, 12(5), e143–e150. <https://doi.org/10.1111/j.1467-789X.2010.00786.x>
- Li, M., Fan, Y., Zhang, X., Hou, W., & Tang, Z. (2014). Fruit and vegetable intake and risk of type 2 diabetes mellitus: meta-analysis of prospective cohort studies. *BMJ Open*, 4(11). <https://doi.org/10.1136/bmjopen-2014-005497>



- Livingston, G., Minushkin, S., & Cohn, D. (2012). Hispanics and Health Care in the United States: Access, Information and Knowledge. *Journal of Youth Development, 7*(3), 114–116. <https://doi.org/10.5195/JYD.2012.134>
- Matias, S. L., Stoecklin-Marois, M. T., Tancredi, D. J., & Schenker, M. B. (2013). Adherence to Dietary Recommendations Is Associated with Acculturation among Latino Farm Workers<sup>12</sup>. *The Journal of Nutrition, 143*(9), 1451–1458. <https://doi.org/10.3945/jn.113.177667>
- Montez, J. K., & Eschbach, K. (2008). 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. *Journal of the American Dietetic Association, 108*(3), 473–480. <https://doi.org/10.1016/j.jada.2007.12.008>
- National Cancer Institute. (2016). Developing scoring algorithms in the 2009-2010 NHANES dietary screener. *National Institutes of Health*. Retrieved from: <https://epi.grants.cancer.gov/nhanes/dietscreen/scoring/current/develop.html>
- Neuhouser, M. L., Thompson, B., Coronado, G. D., & Solomon, C. C. (2004). Higher fat intake and lower fruit and vegetables intakes are associated with greater acculturation among Mexicans living in Washington State. *Journal of the American Dietetic Association, 104*(1), 51–57. <https://doi.org/10.1016/j.jada.2003.10.015>
- Osyuk, T. L., Roux, A. V. D., Hadley, C., & Kandula, N. (2009). Are immigrant enclaves healthy places to live? The multi-ethnic study of atherosclerosis. *Social Science & Medicine (1982), 69*(1), 110–120. <https://doi.org/10.1016/j.socscimed.2009.04.010>

- Otero-Sabogal, R., Sabogal, F., Perez-Stable, E., Hiatt, R. (1995). Dietary practices, alcohol consumption, and smoking behavior: ethnic, sex, and acculturation differences. *Journal of the National Cancer Institute. Monographs*, (18), 73-82.
- Park, Y., Neckerman, K., Quinn, J., Weiss, C., Jacobson, J., & Rundle, A. (2011). Neighborhood immigrant acculturation and diet among Hispanic female residents of NYC. *Public Health Nutrition*, 14(9), 1593–1600.  
<https://doi.org/10.1017/S136898001100019X>
- Pérez-Escamilla, R., & Putnik, P. (2007). The role of acculturation in nutrition, lifestyle, and incidence of type 2 diabetes among Hispanics. *The Journal of Nutrition*, 137(4), 860–870.
- Redfield, R., Linton, R., & Herskovits, M. (1936). Memorandum for the study of acculturation. *American Anthropologist*, 38(1).  
<https://doi.org/doi.org/10.1525/aa.1936.38.1.02a00330>
- Reyes-Ortiz, C. A., Ju, H., Eschbach, K., Kuo, Y.-F., & Gaadwin, J. S. (2009). Neighbourhood ethnic composition and diet among Mexican-Americans. *Public Health Nutrition*, 12(12), 2293–2301.  
<https://doi.org/10.1017/S1368980009005047>
- Roos, E., Lahelma, E., Virtanen, M., Prättälä, R., & Pietinen, P. (1998). Gender, socioeconomic status and family status as determinants of food behaviour. *Social Science & Medicine* (1982), 46(12), 1519–1529.
- SAS Institute Inc. Cary, NC, USA. © SAS Software Version 9.4.

- Strolla, L. O., Gans, K. M., & Risica, P. M. (2006). Using qualitative and quantitative formative research to develop tailored nutrition intervention materials for a diverse low-income audience. *Health Education Research, 21*(4), 465–476.  
<https://doi.org/10.1093/her/cyh072>
- Thomson, M. D., & Hoffman-Goetz, L. (2009). Defining and measuring acculturation: A systematic review of public health studies with Hispanic populations in the United States. *Social Science & Medicine, 69*(7), 983–991.  
<https://doi.org/10.1016/j.socscimed.2009.05.011>
- United States Census Bureau. (n.d.). American FactFinder. Retrieved May 6, 2017, from <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>
- United States Census Bureau. (2010). *Geographic Terms and Concepts - Census Tract [United States Census Bureau]*. Retrieved May 14, 2017, from [https://www.census.gov/geo/reference/gtc/gtc\\_ct.html](https://www.census.gov/geo/reference/gtc/gtc_ct.html)
- United States Department of Health and Human Services & The U.S. Department of Agriculture. (2015). *Dietary Guidelines for Americans 2015-2020: Eighth Edition*. Retrieved April 26, 2017, from [https://health.gov/dietaryguidelines/2015/resources/2015-2020\\_Dietary\\_Guidelines.pdf](https://health.gov/dietaryguidelines/2015/resources/2015-2020_Dietary_Guidelines.pdf)
- Van Duyn, M. A., & Pivonka, E. (2000). Overview of the health benefits of fruit and vegetable consumption for the dietetics professional: Selected literature. *Journal of the American Dietetic Association, 100*(12), 1511–1521.  
[https://doi.org/10.1016/S0002-8223\(00\)00420-X](https://doi.org/10.1016/S0002-8223(00)00420-X)

World Health Organization (n.d.). Determinants of health. Retrieved September 15, 2017, from <http://www.who.int/hia/evidence/doh/en/index3.html>

Zelber-Sagi, S., Ratziu, V., & Oren, R. (2011). Nutrition and physical activity in NAFLD: an overview of the epidemiological evidence. *World Journal of Gastroenterology*, *17*(29), 3377–3389. <https://doi.org/10.3748/wjg.v17.i29.3377>

Zhang, D., Meijgaard, J., Shi, L., Cole, B., Fielding, J. (2015). Does neighbourhood composition modify the association between acculturation and unhealthy dietary behaviors? *Journal of Epidemiology and Community Health*, *69*, 724-731. doi:10.1136/jech-2014-203881

## CHAPTER 5 DISCUSSION

In this study, the main and interaction effects of acculturation and the proportion of Hispanic residents within census tracts were examined to predict vegetable intake among an ethnically diverse sample of Hispanics from across the U.S. It was hypothesized that the proportion of Hispanic residents within a census tract would interact with acculturation to further explain the associations previously noted in the literature of vegetable intake decreasing as orientation toward the Anglo-American culture strengthens. However, contrary to hypothesized outcomes, no significant interactions were detected between acculturation and the proportion of Hispanic residents within census tracts to predict vegetable intake.

In terms of the role of Hispanic density within census tracts, existing studies have posited that living in neighborhoods where the ethnic majority is an ethnic minority may slow the acculturative process since the majority culture is not necessarily the assumed White Anglo-American culture (Abraido-Lanza, 2006; Pérez-Escamilla and Putnik, 2007). Businesses in high density Hispanic neighborhoods may be incentivized to provide culturally traditional foods, including familiar vegetables, by popular demand (Osypuk et al., 2009). The formation of social networks in these areas via shared culture and language may also facilitate access to resources and familiar foods (Berkman et al., 2000). However, in the overall model (1) and across subgroup models (2-4), most of the variance was explained by individual variables, an insignificant amount of the variance

was explained by the inclusion of the proportion of Hispanic residents within census tracts. These findings may be attributable to a lack of variation in Hispanic density within census tracts due to the nature of the sampling techniques employed. The main effects of both acculturation variables and the proportion of Hispanic residents in tracts demonstrated slightly different outcomes than in the models including the interaction terms. In the overall model (Model 5), orientation toward the non-Hispanic White orientation was actually significantly predictive of vegetable intake with a stronger orientation resulting in higher vegetable intake. These findings contradict previous findings that found a negative association between Anglo cultural orientation and vegetable intake (Ayala, Baquero & Klinger, 2008; Bermudez, Falcon & Tucker, 2000; Chavez, Sha, Persky & Pestano-Binghay; Dubowitz, Smith-Warner, Acevedo-Garcia, Subramanian & Peterson, 2007; Duffy et al., 2008; Dixon, Sundquist & Winkleby, 2000; Guedelman & Abrams, 1995; Montez and Esbach, 2008; Neuhouser et al., 2004; Otero-Sabogal et al., 1995; Pérez-Escamilla & Putnik, 2007). This was also observed among the Cuban subsample (Model 8), but not among the Mexican and Puerto Rican subsamples (Models 6 and 7, respectively). Therefore, it may have been the Cuban subsample largely driving the significance of the non-Hispanic White acculturation variable in the overall model (Model 5).

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Despite these limitations, very few previous studies have examined acculturation and vegetable intake with a measure of acculturation that attempts to capture the complexities of acculturation as extensively as the ARSMA-II. Additionally, similar previous studies, have examined neighborhood characteristics only in U.S. metropolitan areas among specific Hispanic samples consisting of mothers (Dubowitz et al., 2008), or Mexican-Americans (Reyes-Ortiz et al., 2009) or of general Hispanic ethnicity (Zhang et

al., 2015). This study contributes a more inclusive scope of the U.S. Hispanic population by representing the three largest Hispanic subgroups equally and obtaining a sample from across the United States and Puerto Rico, rather than a single metropolitan area.

However, due to the inconsistencies in the results of this study with previous findings, there is a need to perform further research inclusive of samples with a greater variation of acculturation, assessed with more robust measures of acculturation, and census tracts with a greater variation of Hispanic density to further understand the relationship of these variables. This knowledge is vital for the creation of more comprehensive and effective health interventions that serve to curb the rapid rise of chronic disease currently burdening the U.S. Hispanic population, by increasing vegetable intake.

## REFERENCES

- Abraído-Lanza, A. F., Armbrister, A. N., Flórez, K. R., & Aguirre, A. N. (2006).  
Toward a theory-driven model of acculturation in public health research.  
*American Journal of Public Health, 96*(8), 1342–1346.  
<https://doi.org/10.2105/AJPH.2005.064980>
- Acevedo-Garcia, D., Lochner, K. A., Osypuk, T. L., & Subramanian, S. V. (2003).  
Future Directions in Residential Segregation and Health Research: A Multilevel  
Approach. *American Journal of Public Health, 93*(2), 215–221.
- Allen, J. D., Caspi, C., Yang, M., Leyva, B., Stoddard, A. M., Tamers, S., ...  
Sorensen, G. C. (2014). Pathways between acculturation and health behaviors  
among residents of low-income housing: The mediating role of social and  
contextual factors. *Social Science & Medicine, 123*(Supplement C), 26–36.  
<https://doi.org/10.1016/j.socscimed.2014.10.034>
- Ayala, G. X., Baquero, B., & Klinger, S. (2008). A Systematic Review of the  
Relationship between Acculturation and Diet among Latinos in the United  
States: Implications for Future Research. *Journal of the American Dietetic  
Association, 108*(8), 1330–1344. <https://doi.org/10.1016/j.jada.2008.05.009>
- Baker, A. H., & Wardle, J. (2003). Sex differences in fruit and vegetable intake in  
older adults. *Appetite, 40*(3), 269–275. [https://doi.org/10.1016/S0195-6663\(03\)00014-X](https://doi.org/10.1016/S0195-6663(03)00014-X)

- Berkman, L., Glass, T., Brissette, I., Seeman, T. (2000). From social integration to health: Durkheim in the new millennium. *Social Science & Medicine*, 51(6), 843-857.
- Bermudez, O. L. I., Falcón, L. M., & Tucker, K. L. (2000). Intake and food sources of macronutrients among older Hispanic adults: Association with ethnicity acculturation, and length of residence in the United States. *Journal of the American Dietetic Association*, 100(6), 665–673. [https://doi.org/10.1016/S0002-8223\(00\)00195-4](https://doi.org/10.1016/S0002-8223(00)00195-4)
- Berry, J.W. (1980). Acculturation as varieties of adaptation. In A. Padilla (Ed.), *Acculturation: Theory, models and some new findings*. (pp. 9-25). Boulder: Westview Press.
- Carter, P., Gray, L. J., Troughton, J., Khunti, K., & Davies, M. J. (2010). Fruit and vegetable intake and incidence of type 2 diabetes mellitus: systematic review and meta-analysis. *BMJ (Clinical Research Ed.)*, 341, 4229.
- Cason, K., Nieto-Montenegro, S., & Chavez-Martinez, A. (2006). Food choices, food sufficiency practices, and nutrition education needs of Hispanic migrant workers in Pennsylvania. *Topics in Clinical Nutrition*, 21(2), 145–158.
- Centers for Disease Control and Prevention. (2010). National Center for Health Statistics National Health and Nutrition Examination Survey Dietary Screener. *Department of Health and Human Services*. Retrieved from: [https://epi.grants.cancer.gov/nhanes /dietscreen/nhanes\\_dtq\\_en.pdf](https://epi.grants.cancer.gov/nhanes /dietscreen/nhanes_dtq_en.pdf)

- Chávez, N., Sha, L., Persky, V., Langenberg, P., & Pestano-Binghay, E. (1994). Effect of length of U.S. residence on food group intake in Mexican and Puerto Rican women. *Journal of Nutrition Education, 26*(2), 79–86.  
[https://doi.org/10.1016/S0022-3182\(12\)81075-2](https://doi.org/10.1016/S0022-3182(12)81075-2)
- Cohn, D., Patten, E., & Lopez, M. H. (2014, August 11). Puerto Rican population declines on island, grows on U.S. mainland. Retrieved October 6, 2017, from <http://www.pewhispanic.org/2014/08/11/puerto-rican-population-declines-on-island-grows-on-u-s-mainland/>
- Colby, S. L., & Ortman, J. M. (2015). Projections of the size and composition of the U.S. population: 2014 to 2060. *Current Population Reports*, (P25-1143). Retrieved from <https://pdfs.semanticscholar.org/09c9/ad858a60f9be2d6966ebd0bc267af5a76321.pdf>
- Coronado, G., Thompson, B., McLerran, D., Schwartz, S. M., Koepsell, T. (2005). A Short acculturation scale for Mexican-American populations. *Ethnicity and Disease, 15*, 53-62.
- Cuellar, I., Arnold, B., & Maldonado, R. (1995). Acculturation rating scale for Mexican Americans-II: A Revision of the original ARSMA scale. *Hispanic Journal of Behavioral Sciences, 17*(3), 275–304.
- Cuellar, I., Harris, L., & Jasso, R. (1980). An acculturation scale for Mexican American normal and clinical populations. *Hispanic Journal of Behavioral Sciences, 2*(3), 199-217.

- Dixon, L. B., Sundquist, J., & Winkleby, M. (2000). Differences in energy, nutrient, and food intakes in a US sample of Mexican-American women and men: Findings from the third National Health and Nutrition Examination Survey, 1988–1994. *American Journal of Epidemiology*, *152*(6), 548–557.  
<https://doi.org/10.1093/aje/152.6.548>
- Dominguez, K., Penman-Aguilar, A., Chang, M.-H., Moonesinghe, R., Castellanos, T., Rodriguez-Lainz, A., & Shieber, R. (2015). Vital signs: Leading causes of death, prevalence of diseases and risk factors, and use of health services among Hispanics in the United States -- 2009-2013. *Morbidity and Mortality Weekly Report No. 64*(17), 469–478. Centers for Disease Control and Prevention.  
Retrieved from <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6417a5.htm>
- Dubowitz, T., Heron, M., Bird, C. E., Lurie, N., Finch, B. K., Basurto-Dávila, R., ... Escarce, J. J. (2008). Neighborhood socioeconomic status and fruit and vegetable intake among whites, blacks, and Mexican Americans in the United States. *The American Journal of Clinical Nutrition*, *87*(6), 1883–1891.
- Dubowitz, T., Smith-Warner, S. A., Acevedo-Garcia, D., Subramanian, S. V., & Peterson, K. E. (2007). Nativity and duration of time in the United States: differences in fruit and vegetable intake among low-income postpartum women. *American Journal of Public Health*, *97*(10), 1787–1790.  
<https://doi.org/10.2105/AJPH.2005.074856>

- Dubowitz, T., Subramanian, S., Acevedo-Garcia, D., Osypuk, T. L., & Peterson, K. E. (2008). Individual and neighborhood differences in diet among low-income foreign and U.S.-born women. *Women's Health Issues: Official Publication of the Jacobs Institute of Women's Health*, 18(3), 181–190.  
<https://doi.org/10.1016/j.whi.2007.11.001>
- Duffey, K. J., Gordon-Larsen, P., Ayala, G. X., & Popkin, B. M. (2008). Birthplace is associated with more adverse dietary profiles for US-born than for foreign-born Hispanic adults. *The Journal of Nutrition*, 138(12), 2428–2435.  
<https://doi.org/10.3945/jn.108.097105>
- Environmental Systems Research Institute Copyright © 2017. *ArcGIS® 10.5.1*.  
Redlands, CA.
- Fan, J.-G., & Cao, H.-X. (2013). Role of diet and nutritional management in non-alcoholic fatty liver disease. *Journal of Gastroenterology and Hepatology*, 28(S4), 81–87. <https://doi.org/10.1111/jgh.12244>
- Flannery, W. P., Reise, S. P., & Yu, J. (2001). An empirical comparison of acculturation models. *Personality and Social Psychology Bulletin*, 27(8), 1035–1045.



- Furr, M. (2011). *Scale construction and psychometrics for social and personality psychology*. SAGE Publications Ltd. Retrieved from [http://books.google.com/books?hl=en&lr=&id=bwp5W4DAz8MC&oi=fnd&pg=PP2&dq=%22robust+correlation+between+dimensions+suggests+that+the+dimensions,%22+%22is+important+because+each+dimension+should+be+scored%22+%22it+has+implications+for+the+meaningfulness+of+combined+scores%22+&ots=b\\_yc5Uivha&sig=W4zMNfDzdpTeeCmGN--Z0rWnLzU](http://books.google.com/books?hl=en&lr=&id=bwp5W4DAz8MC&oi=fnd&pg=PP2&dq=%22robust+correlation+between+dimensions+suggests+that+the+dimensions,%22+%22is+important+because+each+dimension+should+be+scored%22+%22it+has+implications+for+the+meaningfulness+of+combined+scores%22+&ots=b_yc5Uivha&sig=W4zMNfDzdpTeeCmGN--Z0rWnLzU)
- Giovannucci, E. (2002). Epidemiologic studies of folate and colorectal neoplasia: a review. *The Journal of Nutrition*, 132(8), 2350S–2355S.
- Gray, V. B., Cossman, J. S., Dodson, W. L., & Byrd, S. H. (2005). Dietary acculturation of Hispanic immigrants in Mississippi. *Salud Pública de México*, 47(5), 351–360.
- Guendelman, S., & Abrams, B. (1995). Dietary intake among Mexican-American women: generational differences and a comparison with white non-Hispanic women. *American Journal of Public Health*, 85(1), 20–25.
- Hampl, J. S., & Sass, S. (2001). Focus groups indicate that vegetable and fruit consumption by food stamp-eligible Hispanics is affected by children and unfamiliarity with non-traditional foods. *Journal of the American Dietetic Association*, 101(6), 685–687. [https://doi.org/10.1016/S0002-8223\(01\)00171-7](https://doi.org/10.1016/S0002-8223(01)00171-7)
- Hazuda, H. P., Stern, M. P., & Haffner, S. M. (1988). Acculturation and assimilation among Mexican Americans: scales and population-based data. *Social Science Quarterly (University of Texas Press)*, 69(3), 687–706.

Healthy People 2020. (n.d.). Determinants of health. Retrieved September 15, 2017, from <https://www.healthypeople.gov/2020/about/foundation-health-measures/Determinants-of-Health>

Healthy People 2020. (n.d.). Search the data. Retrieved May 2, 2017, from <https://www.healthypeople.gov/2020/data-search/Search-the-Data#objid=4939;hdisp=1>.

Heron, M. (2016). *Deaths: Leading Causes for 2014* (National Vital Statistics Reports No. Volume 65, Number 5). Centers for Disease Control and Prevention. Retrieved from [https://www.cdc.gov/nchs/data/nvsr/nvsr65/nvsr65\\_05.pdf](https://www.cdc.gov/nchs/data/nvsr/nvsr65/nvsr65_05.pdf)

Huang, M. A., Greenon, J. K., Chao, C., Anderson, L., Peterman, D., Jacobson, J., ... Conjeevaram, H. S. (2005). One-year intense nutritional counseling results in histological improvement in patients with non-alcoholic steatohepatitis: a pilot study. *The American Journal of Gastroenterology*, *100*(5), 1072–1081. <https://doi.org/10.1111/j.1572-0241.2005.41334.x>

Hung, H.-C., Joshipura, K. J., Jiang, R., Hu, F. B., Hunter, D., Smith-Warner, S. A., ... Willett, W. C. (2004). Fruit and Vegetable Intake and Risk of Major Chronic Disease. *JNCI Journal of the National Cancer Institute*, *96*(21), 1577–1584. <https://doi.org/10.1093/jnci/djh296>

- Jimenez, D. E., Gray, H. L., Cucciare, M., Kumbhani, S., & Gallagher-Thompson, D. (2010). Using the revised acculturation rating scale for Mexican Americans (ARSMA-II) with older adults. *Hispanic Health Care International : The Official Journal of the National Association of Hispanic Nurses*, 8(1), 14–22. <https://doi.org/10.1891/1540-4153.8.1.14>
- Kaiser, L. L., Melgar-Quiñonez, H., Townsend, M. S., Nicholson, Y., Fuji, M. L., Martin, A. C., & Lamp, C. L. (2003). Food insecurity and food supplies in Latino households with young children. *Journal of Nutrition Education and Behavior*, 35(3), 148–153.
- Kochanek, K. D., Murphy, S. L., Xu, J., & Tejada-Vera, B. (2016). Deaths: Final data for 2014 *National Vital Statistics Reports*, 65(4). National Center for Health Statistics. Retrieved from [https://www.cdc.gov/nchs/data/nvsr/nvsr65/nvsr65\\_04.pdf](https://www.cdc.gov/nchs/data/nvsr/nvsr65/nvsr65_04.pdf)
- Ledoux, T. A., Hingle, M. D., & Baranowski, T. (2011). Relationship of fruit and vegetable intake with adiposity: a systematic review. *Obesity Reviews*, 12(5), e143–e150. <https://doi.org/10.1111/j.1467-789X.2010.00786.x>
- Leenders, M., Siersema, P. D., Overvad, K., Tjønneland, A., Olsen, A., Boutron-Ruault, M.-C., ... Bueno-de-Mesquita, H. B. (2015). Subtypes of fruit and vegetables, variety in consumption and risk of colon and rectal cancer in the European Prospective Investigation into Cancer and Nutrition. *International Journal of Cancer*, 137(11), 2705–2714. <https://doi.org/10.1002/ijc.29640>

- Li, M., Fan, Y., Zhang, X., Hou, W., & Tang, Z. (2014). Fruit and vegetable intake and risk of type 2 diabetes mellitus: meta-analysis of prospective cohort studies. *BMJ Open*, 4(11). <https://doi.org/10.1136/bmjopen-2014-005497>
- Livingston, G., Minushkin, S., & Cohn, D. (2012). Hispanics and Health Care in the United States: Access, Information and Knowledge. *Journal of Youth Development*, 7(3), 114–116. <https://doi.org/10.5195/JYD.2012.134>
- Lopez-Cepero, A., Valencia, A., Jimenez, J., Lemon, S. C., Palacios, C., & Rosal, M. C. (2017). Comparison of dietary quality among Puerto Ricans Living in Massachusetts and Puerto Rico. *Journal of Immigrant and Minority Health*, 19(2), 494–498. <https://doi.org/10.1007/s10903-016-0480-5>
- Marín, G., & Gamba, R. J. (1996). A new measurement of acculturation for Hispanics: The bidimensional acculturation scale for Hispanics (BAS). *Hispanic Journal of Behavioral Sciences*, 18(3), 297–316.
- Marín, G., Sabogal, F., Marín, B., Otero-Sabogal, R., Perez-Stable, E. (1987). Development of a short acculturation scale for Hispanics. *Hispanic Journal of Behavioral Sciences*. 9(2), 183-205.
- Martínez, A. D. (2013). Reconsidering acculturation in dietary change research among Hispanic immigrants: challenging the preconditions of US migration. *Ethnicity & Health*, 18(2), 115–135. <https://doi.org/10.1080/13557858.2012.698254>

- Matias, S. L., Stoecklin-Marois, M. T., Tancredi, D. J., & Schenker, M. B. (2013). Adherence to Dietary Recommendations Is Associated with Acculturation among Latino Farm Workers<sup>12</sup>. *The Journal of Nutrition*, *143*(9), 1451–1458. <https://doi.org/10.3945/jn.113.177667>
- Montez, J. K., & Eschbach, K. (2008). 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. *Journal of the American Dietetic Association*, *108*(3), 473–480. <https://doi.org/10.1016/j.jada.2007.12.008>
- Motel, S., & Patten, E. (2012, June 27). The 10 Largest Hispanic Origin Groups: Characteristics, Rankings, Top Counties. Retrieved April 24, 2017, from <http://www.pewhispanic.org/2012/06/27/the-10-largest-hispanic-origin-groups-characteristics-rankings-top-counties/>
- National Cancer Institute. (2016). Developing scoring algorithms in the 2009-2010 NHANES dietary screener. *National Institutes of Health*. Retrieved from: <https://epi.grants.cancer.gov/nhanes/dietscreen/scoring/current/develop.html>
- Neuhouser, M. L., Thompson, B., Coronado, G. D., & Solomon, C. C. (2004). Higher fat intake and lower fruit and vegetables intakes are associated with greater acculturation among Mexicans living in Washington State. *Journal of the American Dietetic Association*, *104*(1), 51–57. <https://doi.org/10.1016/j.jada.2003.10.015>

- Osypuk, T. L., Roux, A. V. D., Hadley, C., & Kandula, N. (2009). Are immigrant enclaves healthy places to live? The multi-ethnic study of atherosclerosis. *Social Science & Medicine* (1982), 69(1), 110–120. <https://doi.org/10.1016/j.socscimed.2009.04.010>
- Otero-Sabogal, R., Sabogal, F., Perez-Stable, E., Hiatt, R. (1995). Dietary practices, alcohol consumption, and smoking behavior: ethnic, sex, and acculturation differences. *Journal of the National Cancer Institute. Monographs*, (18), 73-82.
- Palmer, M., & Schaffner, F. (1990). Effect of weight reduction on hepatic abnormalities in overweight patients. *Gastroenterology*, 99(5), 1408–1413.
- Park, R., & Miller, H. (1921). *Old world traits transplanted*. New York: Arno Press.
- Park, Y., Neckerman, K., Quinn, J., Weiss, C., Jacobson, J., & Rundle, A. (2011). Neighborhood immigrant acculturation and diet among Hispanic female residents of NYC. *Public Health Nutrition*, 14(9), 1593–1600. <https://doi.org/10.1017/S136898001100019X>
- Patten, E. (2016, April 20). The nation’s Latino population is defined by its youth. Retrieved April 24, 2017, from <http://www.pewhispanic.org/2016/04/20/the-nations-Latino-population-is-defined-by-its-youth/>
- Pérez-Escamilla, R., & Putnik, P. (2007). The role of acculturation in nutrition, lifestyle, and incidence of type 2 diabetes among Hispanics. *The Journal of Nutrition*, 137(4), 860–870.
- Portes, A., Zhou, M. (1993). The new second generation: segmented assimilation and its variants. *The Annals of the American Academy of Political and Social Science*, 530(1), 74-96.

- Redfield, R., Linton, R., & Herskovits, M. (1936). Memorandum for the study of acculturation. *American Anthropologist*, 38(1).  
<https://doi.org/doi.org/10.1525/aa.1936.38.1.02a00330>
- Reyes-Ortiz, C. A., Ju, H., Eschbach, K., Kuo, Y.-F., & Gaadwin, J. S. (2009). Neighbourhood ethnic composition and diet among Mexican-Americans. *Public Health Nutrition*, 12(12), 2293–2301.  
<https://doi.org/10.1017/S1368980009005047>
- Roos, E., Lahelma, E., Virtanen, M., Prättälä, R., & Pietinen, P. (1998). Gender, socioeconomic status and family status as determinants of food behaviour. *Social Science & Medicine* (1982), 46(12), 1519–1529.
- Satia-Abouta, J., Patterson, R., Neuhouser, M., & Elder, J. (2002). Dietary acculturation: Applications to nutrition research and dietetics. *Journal of the American Dietetic Association*, 102, 1105–1118.
- Sartorelli, D. S., Franco, L. J., & Cardoso, M. A. (2008). High intake of fruits and vegetables predicts weight loss in Brazilian overweight adults. *Nutrition Research*, 28(4), 233–238. <https://doi.org/10.1016/j.nutres.2008.02.004>
- Siegel, P., Martin, E., Bruno, R., & others. (2001). Language use and linguistic isolation: Historical data and methodological issues. *Washington, DC: US Census Bureau*. Retrieved from <https://census.gov/content/dam/Census/library/working-papers/2001/demo/2001-Siegel-Martin-Bruno.pdf>

- Song, M., Fung, T., Hu, F. B., Willett, W. C., Longo, V. D., Chan, A. T., & Giovannucci, E. L. (2016). Association of animal and plant protein intake with all-cause and cause-specific mortality. *JAMA Internal Medicine*, *176*(10), 1453–1463. <https://doi.org/10.1001/jamaintern.med.2016.4182>
- Steppler, R., & Brown, A. (2016, April 19). Statistical portrait of Hispanics in the United States. Retrieved April 23, 2017, from <http://www.pewhispanic.org/2016/04/19/statistical-portrait-of-hispanics-in-the-united-states-key-charts/>
- Storey, M., & Anderson, P. (2014). Income and race/ethnicity influence dietary fiber intake and vegetable consumption. *Nutrition Research*, *34*(10), 844–850. <https://doi.org/10.1016/j.nutres.2014.08.016>
- Strolla, L. O., Gans, K. M., & Risica, P. M. (2006). Using qualitative and quantitative formative research to develop tailored nutrition intervention materials for a diverse low-income audience. *Health Education Research*, *21*(4), 465–476. <https://doi.org/10.1093/her/cyh072>
- Svendsen, M., Blomhoff, R., Holme, I., & Tonstad, S. (2007). The effect of an increased intake of vegetables and fruit on weight loss, blood pressure and antioxidant defense in subjects with sleep related breathing disorders. *European Journal of Clinical Nutrition*, *61*(11), 1301.
- Thomson, M. D., & Hoffman-Goetz, L. (2009). Defining and measuring acculturation: A systematic review of public health studies with Hispanic populations in the United States. *Social Science & Medicine*, *69*(7), 983–991. <https://doi.org/10.1016/j.socscimed.2009.05.011>



- Tienda, M., & Mitchell, F. (2006). *Hispanics and the future of America*. Washington, D.C: National Academies Press.
- Ueno, T., Sugawara, H., Sujaku, K., Hashimoto, O., Tsuji, R., Tamaki, S., ... Tanikawa, K. (1997). Therapeutic effects of restricted diet and exercise in obese patients with fatty liver. *Journal of Hepatology*, 27(1), 103–107.
- United States Census Bureau. (n.d.). American FactFinder. Retrieved May 6, 2017, from <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>
- United States Census Bureau. (2010). *Geographic Terms and Concepts - Census Tract [United States Census Bureau]*. Retrieved May 14, 2017, from [https://www.census.gov/geo/reference/gtc/gtc\\_ct.html](https://www.census.gov/geo/reference/gtc/gtc_ct.html)
- United States Census Bureau. (n.d.). *Hispanic or Hispanic origin by specific origin*. Retrieved March 23, 2017, from [https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=A\\_CS\\_15\\_5YR\\_B03001&prodType=table](https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=A_CS_15_5YR_B03001&prodType=table)
- United States Census Bureau QuickFacts: UNITED STATES. (2017). Retrieved July 7, 2018, from <https://www.census.gov/quickfacts/fact/table/US/PST045217>
- United States Census Bureau. (n.d.). *When to use 1-year, 3-year, or 5-year estimates. [American Community Survey]*. Retrieved May 14, 2014, from: <https://www.census.gov/programs-surveys/acs/guidance/estimates.html>
- United States Department of Health and Human Services & The U.S. Department of Agriculture. (2015). *Dietary Guidelines for Americans 2015-2020: Eighth Edition*. Retrieved April 26, 2017, from [https://health.gov/dietaryguidelines/2015/resources/2015-2020\\_Dietary\\_Guidelines.pdf](https://health.gov/dietaryguidelines/2015/resources/2015-2020_Dietary_Guidelines.pdf)

- Van Duyn, M. A., & Pivonka, E. (2000). Overview of the health benefits of fruit and vegetable consumption for the dietetics professional: Selected literature. *Journal of the American Dietetic Association*, *100*(12), 1511–1521.  
[https://doi.org/10.1016/S0002-8223\(00\)00420-X](https://doi.org/10.1016/S0002-8223(00)00420-X)
- Vespa, J., Armstrong, D., & Medina, L. (2018). *Demographic Turning Points for the United States: Population Projections for 2020 to 2060* (p. 15). U.S. Census Bureau. Retrieved from [https://www.census.gov/content/dam/Census/library/publications/2018/demo/P25\\_1144.pdf](https://www.census.gov/content/dam/Census/library/publications/2018/demo/P25_1144.pdf)
- Wang, X., Ouyang, Y., Liu, J., Zhu, M., Zhao, G., Bao, W., & Hu, F. B. (2014). Fruit and vegetable consumption and mortality from all causes, cardiovascular disease, and cancer: systematic review and dose-response meta-analysis of prospective cohort studies. *BMJ (Clinical Research Ed.)*, *349*, g4490.
- Wiley, J. F., Cloutier, M. M., Wakefield, D. B., Hernandez, D. B., Grant, A., Beaulieu, A., & Gorin, A. A. (2014). Acculturation Determines BMI Percentile and Noncore Food Intake in Hispanic Children. *The Journal of Nutrition*, *144*(3), 305–310. <https://doi.org/10.3945/jn.113.182592>
- Willett, W. C., Koplan, J. P., Nugent, R., Dusenbury, C., Puska, P., & Gaziano, T. A. (2006). Prevention of Chronic Disease by Means of Diet and Lifestyle Changes. In D. T. Jamison, J. G. Breman, A. R. Measham, G. Alleyne, M. Claeson, D. B. Evans, ... P. Musgrove (Eds.), *Disease Control Priorities in Developing Countries* (2nd ed.). Washington (DC): World Bank. Retrieved from <http://www.ncbi.nlm.nih.gov/books/NBK11795/>

World Health Organization (n.d.). Determinants of health. Retrieved September 15, 2017, from <http://www.who.int/hia/evidence/doh/en/index3.html>

Zelber-Sagi, S., Ratziu, V., & Oren, R. (2011). Nutrition and physical activity in NAFLD: an overview of the epidemiological evidence. *World Journal of Gastroenterology*, *17*(29), 3377–3389. <https://doi.org/10.3748/wjg.v17.i29.3377>

Zhang, D., Meijgaard, J., Shi, L., Cole, B., Fielding, J. (2015). Does neighbourhood composition modify the association between acculturation and unhealthy dietary behaviors? *Journal of Epidemiology and Community Health*, *69*, 724-731. doi:10.1136/jech-2014-203881

## APPENDIX A:

### ADAPTED ARSMA-II ACCULTURATION SCALE

#### **Acculturation**

These items were only administered to Hispanic respondents. This scale was adapted from:

Cuéllar, Israel, Bill Arnold, and Roberto Maldonado. 1995. "Acculturation rating scale for Mexican Americans-II: A revision of the original ARSMA scale." *Hispanic Journal of Behavioral Sciences* 17 (3):275-304.

Response options for the following items included: "never," "sometimes," "often," and "always."

1. How often do you think in the Spanish language?
2. How often does or did your father identify himself as [Mexican/Cuban/Puerto Rican]?
3. How often does or did your mother identify herself as [Mexican/Cuban/Puerto Rican]?
4. How often does your family cook [Mexican/Cuban/Puerto Rican] foods?
5. How often does your family cook American foods?
6. How often do you identify yourself as [Mexican/Cuban/Puerto Rican]?
7. How often do you identify yourself as an American?
8. How often do you socialize with [Mexicans/Cubans/Puerto Ricans]?
9. How often do you socialize with White Americans who are not Hispanic or Latino?
10. How often do you think in the English language?

Response options for the following items included: "not at all well," "somewhat well," "very well," and "extremely well."

11. How well do you speak Spanish?
12. How well do you speak English?
13. How well do you write in Spanish?
14. How well do you write in English?

Response options for the following items included: “not at all,” “somewhat,” “very much,” and “completely.”

15. How much do you enjoy speaking Spanish?
16. How much do you enjoy listening to Spanish language music?
17. How much do you enjoy listening to English language music?
18. How much do you enjoy Spanish language TV?
19. How much do you enjoy Spanish language movies?
20. How much do you enjoy reading in English?
21. How much do you enjoy English language TV?
22. How much do you enjoy reading in Spanish?
23. How much do you enjoy English language movies?

Response options for the following items included: “none,” “some,” “most,” and “all.”

24. How many of your friends, while you were growing up, were of [Mexican/Cuban/Puerto Rican] origin?
25. How many of your friends now are of [Mexican/Cuban/Puerto Rican] origin?
26. How many of your friends, while you were growing up, were White Americans who were not Hispanic or Latino?
27. How many of your friends now are White Americans who are not Hispanic or Latino?

**APPENDIX B:  
VEGETABLE INTAKE QUESTION ALTERATIONS**

The changes to the vegetable intake questionnaire were made to enhance clarity and cultural appropriateness by including mention of particular foods and ensuring a clear understanding for participants from all three Hispanic ethnic subgroups in both English and Spanish. These changes were made in consultation with study team experts on nutrition and survey methodology.

\*Red text denotes changes to the original NHANES 2009-2010 Dietary Screener Questions

Vegetable Intake Questions Used in Present study	NHANES 2009-2010 Dietary Screener Questions
<p><b>Think about how often during the past 30 days you ate a salad made with leafy greens, such as spinach or lettuce, with or without other vegetables. <u>Do not include leafy greens that have been cooked, such as steamed spinach.</u></b></p> <p>During the past <b>30 days</b>, how often did you eat a <b>salad made with leafy greens</b>? You can tell me <b>how many times per</b> day, per week, or per month.</p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS:</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>	<p>During the past month, how often did you eat a green leafy or lettuce salad, with or without other vegetables? You can tell me per day, per week or per month.</p> <p>INTERVIEWER INSTRUCTIONS:</p> <p>INCLUDE SPINACH SALADS</p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS:</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>

<p><b>Think about how often during the past 30 days you ate any kind of <u>fried potatoes</u>, such as French fries, home fries, or hash brown potatoes. <b>Do not include mashed potatoes</b> or potato chips.</b></p> <p>During the past <b>30 days</b>, how often did you eat any kind of <u>fried potatoes</u>? You can tell me <b>how many times</b> per day, per week, or per month. (Adapted from NCI Fruit and Vegetable Dietary Screener, 2009; NHANES 2009-2010)</p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS:</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>	<p>During the past month, how often did you eat any kind of fried potatoes, including french fries, home G/Q/U fries, or hash brown potatoes? You can tell me per day, per week or per month.</p> <p>INTERVIEWER INSTRUCTIONS: DO NOT INCLUDE: POTATO CHIPS.</p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS:</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>
<p><b>Think about how often during the past 30 days you ate beans that had been cooked. Think about beans you ate as a side dish, beans and rice, or beans that you ate that were included in other foods, such as soups or casseroles. Include dried or canned beans that were then cooked.</b> Examples may include ---- , ----, pinto beans, black beans, kidney beans, <b>chickpeas, cannellini</b> beans, lentils, black-eyed peas, and lima beans. Do <u>not</u> include green beans <b>or green peas</b>. During the past 30 days, how often did you eat beans that had been cooked? (You can tell me how many times per day, per week, or per month.)</p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS:</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>	<p>During the past month, how often did you eat refried beans, baked beans, beans in soup, pork and beans or any other type of cooked dried beans? Do not include green beans. You can tell me per day, per week or per month.</p> <p>INTERVIEWER INSTRUCTIONS: INCLUDE: <b>SOYBEANS, KIDNEY, PINTO, GARBANZO, LENTILS, BLACK, BLACK-EYED PEAS, COW PEAS, AND LIMA BEANS.</b></p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS:</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>

<p><b>Think about how often during the past 30 days you ate the type of <u>salsa</u> that is made with raw tomatoes or tomatillos. Do <u>not</u> count tomato sauces that have been cooked, such as spaghetti or enchilada sauce.</b></p> <p>During the past <b>30 days</b>, how often did you eat <u>salsa</u> made with <b>raw</b> tomatoes or <b>tomatillos</b>? You can tell me how many times per day, per week, or per month. (Adapted from NCI Fruit and Vegetable Dietary Screener, 2009; NHANES 2009-2010)</p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS:</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>	<p>During the past month, how often did you have Mexican-type salsa made with tomato? You can tell me per day, per week or per month.</p> <p>INTERVIEWER INSTRUCTIONS: INCLUDE: ALL TOMATO-BASED SALSAS.</p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS:</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>
<p><b>Think about how often during the past 30 days you ate <u>cooked tomato sauces</u> that were either on top of or mixed into foods such as lasagna, spaghetti, <b>enchiladas</b>, or <b>burritos</b>. Do <u>not</u> count ketchup or tomato sauce that was on pizza.</b></p> <p>During the past <b>30 days</b>, how often did you eat <u>cooked tomato sauces</u>? You can tell me <b>how many times</b> per day, per week, or per month.</p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS: _____</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>	<p>During the past month, how often did you have tomato sauces such as with spaghetti or noodles or G/Q/U mixed into foods such as lasagna? Please do not count tomato sauce on pizza. You can tell me per day, per week or per month.</p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS:</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>



<p><b>Think about how often during the past 30 days you ate <u>other vegetables</u> that we haven't talked about yet.</b> Examples may include tomatoes, <b>avocados, onions, mushrooms, green peas, jicama, potatoes, yucca, squash, peppers,</b> green beans, <b>carrots,</b> corn, cabbage, and broccoli. <u>Include</u> vegetables eaten raw, as well as vegetables that were canned, frozen, or cooked. <b>Include vegetables eaten on their own or included in other dishes such as soups, casseroles, or sandwiches. Do <u>not</u> include vegetables that were fried, ketchup, rice, or vegetables that we have already talked about.</b></p> <p>During the past 30 days, how often did you eat these kinds of <u>other vegetables</u> that we have not already talked about? You can tell me <b>how many times</b> per day, per week, or per month. (Adapted from NCI Fruit and Vegetable Dietary Screener, 2009; NHANES 2009-2010)</p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS:</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>	<p>During the past month, not including what you just told me about (lettuce salads, potatoes, cooked dried G/Q/U beans), how often did you eat other vegetables? You can tell me per day, per week or per month.</p> <p>INTERVIEWER INSTRUCTIONS:  DO NOT INCLUDE: RICE  EXAMPLES OF OTHER VEGETABLES INCLUDE: TOMATOES, GREEN BEANS, CARROTS, CORN, CABBAGE, BEAN SPROUTS, COLLARD GREENS, AND BROCCOLI. INCLUDE ANY FORM OF THE VEGETABLE (RAW, COOKED, CANNED, OR FROZEN).</p> <p>ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS:</p> <p><input type="checkbox"/> DAY  <input type="checkbox"/> WEEK  <input type="checkbox"/> MONTH  <input type="checkbox"/> DON'T KNOW  <input type="checkbox"/> REFUSED</p>
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National Center for Health Statistics. (2010). National Health and Nutrition Examination Survey dietary screener module. Retrieved from: [https://wwwn.cdc.gov/nchs/data/nhanes/2009-2010/questionnaires/mi\\_dtq\\_f.pdf](https://wwwn.cdc.gov/nchs/data/nhanes/2009-2010/questionnaires/mi_dtq_f.pdf)