EXAMINING THE ASSOCIATION BETWEEN ACCULTURATION INDICATORS AND METABOLIC SYNDROME AMONG HISPANIC ADULTS

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DEDICATION

I dedicate this project to:

Mi mamá, Luz and my father, Salvador. All that I am is because of you. Doy gracias a Dios por la gran bendición de tenerlos como mis padres.

To my sister, Susie: I can honestly say I would not be here without you. Your unwavering faith in me kept me going.

To mi amor, José: Thank you for your loving and calming presence.

And to my brother-in-law, Wahed; my nino, John; my nina, Aurora; my brother, Sal; and my sister-in-law, Ana. Thank you for all your love and support.

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ABSTRACT

ALEJANDRA QUEZADA

EXAMINING THE ASSOCIATION BETWEEN ACCULTURATION INDICATORS AND METABOLIC SYNDROME AMONG HISPANIC ADULTS

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The purpose of the study was to examine the relationship between acculturation indicators and metabolic syndrome (MetS) among Hispanic adults living in the Dallas-Fort Worth metropolitan area in Texas. MetS is a pressing public health problem, and Hispanics have the highest prevalence among all ethnic groups in the United States (35.4%). MetS is a cluster of five risk factors (blood pressure, waist circumference, high-density lipoprotein cholesterol, fasting blood glucose, and triglycerides) that increase a person's risk of developing cardiovascular disease and diabetes. Currently, Hispanics are the second-largest ethnic group in the United States, and more than one-third of the U.S. Hispanic population is foreign-born. As immigrants and subsequent generations are exposed to the mainstream U.S. culture, the process of acculturation affects their lifestyle behaviors and health.

Acculturation indicators (nativity, duration in the United States, and scores from the Short Acculturation Scale for Hispanics) and the five MetS markers were assessed among 128 adult participants. Logistic regression modeling was conducted to predict MetS status (present/not present) by acculturation indicators and covariates (sex, age, and education). Additional analyses were conducted to assess the relationship between each individual MetS marker, acculturation indicators, and the identified covariates.

For every one-unit increase in a participant's duration in the United States (measured in years), the likelihood of having abnormal blood pressure increased by 6% and the likelihood of having abnormal blood glucose increased by 5%. Results indicate increasing exposure to the mainstream American culture negatively affects health risks and status among Hispanics.

The primary treatment for MetS is lifestyle modification that includes regular physical activity, healthy eating, and weight loss. Health care providers can aid in reducing MetS prevalence by raising awareness of the condition and associated risk factors among their patients as well as recommending lifestyle modification to reduce their risk. Study results can aid health educators in planning, implementing, and evaluating health communication campaigns and health education/promotion programs to prevent MetS among Hispanics. Further examination of what changes occur in health behaviors that increase risk of MetS would provide further insight into why duration in the United States is associated with elevated blood pressure and elevated fasting blood glucose levels.

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CHAPTER I

INTRODUCTION

Metabolic syndrome (MetS) is a prevalent and quickly growing national problem in the United States. It has reached epidemic proportions, presenting "an explosion in the prevalence of diabetes and related metabolic disorders" (Jain & Saraf, 2010, p. 55). MetS is a condition characterized by the manifestation of a cluster of risk factors associated with an increased risk for cardiovascular disease (CVD) and diabetes mellitus type two (diabetes) (Alberti et al., 2009; Eckel, Alberti, Grundy, & Zimmet, 2010). Overall prevalence of MetS among United States adults (aged 20 and older) increased from 32.9% in 2003 to 34.7% in 2012 (Aguilar, Bhuket, Torres, Liu, & Wong, 2015). Individuals with MetS are at a five-fold increased risk for developing diabetes and a two-fold increased risk for developing CVD when compared to healthy individuals (Grundy, 2008).

Diabetes is one of the major causes of morbidity and mortality in the United States and is currently ranked as the seventh leading cause of death; it is also responsible for severe health complications such as kidney failure, vision loss, and lower-limb amputation (Centers for Disease Control & Prevention [CDC], 2017b, 2017d). Diabetes prevalence continues to rise every year in the United States, having increased from 4.5% in 1995 to 9.4% in 2015 (CDC, 2012b, 2017d). An additional 2.9% of adults in the United States were estimated to have undiagnosed diabetes in 2015 (CDC, 2017d). CVD is the leading cause of death in the United States, accounting for approximately one-fourth of all deaths (CDC, 2017c). There were an estimated 121.5 million individuals (age 20 years and older) living with CVD in the United States in 2016 (Benjamin et al., 2019). CVD death rates were approximately 1.7 times higher among adults aged 18 years and older with diagnosed diabetes than among adults without diagnosed diabetes (CDC, 2014). CVD is the leading cause of death in individuals with diabetes (National Institute of Diabetes & Digestive & Kidney Disease [NIDDK], 2017).

Chronic conditions such as MetS, diabetes, and CVD are increasingly prevalent in the United States; however, certain ethnic groups are disproportionately affected. Hispanics have the highest prevalence of MetS among any ethnic group in the United States (35.4% vs. 33.4% in non-Hispanic Whites) (Aguilar et al., 2015). Among Hispanics aged 60 years or older, more than 50% have MetS (vs. 46.7% in all groups) (Aguilar et al., 2015). Additionally, diabetes is more prevalent among Hispanics (12.1% of Hispanics versus 7.4% of non-Hispanic Whites) (CDC, 2017d); and CVD is the leading cause of mortality among Hispanics (American Heart Association [AHA], 2016).

In 2016, Hispanics represented 18% of the total U.S. population and were the second largest racial or ethnic group in the United States (Flores, 2017). Hispanics are also the second-fastest-growing racial or ethnic group in the United States (Flores, 2017). The U.S. Census Bureau (2010) projected that Hispanics will comprise 25% of the entire U.S. population by 2050. In Texas, Hispanics represent 39.4% of the state's population (U.S. Census Bureau, n. d.). The Hispanic population in Texas grew 60% from 2000-

2015 (Flores, 2017). There are 1.94 million Hispanics (28.4%) living in the Dallas-Fort Worth (DFW) metropolitan area of Texas, and approximately 38% of this population is foreign-born (Pew Research Center, 2016).

More than one-third of the U.S. Hispanic population is foreign-born (Flores, 2017). Research findings suggest Hispanics are relatively healthy upon immigration compared to their U.S.-born counterparts, but their health status declines the longer they live in the United States (Alcantara, Estevez, & Alegria, 2017; Lara, Gamboa, Kahramanian, Morales, & Hayes Bautista, 2005; Perez-Escamilla, 2011; Schwartz & Unger, 2017). For instance, researchers have shown that the prevalence of self-reported coronary heart disease (CHD) and stroke is generally lower among foreign-born Hispanics when compared to U.S.-born Hispanics (Daviglus et al., 2012). Additionally, CHD prevalence is significantly higher among Latinos who have resided in the United States 10 or more years when compared to Latinos who have resided in the United States less than 10 years (Daviglus et al., 2012); Hispanics with higher acculturation levels have higher hypertension prevalence in comparison with Hispanics with lower acculturation levels (Vaeth & Willett, 2005); and diabetes prevalence has doubled among Hispanics who have been in the United States for over 25 years compared to those who immigrated within the past 10 years (Ahmed et al., 2009).

Acculturation is a dynamic process that occurs among groups and individuals of autonomous cultures when they come in contact with one another (Berry, 2017). Individuals from the receiving culture as well as the migrating individuals are assumed to both experience some cultural change as a result of this contact; however, most health research has examined the cultural changes that occur within the individual migrants (Berry, 2017). The cultural changes that occur as migrants (e.g., Hispanics) are exposed to the receiving culture (e.g., American culture) may affect behavior among the migrants, including changes in diet, language, values, beliefs, attitudes, and identities (Berry, 2017). As immigrants and subsequent generations are exposed to the U.S. mainstream culture, the process of acculturation affects their lifestyle (pertaining to diet and physical activity) and consequently, their overall health. As Abraído-Lanza, Armbrister, Flórez, and Aguirre (2006) observed, the "large proportion of immigrants illustrates, in part, the importance of considering acculturation in research on the health of [Hispanics]" (p. 1342). Examining the role of acculturation in determining health behaviors and outcomes can provide valuable insight to better understand Hispanic population health in the United States (Thomson & Hoffman-Goetz, 2009). Furthermore, because Hispanics are disproportionately affected by MetS, diabetes, and CVD, it is important to address these health disparities to improve health outcomes among Hispanics, thereby reducing disability-adjusted life years (DALYs) and healthcare costs (direct and indirect) (CDC, 2017d; Dall et al., 2010; Heidenreich et al., 2011; Kassebaum et al., 2016; Mokdad et al., 2018; Saklayen, 2018; Tsai, Williamson, & Glick, 2011). To date, few studies have examined the association between acculturation indicators and MetS among Hispanics, and the existing studies have reported inconsistent and conflicting findings (de Heer, Balcazar, Cardenas, Rosenthal, & Schulz, 2011; Espinosa de los Monteros, Gallo, Elder,

& Talavera, 2008; González, Tarraf, & Haan, 2011; Shivpuri, Allison, Macera, Lindsay, & Gallo, 2013; Vella, Ontiveros, Zubia, & Bader, 2011).

Statement of the Purpose

The purpose of the study was to use secondary data to examine the relationship between acculturation indicators and MetS among Hispanic adults living in the DFW metropolitan area.

Research Questions

1. Is there a relationship between acculturation indicators (nativity, duration in the United States, and the Short Acculturation Scale for Hispanics [SASH] score) and MetS among Hispanics living in the Dallas-Fort Worth metropolitan area (DFW)?

2. Is there a relationship between acculturation indicators (nativity, duration in the United States, and the SASH score) and the individual markers associated with MetS (high waist circumference, high blood pressure, elevated fasting blood glucose, elevated blood triglycerides, and reduced high-density lipoprotein cholesterol) among Hispanic adults living in DFW?

Hypotheses

The following null hypotheses were tested at the 0.05 level of significance:

1. There will be no relationship between acculturation indicators (nativity, duration in the United States, and SASH score) and MetS among Hispanics living in DFW.

2. There will be no relationship between acculturation indicators (nativity, duration in the United States, and the SASH score) and the individual markers associated with MetS

(high waist circumference, high blood pressure, elevated fasting blood glucose, elevated blood triglycerides, and reduced high-density lipoprotein cholesterol) among Hispanic adults living in DFW.

Delimitations

The delimitations in this study are as follows:

1. Participants were at least 18 years of age and living in DFW.

2. Participants self-identified as Hispanic.

3. Participants were not currently pregnant. Pregnancy can affect laboratory results as well as waist circumference; therefore, pregnant women may be falsely identified as having MetS (Dos Prazeres Tavares et al., 2016).

Limitations

The limitations of this study are as follows:

1. The unidimensional composition of the SASH does not account for the possibility of an individual becoming multicultural (Pérez-Escamilla, 2009).

2. The correlational analysis may suggest that there is a relationship between acculturation indicators and MetS among Hispanics, but it cannot show a causal relationship between factors.

3. Due to the modest sample size of the primary study, the findings cannot be generalizable to a larger population.

4. Selection bias may have occurred as participants with specific characteristics may have been more likely to participate in this study. Individuals without access to affordable

healthcare may have been more likely to participate in this study as a means of receiving a free health screening (Green, Johnson, & Yarborough, 2013; Murray, Liang, Barnack-Tavlaris, & Navarro, 2014). The data collection was performed on weekends; therefore, individuals who were not able to take time off work during the week and did not have access to their doctor on the weekends may have been more likely to participate in this study (Green et al., 2013).

Assumptions

The assumptions for this study were:

1. Participants were able to read and understand the English or Spanish language.
2. Participants answered the questions honestly and to the best of their ability.
3. The primary data collection instruments were constructed and administered in a manner consistent with sound research practices.

Definition of Terms

Acculturation - Acculturation is the process of adopting a new culture's attitudes, beliefs, values, customs, and behaviors (Abraído-Lanza, White, & Vasques, 2004; Pérez-Escamilla, 2009).

Body Mass Index (BMI) - BMI is a person's weight in kilograms divided by the square of height in meters. A high BMI is used as an indicator of body fatness as research has shown that BMI is correlated with more direct measures of body fatness (CDC, 2017a). BMI is a useful screening tool to assess risk of weight-related health problems; however, it is “not a diagnostic of the body fatness or health of an individual” (CDC, 2017a, para. 2).

Insulin - Insulin is a hormone made in the pancreas that plays a major role in metabolism by helping cells throughout the body absorb glucose and use it for energy (NIDDK, 2014).

Insulin Resistance (IR) - IR is defined as the body’s decreased response to insulin leading to impaired cellular action (Weiss, Bremer, & Lustig, 2013).

Health and Wellness Coaching - Health and wellness coaching is a coaching specialization in which coaches partner with clients to set and achieve self-determined goals that align with their values and promote health and wellness (National Board for Health & Wellness Coaching [NBHWC], n.d.).

Hispanic or Latino - “Hispanic or Latino” refers to a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race. The terms "Hispanic," "Latino," and "Spanish" are used interchangeably (Ennis, Ríos-Vargas, & Albert, 2011).

Metabolic Syndrome (MetS) - MetS is a condition characterized by the manifestation of a cluster of risk factors that are associated with an increased risk for CVD and diabetes. The Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III [ATP III]) published MetS criteria in 2002. In 2005, the criteria were revised (Grundy et al., 2005). According to the 2005 ATP III revised MetS criteria, there must be at least three of the following five risk factors for an individual to be diagnosed with MetS: enlarged waist circumference (WC) of greater than 40 inches in males or greater than 35 inches in females; elevated triglycerides (TG) of greater than or equal to 150 mg/dL; reduced high-density lipoprotein (HDL) cholesterol of less than 40 mg/dL in men and less than 50 mg/dL in women; elevated blood pressure (BP) with a systolic blood pressure greater than or equal to 130 mmHg or a diastolic blood pressure greater than or equal to 85 mm Hg; and elevated fasting glucose (FBG) greater than or equal to 100 mg/dL (Eckel et al., 2010; Gupta & Gupta, 2010).

Obesity - Obesity is a condition characterized by the accumulation of excess body fat that may negatively affect health outcomes (World Health Organization [WHO], 2018).

Prudent Diet - the prudent (or healthy) dietary pattern is characterized by higher intake of fruits, vegetables, whole grains, fish and seafood, legumes, poultry, olive oil, nuts, seeds and non- or low-fat dairy (Rodríguez-Monforte, Sanchez, Barrio, Costa, & Flores-Mateo, 2016).

Short Acculturation Scale for Hispanics (SASH) - SASH is a brief, 12-item scale developed by Marín et al. (1987) as an acculturation scale that can be used with any Latino subgroup. SASH consists of three factors: language use (5 items), media (3 items), and ethnic social relations (4 items).

Visceral Adiposity - Visceral adiposity is characterized as increased adipose tissue surrounding the intra-abdominal organs (Shuster, Patlas, Pinthus, & Mourtzakis, 2012) and is of particular interest as visceral adiposity is linked to an increased risk for developing CVD and diabetes (Gupta & Gupta, 2010).

Western Dietary Pattern (Western diet) - The Western diet is characterized by higher intake of refined grain products, refined sugar, and processed meats **(**Bouchard-Mercier, Rudkowska, Lemieux, Couture, & Vohl, 2013)

Significance of the Study

Few studies have examined the association between acculturation indicators and MetS among Hispanics, and the existing studies have reported conflicting findings. This study adds to the existing literature by examining the relationship between acculturation indicators and MetS among Hispanics living in the DFW area of Texas. Study results can aid health care providers in reducing MetS prevalence by raising awareness of the condition and associated risk factors among their patients as well as recommending lifestyle modification to reduce their risk. Furthermore, study results can assist health education specialists in planning, implementing, and evaluating health education/promotion programs to prevent MetS and related chronic conditions among Hispanics in Texas.

CHAPTER II

REVIEW OF THE LITERATURE

The following databases were used for this literature review: Academic Search Complete, CINAHL Complete, Health Source-Nursing/Academic Edition, Medline, Psychology and Behavioral Sciences Collection, PsycARTICLES, PsycINFO, PubMed, and SocINDEX. Dates searched were January 1, 2002 to present. The 2002 date was selected based on the publication year of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Adult Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III [ATP III]) (NCEP, 2002). This report provided the first definition of MetS by the NCEP and identified individuals with “multiple metabolic risk factors as candidates for intensified therapeutic lifestyle changes” (NCEP, 2002, p. I-3). Search terms included metabolic syndrome, metabolic syndrome X, diabetes, diabetes mellitus, type 2 diabetes, insulin resistance, cardiovascular disease, cardiometabolic, heart disease, overweight, obesity, and central obesity in combination with Hispanic or Latino and acculturation. Inclusion criteria were English language, peer reviewed articles including commentaries, and studies surveying and/or assessing adult participants. Exclusion criteria encompassed articles only focusing on or including samples of children.

This literature review is divided into the following sections: MetS, MetS Prevalence, MetS Link to CVD and Diabetes, Diabetes, Cardiovascular Disease, Overweight/Obesity, Hispanic Health Disparities, U.S. Hispanic Population, Acculturation, Acculturation Measures, and Acculturation and U.S. Hispanics. Figure 1 provides a representation of the literature review progression.

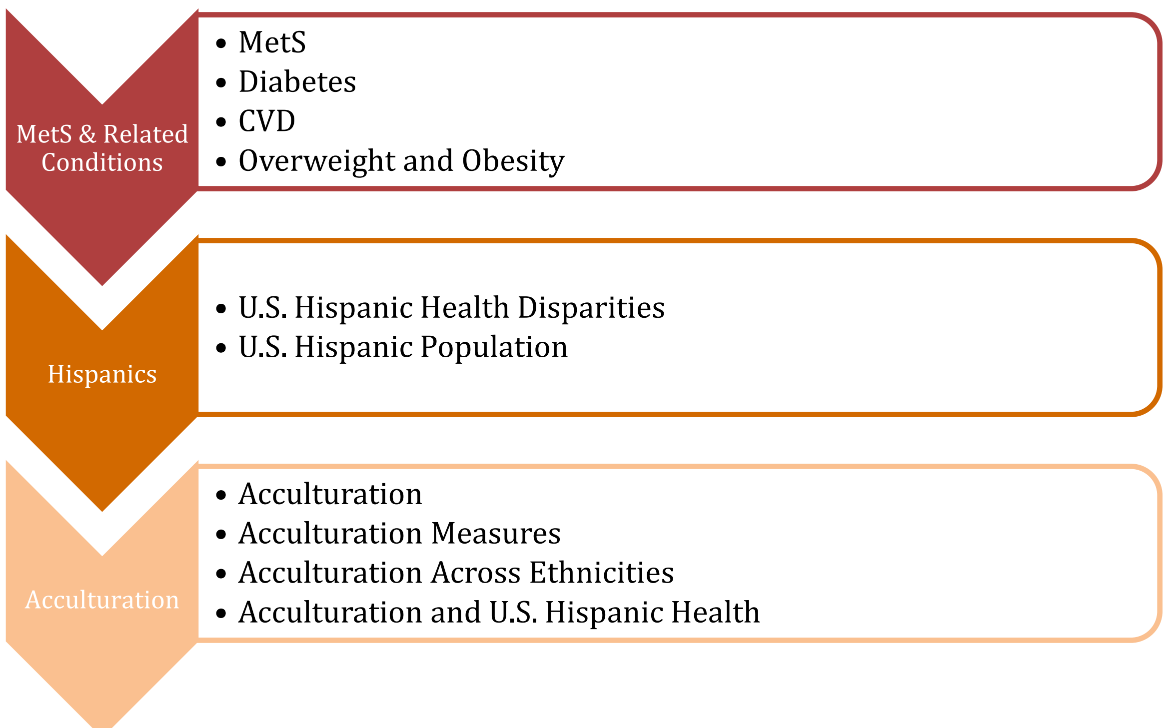

Figure 1. Visual Representation of Literature Review

MetS

MetS is a condition characterized by the manifestation of a cluster of risk factors that are associated with an increased risk for cardiovascular disease and diabetes (Davila et al, 2010; Unwin, 2006). MetS is associated with an increased risk of comorbid conditions such as cancer, arthritis, and gastroesophageal reflux disease (GERD)

(Mohammadi, Jolfaie, Alipour, & Zarrati, 2016; Moore, Chaudhary, & Akinyemiju, 2017). MetS is increasingly prevalent in the United States and around the world having reached pandemic levels (Kelli, Kassas, & Lattouf, 2015; Moore et al., 2017).

History

MetS did not initially originate as an officially diagnosable condition (Kaur, 2014). MetS origins are traced to 1920 when Swedish physician Kylin first identified an association between hypertension, hyperglycemia, and gout (Cornier et al., 2008; Kaur, 2014). Through the following years, researchers identified other key elements of MetS including visceral obesity and its association with CVD and diabetes (Gupta & Gupta, 2010; Kaur, 2014). Reaven (1988) later advanced the field by introducing the concept of insulin resistance. Reaven (1988) also identified a "series of related variables" that are of significant importance in the development of coronary artery disease and labeled it "syndrome X" (p. 1605). "Syndrome X" was later renamed "the deadly quartet" and then later renamed again as "the insulin resistance syndrome" (Gupta & Gupta, 2010). Other names of MetS include plurimetabolic syndrome, the X syndrome, the cardiovascular metabolic syndrome, and the syndrome of atherogenic factors' agglomeration (Milici, 2010). "Syndrome X" was later renamed as "Metabolic Syndrome" (Kassi, Pervanidou, Kaltsas, & Chrousos, 2011). The first group to provide a definition of MetS was a diabetes consultation group of the World Health Organization (WHO) in 1998 (Alberti & Zimmet, 1998). Other groups responded with their own definitions, including the European Group for the Study of Insulin Resistance (EGIR), the AHA/National Heart, Lung, and Blood Institute's (NHLBI) National Cholesterol Education Program Adult Treatment Panel (NCEP/ATP), and the American Association of Clinical Endocrinologists (AACE) (Grundy et al., 2004; Grundy, 2008). Thus, multiple definitions of MetS were created, indicating the need for a unifying definition (Kaur, 2014).

Definition

The differences in criteria outlined in each definition result in varying MetS prevalence estimates as some individuals may or may not be diagnosed with MetS depending on the criteria used. For example, the ATP III definition does not require evidence of insulin resistance for diagnosis; and the presence of diabetes does not exclude a diagnosis of MetS (Grundy et al., 2004). In addition, the main difference between the ATP III and IDF definitions is that waist-circumference cut points for Whites, Blacks, and Hispanics are higher in ATP III than in IDF. WHO requires insulin resistance, has a higher blood pressure criteria established than ATP III, body mass index (BMI) is used instead of waist circumference, microalbuminuria is an additional criterion, and the presence of diabetes does not exclude a diagnosis of MetS. AACE has no defined number of risk factors or criteria, leaving diagnosis open to clinical judgment; and when a person develops diabetes, the diagnosis of MetS is excluded (Grundy, Brewer, Cleeman, Smith, & Lenfant, 2004; Grundy, 2008).

The varying definitions have made it difficult to compare the prevalence of MetS across populations (Falkner & Cossrow, 2014; Moore et al., 2017; O'Neill & O'Driscoll, 2015). The variability within diagnostic criteria also affects the ability of physicians and other health care providers to reach a consensus on best treatment and intervention methods. This is problematic because early diagnosis and intervention is critical to reduce the risks associated with MetS including CVD, diabetes, and cancer (O'Neill & O'Driscoll, 2015).

To address and resolve the discrepancies, in 2009 the IDF and AHA/NHLBI joined the World Heart Federation, International Atherosclerosis Society, and the International Association for the Study of Obesity to develop one unified definition for MetS (Alberti et al., 2009). The joint definition has the same guidelines as the 2005 revised ATP III (refer to Definition of Terms) with the addition of drug treatments for elevated TG, BP, & FBG and for low HDL as alternate indicators. The joint definition also established population- and country-specific cut points for WC (Alberti et al., 2009). The 2005 ATP III revised MetS criteria were used for this study (Eckel et al., 2010; Grundy et al., 2005; Gupta & Gupta, 2010) as the ATP III definition is one of the most widely used criteria of MetS (Handelsman, 2009; Huang, 2009; Kassi et al., 2011).

MetS Prevalence in the United States

Aguilar et al. (2015) used 2003-2012 National Health and Nutrition Examination Survey (NHANES) data and ATP III 2005 criteria to determine the overall prevalence of MetS in the United States. Using ATP III 2005 criteria the overall prevalence of MetS among U.S. adults (aged 20 and older) increased from 32.9% in 2003 to 34.7% in 2012 (Aguilar et al., 2015). However, in using IDF criteria to determine MetS prevalence, the percentage is 39.0% among U.S. adults (O'Neill & O'Driscoll, 2015). MetS prevalence varies based on age, sex, and race/ethnicity. In the United States, 2003-2012 NHANES data indicated that women had significantly higher prevalence of MetS than men (35.6% vs. 30.3%, respectively) (Aguilar et al., 2015). Using NHANES 1999-2006 data, researchers estimated approximately 68 million U.S. adults have MetS (the majority being women, 35.3 million) (O'Neill & O'Driscoll, 2015). Hispanics have the highest prevalence of MetS (35.4%), followed by non-Hispanic Whites (33.4%), and Blacks (32.7%). In addition, MetS prevalence appears to increase with age. For example, among adults aged 20 to 39 years, MetS prevalence has been estimated at 18.3% and 46.7% among those aged 60 years or older (Aguilar et al., 2015).

Risk Factors

Risk factors for MetS include age, race, presence of comorbid diseases (e.g., polycystic ovarian syndrome or nonalcoholic fatty liver disease), and lifestyle behaviors (e.g., poor dietary habits and physical inactivity) (NHLBI, 2015). The heritability of MetS has been estimated to be between 10% - 30% (Phillips, 2013). Obese individuals, overweight individuals, older adults, individuals who smoke, those who are sedentary, and those who have a high intake of alcohol are all more likely to develop MetS than people exhibiting fewer health risk behaviors (Chang, Chen, Chien, & Wu, 2016). Sex may also be a risk factor as in the United States adult women have a higher prevalence of MetS when compared to adult men (aged 20 and older) (Aguilar et al., 2015).

Pathophysiology

MetS is a "state of chronic low-grade inflammation as a consequence of complex interplay between genetic and environmental factors" (Kaur, 2014, p. 3). The pathophysiology of MetS is complex and only partially understood. One theory posits insulin resistance (IR) as the key pathogenic factor (Falkner & Cossrow, 2014). Another theory posits obesity as the potential main cause of MetS (Grundy, 2016).

Insulin resistance. Insulin is a hormone produced by the islet beta-cells of the pancreas (NIDDK, 2018). Insulin plays a major role in metabolism, specifically in the way the body's cells use food for energy. Glucose is broken down from carbohydrates, absorbed into the bloodstream, and enters the body's cells with the help of insulin (NIDDK, 2018). Insulin has three primary roles in regulating blood glucose. Insulin helps muscle, fat, and liver cells absorb glucose; insulin stimulates the liver and muscle tissue to store excess glucose (glycogen); and insulin reduces glucose production by the liver to lower blood glucose levels (NIDDK, 2018). In a person without diabetes or insulin resistance, these functions keep glucose levels within normal ranges (normal fasting blood glucose is defined as less than 100mg/dL) (NIDDK, 2018).

IR is defined as the body's decreased response to insulin leading to impaired cellular action (Weiss et al., 2013). IR is a condition in which a normal insulin concentration does not produce a normal insulin response in the body's target tissues (Kaur, 2014). When the body's muscle, adipose, and liver tissues do not respond normally to insulin and are subsequently not able to absorb glucose from the bloodstream, the body requires higher levels of insulin (hyperinsulinemia) to help the cells absorb glucose. The islet beta-cells produce more insulin to meet the higher demand; however, the islet beta-cells eventually struggle to sustain the body's demand for insulin and hyperglycemia can occur (NIDDK, 2018). Additionally, compensatory hyperinsulinemia may allow for temporary normal blood glucose maintenance; however, other tissues with normal insulin sensitivity may be subject to overexpression of insulin action (Kaur, 2014). The heightened insulin action in some tissues in combination with the resistance to other insulin actions results in the clinical manifestation of MetS (Kaur, 2014). IR is associated with obesity and high levels of visceral fat (Kelli et al., 2015). Insulin-resistant individuals are more likely to have abnormal fat distribution (i.e., predominantly excess upper body fat) even if not necessarily obese (Kaur, 2014).

Obesity. Obesity is known to promote IR (Ye, 2013) and is a key component of MetS; however, it remains unclear whether obesity is a cause or result of MetS (Falkner & Cossrow, 2014). Cellular activity of certain cells such as adipocytes (fat cells) is influenced by the distribution (subcutaneous, visceral, and intermuscular) and quantity of adipose tissue present (Gallagher et al., 2009; Heymsfield & Wadden, 2017). Subcutaneous fat is located just beneath the skin, and visceral fat surrounds the organs of the abdominal region (Harvard Women's Health Watch, 2010). Intermuscular fat is located between skeletal muscles (Hausman, Basu, Du, Fernyhough-Culver, & Dodson, 2014). Research indicates that adipose tissue distribution differs between individuals with type 2 diabetes and those without type 2 diabetes. Individuals with diabetes have higher amounts of visceral and intermuscular fat, which are connected to IR (Gallagher et al., 2009; Hausman et al., 2014). One way in which obesity promotes IR is due to the increase in proinflammatory adipokines caused by secretions from macrophages and other immune cells (Heymsfield & Wadden, 2017). Additionally, the levels of free fatty acids (produced by breaking down triglycerides) are high in obese individuals, further contributing to insulin resistance (Heymsfield & Wadden, 2017).

MetS is becoming more prevalent in step with increasing BMI (O'Neill & O'Driscoll, 2015). The increasing global obesity epidemic raises concerns about increasing rates of MetS around the world (Falkner & Cossrow, 2014). A study by Ervin (2009) revealed that overweight males across ethnic groups (aged 20 years and older) were approximately six times more likely than normal-weight males to meet MetS criteria, and obese adult males were approximately 32 times more likely than normal-weight males to meet the criteria for MetS. Additionally, overweight and obese females (aged 20 years and older) across ethnic groups were more likely than normal-weight females to meet the criteria for MetS (five times and 17 times more likely, respectively) (Ervin, 2009). The observed prevalence of MetS in the third NHANES survey was 5% among individuals of normal weight, 22% among the overweight, and 60% among the obese (Park et al., 2003). In assessing MetS, obesity is more commonly identified by measuring WC rather than BMI (Kaur, 2014; O'Neill & O'Driscoll, 2015). IR is strongly linked with excess visceral (abdominal) adiposity (Heymsfield & Wadden, 2017). An individual's WC provides a measure of visceral adiposity, which has a stronger association with the development of diabetes and CVD than BMI (Gallagher et al., 2009; Gupta & Gupta, 2010). Furthermore, each 11-centimeter increase in WC is associated with an adjusted 80% increased risk of developing MetS within five years (Palaniappan et al., 2004).

Although the precise metabolic pathways by which MetS occurs have not been fully determined, the general consensus among researchers is that MetS is a "lifestyle syndrome" (Kelli et al., 2015, p. 2). A poor diet (including excessive nutrient intake and excessive consumption of calorie-rich/nutrient-poor foods) and physical inactivity increase a person's risk of developing MetS (Goldberg & Mather, 2012; Grundy, 2008; Grundy, 2016; Gupta & Gupta, 2010; Unger & Scherer, 2010; Weiss et al., 2013). Genetic predisposition in combination with key lifestyle factors (i.e. nutrition and physical activity) may interact and lead to the development of lifestyle diseases such as MetS (Phillips, 2013). The Western dietary pattern is of particular concern to health researchers and health education practitioners (Kershaw, Albrecht, & Carnethon, 2013). According to Kaur (2014), "the 'obesity epidemic' is principally driven by an increased consumption of cheap, calorie-dense food and reduced physical activity" (p. 3). Similarly, Weiss, Bremer, and Lustig (2013) proposed "that an overhaul of the typical Western diet will be required to beat [MetS] once and for all" (p. 135).

Western Dietary Pattern

Human diets markedly changed after the advent of agriculture and farming thousands of years ago (Cordain et al., 2005). Following the industrial revolution, the quality and quantity of foods in the human diet changed substantially. According to Cordain et al. (2005), some scientists posit that the marked changes in diet (as well as other environmental conditions) have occurred too recently and too quickly on an evolutionary time scale to allow the human genome to adapt, thereby leading to "evolutionary discordance" between contemporary human biology and nutritional culture as well as activity patterns. This discordance is thought to be the underlying cause of many of the lifestyle diseases commonly observed in modern times (Cordain et al., 2005).

Agriculture, industrialization, and modern technology have considerably changed the quantity and quality of the foods available for human consumption and therefore have changed the dietary patterns of many populations. Cordain et al. (2005) described this process as follows:

> The novel foods (dairy products, cereals, refined cereals, refined sugars, refined vegetable oils, fatty meats, salt, and combinations of these foods) introduced as staples during the Neolithic and Industrial Eras fundamentally altered several key nutritional characteristics of ancestral hominin diets and ultimately had far-reaching effects on health and well-being. As these foods gradually displaced the minimally processed wild plant and animal foods in hunter-gatherer diets, they adversely affected the following dietary indicators: 1) glycemic load, 2) fatty acid composition, 3) macronutrient composition, 4) micronutrient density, 5) acid-base balance, 6) sodium-potassium ratio, and 7) fiber content (p. 346).

In today's American society, foods commonly consumed prior to the advent of agriculture are consumed in smaller quantities while foods that could not have been consumed pre-agriculture and pre-industrialization are now consumed in large quantities (Cordain et al., 2005). For example, dairy products, cereals, refined sugars, refined vegetable oils, and alcohol compose an estimated 72% of the total daily energy consumed by Americans; however, these foods would have comprised a small portion (or not at all) of the pre-agricultural diet (Cordain et al., 2005). Similarly, processed foods such as cookies, cakes, bakery foods, breakfast cereals, bagels, rolls, muffins, crackers, chips, snack foods, pizza, soft drinks, candy, ice cream, condiments, and salad dressings are prolific in the American diet; but these foods were not available pre-agriculture and pre-industrialization (Cordain et al., 2005). The changes in dietary indicators are reflected in the Western dietary pattern.

The Western dietary pattern is also characterized by a high intake of animal fats and animal products, eggs, meat, milk, offals, stimulants, refined grains, sugar and sweeteners, including sugary beverages and desserts, fast food, snack foods, alcoholic beverages, and total calories (Danaei et al., 2013; Rodríguez-Monforte et al., 2016). Conversely, the healthy or prudent dietary pattern is characterized by higher intake of fruits, vegetables, whole grains, fish and seafood, legumes, poultry, olive oil, nuts, seeds and non- or low-fat dairy (Rodríguez-Monforte et al., 2016). The specific foods commonly consumed vary by culture and geographic region; however, the fruit and vegetable groups are the most consistent foods found in the healthy dietary pattern

(Rodríguez-Monforte et al., 2016). Alcohol is generally grouped with unhealthy foods; however, some studies indicate that moderate alcohol intake is not associated with an increased risk of developing MetS; and in certain populations, moderate alcohol intake may even reduce the risk of MetS (Rodríguez-Monforte et al., 2016).

Research examining the relationship between dietary patterns, types of foods, and health outcomes provide useful information for identifying risk factors and protective factors related to chronic conditions such as diabetes and CVD (Cordain et al., 2005). Studies regarding the effects of dietary interventions with dietary patterns similar to those found in pre-industrial and pre-agricultural diets (i.e., non-processed or less processed foods) have demonstrated positive health outcomes (Cordain et al., 2005). Evidence indicates that fruit and vegetables are protective against the development of metabolic disease with no official maximum recommended daily servings (Rodríguez-Monforte et al., 2016). One study found that dairy intake might be protective against the development of MetS (Lutsey, Steffen, & Stevens, 2008). Conversely, intake of refined grains, sweets, sodas, and fast food are associated with an increased risk of developing MetS (Rodríguez-Monforte et al., 2016). A prospective cohort study of over 9,000 American adults found that a Western diet was associated with an increased risk of developing MetS with 18% higher risk among individuals with the highest Western dietary pattern scores compared to individuals with the lowest Western dietary pattern scores (Lutsey et al., 2008). Meat, fried food, and diet soda intake were also associated with an increased risk of developing MetS among individuals with the highest intake of the food type when compared to individuals with the lowest intake of the food type (26%, 25%, & 34% increased risk, respectively) (Lutsey et al., 2008). Studies such as these are not limited to adults in a specific demographic group. Among Lebanese adolescents, the Western dietary pattern was associated with increased risk of overweight (Naja et al., 2015). Additionally, in a study of approximately 1,000 adolescents, a healthy dietary pattern was protective against non-alcoholic fatty liver disease (NAFLD) in adolescents with central obesity. On the other hand, a Western dietary pattern was associated with an increased risk of NAFLD, particularly in obese adolescents (Liccardo, Alisi, Porta, & Nobili, 2014).

Studies of the Pima Indians illustrate the impact of environment on the development of metabolic disorders as Pima Indians in Mexico have a significantly lower prevalence of metabolic disease in comparison to the Pima Indians in the United States (Phillips, 2013). Initial research with Pima Indians in the United States and Mexico determined that Mexican Pima Indians had less than one-fifth prevalence of diabetes than American Pima Indians (6.9% vs. 38%) (Schulz & Chaudhari, 2015). Environmental factors such as the "modern Westernized environment of physical inactivity and excessive caloric consumption" may be largely responsible for the higher rates of metabolic disease in American Pima Indians (Phillips, 2013, p. 39). For example, physical activity levels were more than two and a half times higher among male Mexican Pima Indians and seven times greater among female Mexican Pima Indians in comparison to their American Pima counterparts (Schulz & Chaudhari, 2015). Research including Pima Indian samples has provided important insights into the roles genetics and environment play in health outcomes as the two populations are genetically related but live in different environments (Schulz & Chaudhari, 2015). This research provides strong evidence of the impact of environment on health outcomes and how maintaining a traditional lifestyle may be protective against chronic conditions such as diabetes and obesity (Schulz & Chaudhari, 2015).

With the implementation of NAFTA between Canada, Mexico, and the United States in 1994, the food environment in Mexico drastically changed (Clark, Hawkes, Murphy, Hansen-Kuhn, & Wallinga, 2012). Following the trade agreement, the flow of certain key food products from the United States to Mexico increased. Flow analyses of these key products determined that corn, soybeans, sugar, snack foods, and meat products are increasingly exported by the United States (Clark et al., 2012). Foreign direct investments from the United States on the Mexican agri-food industry also impacted the food supply chain from production and processing to distribution and retail (Clark et al., 2012). This led to the Mexican food system more closely resembling that of the United States. As a result, Mexicans are consuming traditional food staples less often and increasingly consuming more nutrient-poor, high calorie, processed foods (i.e., the Western diet) (Clark et al., 2012). These dietary behaviors contribute to Mexico having the second highest adult obesity prevalence among the Organisation for Economic Co-operation and Development (OECD) countries (32.4%) (OECD, 2017). The OECD is an international organization of (currently 36) countries with democratic governments and market economies that seeks "to promote economic growth, prosperity, and sustainable development" (United States Mission to the OECD, n.d., para. 1). Thus, there is evidence indicating that NAFTA has contributed to specific changes in the Mexican dietary pattern that are associated with overweight/obesity (Clark et al., 2012).

In summary, environmental transformations produced by significant developments such as industrialization and globalization have led to changes in dietary patterns (Clark et al., 2012; Cordain et al., 2005). The Western dietary pattern is associated with an increased risk for the development of MetS in addition to other health problems such as diabetes and heart disease (Lutsey et al., 2008; Naja et al., 2015; Rodríguez-Monforte et al., 2016). In contrast, the prudent or healthy dietary pattern can protect against the development of chronic conditions including MetS and CVD (Liccardo et al., 2014; Rodríguez-Monforte et al., 2016).

Prevention and Treatment

MetS may be prevented or treated by lifestyle changes that include engaging in regular physical activity, improving dietary habits such as avoiding overnutrition and improving the quality of foods, and achieving and maintaining a healthy body weight (Falkner & Cossrow, 2014; Grundy, 2012; Grundy, 2016; Gupta & Gupta, 2010; Huang, 2009; Rochlani, Pothineni, Kovelamudi, & Mehta, 2017). A review including eight randomized clinical trials found improvements in MetS risk factors within one year through dietary and other lifestyle changes (Bassi et al., 2014).

Diet. The first line of treatment for MetS is lifestyle modification such as changes in diet and increase in physical activity with an emphasis on moderate weight loss (Goldberg & Mather, 2012; Grundy et al., 2004). Macronutrient proportions should also be considered for recommended dietary changes as too much carbohydrate and saturated fat in the diet can worsen MetS risk (Grundy, 2016; Kaur, 2014). The DASH diet (dietary approaches to stopping hypertension) focuses on the consumption of vegetables, fruits, whole grains, fat-free or low-fat dairy products, and lean proteins. In addition, DASH calls for limiting foods that are high in saturated fat and limiting sugar-sweetened beverages and sweets. The DASH diet also promotes foods that are low in saturated and trans fats; rich in potassium, calcium, magnesium, fiber, and protein; and lower in sodium (NHLBI, n.d.-a). In terms of prevention and treatment, the DASH diet is associated with a decreased risk of developing MetS (Drehmer et al., 2017; Ghorabi et al., 2019; Saneei et al., 2015). DASH-like diets that are high in protein and unsaturated fats may be most effective in improving MetS risk (Root & Dawson, 2013).

The Mediterranean diet is another diet that has been shown to be effective in preventing and treating MetS (Babio, Bulló, & Salas-Salvadó, 2009; Di Daniele et al., 2017; Godos et al., 2017). This diet is characterized by balanced intake of fruits, vegetables, fish, legumes, cereals, and unsaturated fats (nuts and olive oil), with a low intake of meat and dairy products and moderate intake of alcohol (Babio et al., 2009; Di Daniele et al., 2017). A meta-analysis consisting of eight cross-sectional and four prospective studies with a total of 33,847 individuals found a significant and consistent inverse association between the Mediterranean diet and MetS (RR = 0.81) (Godos et al., 2017). The Mediterranean dietary pattern was also inversely associated with some of the individual factors of MetS including WC, BP, and HDL (Godos et al., 2017). One large randomized trial indicated that the Mediterranean diet might also help to ameliorate the MetS factors in individuals who have already developed MetS (Godos et al., 2017). The Mediterranean dietary pattern may be utilized for primary intervention as well as part of treatment once MetS has been developed (Babio et al., 2009; Di Daniele et al., 2017; Godos et al., 2017).

Another example of the effectiveness of lifestyle intervention in reducing MetS and diabetes risk is the Diabetes Prevention Program (DPP). This program involved the examination of the effects of lifestyle intervention (dietary changes and increased physical activity) and medication therapy (metformin) among more than 3,200 individuals in 27 clinical centers across the United States who were at high risk of developing diabetes (NIDDK, n.d.). The lifestyle changes included eating less fat and fewer calories, engaging in 150 minutes of physical activity per week, and losing 7% of body weight (NIDDK, n.d.). In less than three years, those who participated in the DPP reduced their risk for diabetes by 58% in the lifestyle intervention group and 31% in the metformin group (vs. the placebo group) (NIDDK, n.d.). Additionally, the DPP lifestyle intervention group had a significantly reduced MetS prevalence in individuals at high risk for diabetes. In comparison, metformin did not reduce the risk of MetS (Goldberg & Mather, 2012). These results provide a strong argument for the importance of lifestyle interventions to address MetS and temper the diabetes epidemic (Goldberg & Mather, 2012).

Physical activity. Physical activity positively impacts MetS in multiple ways including improving insulin sensitivity (i.e., reduce insulin resistance), increasing daily calorie expenditure thereby positively affecting calorie balance, and improving cardiovascular fitness, which independently reduces the risk for CVD (Grundy, 2016; Kaur, 2014; Kelli et al., 2015). A combination of resistance training and aerobic training is recommended for managing obesity and MetS (Strasser, 2013). A study of 1,069 men in Finland found that those engaging in at least three hours of physical activity per week had a 60% lower risk of developing MetS (Kelli et al., 2015). A meta-analysis of 17 studies including over 64,000 participants found that a high level of physical activity (or leisure-time physical activity) was associated with a decreased risk of MetS (RR = 0.80). A moderate level of physical activity was also associated with a decreased risk of MetS although that association was weak (RR = 0.95) (He et al., 2013). As noted previously, the DPP lifestyle intervention included engaging in 150 minutes of physical activity per week, and this lifestyle change in combination with healthy dietary changes and modest weight loss resulted in significant improvements in MetS risk (NIDDK, n.d.).

Long-term lifestyle changes. A critical health promotion challenge is helping individuals maintain impactful lifestyle changes to effectively reduce MetS risk factors (Grundy, 2016; Kaur, 2014). Long-term adherence to healthy lifestyle changes requires behavioral modifications that call for social and environmental changes such as increasing the availability and accessibility of healthy foods, increasing the attractiveness of the physical activity environment, and providing opportunities for physically active group activities to support the individuals' efforts (Grundy, 2016; Kremers, Eves, & Andersen, 2012). The systematic review of lifestyle interventions for MetS by Bassi et al. (2014) revealed that adherence to lifestyle change can be bolstered with frequent encounters with the health care system and use of technology such as mobile phones and the internet to enhance patient-provider communication (while not replacing personal contact). A multidisciplinary approach including physicians and allied health professionals such as dietitians, exercise physiologists, & health educators can assist patients in making lifestyle modifications (Kaur, 2014).

Health coaching is another effective strategy for helping patients make lifestyle changes to improve their nutrition, physical activity level, and achieve healthy weight loss (Heymsfield & Wadden, 2017; Olsen & Nesbitt, 2010; Oliveira, Sherrington, Amorim, Dario, & Tiedemann, 2017; Sherman & Ganguli, 2017), thereby reducing MetS risk factors. Health coaches play a valuable role in assisting individuals with behavior change by increasing knowledge, eliciting motivation for change, helping with goal setting and developing action plans, and providing ongoing support and accountability (Gordon et al., 2016). Health coaching has been effective in helping patients better control their cholesterol and blood glucose (hemoglobin A1c), lose weight, decrease waist circumference, and reduce the prevalence of MetS factors (Jo, Jung, & Lee, 2012;

Luley et al., 2014; Pludwinski, Ahmad, Wayne, & Ritvo, 2016; Willard-Grace et al., 2015).

Criticisms of MetS

The purpose of identifying MetS is to identify individuals at high risk for developing CVD and diabetes (Cornier et al., 2008). The validity and clinical utility of MetS diagnosis is still being debated (Arguelles, 2012). One criticism of MetS is whether MetS can predict CVD and diabetes beyond the predictive power of well-known risk factors such as low-density lipoprotein and tobacco use for CVD and fasting glucose concentration for diabetes (Cornier et al., 2008). Some researchers contend that although individuals with isolated hypertension, isolated hyperlipidemia, or isolated obesity are at risk for CVD and diabetes, their risk is less than among those with MetS (Huang, 2009).

Another criticism of MetS is the definition consisting of divergent criteria. The divergent criteria have made it challenging to accurately determine the prevalence of MetS globally and in the United States (O'Neill & O'Driscoll, 2015). Some scientific groups have expressed concern about the lack of clarity in the MetS definition and feel that it must be better defined (Cornier et al., 2008). Certain definitions place greater emphasis on WC (i.e., central obesity), while others focus on insulin resistance (Kassi et al., 2011). One of the difficulties in defining MetS is identifying criteria for MetS (specifically waist or obesity measures) that are applicable across different ethnic populations (Cornier et al., 2008). For example, the risk of developing diabetes is present at lower levels of obesity among Asians compared to Europeans (Kassi et al., 2011).

Further, different criteria are set for men and women, indicating sex-based differences in the risk associated with some MetS factors. Although Kahn, Buse, Ferrannini, and Stern, (2005) argued that there is insufficient evidence warranting the use of these differing cut-points based on sex, more current research points to sex-specific differences in MetS and CVD risk (Beigh & Jain, 2012; Pradhan, 2014; Pucci et al., 2017; Santilli, D'Ardes, Guagnano, & Davi, 2017). One challenge to having a greater understanding of the sex-specific pathophysiological differences in the prevalence of MetS may be due to underrepresentation of women in clinical trials (Santilli et al., 2017).

Additionally, there is the challenge posed by the causal mechanisms of MetS not yet identified (Cornier et al., 2008). Additional research is needed to gather more evidence to determine the cause of MetS and its impact on CVD and diabetes prevalence (Cornier et al., 2008). IR has been identified as a possible underlying cause of MetS; however, multiple studies have found that not all individuals with MetS are insulin resistant (Arguelles, 2012). Obesity is another possible cause as obesity is strongly associated with all of the components of MetS; however, some studies have found that caloric restriction, even in the presence of ongoing obesity, reverses most MetS risk factors (Grundy, 2016). One study among Taiwanese adults found that obese individuals who engaged in regular physical activity and had an adequate intake of fruit were less likely to have MetS. Overweight individuals who were nonsmokers and had adequate vegetable intake were also less likely to have MetS (Chang et al., 2016). This indicates that excess adiposity is not the primary cause of MetS. Although evidence indicates IR and obesity are not the primary causes of MetS, they both play significant roles in the presence (and possibly development) of MetS (Arguelles, 2012; Grundy, 2016).

Despite its flaws, the diagnosis of MetS provides early identification of risk for developing CVD and diabetes (Cornier et al., 2008). In the opinion of Kassi et al. (2011), the consensus definition incorporating the IDF and AHA/NHLBI definitions is considered the most suitable for use in clinical practice. The NCEP ATP III definition can be easily applied in a clinical setting (Handelsman, 2009; Huang, 2009). This serves as an opportunity for early intervention to prevent or delay the development of CVD and diabetes (Handelsman, 2009). Furthermore, promotion of lifestyle changes among individuals who present with the cluster of risk factors can help reduce their risk for developing CVD and diabetes in the future (Cornier et al., 2008; Grundy, 2016; Handelsman, 2009; Phillips, 2013).

MetS Link to Diabetes & CVD

MetS predicts diabetes independently of other factors (Lorenzo, Okoloise, Williams, Stern, & Haffner, 2003) and raises the risk for diabetes by about 5-fold (Grundy, 2008). The Framingham Study determined that “almost half of the population-attributable risk for diabetes could be explained by the presence of [MetS]” (Grundy et al., 2004, p. 437). MetS is also linked to an increased risk of CVD. The occurrence of these metabolic abnormalities “occur simultaneously more frequently than would be expected by chance and the concurrence of several factors increases cardiovascular risk over and above the risk associated with the individual factors alone” (Kaur, 2014, p. 3).

In a meta-analysis including 87 studies and more than 950,000 individuals, MetS carried twice the risk for CVD (including CVD death, myocardial infarction, and stroke) and 1.5 times increased risk of all-cause mortality (Mottillo et al., 2010). MetS also doubles the risk for stroke (Grundy, 2016). Additionally, the level of risk of CVD and diabetes increases with the number of MetS factors present, indicating an additive effect of each MetS factor (Kaur, 2014; O'Neill & O'Driscoll, 2015).

Diabetes

Diabetes is a group of diseases in which there is a problem with insulin production and/or the body's ability to use it, leading to hyperglycemia (CDC, 2017b). There are three main types of diabetes: type 1, type 2, and gestational. Type 2 accounts for more than 90% of the cases (CDC, 2017b), develops over many years, and is usually adult onset. With type 2, the body does not use insulin properly (i.e., insulin resistance). This differs from type 1 that is caused by an autoimmune response in which the insulin producing cells of the body (islet beta-cells) no longer produce insulin. Type 1 is most commonly diagnosed in children, adolescents, and young adults (CDC, 2017b). Gestational diabetes can occur in women who have never had diabetes. Gestational diabetes typically resolves after the baby is born; however, the woman's risk for developing type 2 diabetes in the future increases (CDC, 2017b). Additionally, the child's risk for MetS and other chronic conditions such as diabetes and obesity also increases from fetal exposure to gestational diabetes (Burguet, 2010; Durnwald & Landon, 2013; Moore, 2010). Nevertheless, it is difficult to differentiate between the role of maternal weight and the effects of exposure to gestational diabetes in the risk of MetS among children (Burguet, 2010).

The precise mechanisms behind the hyperglycemia of type 2 diabetes are not well understood; nevertheless, dietary habits, sedentary lifestyle, abdominal obesity, as well as genetics all play a role in the development of the disease (CDC, 2017b; Hussain, Claussen, Ramachandran, & Williams, 2007). Fifty percent of type 2 diabetes risk is estimated to be genetic (Phillips, 2013). Unlike type 1 diabetes, type 2 diabetes has no clear distinction between normality and abnormality; and there continues to be a debate as to how to clearly distinguish between normal and abnormal metabolic function (Forouhi & Wareham, 2010). IR and beta-cell dysfunction are fundamental defects known to precede the onset of type 2 diabetes by many years (Forouhi & Wareham, 2010; Hussain et al., 2007). Beta-cell dysfunction (impaired insulin secretion) may start about 10-12 years prior to the presentation of type 2 diabetes, which provides an opportunity to prevent type 2 diabetes (Cerf, 2013; Hussain et al., 2007; Saisho, 2015). Studies examining the relationship between fat distribution and type 2 diabetes indicate that visceral fat may also play a significant role in the development of type 2 diabetes (Gallagher et al., 2009). Hyperglycemia is typically not one of the first indicators of MetS but develops as a later result of metabolic dysfunction. The presence of MetS can potentially serve as an earlier indicator of risk for diabetes than pre-diabetes (i.e., elevated blood glucose) (Grundy, 2016).

Diabetes Complications

The effects of diabetes can negatively affect many systems of the body. Diabetes complications are divided into two categories: microvascular and macrovascular complications (WHO, n.d.-a). Microvascular disease is a primary clinical outcome of hyperglycemia. Microvascular complications are due to damage to small blood vessels that lead to retinopathy (damage to the eyes), neuropathy (damage to the nerves), and nephropathy (damage to the kidneys). At the most severe levels, retinopathy may lead to blindness, nephropathy may lead to renal failure, and neuropathy can lead to limb amputation (Fowler, 2008; Grundy, 2016; WHO, n.d.-a). Microvascular disease may also contribute to the development of congestive heart failure and atherogenesis (Grundy, 2016).

Diabetic eye disease is caused by too high blood glucose levels that damage the blood vessels in the eye. The damaged vessels can bleed into the eye, lead to scarring, and also cause high pressure inside the eye (NIDDK, 2016). Approximately one in three people with diabetes who are older than age 40 have signs of diabetic retinopathy (NIDDK, 2016). In the United States, the 2010 prevalence of diabetic retinopathy was estimated at 5.4% (National Eye Institute [NEI], 2015). African Americans, American Indians and Alaska Natives, Hispanics/Latinos, Pacific Islanders in the United States are at greater risk of experiencing vision loss or going blind from diabetes (NEI, 2015; NIDDK, 2016).

Diabetes is the leading cause of nephropathy (also called kidney disease). High blood pressure also increases the risk of developing kidney disease, and diabetes is a risk factor for high blood pressure (NIDDK, 2016). Kidney failure indicates kidney damage advanced to the point where only 15% of the kidney is functioning (NIDDK, 2016). End-stage renal (kidney) disease (ESRD) refers to kidney failure treated by dialysis or kidney transplant (NIDDK, 2016). Some studies indicate that 80% of cases of ESRD are caused by diabetes, high blood pressure, or a combination of both (WHO, 2016). Diabetes alone may be responsible for 12-55% of ESRD cases. People with diabetes have a 10-fold greater risk of developing ESRD in comparison to those without diabetes (WHO, 2016). Among U.S. adults aged 20 years and older with diagnosed diabetes, the prevalence of chronic kidney disease was 36.5% during 2011-2012 (CDC, 2017d). In 2014, approximately 52,000 people in the United States developed ESRD with diabetes as the main cause (CDC, 2017d). Individuals of certain ethnic groups are at greater risk of developing nephropathy: African Americans, American Indians, and Hispanics/Latinos all develop kidney disease and kidney failure at higher rates when compared to Caucasians (NIDDK, 2016).

Diabetic neuropathy affects nerves throughout the body. The symptoms of nerve damage will manifest differently according to the nerves affected. Some common symptoms are numbness, tingling or pain in the hands, feet, toes, and fingers; indigestion, nausea, and vomiting; as well as weakness and dizziness (NIDDK, 2016). Diabetic neuropathies affect approximately 60 to 70% of people with diabetes (NIDDK, 2016).

The risk for developing neuropathy increases with age and with longer duration of diabetes. The highest rates of neuropathy are among individuals who have had diabetes for 25 years or longer (NIDDK, 2016). Lower limb amputation rates are 10 to 20 times higher among people with diabetes (WHO, 2016). More than 60% of all non-traumatic lower-limb amputations in the United States occur in persons with diabetes. In 2014, 108,000 hospital discharges in the United States were due to lower-extremity amputations related to diabetes (CDC, 2017d).

Macrovascular complications include events such as heart attacks, strokes, and venous insufficiency (Fowler, 2008; WHO, n.d.-a). CVD risk factors such as high blood pressure, central obesity, low HDL cholesterol, and high triglycerides increase along with hyperglycemia. Diabetics are also more likely to have more severe coronary artery disease caused by reduced coronary artery diameter & longer arterial damage (Chaturverdi, 2007). Adults with diabetes are two to three times more likely to have CVD than adults without diabetes (WHO, 2016). In the United States in 2014, 1.5 million hospital discharges were due to major CVD. This includes 400,000 for ischemic heart disease and 251,000 for stroke (CDC, 2017d). Adults with diabetes are also two to four times more likely to die from heart disease than adults without diabetes (AHA, 2018). About 68% of individuals with diabetes aged 65 and older die due to heart disease, while 16% are killed by stroke (AHA, 2018). Almost 80,000 death certificates in 2015 indicated diabetes as the underlying cause of death (CDC, 2017d).

Enhanced diabetes care and self-management education have led to an improvement in the prevalence of microvascular complications but has not led to a substantial improvement in the prevalence of macrovascular complications (Chaturverdi, 2007). There has been a decrease in the heart disease mortality in diabetic men, but that improvement is significantly lower than the decrease in heart-disease-related mortality among nondiabetic men (36% vs 13%) (Chaturverdi, 2007). In diabetic women, there has been an increase in heart disease mortality of 23%, while there has been a decrease in heart disease mortality in non-diabetic women (Chaturverdi, 2007). The best way to prevent diabetes complications is to keep blood glucose levels well controlled, close to the normal range (NIDDK, 2016).

Diabetes Prevalence in the United States

In the US, diabetes affects approximately 30.3 million people (9.4% of the population) and is the seventh leading cause of death (CDC, 2017d). About 7.2 million (23.8%) of these individuals may not know they have diabetes (CDC, 2017d). The risk of having diabetes increases with age: the highest prevalence is among adults aged 65 years and older at 25.2%. Prevalence varies among ethnic groups in the United States with American Indians/Alaska Natives having the highest prevalence at 15.1%, non-Hispanic Blacks following at 12.7%, Hispanics next highest at 12.1%, Asians 8.0%, and the lowest prevalence found among non-Hispanic Whites at 7.4% (CDC, 2017d). Education level seems to also be related to diabetes prevalence as the highest rates of diagnosed diabetes are found among adults with less than a high school education

(12.6%) and the lowest rates among people with higher level education (7.2% among those with more than a high school education) (CDC, 2017d).

Economic Impact in the United States

Diabetes places a significant financial burden on society, and costs continue to escalate with the high prevalence of the disease. The economic impact can be measured directly by medical costs and indirectly by assessing productivity loss and premature mortality (American Diabetes Association [ADA], 2018).

In 1980, the cost of diabetes in the United States was estimated between $14 and $20 billion through both direct and indirect costs (Chukwueke & Cordero-MacIntyre, 2010). The costs increased dramatically over the following 30 years; the direct ($116 billion) and indirect costs ($58 billion) associated with diabetes totaled an estimated $174 billion in 2007 (CDC, 2011). Costs continue to increase. The total direct and indirect costs of diagnosed diabetes in the United States were estimated at $327 billion in 2017 ($237 direct medical costs and $90 billion indirect costs) (ADA, 2018). Medical costs are significantly higher among individuals with diabetes (2.3 times higher versus people without diabetes). An average of $13,700 is spent each year on medical expenditures for people with diagnosed diabetes, and almost $8,000 of these costs is attributed to diabetes (CDC, 2017d).

Diabetes Diagnosis

Diabetes is usually diagnosed based on plasma glucose criteria: fasting plasma glucose (FPG) ≥126 mg/dL (7.0 mmol/L), 2-hour plasma glucose value after a 75-g oral glucose tolerance test ≥200 mg/dL (11.1 mmol/L), and a random plasma glucose ≥200 mg/dL (11.1 mmol/L) (ADA, 2014). The ADA has also more recently adopted a hemoglobin A1c cut point of 6.5% for diagnosis (ADA, 2014; Forouhi, & Wareham, 2010).

Hemoglobin A1c. Hemoglobin A1c the primary test used for diabetes management and research (NIDDK, 2014). Hemoglobin A1c is also referred to as just A1c, HbA1c, or glycohemoglobin test. Hemoglobin is the protein in red blood cells that carries oxygen. The A1c test is based on the attachment of glucose to hemoglobin (forms glycated hemoglobin) (NIDDK, 2014). Red blood cells have a lifespan of about three months; therefore, the A1c test is a reflection of the mean daily BG concentration over the past three months (NIDDK, 2014). As BG levels rise, the increase in glycated hemoglobin is in proportion to BG concentration. As the average BG concentration increases, glycated hemoglobin (A1c) increases predictably. The higher the percentage in the A1c result, the higher a person's BG levels have been in the previous months (NIDDK, 2014).

Prediabetes. Individuals with glucose levels that do not meet the criteria for diabetes, but are too high to be considered normal, are identified as having prediabetes (ADA, 2014). An FPG of 100-125 mg/dL (5.6-6.9 mmol/L) is defined as impaired FG, a result between 140-199 mg/dL (7.8-11.0 mmol/L) after an oral glucose tolerance test is defined as impaired glucose tolerance (ADA, 2014). An A1c value between 5.7% and 6.4% is also defined as prediabetes (ADA, 2014).

Diabetes Treatment

The Texas Diabetes Council and the American Association of Clinical Endocrinologists recommend the following at diagnosis of diabetes: diabetes education, self-monitoring of BG, medical nutrition therapy, weight control, exercise, and pharmaceutical monotherapy (or combination therapy, depending on A1c) (Levesque, 2011). The ADA and the European Association for the Study of Diabetes also recommend lifestyle intervention in addition to monotherapy (typically Metformin) at diagnosis (Levesque, 2011). The recommendations may vary slightly depending on the BG control targets and when to apply dual, triple and/or insulin therapy (Levesque, 2011). Diabetes often has no symptoms; but with early screening, the risk of developing diabetes can be identified. Diabetes can be prevented or delayed with lifestyle changes such as losing excess weight, following a healthy diet, engaging in regular physical activity, and avoiding tobacco use (CDC, 2017b, WHO, 2017b). Moderate weight loss of 7% of body weight and increasing physical activity to at least 150 minutes per week of moderate-intensity activity are recommended for the prevention or delay of diabetes (ADA, 2014). Research indicates that a modest reduction in weight and 30 minutes of walking each day decreases the incidence of diabetes by more than 50% (WHO, n.d.-a).

Traditional therapy includes oral hypoglycemic agents, although most of these do not control BG indefinitely and insulin therapy is eventually needed (Jain & Saraf, 2010). Studies have shown that aggressive lifestyle intervention, early intensive pharmacotherapy as well as bariatric surgery can restore normal BG levels (Smushkin & Vella, 2010). Appropriate BG control is key to preventing diabetes complications.

Cardiovascular Disease

CVD is a group of diseases of the heart and blood vessels. CVD consists of several different types of diseases such as CHD (disease of the vessels of the heart), cerebrovascular disease (disease of the vessels of the brain), peripheral arterial disease (disease of the vessels of the arms and legs), and congenital heart disease (abnormalities of the heart present at birth) (WHO, 2017a). Many of these diseases are caused by atherosclerosis, a condition in which plaque builds up in the walls of the arteries leading to narrow arteries and potentially blocked arteries if a clot forms (AHA, 2017). CHD and stroke are the most prevalent of CVD (CDC, 2017c; WHO, 2017a). Myocardial infarction (MI), or heart attack, occurs when a clot blocks blood flow to the heart. An ischemic stroke, the most common type of stroke, is caused by a blockage in blood vessels that supply the brain. A hemorrhagic stroke is caused by a burst blood vessel, typically due to poorly controlled high blood pressure (AHA, 2017).

Cardiovascular Disease Prevalence in the United States

CVD is the leading cause of death in the United States (Heidenreich et al., 2011). Based on 2011 mortality data the death rate attributable to CVD was 229.6 per 100,000 (Mozaffarian et al., 2015). Heart disease causes approximately 610,000 deaths in the United States each year (CDC, 2017c). CHD, the most common type of heart disease, is responsible for more than 370,000 deaths each year (CDC, 2017c). About 735,000 people in the United States experience a heart attack each year, of which 525,000 are a first heart attack (CDC, 2017c). Heart disease is the leading cause of death among both men and women and among most people of most ethnicities. Among people in the United States, 47% have at least one of the three key risk factors for heart disease: hypertension, dyslipidemia, and smoking (CDC, 2017c). Heidenreich et al. (2011) estimated that more than 40% of adults in the United States will have at least one form of CVD by 2030.

Cardiovascular Disease Risk Factors

Hypertension, diabetes, and dyslipidemia (abnormal cholesterol and/or triglyceride levels in the blood) are key risk factors for heart attacks and strokes (CDC, 2017c; WHO, 2016). Individuals with diabetes are twice as likely to die from heart disease or stroke compared to individuals without diabetes (NIDDK, 2017). Elevated blood pressure (defined as blood pressure greater than or equal to 140/90) is the leading risk factor for CVD (WHO, 2017a). The number of adults with elevated blood pressure around the world has almost doubled from 1975 to 2015 (594 million to 1.13 billion, respectively) (WHO, 2017a). In the United States, one in three adults has hypertension and another one in three has prehypertension (CDC, 2017c). Of people with diagnosed hypertension, only 54% have their blood pressure under control (CDC, 2017c). Tobacco use causes about 10% of all CVD deaths in the world (Mendis, 2017).

Additionally, diabetes, overweight/obesity, poor diet, sedentary lifestyle, and excessive alcohol use increase the risk of developing heart disease (CDC, 2017c).

Saturated fat, trans fat, and sodium intake and inadequate fruit and vegetable intake are the "poor diet" factors that affect CVD risk (Mendis, 2017). Saturated and trans fat consumption is declining in high-income countries yet increasing in low- and middle-income countries (Mendis, 2017). Decreased sodium intake in some countries (e.g., England and Finland) is associated with decreased mortality due to stroke (Mendis, 2017). Inadequate intake of fruits and vegetables is linked to 11% of ischemic heart disease deaths and 9% of stroke deaths around the world (Mendis, 2017). More than 780,000 global CVD deaths in 2012 were attributed to alcohol intake (Mendis, 2017). Additional factors to consider when assessing CVD risk are poverty, stress, and genetics (WHO, 2017a).

Economic Impact in the United States

As of 2011, CVD accounted for 17% of health expenditures in the United States (Heidenreich et al., 2011). By 2030 more than 40% of the U.S. population (116 million people) is predicted to have CVD (Heidenreich et al., 2011). As a direct result of increased CVD prevalence, CVD direct medical costs are expected to triple from $273 billion to $818 billion. Indirect costs are projected to increase from $172 billion in 2010 to $276 billion in 2030 (61% increase) (Heidenreich et al., 2011). The projected total cost of CVD is projected to exceed $1 trillion in the United States by 2030 (Heidenreich et al., 2011). The direct and indirect costs are estimated using costs associated with hypertension, CHD, heart failure, and stroke. Hypertension is the most costly CVD, with projected costs at $200 billion in 2030 (Heidenreich et al., 2011).

Cardiovascular Disease Prevention

For the most part, CVD can be prevented (Heidenreich et al., 2011). Heart attacks and strokes have been positively correlated to modifiable lifestyle factors such as tobacco use, poor diet, overweight/obesity, sedentary lifestyle, and excessive alcohol intake. Tobacco cessation, reducing dietary sodium intake, adequate intake of fruits and vegetables, engaging in regular physical activity, and limiting alcohol intake reduces the risk of developing CVD (WHO, 2017a). Effective treatment of conditions such as diabetes, high blood pressure, and dyslipidemia will also reduce the risk of developing CVD (WHO, 2017a). Avoiding lifestyle habits that increase the risk of developing CVD is ideal. Early intervention targeting individuals with increased risk can be particularly impactful as there is a long asymptomatic period before CVD (and diabetes) are diagnosed (Phillips, 2013). Studies show that "individuals who reach middle age with optimal levels of all major risk factors, the remaining lifetime risk of developing CVD is only 6% to 8%" (Heidenreich et al., 2011, p. 936). Poor diet and insufficient physical activity early in life are strong predictors of poor health outcomes in adulthood (Mozaffarian et al., 2015). The earlier the intervention, the better as small improvements in risk factors made in younger years has demonstrated a more significant impact than more considerable changes at an older age (Heidenreich et al., 2011). Early prevention of risk factors and effective treatment of existing risk factors is important to successfully mitigating the impact of CVD (Heidenreich et al., 2011).

Overweight/Obesity

Overweight and obesity are defined as abnormal or excessive accumulation of adipose tissue (fat) that can negatively affect health (WHO, 2018). Excess adiposity is linked to multiple chronic conditions including type 2 diabetes, CVD, obstructive sleep apnea, osteoarthritis, difficulty with physical functioning, nonalcoholic fatty liver disease, cirrhosis, gastroesophageal reflux disease, and several types of cancers such as colon, breast, pancreatic, and liver (CDC, 2018; Heymsfield & Wadden, 2017; Zhang et al., 2014). Additionally, obesity is often accompanied by psychiatric problems such as depression, anxiety, and mood disorders (CDC, 2018; Heymsfield & Wadden, 2017). Excess fat accumulation occurs over time and is generally caused by a long-term energy imbalance in which more energy (calories) is consumed than needed (Heymsfield & Wadden, 2017).

BMI and body fatness are highly correlated (Flegal et al., 2016); therefore, BMI is commonly used to assess body composition. For adults, overweight is defined as a BMI greater than or equal to 25 kg/m^2 and obesity is defined as a BMI greater than or equal to 30 kg/m^2 (WHO, 2018). BMI is an indicator of body fatness; however, as a proxy measure of body fat, BMI has limitations such as not differentiating between fat, muscle, or bone mass and does not assess body fat distribution (i.e., visceral, intermuscular, subcutaneous fat) (CDC, 2011). Muscular individuals or athletes may have a high BMI due to increased muscle mass as opposed to increased body fatness (CDC, 2011). Additionally, some individuals may have a normal BMI (<25 kg/m^2) yet still have abnormal body fat distribution (central obesity), indicating greater risk of conditions such as CVD and diabetes that would not be identified by BMI alone (Lopez-Jimenez & Miranda, 2010). While a person's abdominal obesity has a stronger correlation to MetS, BMI is still considered a valid indicator of MetS (Al-Bachir & Bakir, 2017; Gierach, Gierach, Ewertowska, Arndt, & Junik, 2014; Kelli et al., 2015).

Risk Factors

Excessive accumulation of fat is affected by various factors such as genetics, age, sex, environment, and lifestyle habits (namely physical inactivity and unhealthy diet) (Heymsfield & Wadden, 2017; WHO, 2018). Additional factors that may contribute to overweight/obesity are inadequate sleep, high stress levels, depression, medications, and food addiction (NHLBI, n.d.-b; Zhang et al., 2014). The heritability of BMI is estimated to range from 40% to 70% (Heymsfield & Wadden, 2017). Other research indicates that heritability of BMI can be as high as 80% (Phillips, 2013).

There are environmental factors that increase the risk of obesity such as the food environment, the built environment, and new technologies (Harvard School of Public Health, n.d.-b). In terms of the food environment, there is an increasing supply of energy-dense foods that are often heavily marketed by the food industry and served in large portions (Heymsfield & Wadden, 2017). Additionally, these foods are palatable to large numbers of people and can activate a person's biological reward system contributing to overconsumption (Zhang et al., 2014). Lack of access to supermarkets and greater access to convenience stores may increase the risk of obesity (Harvard School of Public Health, n.d.-c). Some research also indicates that exposure to fast food restaurants is linked to higher intake of fast food and increased risk of obesity (Townshend & Lake, 2017). Furthermore, occupations are increasingly sedentary, less physical activity is required for daily activities (e.g., driving vs. walking), and increased screen time has led to decreased engagement in physically-active leisure-time activities (Heymsfield & Wadden, 2017; Phillips, 2013; WHO, 2018). In one study, low-income and minority neighborhoods were three to eight times more likely to not have access to recreational facilities (Moore, Diez Roux, Evenson, McGinn, & Brines, 2008). This factor may contribute to the higher obesity rates among racial and ethnic groups and among individuals of low-socioeconomic status (Harvard School of Public Health, n.d.-a). Neighborhood safety also influences physical activity level. Areas with higher crime rates negatively affect physical activity levels among its residents. Just the perception of living in an unsafe neighborhood can reduce physical activity levels residents (Harvard School of Public Health, n.d.-a).

Obesity Prevalence in the United States

Between 1960 through 1980, NHANES data revealed no significant changes in obesity prevalence among adults in the United States. In contrast, NHANES II and III (data ranging from 1976 to 1994) showed a significant increase in obesity prevalence (Flegal et al., 2016). From 1985 to 2000, the average caloric intake of Americans increased substantially (Clark et al., 2012), which contributed to the significant increase in obesity prevalence during this time period. The average daily calorie intake in 2007 was 400 calories higher than in 1985 and 600 calories higher than in 1970 (Clark et al., 2012). For 2013-2014, the age-adjusted obesity prevalence in the United States was estimated at 37.7%, an increase from 34.3% in 2005-2006 (Flegal et al., 2016). Obesity prevalence was higher among women (40.5%) than among men (35.0%) (Flegal et al., 2016). Furthermore, obesity became more severe as the prevalence of Class 3 obesity (BMI of 40 kg/m^2 or greater) increased by 70% between 2000-2010 and the proportion of individuals with a BMI of 50 kg/m^2 or higher increased 10-fold between 1986 and 2010 (Sturm & Hattori, 2013).

Obesity prevalence varies by race/ethnicity in the United States. Non-Hispanic Blacks had the highest obesity prevalence (48.4%) in 2013-2014. Obesity prevalence was also very high among Hispanics (42.6%) and non-Hispanic Whites (36.4%). The lowest prevalence was among Non-Hispanic Asians (12.6%). Non-Hispanic Black women and Hispanic women had the highest prevalence of obesity (57.2% and 46.9%, respectively) (Flegal et al., 2016). Non-Hispanic Black women had the highest prevalence of Class 3 obesity at 16.8%. Although Hispanics had a higher prevalence of obesity, they had a lower prevalence of Class 3 obesity (7.1% vs. 7.6% among non-Hispanic Whites and 12.4% among non-Hispanic Blacks) (Flegal et al., 2016).

Consistent with these findings, African American and Hispanic women had the highest prevalence of visceral obesity (70% or greater) in 2009-2010 (WC ≥ 88cm) (Falkner & Cossrow, 2014). NHANES data from 2009-2010 showed that the prevalence of visceral obesity, WC ≥ 88cm in women and ≥ 100cm in men, was high as approximately 50% of men and more than 60% of all race/ethnic groups were considered obese (Falkner & Cossrow, 2014). These findings also indicate a high prevalence of obesity among children: 19.6% for Caucasian children, 22.1% for African American children, and 22.6% for Hispanic children (Falkner & Cossrow, 2014). Studies forecasting the impact of current adolescent overweight predict an increase of future adult obesity by 5% to 15% by 2035 (Heidenreich et al., 2011).

U. S. Hispanic Health Disparities

MetS

U.S. Hispanics suffer disproportionately with the burden of disease (CDC, 2011; Daviglus et al., 2012; Fisher-Hoch et al., 2012; Heiss et al., 2014; Mozaffarian et al., 2015; Zhang, Wang & Huang, 2009). Among all ethnic groups in the United States, Hispanics had the highest prevalence of MetS between 2003-2012 (35.4%) (Aguilar et al., 2015). MetS prevalence was 36% in Hispanic women and 34% in Hispanic men during 2008-2011 (Heiss et al., 2014). Rodriguez et al. (2013) determined that the risk-adjusted odds ratio for MetS in Hispanic women for 2008-2009 was 1.7 when compared to White women, indicating a 70% increased risk of MetS among Hispanic women.

MetS prevalence was highest among Hispanics in all age groups between 2003-2012, affecting approximately 21% among Hispanics aged 20-39 (vs. 18.3% overall), approximately 40% among Hispanics aged 40-59 (vs. approximately 34% overall), and approximately 52% among Hispanics aged 60 and older (vs. 46.7% overall) (Aguilar et al., 2015). MetS also rose with increasing age among Hispanics. In 2008-2011 the prevalence of MetS was 23% among Hispanic women aged 18-44, 50% among Hispanic women aged 45-64, and 62% among Hispanic women aged 65-74. Prevalence was also high among Hispanic men among the three age categories: 25%, 43%, and 55%, respectively (Heiss et al., 2014). Prevalence varies significantly among Hispanic groups. In 2008-2011, MetS prevalence ranged from 27% among South American women to 41% among Puerto Rican women and from 27% among South American men to 35% among Cuban men (Heiss et al., 2014).

Diabetes

In 2015, 12.1% of U.S. Hispanics had diabetes versus 9.4% of the overall population and 7.4% of non-Hispanic Whites (CDC, 2017d). Estimates indicate that Hispanics are 66-94% more likely to be diagnosed with diabetes when compared to non-Hispanic Whites (CDC, 2011; National Diabetes Education Program [NDEP], 2011). Diabetes prevalence is not uniform across the various Hispanic subgroups: 8.5% of Central/South Americans, 9.0% of Cubans, 12.0% of Puerto Ricans, and 13.8% of Mexicans had diabetes (CDC, 2017d).

Additional studies examining diabetes prevalence among Hispanics have found even higher proportions of individuals with diabetes. The Hispanic Community Health Study/Study of Latinos, a prospective, multicenter, population-based study from 2008-2011, included 16,415 participants of Hispanic/Latino descent aged 18-74. Diabetes prevalence was lowest among South Americans (10.2%) and Cubans (13.4%) and highest among Central Americans (17.7%), Dominicans (18%), Puerto Ricans (18%), and

Mexicans (18.3%) (Schneiderman et al., 2014). In addition, Hispanic participants in the California's Men's Study had a diabetes prevalence of 22% (Ahmed et al., 2009), while the Cameron County Hispanic Cohort of Mexican Americans had a diabetes prevalence of 28% and a prediabetes prevalence of 31.6% (Fisher-Hoch et al., 2015).

There is also an overall worsening trend in the diabetes prevalence among Hispanics. A study by Zhang, Wang and Huang (2009), in which weight classification was stratified, revealed increases in racial disparities from 1974-2004 within the normal-weight group. The overweight group had more severe increases in diabetes prevalence with an increase of 33.3% in Whites, 60.0% in Blacks, and 227.3% in Mexican Americans. Within the Mexican American group, diabetes prevalence increased from 3.4% to 11% in 30 years (Zhang et al., 2009). Another study by Beard et al. (2009) showed that the prevalence of diabetes among Mexican Americans aged ≥ 75 years nearly doubled between 1993–1994 (20.3%) and 2004–2005 (37.2%). Furthermore, undetected and untreated diabetes is prevalent in the Hispanic population (Coffman, Norton, & Beene, 2012; Fisher-Hoch et al., 2015; Lindberg et al., 2019); and Hispanics are more likely to suffer from diabetic complications such as ESRD, diabetic retinopathy, and lower-extremity amputation (Chukwueke & Cordero-MacIntyre, 2010; Desai, Lora, Lash, & Ricardo, 2019).

CVD

Hispanics also have a high risk of CVD. Hypercholesterolemia (high cholesterol) prevalence was highest among Central American men (54.9%) and Puerto Rican women

(41.0%) (Daviglus et al., 2012). Hispanic men were more likely to have total cholesterol greater than 240mg/dL than non-Hispanic White men (14.8% vs. 11.5%) and were significantly more likely to have LDL cholesterol greater than 130mg/dL when compared to non-Hispanic White men (38.8% vs. 29.4%). Among those with high LDL, Mexican Americans had a high prevalence of having poorly controlled LDL (Mozaffarian et al., 2015). Hispanic men (33.8%) and women (12.8%) were both more likely to have low HDL (<40mg/dL in men and <50mg/dL in women) when compared to non-Hispanic men (28.7%) and women (10.2%) (Mozaffarian et al., 2015).

The prevalence of hypertension among Hispanics (24.7%) is lower than among non-Hispanic Blacks (42.2%) and Whites (28%) and comparable to Asians (24.7%); however, looking at data of Hispanic subgroups demonstrates that some groups have a higher prevalence of hypertension. For example, Dominican Republic men had the highest prevalence of hypertension at 32.6%. Mexican Americans with hypertension had 40% higher odds of uncontrolled BP than non-Hispanic Whites (Mozaffarian et al., 2015). Puerto Rican women had high prevalence of hypertension at 29.1%. Puerto Ricans also had a consistently higher hypertension-related death rate than all other Hispanic subpopulations and non-Hispanic Whites (Mozaffarian et al., 2015).

Among Hispanics, CHD prevalence is 6.7% for men and 5.9% for women (6.2% in U.S. adults ≥20 years of age). CHD prevalence among Hispanic men is lower than for all men in the United States (7.6%); however, CHD prevalence is higher among Hispanic women when compared to all women in the United States (5.0%) (Mozaffarian et al., 2015). Among Hispanics, MI prevalence is 3.5% for men and 1.7% for women. MI prevalence in U.S. adults ≥20 years of age is 4.0% for men and 1.8% for women (Mozaffarian et al., 2015). Total CVD prevalence is lower among Hispanics (approximately 32%) when compared to the prevalence of the total U.S. population (35%); however, CVD is nonetheless a significant concern, as it is the leading cause of mortality among Hispanics in the United States (AHA, 2016).

Obesity

According to NHANES 2009 to 2012, Hispanic men were more likely to be overweight or obese (80.1%) in comparison to non-Hispanic White men (72.7%) (Mozaffarian et al., 2015). Among women, Hispanics were more likely to be overweight or obese (76.3%) in comparison to non-Hispanic Whites (61.2%). Among men, Hispanics were more likely to be obese than non-Hispanic Whites (38.4% vs. 34.2%, respectively). Hispanic women were more likely to be obese than non-Hispanic Whites (42.9% vs. 32.5%, respectively) (Mozaffarian et al., 2015). Hispanic women aged 40-49 years had high obesity prevalence (51.1%) (Flegal et al., 2016). Overall, Hispanics had a much lower prevalence of Class 3 obesity in comparison to non-Hispanic Blacks and Whites (Flegal et al., 2016).

U.S. Hispanic Population

The Hispanic population represents one of the largest and fastest growing ethnic groups in the United States (Flores, 2017). As of 2016, the Hispanic population represented 17.8% of the total U.S. population or 57.5 million people (U.S. Census

Bureau, 2017). This represents an increase from just under 15% of the population or 44.3 million people in 2006 (U.S. Census Bureau, 2010). The Hispanic fertility rate in 2015 was 71.7 per 1000 Hispanic women aged 15-44, which was higher than the general U.S. fertility rate of 62.5 per 1,000 women aged 15-44 (Martin, Hamilton, Osterman, Driscoll, & Mathews, 2017). In the one-year span between July 2015 and July 2016, the U.S. population grew by 2.2 million people. Hispanics accounted for over half of this growth (U.S. Census Bureau, 2017). By 2060, the Hispanic population will comprise 28.6% of the total U.S. population (about 119 million people) (U.S. Census Bureau, 2017). More than 34% of the U.S. Hispanic population in 2016 was foreign-born (U.S. Census Bureau, 2017). Hispanics are also the youngest ethnic group in the United States (Patten, 2016). Among U.S.-born Hispanics, 47% are younger than 18 (Patten, 2016). In contrast, the proportion of the population younger than 18 is significantly lower among U.S.-born Blacks (27%) and U.S.-born Whites (20%) (Patten, 2016).

The U.S. Hispanic population is diverse; however, the majority is of Mexican origin, 63.2% in 2016. Puerto Ricans represented 9.5% of the U.S. Hispanic population, Salvadorans 3.8%, Cubans 3.9%, Dominicans 3.3%, and Guatemalans 2.5%. The remaining Hispanic population represents other Central American, South American, or Hispanic (U.S. Census Bureau, 2017).

Spanish is the second most common language spoken in the United States (Krogstad & Lopez, 2017). Hispanics commonly speak both English and Spanish. More than 37 million (approximately 73%) of Latinos speak Spanish at home (Krogstad &

Lopez, 2017). In the DFW area, 79% of Hispanics identified in the 2015 American Community Survey reported speaking Spanish at home (Krogstad & Lopez, 2017). Of all Hispanic Spanish speakers identified in the 2016 American Community Survey, 57.5% spoke English “very well” (U.S. Census Bureau, 2017).

For the year 2016, California and Texas had the highest Hispanic populations in the United States with 15.3 and 10.9 million Hispanics residing in each state, respectively (U.S. Census Bureau, 2017). For the year 2018, Hispanics represented 39.6% of the Texas population (U.S. Census Bureau, n. d.). The Hispanic population in Texas grew 60% from 2000 to 2015 (Flores, 2017). There were 1.94 million Hispanics (28.4%) living in the DFW metropolitan area in 2014. Approximately 38% of this population was foreign-born (Pew Research Center, 2016).

Research suggests Hispanics are relatively healthy upon immigration compared to their U.S.-born counterparts, but their health status worsens as their duration in the United States increases (Lara et al., 2005; Pérez-Escamilla, 2011; Schwartz & Unger, 2017). More than a third of the U.S. Hispanic and the Hispanic population in Texas are foreign born (Flores, 2017; Pew Research Center, 2016). This large segment of immigrants denotes the importance of examining the role of acculturation in health outcomes among Hispanics (Abraído-Lanza, Armbrister, Flórez & Aguirre, 2006). Exploring the role of acculturation in determining health behaviors and outcomes can contribute to better understanding of the health of the Hispanic population in the United States (Thomson & Hoffman-Goetz, 2009).

Acculturation

Research examining the health disparities observed in the Hispanic population has largely focused on the different ways acculturation influences health among Hispanics in the United States (Zambrana & Carter-Pokras, 2010). There currently is not an agreed-upon definition of acculturation (Schwartz & Unger, 2017). Nevertheless, it is generally accepted that acculturation describes how immigrants (individuals and communities) make behavioral changes in response to their new environment and provides insight into how these changes influence health outcomes (Schwartz & Unger, 2017).

In the 19th century, social scientists began theorizing about the process by which immigrants coming to the United States would adapt to the mainstream culture (Padilla & Pérez, 2003). Robert Park was one of the first social scientists to examine the process by which immigrants incorporated into mainstream American culture (Padilla & Pérez, 2003). Park's model included three stages: contact, accommodation, and assimilation (Persons, 1987). According to Park's model, assimilation was the expected end product of exposure to the mainstream culture; and in Park's view, the assimilation process was irreversible (Padilla & Pérez, 2003). Redfield, Linton, and Herskovits (1936) did not believe that assimilation was the only possible outcome and presented an early definition of acculturation: "Acculturation comprehends those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact, with subsequent changes in the original cultural patterns of either or both groups" (p. 149). The Social Science Research Council (1954) further added to the understanding of acculturation, emphasizing that acculturation can be multifaceted. The Council viewed acculturation as:

> . . . culture change that is initiated by the conjunction of two or more autonomous cultural systems. Acculturative change may be the consequence of direct cultural transmission; it may be derived from noncultural causes, such as ecological or demographic modifications induced by an impinging culture; it may be delayed, as with internal adjustments following upon the acceptance of alien traits or patterns; or it may be a reactive adaptation of traditional modes of life. Its dynamics can be seen as the selective adaptation of value systems, the processes of integration and differentiation, the generation of developmental sequences, and the operation of role determinants and personality factors (1954, p. 974).

This expanded definition is significant because it recognized that cultural change can be selective; the persons experiencing cultural change due to intergroup contact can determine which cultural components they want to adopt or abandon (Padilla & Pérez, 2003).

Graves (1967) distinguished between acculturation at the group level and acculturation at the individual level (psychological acculturation). Psychological acculturation comprises change in the psychology of the individual (e.g., norms and values) and changes in behavioral patterns (e.g., diet and dress). Berry (1997) further expanded the concept of acculturation and presented acculturation as a multidimensional process with multiple and flexible outcomes. Berry (1997) further emphasized that cultural change can be selective and selecting components that are adopted or abandoned is part of the acculturation process.

In the acculturation process, cultural changes occur that may “range from relatively superficial changes in what is eaten or worn, to deeper ones involving language shifts, religious conversions, and fundamental alterations to value systems” (Berry, 1997, p. 17). During the acculturation process, people may adopt elements of the new culture's attitudes, beliefs, values, customs, and behaviors, including health-related behaviors of the mainstream culture (Abraido-Lanza, White, & Vasques, 2004; Pérez-Escamilla, 2009). To date, there are two contrasting views of the acculturation process -- unidimensionality and bidimensionality. Unidimensionality views acculturation as a linear process and implies that individuals lose some or all of their original cultural characteristics (Hispanic culture) as they acquire a new cultural identity in the receiving society (American culture) (Abraído-Lanza et al., 2006). Unidimensional definitions assume that the ultimate outcome of acculturation is assimilation (Thomson & Hoffman-Goetz, 2009). This view reflects acculturation as a “zero-sum system” where one culture is eventually completely replaced by another (Schwartz & Unger, 2017). On the other hand, bidimensionality indicates that groups or individuals do not necessarily lose their original culture while identifying and acquiring aspects of a new culture (Pérez-Escamilla, 2009). The bidimensional model acknowledges that individuals can maintain their culture of origin, while simultaneously developing relationships with the new culture. Acquisition of the new culture and retention of the original culture are viewed as separate dimensions of acculturation (Schwartz & Unger, 2017). This bidimensional view implies that the retention of original culture is not dependent on the acquisition of the new culture (Schwartz & Unger, 2017). Because of this independence, bidimensional models are thought to be more realistic and offer greater insight into the acculturative process of the individual (Thomson & Hoffman-Goetz, 2009).

Berry's (1997) bidimensional model is one of the most studied multidimensional theories of acculturation (Fox, Merz, Solórzano, & Roesch, 2013). Berry (1997) developed the following four mutually exclusive categories: (a) *Assimilated*: Hispanics do not maintain their Hispanic culture and seek interaction with other cultures, such as the 'mainstream' American culture. They have entirely adopted the attitudes and behaviors of the new culture; (b) *Integrated or bicultural*: Hispanics have maintained many attitudes and/or behaviors from their Hispanic culture but have also adopted behaviors and attitudes from American culture; (c) *Separated*: Hispanics choose to retain their original Hispanic culture without attempting to integrate (reject) into the new culture; (d) *Marginalized*: Hispanics may lose their Hispanic culture without seeking integration into the mainstream society; they do not identify with either culture. Marginalization typically occurs through enforced cultural loss combined with exclusion, not per choice (Berry, 1997). In this model, receiving-culture acquisition and heritage-culture retention are cast as two dimensions that intersect to create the four acculturation categories just described (Schwartz, Unger, Zamboanga & Szapocznik, 2010).

Acculturation Measures

Researchers studying acculturation have used various measures to assess acculturation in the Hispanic population. However, there is no universal consensus as to how acculturation should be measured (Thomson & Hoffman-Goetz, 2009). Basic proxy measures of acculturation such as language preference, nativity, and duration in the host country are commonly used in public health research (Abraido-Lanza et al., 2006; Thomson & Hoffman-Goetz, 2009; Wallace, Pomery, Latimer, Martinez, & Salovey, 2010). Language explains much of the variance in acculturation measures (Marin, 1992) and is one of the easiest constructs to measure (Lara et al., 2005). Nativity and duration are commonly used in acculturation research as greater exposure to the host culture increases the probability of adopting the cultural characteristics of the mainstream culture (Portes & Rumbaut, 2006). An acculturation assumption is that being born in the host country and longer length of time in the host country is associated with higher levels of acculturation (Schwartz & Unger, 2017). Other health studies utilize established acculturation scales such as the SASH (used in this study), the Acculturation Rating Scale for Mexican Americans II (ARSMA II) (Cuellar, Arnold, & Maldonado, 1995), the Bidimensional Acculturation Scale (BAS) (Marin & Gamba, 1996), the Hazuda Scale (Hazuda, Stern, & Haffner, 1988), and the Anderson Scale (Anderson et al., 2004) (Thomson & Hoffman-Goetz, 2009; Wallace et al., 2010).

Testing and validation of existing multidirectional scales that allow for the classification of study participants into meaningful acculturation categories (Pérez-

Escamilla, 2009) as well as measure Hispanic diversity and beliefs that influence lifestyle behaviors can provide valuable insight into the relationship between acculturation and health outcomes among Hispanics (Wallace et al., 2010). The ARSMA II, SASH, and BAS are well-researched and validated scales (Wallace et al., 2010). Using well-researched and validated scales can improve the body of research examining acculturation and health outcomes in the Hispanic population (Wallace et al., 2010). Researchers seeking to understand how acculturation influences behavior and health outcomes should view the construct of acculturation as multidimensional and use validated acculturation scales (Fox, Thayer, & Wadhwad, 2017; Pérez-Escamilla, 2009; Schwartz & Unger, 2017).

Acculturation Across Ethnicities

Several groups in the United States go through the process of acculturation to varying degrees. More recent immigrants such as Hispanics from Latin American countries, Asians, and religious minorities (e.g., Muslims) experience acculturation in the United States (Ferguson, 2016; Schwartz et al., 2010). Established ethnic minorities such as African Americans and Native Americans also experience acculturation, although they may likely experience acculturation differently than migrating groups due to involuntary subjugation (Schwartz et al., 2010). Research on acculturation and research has focused on migrating groups, and the issues affecting migrating groups may differ from issues faced by established ethnic minorities such as African Americans and Native Americans (Schwartz et al., 2010). Different factors influence the acculturation process among migrating groups, including the circumstances which led to the migration (e.g., immigration, asylum seeking, and refugee status), ethnicity, and language proficiency (Schwartz et al., 2010; Schwartz & Unger, 2017). For example, migrants from English-speaking countries may experience less acculturative stress and discrimination in the United States than individuals who are from non-English speaking countries or are otherwise not proficient in the English language (Schwartz et al., 2010). Although several groups experience acculturation, most research examining acculturation and health in the United States has focused on Hispanics and Asians (Fox et al., 2017; Rudmin, Wang, & de Castro, 2017); this is likely due to an influx of immigrants from Latin America and Asia over the past 50 years (Ferguson, 2016).

The immigrant paradox is a public health phenomenon in which immigrants' health status is better than that of the native-born population, yet immigrants' health declines with greater duration in the host country (Schwartz & Unger, 2017). The immigrant paradox has been reported in multiple studies among different ethnic groups, including Hispanics (Rudmin et al., 2017). Rudmin et al. (2017) criticized the term "immigrant paradox" as it indicates an "undeclared presumption that minorities were expected to be inferior on the selected criteria variables" (p. 79), which implies that minorities are naturally inferior.

Acculturation research among other ethnicities has found inconsistencies in the relationship between acculturation and health. Studies have found positive relationships, negative relationships, mixed findings, as well as no relationship between acculturation and health (Bulut & Gayman, 2016; Effoe et al., 2015; Kane et al., 2016; Lee, Sobal, & Frongillo, 2000; Tseng & Fang, 2015; Tseng, Wright, & Fang, 2015; Vargas & Jurado, 2015; Yi et al., 2016). For example, among Chinese immigrant women in Philadelphia, increased duration in the United States was associated with increased acculturation score that was significantly associated with higher caloric intake, higher intake of fat and sugar, and a lower dietary moderation score (calculated by assessing intake of total fat, saturated fat, cholesterol, sodium, and empty calorie foods) (Tseng et al., 2015). Other research by Tseng and Fang (2015) revealed that insulin resistance increased with acculturation among Chinese immigrant women. Conversely, research has indicated a positive effect of acculturation on physical activity among Chinese Americans in that strong identification with American culture was associated with higher levels of physical activity (Yi et al., 2016).

Among other Asian groups, there are additional examples of conflicting findings. For instance, among first-generation Filipino Americans in New Jersey there was no significant association between dietary acculturation, dietary intake, BMI, and WC (Vargas & Jurado, 2015). However, among a sample of Asian Indian adults, dietary acculturation was associated with increased risk of diabetes (Venkatesh, Conner, Song, & Weatherspoon, 2017). Although other research has indicated a relationship between higher acculturation and alcohol intake (Caetano, Ramisetty-Mikler, & Rodriguez, 2009; Lee, Almeida, Colby, Tavares, & Rohsenow, 2016; Lui & Zamboanga, 2018; Serafini, Wendt, Ornelas, Doyle, & Donovan, 2017) acculturation was not associated with alcohol intake among a sample of adult Cambodian and Vietnamese women (Kane et al., 2016). In addition, Bulut and Gayman (2016) assessed different dimensions of acculturation (recent arrivals, separated, bicultural, and assimilated) and found that biculturalism was associated with positive health among Asians as bicultural immigrants had the best self-reported mental health. However, separated immigrants and recent arrivals had the worst reported mental health (Bulut & Gayman, 2016).

Other research has also revealed inconsistent findings between acculturation and health among differing ethnic groups, such as analyses of secondary data from the Multi-Ethnic Study of Atherosclerosis (MESA) study (Bild et al., 2002). Effoe et al. (2015) found that higher mean left ventricular mass index (LVMI) (risk factor for CVD) was associated with longer duration (i.e., higher acculturation) in the United States among foreign-born participants in a multi-ethnic sample comprised of non-Hispanic whites, Hispanics, African-Americans, and Chinese adults aged 45-84. Among the MESA participants, those with lower acculturation scores had higher mean SBP, higher prevalence of hypertension, and higher BMI (Effoe et al., 2015). Among African-American participants, nativity was associated with LVMI; and being born in the United States was associated with lower mean LVMI (after adjusting for covariates including age, sex, and income level) (Effoe et al., 2015). Another study assessing acculturation and health among non-Hispanic Blacks found that acculturation was not associated with dietary intake among Jamaican adult immigrants living in Florida (Oladele et al., 2018). Additionally, in another study greater acculturation as measured by generation status was associated with higher rates of psychiatric disorders among Caribbean Blacks (Williams et al., 2007). In this sample, third-generation Caribbean Blacks had significantly higher rates of psychiatric disorders compared to first-generation Caribbean Blacks (Williams et al., 2007). In sum, the relationship between acculturation and health across ethnic groups varies according to acculturation measure and health variable.

Acculturation and U.S. Hispanic Health

The immigrant paradox phenomenon has been observed among Hispanics in the United States. Over time, the health of immigrants (and that of subsequent generations) eventually becomes similar to the health of the native-born population; or, they experience worse health outcomes than the native-born population (Schwartz & Unger, 2017). It is not clear whether this phenomenon "results from acquiring receiving-cultural practices, values, and identifications (i.e., the receiving culture makes people sick) or whether the paradox results from loss of heritage-cultural practices, values, and identifications (i.e., the heritage culture keeps people healthy)" (Schwartz & Unger, 2017, p. 12). The health intervention differs depending if the observed worsening of health is due to the acquisition of the new culture or the loss of cultural heritage. The implication bears the question, "Should we aim to keep migrants away from receiving-cultural influences (if that is possible), or should we encourage them to retain their cultural heritage?" (Schwartz & Unger, 2017, p. 12). While this question has not been definitively answered, emerging research suggests that the immigrant paradox results from the loss of cultural heritage (Schwartz & Unger, 2017).

Acculturation and Diabetes

The prevalence of diabetes varies with acculturation. Studies examining the relationship between diabetes and acculturation have used differing measures of acculturation such as generational status, language preference, and duration of residence as well as standardized acculturation scales (Afable-Munsuz, Mayeda, Pérez-Stable, & Haan, 2014; Ahmed et al., 2009; Rodriguez, Hicks, & López, 2012). Due to the varying measures of acculturation used in health research, it is difficult to establish a clear relationship between acculturation and diabetes prevalence (Rodriguez et al., 2012).

Increasing years of U.S. residence is associated with increased disease prevalence (Rodriguez et al., 2012). Some studies have found that diabetes prevalence doubled among Hispanics who have been in the United States for over 25 years compared to those who immigrated within the past 10 years (Ahmed et al., 2009). According to Ahmed et al. (2009), recently immigrated Latinos have a risk of diabetes similar to that of U.S.-born Whites. In addition, using generational status as an acculturation proxy, higher acculturation is associated with an increased risk of having diabetes. Second-generation Mexican American adults have an odds ratio (versus first-generation adults) of 1.8 and third-generation adults have an even greater odds ratio of having diabetes (2.1). However, in a conflicting finding, greater U.S.-acculturation (as measured by 10 items from the ARSMA II), is associated with decreased diabetes prevalence (Afable-Munsuz et al., 2014).

Acculturation and CVD

The relationship between CVD and acculturation among Hispanics is also unclear. Research findings revealed positive, negative, and no associations between acculturation and CVD among Hispanics (Daviglus et al., 2012; Moran et al., 2007; Mozaffarian et al., 2015). For example, CHD prevalence is significantly higher among Latinos who resided in the United States 10 or more years (Daviglus et al., 2012). Higher acculturation (indicators included nativity, duration in the United States, and preferred language) was associated with higher risk of CVD as more acculturated participants have higher prevalence of three or more CVD risk factors when compared with participants with lower acculturation levels (Daviglus et al., 2012). Stroke prevalence was significantly higher among participants born in the United States (a proxy for higher acculturation) (Daviglus et al., 2012). Additionally, the Dallas Heart Study results indicated that Hispanics with higher acculturation levels had higher hypertension prevalence compared with Hispanics with lower acculturation levels (Vaeth & Willett, 2005). Lower acculturation is also associated with higher odds of having a low risk profile (indicating low risk for CVD) among women but not men (Daviglus et al., 2016).

Mexican-born and South-American born participants in the MESA (a multiethnic cohort study) had lower prevalence of hypertension compared to U.S.-born Hispanics (Moran et al., 2007). However, Caribbean- and Central American-born participants have higher prevalence of hypertension when compared to U.S.-born Hispanics (Moran et al., 2007). Moran et al. (2007) believed that one possible explanation for the higher prevalence of hypertension among Central American and Caribbean participants is that the participants may have already experienced greater exposure to the American diet and lifestyle before immigrating to the United States. MESA researchers also found that Hispanics with hypertension and high cholesterol who spoke Spanish at home (a proxy for lower acculturation) and spent less time in the United States had higher SBP and LDL cholesterol, respectively, than Hispanics who spoke English at home and had a longer duration in the United States (Eamranond et al., 2009). Additionally, participants who preferred Spanish were more likely to have higher dyslipidemia (abnormal lipids) prevalence (Rodriguez et al., 2014). In contrast, other research has found no link between higher acculturation and the prevalence of CVD risk factors (Chang et al., 2015).

Acculturation and Obesity

Studies examining the relationship between obesity and acculturation have found positive relationships, negative relationships, and no association between the two variables. Increases in BMI and obesity were observed across succeeding generations among Latinos, indicating increased risk of obesity with higher acculturation level (Bates, Acevedo-Garcia, Alegria, & Krieger, 2008). However, this relationship was not seen among Puerto Ricans as later generations saw a significant decrease in obesity (Bates et al., 2008). In another study, U.S.-born Hispanics who immigrated to the United States at an early age (before age 14) and with longer duration in the United States (≥20 years) had the highest prevalence of moderate obesity (BMI 30-39 kg/m^2) and extreme obesity (BMI ≥ 40 kg/m^2) (Isasi et al., 2015). In this same study, dietary acculturation was assessed by asking participants if the foods they commonly consumed were from Hispanic or American origin. Using dietary acculturation to assess obesity risk, eating mostly Hispanic foods was associated with lower risk of extreme obesity when compared with individuals whose diet consisted of both Hispanic and American foods equally (Isasi et al., 2015). However, acculturation as assessed by the SASH was not significantly associated with obesity among Hispanics (Isasi et al., 2015).

In their study, Glick and Yabuki (2015), defined the high acculturation group as those born in the United States, residing in the United States 10 or more years, and living in an English or bilingual household. Study findings demonstrated that the high acculturation group was significantly more obese in comparison to Hispanic immigrants who had been in the United States less than 10 years and Hispanic immigrants who had been in the United for more than 10 years but were from predominantly Spanish-speaking households (31.4%, 40.9%, and 49.5%, respectively). Moreover, the Mexican residents in this study had an even lower obesity prevalence at 25.7% (Glick & Yabiku, 2015).

In another study, Estrella et al. (2019) examined individuals who are obese but metabolically healthy (i.e., metabolically healthy obesity [MHO] phenotype). The MHO phenotype is characterized by obesity (defined in this study as BMI ≥ 30 kg/m^2) coupled with the absence of cardiometabolic abnormalities such as elevated BP and BG and abnormal lipids. This study found that Hispanics with higher acculturation (as defined by nativity and language preference) were more likely to have the MHO phenotype in comparison with Hispanics with lower acculturation (Estrella et al., 2019). Among women, duration in the United States was associated with the MHO phenotype; women who had been in the United States fewer years were more likely to have the MHO phenotype (Estrella et al., 2019). It is important to note that fewer than 10% of the study participants were classified with the MHO phenotype, indicating that few Hispanics with obesity are metabolically healthy (Estrella et al., 2019).

Acculturation and Health Behaviors

Diet. There is evidence to support the association of acculturation with poor dietary quality among Hispanics (Ayala, Baquero, & Klinger, 2008; Bolstad & Bungum, 2013; Duffey, Gordon-Larsen, Ayala, & Popkin, 2008; Langellier, Brookmeyer, Wang, & Glik, 2015; Reininger, Lee, Jennings, Evans, & Vidoni, 2017; Yoshida et al., 2017). Research investigating the association between acculturation and diet found that lesser acculturated adults had higher consumption of fruit, vegetables, beans, grains, and legumes and a lower intake of salty snacks, desserts, sugar-sweetened beverages, and added dietary fats (Ayala et al., 2008; Bolstad & Bungum, 2013; Pérez-Escamilla, 2011; Pérez-Escamilla & Putnik, 2007).

Multiple studies have linked nativity and language with higher quality diet (Bolstad & Bungum, 2013; Duffey et al., 2008; Perez-Escamilla, 2011; Reininger et al., 2017; Zhang, Meijgaard, Shi, Cole, & Fielding, 2015). For example, adults born in Mexico had a higher consumption of fruit, vegetables, grains, and legumes and a lower intake of salty snacks, desserts, and added dietary fats (Perez-Escamilla, 2011). Mexican American women born in Mexico had a lower intake of fat, and women who spoke predominantly English had lower intakes of fruit and vegetables compared with women who predominantly spoke Spanish (Perez-Escamilla, 2011). In another study, Hispanics born outside of the United States had higher intake of legumes, fruits, and low-fat/high-fiber breads and lower intake of fast food, snacks, and desserts when compared to native-born Hispanics. Hispanics who prefer using the Spanish language also had a higher intake of legumes, rice, fruits, soups, and potatoes (Duffey et al., 2008). Research has also shown that U.S.-born women who speak predominantly English tended to have the lowest fruit and vegetable intakes (Pérez-Escamilla, 2011). Additional research demonstrated that being born in the United States was associated with an overall higher intake of calories (total energy) and a lower proportion of energy intake from fruits and vegetables (Duffey et al., 2008).

In another study, Bolstad and Bungum (2013) found that greater acculturation (as determined by language preference) was significantly predictive of lower fruit and vegetable consumption. Then too, Reininger et al. (2017) found Hispanic women and men who preferred to speak Spanish were more likely to report an intake of healthy foods. Additionally, Hispanic women and men who prefer to speak Spanish were less likely to have a higher unhealthy eating pattern (Reininger et al., 2017). In contrast, another study showed that participants who prefer Spanish had a higher intake of sugar-sweetened beverages (Park, Blanck, Dooyema, & Ayala, 2016). Using a different measure of acculturation (years in the United States), the same researchers found that sugar-sweetened beverage intake among Hispanics who had been in the United States more than five years was almost two and a half to three times higher than those who had been in the United States less than five years (Park et al., 2016).

An interesting finding by Grimm and Blanck (2011) revealed that higher acculturation (determined by language preference) was associated with lower fruit intake; however, higher acculturation was also associated with higher vegetable intake among Hispanics (when compared to lower acculturation). Although there are some conflicting findings, evidence indicates that the healthy aspects of the Latino diet appear to be negatively impacted during the acculturation process (Ayala et al., 2008). Access to traditional foods may be critical as areas with a high density of Hispanics (ethnic enclaves) have been shown to have greater availability of traditional Hispanic foods such as familiar fruits, vegetables, and legumes, which have been linked to better health outcomes (Kershaw et al., 2013; Yeh et al., 2008; Zhang et al., 2015).

Physical activity. The majority of Hispanics in the United States do not meet the recommended guidelines for physical activity (Abraido-Lanza, Florez, & Shelton, 2017). The connection between acculturation and physical activity is not clear. For example, Latinas living in ethnic enclaves had lower acculturation levels with higher participation in physical activity (Lopeź, Bryant, & McDermott, 2008). Results from Joseph et al.'s study (2018) supported this finding as their results also found that lower acculturation (assessed using the Hazuda Acculturation and Assimilation Scales) was associated with higher levels of moderate-to-vigorous physical activity than among participants with higher acculturation. High occupational physical activity was associated with being born outside of the mainland United States (Chasan-Taber et al., 2007). Consistent with this finding, Marquez and McAuley (2006) reported lower occupational physical activity among more acculturated Hispanics.

Conversely, other research findings indicate that lower acculturation is associated with lower physical activity levels (Chasan-Taber et al., 2007; Echeverría et al., 2013; Pérez-Escamilla & Putnik, 2007; Vermeesch & Stommel, 2014). More acculturated Hispanics (determined by degree of English spoken) were more likely to engage in vigorous-intensity leisure time physical activity in comparison to Hispanic adults with lower acculturation levels (Lopez & Yamashita, 2018). Additionally, other research has not found a relationship between physical activity level and acculturation. Guinn, Vincent, Wang, and Villas (2011) assessed acculturation using the Marin and VanOss Marin language-use acculturation scale and did not find a significant difference in leisure-time physical activity level between Hispanics with high or low acculturation levels. Similarly, Fieser (2013) found no significant difference in physical activity level based on acculturation as measured by the SASH. Merchant et al. (2015) also found no differences in physical activity level (assessed as sedentary time) based on the acculturation proxies of language preference, nativity, and duration in the United States.

Although much of the current research indicates that Hispanics are sedentary, some research (although not focused on acculturation) has determined that Hispanics may have higher levels of physical activity than what is generally discussed (Abraido-Lanza, Florez, & Shelton, 2017). Using objective physical activity measures versus self-report, research by Ross (2015) and Gay and Buchner (2014) determined that Hispanics have higher physical activity levels than non-Hispanic Whites. This may be due to higher levels of occupational physical activity among Hispanics (Gay & Buchner, 2014). This discrepancy highlights the need to assess physical activity objectively (e.g., pedometers) and to include different types of physical activity (not just leisure physical activity) when assessing total physical activity (Abraido-Lanza et al., 2017).

Acculturation and MetS

There have been few studies that have examined acculturation and MetS prevalence among Hispanics. Currently, the relationship between acculturation and MetS prevalence is inconclusive as available data reflect both positive and negative relationships between acculturation and MetS. An increase in MetS prevalence has been associated with increasing duration in the United States (Nelson, Pérez, Alcaraz, Talavera, & McCarthy, 2007). A study of young Mexican and Mexican American women found that increased acculturation (measured with the SASH and nativity) was related to individual factors of MetS and increased risk of MetS (Vella et al., 2011). Among older Mexican Americans, higher acculturation (measured using the ARSMA-II) was associated with lower MetS risk among immigrants but not in U.S.-born older Mexican American adults (González et al., 2011). In this same study, nativity was not associated with MetS risk (Gonzalez et al., 2011). Espinosa de los Monteros et al. (2008) reported that higher acculturation (measured using the ARSMA-II and years in the United States) was inversely associated with the prevalence of MetS in Mexican American women. In another study, higher ethnic pride, an acculturation variable of Balcazar's General Acculturation Index, was associated with lower risk of MetS (de Heer et al., 2011).

Summary

MetS is a prevalent and growing national problem (Aguilar et al., 2015; Jain & Saraf, 2010). Hispanics are disproportionately affected by MetS and its associated conditions (Aguilar et al., 2015; AHA, 2016; CDC, 2017d). Evidence indicates that immigrants are healthier upon arrival, but their health tends to deteriorate with longer duration in the United States (i.e., immigrant paradox) (Afable-Munsuz & Pérez-Stable, 2017; Schwartz & Unger, 2017). Conflicting findings tend to plague acculturation studies (Fox et al., 2017) and are likely due to the variation in measures assessing acculturation (Schwartz & Unger, 2017) as well as "shortcomings in the conceptualization and operationalization of acculturation" in health research (Fox et al., 2017, p. 125). Despite the inherent flaws of acculturation research (Zambrana & Carter-Pokras, 2010) and uncertainty as to the exact mechanism(s) of influence, it is important to recognize and examine the influence of acculturation on the health of Hispanics (Thomson & Hoffman-Goetz, 2009; Wallace et al., 2010). Research examining the effect of acculturation on health outcomes among Hispanics can provide an "understanding [of] the acculturation–health relationship across the life span [affording] health scientists opportunities of identifying critical developmental periods for improving the public health of this increasingly important segment of the U.S. population" (González et al., 2011, p. 1113).

The conflicting findings along with the varying measures of acculturation used in health research, the high prevalence of MetS in Hispanics, and the limited number of studies examining acculturation and MetS in Hispanics indicate a need for additional studies examining the relationship between acculturation and MetS in Hispanics. The findings of such research can provide information that can be used to tailor interventions to the acculturation level of Hispanic individuals that may aid in the reduction of health disparities among Hispanics in the United States.

CHAPTER III

METHODOLOGY

Few studies have examined the relationship between acculturation indicators and MetS among Hispanics, and the existing studies have reported conflicting findings. The purpose of this study was to use secondary data to examine the relationship between acculturation indicators and MetS among Hispanic adults living in the DFW metropolitan area. Chapter Three describes the research design and approach to answering the following research questions:

- Research Question 1. Is there a relationship between acculturation indicators (nativity, duration in the United States, and the Short Acculturation Scale for Hispanics [SASH] score) and MetS among Hispanics living in Dallas-Fort Worth (DFW)?
- Research Question 2. Is there a relationship between acculturation indicators (nativity, duration in the United States, and the Short Acculturation Scale for Hispanics [SASH] score) and the individual markers associated with MetS (high waist circumference, high blood pressure, elevated fasting blood glucose, elevated blood triglycerides, and reduced high-density lipoprotein cholesterol) among Hispanic adults living in DFW?

This chapter discusses procedures, data collection, protection of human subjects, measures, instrumentation, data preparation and cleaning, data recoding, and data analyses.

Procedures and Data Collection

This study utilized secondary data collected from a larger study investigating health outcomes among Latinos. The primary study included 128 Latino adults recruited from Latino-serving community centers, churches, and health fairs in DFW in 2014. Participants completed a questionnaire that assessed demographics, their health behaviors (e.g., diet, physical activity, preventive care such as a physical exam or a dental exam), and acculturation level (e.g. nativity, duration in the United States). The participants also completed a health screening consisting of body composition (e.g., height, weight, and WC), blood pressure assessment, and blood draw via venipuncture for laboratory analysis. Laboratory analysis consisted of several measures; however, this study specifically addressed the items related to MetS (i.e., HDL, FBG, and TG).

Protection of Human Participants

This study was a secondary data analysis. Participants were not contacted for the purpose of this study and their contact information remained confidential. Study data did not contain identifying information; therefore, this study was granted exempt status by the Texas Woman's University Institutional Review Board (see Appendix A).

Measures

Metabolic Syndrome

The ATP III revised MetS criteria were used for this study (Grundy et al., 2005) as the ATP III definition is one of the most widely used criteria of MetS (Galassi, Reynolds, & He, 2006; Handelsman, 2009; Huang, 2009; Kassi et al., 2011). There must be at least three of the following five risk factors for an individual to be diagnosed with MetS: enlarged WC of >40 inches in men or >35 inches in women; elevated (BP) with a systolic BP ≥130 mmHg or a diastolic BP ≥85 mm Hg; and elevated FBG ≥100 mg/dL; elevated TG of ≥ 150 mg/dL; and reduced HDL cholesterol of <40 mg/dL in men and <50 mg/dL in women (Grundy et al., 2005).

Acculturation

There is no universally accepted method for measuring acculturation (Ellison, Jandorf, & Duhamel, 2011). Proxy measures of acculturation in this study included number of years residing in the United States and nativity (born in the United States and born outside of the United States); both measures are commonly used in similar research studies (Wallace et al., 2010). The SASH was also used to assess acculturation as described in the Instrumentation section.

Instrumentation

The SASH was used to measure acculturation in the primary study (see Appendix B). The SASH is a 12-item scale developed by Marin et al. as an acculturation scale that can be used with any Latino subgroup (Marin, Sabogal, VanOss Marín, Otero-Sabogal, Pérez-Stable, 1987). The SASH consists of three factors: language use (5 items), media (3 items), and ethnic social relations (4 items) (Marin et al., 1987). To arrive at a total acculturation score, responses across the 12 items are averaged and can range from 1 to 5. Participants respond to each item using a five-point bipolar scale where 1 is "Only Spanish" and 5 is "Only English", with a midpoint (3) of "Both equally." To score the SASH, the average rating across all answered items is calculated. An average rating of 2.99 is the recommended cut point where scores above this rating represent higher levels of acculturation, and scores below this rating represent lower levels of acculturation (Marin et al., 1987).

The SASH has been utilized in multiple research studies (e.g., Fieser, 2013; Isasi et al., 2015; Perez, 2015; Vella et al., 2011) and has high reliability and validity (Ellison et al., 2011; Marín et al., 1987). According to Marin et al. (1987), the SASH was reliable with an alpha-coefficient of 0.92. Among a sample of 363 Hispanic adults, the SASH was highly correlated with the following validation criteria: respondents' generation, length of residence in the United States, age of arrival, ethnic self-identification, and an acculturation index (Marin et al., 1987).

Data Preparation and Cleaning

Data were examined for errors that could influence the study results using the IBM SPSS Statistics for Windows, version 25 (IBM Corp., 2017). Errors in the data can lead to incorrect analysis, thereby increasing the probability of drawing inaccurate conclusions. Therefore, data cleaning is the process of identifying and correcting errors present in the data set to reduce their effects on the data analysis (Van den Broeck, Argeseanu Cunningham, Eeckels, & Herbst, 2005).

After preparing the data for analysis, the primary researcher observed that out of 128 recorded cases, 25 cases contained missing data (19.5%); and out of 24 variables, 24 variables contained missing data (100%). Of the 3,072 total observations, there were 156 missing values, which amounted to 5.1% missing information in the dataset. To assess whether the pattern of missing values was missing completely at random (MCAR), Little's MCAR test was conducted (Little, 1988). The null hypothesis of Little's MCAR test is that the data pattern is MCAR and follows a $\chi 2$ distribution. Using an expectation-maximization algorithm, the MCAR test estimates the univariate means and correlations for each of the variables. The results revealed that the pattern of missing values in the data was MCAR, $\chi 2$ (129) = 146.39, p = .140. Statistical analysis revealed no statistically significant differences in study variables for those with missing versus complete data.

Next, the dataset was checked for invalid cases and values as invalid data can reflect inaccurate, inattentive, or careless response values. These types of data can bias findings; therefore, invalid data were identified and removed from the dataset. Nonvalid values were identified in the dataset. The researcher of the current study was also one of the researchers involved with the original, primary study. At the time of the primary study, the current researcher identified two WC values as improbable as they were not consistent with the participants of the study. The two improbable values were removed from the data set. No duplicate cases were identified in the dataset.

Data Recoding

Continuous variables WC, SBP, DBP, TG, FBG, and HDL were recoded into new variables using the 2005 ATP III revised MetS criteria. The new variables identified normal values (did not meet criteria for MetS) and abnormal values (met criteria for Mets). SBP and DBP were combined into one variable, BP. The new BP variable coded SBP ≥130 mmHg or a DBP ≥85 mmHg (or both) as abnormal BP and values below 130/85 as normal BP. These new variables were then recoded into a new variable identifying if the participant had MetS (MetS present/not present). Nativity was recoded so that the direction of the variable moved from lower acculturation to higher acculturation (non-U.S. born to U.S. born). This recoding aligned the direction of the variable with duration in the United States and SASH scores. Duration in the United States was recoded from a continuous variable into a dichotomous variable (fewer than 20 years in the United States and 20 years or more in the United States). The 20-year cut point was utilized as it has been used in other research and shown that diabetes risk increases at this point (O'Brien, Alos, Davey, Bueno, & Whitaker, 2014; Oza-Frank, Chan, Liu, Burke, & Kanaya, 2013). Each participant's SASH score was recoded from a continuous variable into a dichotomous variable (lower acculturation [≤2.99] and higher acculturation [>2.99]). The SASH score cut points were established by Marin et al. (1987). Education was collapsed and recoded from a seven-category variable into a three-category variable. The collapsed categories included: 1) No school and middle school collapsed into some high school, 2) High school diploma/GED and some college/trade school collapsed into high school diploma/GED, and 3) Bachelor's degree, master's degree, and professional degree collapsed into college graduate or higher. The researcher also intended to use household income as a study variable; however, there were too many participants with missing income data (44.5%). Age was recoded from a continuous variable to a categorical variable with four response levels (18-29 years, 30-39 years, 40-49 years, and 50 years and older).

Data Analysis

Secondary data analysis was performed using SPSS version 25 (IBM Corp, 2017). Frequencies and percentages were calculated for all categorical-level data (i.e., sex, age, education, nativity, acculturation orientation [SASH score], duration in the United States, MetS status [present/not present], and the five MetS markers [WC, BP, FBG, TG, and HDL]).

Preliminary analyses were conducted to test relationships among the variables. The chi-square test for association was used to check the relationships between categorical variables (nativity, sex, education categories, and age categories) and MetS status (present/not present). The chi-square test for association was also used to check the relationships between categorical variables (nativity, sex, education categories, and age categories) and the five individual MetS markers (WC, BP, FBG, TG, and HDL). *T*-tests were used to analyze relationships between continuous variables of duration in the United States, SASH score, and age and dichotomous MetS status (present/not present).

The data were bootstrapped to check for the stability of the results. Bootstrapping is used to make the sample more representative of the population through multiple random resamplings of the respondents. This method derives estimates for confidence intervals and standard errors for complex parameters (Singh & Xie, n.d.). All tables presented are based on non-bootstrapped data, as the results with bootstrapping were consistent with the results without bootstrapping.

Factor analysis was used to create a single acculturation composite score that represented the three indicators of acculturation: nativity, duration in the United States, and SASH score. The factor scores (i.e., acculturation factor) were used in different logistic regression models.

Four logistic regression models were conducted to predict MetS status (present/not present) by nativity, duration in the United States, SASH score, acculturation factor, and covariates (sex, age, and education). The first model had only independent variables. The second model added covariates. The third model was the acculturation factor, and the last model was the acculturation factor added with covariates.

Additional analyses were conducted to assess the relationship between each individual marker of MetS (WC, BP, FBG, TG, and HDL) and nativity, duration in the United States, SASH score, acculturation factor, and covariates (sex, age, and education). The first model had only independent variables. The second model added covariates. The third model was the acculturation factor, and the last model was the acculturation factor added with covariates.

CHAPTER IV

RESULTS

The purpose of this study was to address the gap in the literature regarding the relationship between acculturation indicators and MetS among a sample of Hispanic adults in Texas. Chapter Four presents the results of this study and is divided into three sections: 1) final sample and descriptive statistics, 2) analysis and interpretation, and 3) summary.

Final Sample and Descriptive Statistics

Frequencies and percentages for categorical variables are displayed in Table 1. Most participants were female (68.8%), aged 40 and older (57.1%), and born outside of the United States (82.8%). The mean age of the participants was 43.57 years (*SD* 12.04 years). More than half of the participants had been in the United States for fewer than 20 years (54.7%) and were less acculturated according to their SASH score (77.3%). The mean duration in the United States was 19.79 years (*SD* 12.18 years). The mean SASH score was 1.96 (*SD* 1.04). More than one-third of the participants had MetS (35.2%). Prevalence of MetS was higher among females compared to males (37.5% vs. 32.4%). Most participants had abnormal HDL (58.6%) and WC (53.9%). Most female participants had abnormal WC (65.9%) and abnormal HDL (64.8%). Most males also had abnormal HDL (52.9%).

Table 1

Frequencies and Percentages for Categorical Variables

Variable	*n*	*%*
Sex		
Male	34	26.6
Female	88	68.8
Age		
18-29y	12	9.4
30-39y	36	28.1
40-49y	44	34.4
50y+	29	22.7
Level of Education		
Some high school	46	35.9
High school diploma/GED	59	46.1
College graduate or higher	18	14.1
Born in the US		
No	106	82.8
Yes	16	12.5
Acculturation Orientation (SASH Score)		
Less Acculturated	99	77.3
More Acculturated	23	18.0
Duration in the US		
<20y	70	54.7
≥20y	51	39.8
MetS Present		
No	67	52.3
Yes	45	35.2
WC		
Normal	49	38.3
Abnormal	69	53.9
BP		
Normal	87	68.0
Abnormal	37	28.9
FBG		
Normal	68	53.1
Abnormal	49	38.3
TG		
Normal	95	74.2
Abnormal	22	17.2
HDL		
Normal	35	27.3
Abnormal	75	58.6

Note. Less acculturated is defined as SASH score ≤2.99; more acculturated is defined as SASH score >2.99. Abnormal waist circumference is defined as >40 inches for men and >35 inches for women. Abnormal blood pressure is defined as systolic blood pressure ≥130 mmHg or a diastolic blood pressure ≥85 mm Hg. Abnormal fasting blood glucose is defined as ≥100 mg/dL. Abnormal triglycerides defined as ≥150 mg/dL. Abnormal high-density lipoprotein cholesterol is defined as <40 mg/dL for men and <50 mg/dL for women. GED = general education diploma

Analysis and Interpretation

Research Question 1: Is there a relationship between acculturation indicators (nativity, duration in the United States, and the Short Acculturation Scale for Hispanics [SASH] score) and MetS among Hispanics living in Dallas-Fort Worth (DFW)?

Research Question 1: Analysis

A chi-square test for association was performed to examine the relationship between nativity, sex, level of education, age, and MetS (see Table 2). There was not a statistically significant difference in MetS status between participants born in the United States and those born outside of the United States, $\chi^2 = 2.31$ (1), $p = 0.129$. A limitation of this analysis was that the sample size of individuals born in the United States was small ($n = 14$). There was no statistically significant difference in MetS status based on sex, $\chi^2 = .31$ (1), $p = 0.577$ or age, $\chi^2 = 4.15$ (3), $p = 0.246$. There was a statistically significant difference in MetS status based on level of education, $\chi^2 = 8.27$ (2), $p = 0.016$. Participants with a college degree or higher were less likely to have MetS. Most participants with a college degree or higher did not have MetS (93.3%).

Independent samples *t*-tests were performed to compare participants with MetS and participants without MetS on age, duration in the United States, and SASH Score. The two groups, participants without MetS ($M = 42.03$, $SD = 10.74$) and with MetS ($M = 46.64$, $SD = 13.21$), significantly differed in age $t(107) = 1.99$, $p = .049$. Participants with MetS tended to be older. Results indicated that the two groups — without MetS ($M = 19.62$, $SD = 11.61$) and with MetS ($M = 20.56$, $SD = 14.24$) — did not differ on their mean years in the United States, *t*(108) = .38, *p* = .704. Results also indicated that participants without MetS (*M* = 2.08, *SD* = 1.17) and participants with MetS (*M* = 1.74, *SD* = 1.01) did not differ on their mean SASH score, *t*(103) = 1.55, *p* = .126.

Table 2

Descriptive Analysis of Hispanic Adults by Metabolic Syndrome (MetS) Status (n = 128)

	Does Not Have MetS		Have MetS		χ^2	*p*
	n	(%)	*n*	(%)		
Born in U.S.					2.31	.129
No	55	83.3	41	93.2		
Yes	11	16.7	3	6.8		
Sex					.31	.577
Male	20	29.9	11	25.0		
Female	47	70.1	33	75.0		
Level of Education					8.27	.016
Some high school	23	34.8	20	44.4		
High school diploma/GED	29	43.9	24	53.3		
College graduate or higher	14	21.2	1	2.2		
Age (categories in years)					4.15	.246
18-29	8	11.9	2	4.8		
30-39	19	28.4	13	31.0		
40-49	27	40.3	13	31.0		
50 or older	13	19.4	14	33.3		

Note. MetS presence indicates participant has three or more abnormal MetS makers. Abnormal waist circumference is defined as >40 inches for men and >35 inches for women. Abnormal blood pressure is defined as systolic blood pressure ≥130 mmHg or a diastolic blood pressure ≥85 mm Hg. Abnormal fasting blood glucose is defined as ≥100 mg/dL. Abnormal triglycerides defined as ≥150 mg/dL. Abnormal high-density lipoprotein cholesterol is defined as <40 mg/dL for men and <50 mg/dL for women. GED = general education diploma

Factor analysis was used to create a single acculturation composite score that represented the three indicators of acculturation: nativity, duration in the United States, and SASH score (acculturation factor). Table 3 shows the factor loadings of the acculturation indicators (nativity, duration in the US, and SASH score). There was a strong positive correlation between nativity and acculturation factor (.86). There was also a strong positive correlation between duration in the United States and acculturation factor (.74) and between SASH score and acculturation factor (.78). The acculturation factor explained 73% of the variance in nativity. The acculturation factor explained 55% of the variance in duration in the United States. Moreover, the acculturation factor explained 61% of the variance in SASH score. The eigenvalue indicates that the acculturation factor is a good indicator with a value of 1.88. The acculturation factor explained approximately 62.9% of the covariation among all three acculturation indicators.

Table 3

Factor Loadings on Acculturation Factor, Hispanic Adults

Indicator	Factor Loadings Acculturation Factor	h_j^2
Nativity Status (U.S. born)	.86	.73
Duration in United States (in years)	.74	.55
SASH score (5-point scale)	.78	.61
Eigenvalues	1.88	
% of variance explained	62.9	

Extraction method: Principle component analysis. No rotation performed as there was only one factor

Four logistic regression models were conducted to predict MetS status (present/not present) by nativity, duration in the United States, SASH score, acculturation factor, and covariates (sex, age, and education) (see Table 4). Logistic regression model 1 was not statistically significant at the .05 level of significance but was statistically significant at the .10 level of significance, χ^2 (3) = 7.04, p = .071. Model 1 explained 9.1% (Nagelkerke R^2) of the variance in MetS presence in Hispanic adults and correctly classified 57.4% of cases. Sensitivity was 19.5%, specificity was 83.3%, positive predictive value was 44.4%, and negative predictive value was 60.2%.

The three predictor variables (nativity, duration in the United States, and SASH score) were not significant at the .05 level of significance. However, duration in the United States was significant at the .10 level of significance (p = .074) (shown in Table 4). For every one-unit increase in a participant's duration in the US (measured in years), the likelihood of having MetS increased by 4%. After controlling for sex, age, and education, the three predictors in the logistic model 2 together accounted for 8.4% (Nagelkerke R^2) of the explanation for the presence of MetS in a sample of Hispanic adults; however, this model was not statistically significant. Acculturation factor in logistic model 3 accounted for 1.6% (Nagelkerke R^2) of the explanation for the presence of MetS in Hispanic adults. After controlling for sex, age, and education, acculturation factor one in logistic model 4 accounts for 3.5% (Nagelkerke R^2) of the explanation for the presence of MetS in a sample of Hispanic adults. There was no statistically significant relationship between the acculturation factor and the predictors, either when unadjusted or adjusted with the presence of covariates (see Table 4, Models 3 and 4).

Table 4

Logistic Regression Predicting Metabolic Syndrome (MetS) in Hispanic Adults.

Predictor	Unadjusted OR (95% CI) Model 1	Adjusted OR (95% CI)[a] Model 2	Unadjusted OR (95% CI) Model 3	Adjusted OR (95% CI)[a] Model 4
Nativity (U.S. born)	.22 (.03, 1.64)	.23 (.03, 1.79)		
Duration in United States (in years)	1.04 (.99, 1.08)*	1.03 (.99, 1.08)		
SASH score (5-point scale)	.78 (.48, 1.25)	.87 (.51, 1.46)		
Acculturation Factor			.78 (.53, 1.21)	.89 (.56, 1.40)
-2 log likelihood	129.36	123.68	135.22	127.38
Model χ^2	7.04*	6.20	1.20	2.51
Pseudo R^2	.091	.084	.016	.035
n	101	97	101	97

$^{*}p < .10$ $^{**}p < .05$ $^{***}p < .01$
OR=odd ratios; CI=confidence intervals
Dependent variable MetS coded as 1 = present and 0 = not present
[a]After controlling for sex, age, and education
Nativity reference category is non-U.S. born

Research Question 2: Is there a relationship between acculturation indicators (nativity, duration in the United States, and the Short Acculturation Scale for Hispanics [SASH] score) and the individual markers associated with MetS (high waist circumference, high blood pressure, elevated fasting blood glucose, elevated blood triglycerides, and reduced high-density lipoprotein cholesterol) among Hispanic adults living in DFW?

Research Question 2: Analysis

Chi-square tests for association were performed to examine the relationship between nativity, sex, level of education, age; and the five MetS markers (WC, BP, FBG, TG, and HDL) (see Tables 5 - 9). There was a statistically significant difference in abnormal WC status based on sex, $\chi^2 = 15.91$ (1), $p < .001$. Hispanic women were more likely have an abnormal WC status than Hispanic men. The difference in abnormal WC based on age was not statistically significant at the .05 level of significance but was statistically significant at the .10 level of significance, $\chi^2 = 6.61$ (3), $p = .085$ (as shown in Table 5). Younger participants (age 18-29) were more likely to have normal WC status. There was a statistically significant difference in abnormal BP status based on age, $\chi^2 = 10.85$ (3), $p = .013$ (as shown in Table 6). Participants with abnormal BP were more likely to be older (age 50 or older). There was a statistically significant difference in abnormal FBG status based on level of education, $\chi^2 = 8.92$ (2), $p = .012$; and age, $\chi^2 = 8.36$ (3), $p = .039$ (as shown in Table 7). Participants with a college degree or higher and participants age 18-29 were less likely to have abnormal FBG. There were no statistically significant differences in abnormal TG status based on nativity, sex, level of education, and age (see Table 8). There were no statistically significant differences in abnormal HDL status based on nativity, sex, level of education, and age (see Table 9).

Table 5

Descriptive Statistics of Hispanic Adults by Waist Circumference (n = 118)

	Normal Waist Circumference		Abnormal Waist Circumference		χ^2	*p*
	n	(%)	*n*	(%)		
Born in U.S.					1.02	.314
No	40	83.3	61	89.7		
Yes	8	16.7	7	10.3		
Sex					15.91	.000
Male	23	46.9	9	13.4		
Female	26	53.1	58	86.6		
Level of Education					3.04	.219
Some high school	14	29.2	31	44.9		
High school diploma/GED	26	54.2	30	43.5		
College graduate or higher	8	16.7	8	11.6		
Age (categories in years)					6.61	.085
18-29	8	16.7	2	3.0		
30-39	13	27.1	21	31.3		
40-49	17	35.4	27	40.3		
50 or older	10	20.8	17	25.4		

Note. Abnormal waist circumference is defined as >40 inches for men and >35 inches for women.

Table 6

Descriptive Statistics of Hispanic Adults by Blood Pressure (n = 119)

	Normal Blood Pressure		Abnormal Blood Pressure		χ^2	*p*
	n	%	*n*	%		
Born in U.S.					.65	.420
No	72	85.7	31	91.2		
Yes	12	14.3	3	8.8		
Sex					2.53	.112
Male	19	22.9	13	37.1		
Female	64	77.1	22	62.9		
Level of Education					3.52	.172
Some high school	29	34.5	17	48.6		
High school diploma/GED	41	48.8	16	45.7		
College graduate or higher	14	16.7	2	5.7		
Age (categories in years)					10.85	.013
18-29	10	11.9	1	3.0		
30-39	26	31.0	9	27.3		
40-49	35	41.7	9	27.3		
50 or older	13	15.5	14	42.4		

Note. Abnormal blood pressure is defined as systolic blood pressure ≥130 mmHg or a diastolic blood pressure ≥85 mm Hg.

Table 7

Descriptive Statistics of Hispanic Adults by Fasting Glucose (n = 112)

	Normal Fasting Glucose		Abnormal Fasting Glucose		χ^2	*p*
	n	%	*n*	%		
Born in U.S.					2.64	.104
No	54	83.1	43	93.5		
Yes	11	16.9	3	6.5		
Sex					1.10	.295
Male	16	24.2	15	33.3		
Female	50	75.8	30	66.7		
Level of Education					8.92	.012
Some high school	22	33.8	21	44.7		
High school diploma/GED	29	44.6	25	53.2		
College graduate or higher	14	21.5	1	2.1		
Age (categories in years)					8.36	.039
18-29	9	13.6	1	2.3		
30-39	21	31.8	11	25.0		
40-49	25	37.9	16	36.4		
50 or older	11	16.7	16	36.4		

Note. Abnormal fasting blood glucose is defined as ≥100 mg/dL.

Table 8

Descriptive Statistics of Hispanic Adults by Triglycerides (n = 112)

	Normal Triglycerides		Abnormal Triglycerides		χ^2	*p*
	n	%	*n*	%		
Born in U.S.					1.45	.229
No	77	85.6	20	95.2		
Yes	13	14.4	1	4.8		
Sex					.22	.640
Male	26	28.9	5	23.8		
Female	64	71.1	16	76.2		
Level of Education					.64	.728
Some high school	35	38.9	8	36.4		
High school diploma/GED	42	46.7	12	54.5		
College graduate or higher	13	14.4	2	9.1		
Age (categories in years)					5.09	.165
18-29	9	10.1	1	4.8		
30-39	28	31.5	4	19.0		
40-49	34	38.2	7	33.3		
50 or older	18	20.2	9	42.9		

Note. Abnormal triglycerides defined as ≥150 mg/dL.

Table 9

Descriptive Statistics of Hispanic Adults by High-density Lipoprotein (n = 110)

	Normal High-density Lipoprotein		Abnormal High-density Lipoprotein		χ^2	*p*
	n	%	*n*	%		
Born in U.S.					.97	.326
No	28	82.4	66	89.2		
Yes	6	17.6	8	10.8		
Sex					1.27	.259
Male	12	34.3	18	24.0		
Female	23	65.7	57	76.0		
Level of Education					1.09	.581
Some high school	11	32.4	31	41.3		
High school diploma/GED	17	50.0	35	46.7		
College graduate or higher	6	17.6	9	12.0		
Age (categories in years)					2.40	.494
18-29	5	14.3	5	6.8		
30-39	8	22.9	23	31.5		
40-49	12	34.3	28	38.4		
50 or older	10	28.6	17	23.3		

Note. Abnormal high-density lipoprotein cholesterol is defined as <40 mg/dL for men and <50 mg/dL for women.

Table 10 presents findings from independent-samples *t*-tests. Independent-samples *t*-tests were conducted to determine if there were differences in mean duration in the United States (in years), mean SASH score (5-point scale), and age between participants with normal and abnormal MetS markers (WC, BP, FBG, TG, and HDL). Results indicated that the two groups — those with normal MetS markers and abnormal MetS markers — did not differ on their mean duration in the United States and did not significantly differ on their mean SASH score at the .05 level of significance. However, participants with normal WC (*M* = 2.17, *SD* = 1.02) and abnormal WC (*M* = 1.81, *SD* = 1.14) differed on their mean SASH score at the .10 significance level, *t*(108) = 1.72, *p* = .089. Additionally, participants with normal BP (*M* = 18.29, *SD* = 10.51) and abnormal BP (*M* = 23.76, *SD* = 15.47) differed on their mean years (duration) in the United States at the .10 significance level, *t*(46.02) = 1.89, *p* = .065. Levene's test for equality of variance was significant (*p* = .013); therefore, equal variances were not assumed. Participants with normal BP (*M* = 41.25, *SD* = 10.63) and abnormal BP (*M* = 49.03, *SD* = 12.84) and participants with normal TG (*M* = 42.67, *SD* = 11.51) and abnormal TG (*M* = 48.48, *SD* = 12.43) significantly differed in their mean age at the .05 level of significance (*t*(115) = 3.35, *p* = .001 and *t*(108) = 2.05, *p* = .043, respectively). Participants with normal FBG (*M* = 42.15, *SD* = 12.61) and abnormal FBG (*M* = 46.23, *SD* = 10.29) differed in the mean age at the .10 level of significance, *t*(108) = 1.78, *p* = .077.

Table 10

Differences Between Individuals with Normal and Abnormal MetS Indicators

	Normal *M* (*SD*)	Abnormal *M* (*SD*)	*t*	*p*
Waist Circumference				
Duration in U.S. (in years)	22.15 (13.83)	18.52 (11.07)	1.56	.122
SASH score (5-point scale)	2.17 (1.02)	1.81 (1.14)	1.72	.089
Age	41.65 (11.03)	45.01 (12.20)	1.52	.132
Blood Pressure				
Duration in U.S. (in years)	18.29 (10.51)	23.76 (15.47)	1.89	.065
SASH score (5-point scale)	1.97 (1.06)	1.91 (1.19)	.28	.782
Age	41.25 (10.63)	49.03 (12.84)	3.35	.001
Fasting Glucose				
Duration in U.S. (in years)	19.14 (11.13)	21.09 (14.50)	.80	.426
SASH score (5-point scale)	2.07 (1.26)	1.78 (.85)	1.40	.164
Age	42.15 (12.61)	46.23 (10.29)	1.78	.077
Triglycerides				
Duration in U.S. (in years)	20.00 (11.99)	19.82 (15.32)	.06	.952
SASH score (5-point scale)	1.94 (1.11)	1.95 (1.15)	.03	.977
Age	42.67 (11.51)	48.48 (12.43)	2.05	.043
High-Density Lipoprotein Cholesterol				
Duration in U.S. (in years)	21.57 (13.48)	19.15 (12.48)	.92	.360
SASH score (5-point scale)	2.12 (1.08)	1.84 (1.14)	1.18	.242
Age	42.46 (10.48)	44.53 (12.61)	.84	.400

[a]M = Mean; [b]SD = Standard Deviation

Note. Abnormal waist circumference is defined as >40 inches for men and >35 inches for women. Abnormal blood pressure is defined as systolic blood pressure ≥130 mmHg or a diastolic blood pressure ≥85 mm Hg. Abnormal fasting blood glucose is defined as ≥100 mg/dL. Abnormal triglycerides defined as ≥150 mg/dL. Abnormal high-density lipoprotein cholesterol is defined as <40 mg/dL for men and <50 mg/dL for women.

Additional logistic regression models were conducted to predict individual markers of MetS (WC, BP, FBG, TG, and HDL) by nativity, duration in the United States, SASH score, acculturation factor, and covariates (sex, age, and education). BP and FBG were the only markers with models showing statistical significance (see Tables 11 and 12).

Logistic regression was performed to ascertain the effects of nativity, duration in the United States, SASH score, acculturation factor, and covariates (sex, age, and education) on blood pressure (see Table 11). Logistic regression model 1 was statistically significant, $\chi^2(3) = 9.32$, $p = .025$. The three predictors in model 1 together accounted for 11.3% (Nagelkerke R^2) of the variance in blood pressure in Hispanic adults and correctly classified 76.1% of cases. Sensitivity was 21.2%, specificity was 98.8%, positive predictive value was 87.5%, and negative predictive value was 75.2%. Of the three independent variables, only one was statistically significant: duration in the United States ($p = .006$). For every one-unit increase in a participant's duration in the United States (measured in years), the likelihood of having abnormal blood pressure increased by 6%.

Logistic regression model 2 was the adjusted model, controlling for sex, age, and education. Model 2 was statistically significant, $\chi^2(6) = 15.72$, $p = .015$. After controlling for sex, age, and education, the three predictors (nativity, duration in the United States, and SASH Score) in model 2 together accounted for 19.4% (Nagelkerke R^2) of the variance in blood pressure in Hispanic adults and correctly classified 78.7% of cases. Sensitivity was 35.5%, specificity was 96.1%, positive predictive value was 21.4%, and negative predictive value was 78.7%. After controlling for sex, age, and education, only one independent variable was statistically significant: duration in the United States (p = .014). For every one-unit increase in a participant's duration in the United States (measured in years), the likelihood of having abnormal blood pressure increased by 6%. Acculturation factor one in logistic model 3 accounted for 0.4% (Nagelkerke R^2) of the explanation for the presence of abnormal blood pressure in Hispanic adults. After controlling for sex, age, and education, acculturation factor one in logistic model 4 accounted for 13.6% (Nagelkerke R^2) of the explanation for the presence of abnormal blood pressure in Hispanic adults. Model 3 was not statistically significant, $\chi^2(1) = .33$, $p = .567$. Model 4 was statistically significant, $\chi^2(4) = 10.26$, $p = .036$. However, acculturation factor, when adjusted for sex, age, and education, was not a good predictor of abnormal blood pressure in this model (p = .154).

Table 11

Logistic Regression Predicting Blood Pressure in Hispanic Adults

Predictor	Unadjusted OR (95% CI) Model 1	Adjusted OR (95% CI)[a] Model 2	Unadjusted OR (95% CI) Model 3	Adjusted OR (95% CI)[a] Model 4
Nativity (U.S. born)	.25 (.04, 1.82)	.22 (.03, 1.67)		
Duration in United States (in years)	1.06 (1.02, 1.11)***	1.06 (1.01, 1.11)**		
SASH score (5-point scale)	.90 (.50, 1.63)	1.15 (.61, 2.17)		
Acculturation Factor			1.13 (.76, 1.68)	1.41 (.88, 2.26)
-2 log likelihood	127.18	113.77	130.23	113.33
Model χ^2	9.32**	15.72**	.33	10.26**
Pseudo R^2	.113	.194	.004	.136
n	113	108	107	102

*$p < .10$ **$p < .05$ ***$p < .01$
OR=odd ratios; CI=confidence intervals
Dependent variable blood pressure coded as 1 = abnormal and 0 = normal
Abnormal blood pressure defined as a systolic blood pressure greater than or equal to 130 mmHg or a diastolic blood pressure greater than or equal to 85 mm Hg
[a]After controlling for sex, age, and education
Nativity reference category is non-U.S. born

Logistic regression was also performed to ascertain the effects of nativity, duration in the United States, SASH score, acculturation factor, and covariates (sex, age, and education) on fasting blood glucose (see Table 12). Logistic regression model 1 was statistically significant, $\chi^2(3) = 9.06$, $p = .029$. The three predictors in model 1 together accounted for 10.8% (Nagelkerke R^2) of the variance in fasting blood glucose in Hispanic adults and correctly classified 57.4% of cases. Sensitivity was 28.3%, specificity was 79.0%, positive predictive value was 50.0%, and negative predictive value was 59.8%. Of the three predictor variables, only one was statistically significant: duration in the US. For every one-unit increase in a participant's duration in the United States (measured in years), the likelihood of having abnormal fasting blood glucose increased by 5%.

After controlling for sex, age, and education, the three predictors (nativity, duration in the United States, and SASH Score) in logistic model 2 together accounted for 14.3% (Nagelkerke R^2) for the variance in fasting blood glucose in Hispanic adults. Acculturation factor in logistic model 3 accounted for 1.2% (Nagelkerke R^2) of the variance in fasting blood glucose in Hispanic adults. After controlling for sex, age, and education, acculturation factor in logistic model 4 accounted for 11.1% (Nagelkerke R^2) for the variance in fasting blood glucose in Hispanic adults. Models 2, 3, and 4 were not statistically significant at the .05 level of significance. Model 4 was significant at the .10 level of significance, $\chi^2(4) = 8.33$, $p = .080$. However, acculturation factor, when adjusted for sex, age, and education, was not a good predictor of abnormal FBG (p = .647).

Table 12

Logistic Regression Predicting Fasting Blood Glucose in Hispanic Adults

Predictor	Unadjusted OR (95% CI) Model 1	Adjusted OR (95% CI)[a] Model 2	Unadjusted OR (95% CI) Model 3	Adjusted OR (95% CI)[a] Model 4
Nativity (U.S. born)	.38 (.06, 2.51)	.44 (.07, 2.99)		
Duration in United States (in years)	1.05 (1.00, 1.09)**	1.03 (.99, 1.08)		
SASH score (5-point scale)	.64 (.35, 1.16)	.72 (.39, 1.34)		
Acculturation Factor			.83 (.55, 1.24)	.90 (.57, 1.42)
-2 log likelihood	138.29	127.76	138.57	123.14
Model χ^2	9.06**	11.51*	.90	8.33*
Pseudo R^2	.108	.143	.012	.111
n	108	103	102	97

*$p < .10$ **$p < .05$ ***$p < .01$
OR=odd ratios; CI=confidence intervals
Dependent variable fasting blood glucose coded as 1 = abnormal and 0 = normal
Abnormal fasting glucose is defined as greater than or equal to 100 mg/dL;
[a]After controlling for sex, age, and education
Nativity reference category is non-U.S. born

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

This chapter includes a summary and discussion of this study in relation to findings in previous research, implications for health education and health practitioners, limitations of the study, and recommendations for future research and practice.

The purpose of this study was to use secondary data to examine the relationship between acculturation indicators and MetS among Hispanic adults living in DFW. The researcher utilized secondary data collected from a larger study investigating health outcomes among Latinos recruited from Latino-serving community centers, churches, and health fairs in DFW in 2014. Participants completed a questionnaire that assessed demographics, their health behaviors, and acculturation level. The participants also completed a health screening consisting of body composition, blood pressure assessment, and blood draw via venipuncture for laboratory analysis.

The chi-square test for association and t-tests were used to analyze relationships between variables. Factor analysis was used to create a single acculturation composite score that represented the three indicators of acculturation: nativity, duration in the United States, and SASH score. The factor scores (i.e., acculturation factor) were used in different logistic regression models. Logistic regression modeling was conducted to predict MetS status and abnormal MetS markers by acculturation indicators and acculturation factor.

Conclusion

Hypotheses	Conclusion	Explanation
Hypothesis 1	Accepted	No statistically significant relationship found between acculturation indicators and MetS among Hispanics living in DFW.
Hypothesis 2	Partially Rejected	Acculturation indicator Duration in the United States was associated with a statistically significant increased risk of having an abnormal BP and FBG among Hispanics living in DFW.

Figure 2. Summary of Hypotheses and Conclusions

*Hypothesis 1: There will be no relationship between acculturation indicators (nativity, duration in the United States, and SASH score) and MetS among Hispanics living in DFW (see Figure 2)***.**

The chi-square test for association was used to assess the relationship between nativity and MetS status (present/not present). T-tests were used to analyze relationships between duration in the United States and SASH score and MetS status. Logistic regression modeling was conducted to predict MetS status by acculturation indicators (nativity, duration in the United States, and SASH score) and acculturation factor. The hypothesis was accepted, as there was no statistically significant association between acculturation and MetS.

Hypothesis 2: There will be no relationship between acculturation indicators (nativity, duration in the United States, and the Short Acculturation Scale for Hispanics [SASH] *score) and the individual markers associated with MetS (high waist circumference, high blood pressure, elevated fasting blood glucose, elevated blood triglycerides, and reduced high-density lipoprotein cholesterol) among Hispanic adults living in DFW (see Figure 2)***.**

The chi-square test for association was used to assess the relationships between nativity and the five individual MetS markers (WC, BP, FBG, TG, and HDL). *T*-tests were used to analyze relationships between duration in the United States and SASH score and the five individual MetS markers. Logistic regression modeling was conducted to predict abnormal MetS markers by acculturation indicators (nativity, duration in the United States, and SASH score) and acculturation factor. The hypothesis is partially rejected because some of the MetS markers were associated with acculturation indicators. SASH scores and nativity were not associated with abnormal MetS markers, and duration in the United States was not associated with MetS markers WC, HDL, and TG; however, duration in the United States was associated with MetS markers BP and FBG. For every one-unit increase in a participant's duration in the United States (measured in years), the likelihood of having abnormal BP increased by 6%. For every one-unit increase in a participant's duration in the United States (measured in years), the likelihood of having abnormal FBG increased by 6%.

Discussion and Implications

Consistent with estimates of MetS prevalence among Hispanics, 35% of participants in this study met the criteria for MetS (Aguilar et al., 2015). Also consistent with previous findings, the prevalence of MetS was higher among females in comparison to males (37.5% vs. 32.4%) (Heiss et al., 2014). Additionally, 35.9% of participants had less than a high school education, indicating lower education level is often linked to poorer health outcomes (WHO, n.d.-b.).

The findings of this study are consistent with study results reported by Vella et al. (2011) in which the SASH was not associated with MetS prevalence. The current study results are also consistent with Gonzalez et al.'s research (2011) as nativity was not significantly associated with MetS prevalence. However, the current study's findings are inconsistent with Nelson et al. (2007) who determined there was a significant association between MetS and duration in the United States (MetS risk increased with more years in the United States). Furthermore, the current study's findings are inconsistent with other studies examining acculturation and MetS prevalence as studies using a different acculturation scale (ARSMA-II) found that higher acculturation was associated with lower risk of MetS (de Heer et al., 2011; Espinosa de los Monteros et al., 2008; Gonzalez et al., 2011).

Duration in the United States was not significant at the .05 level of significant but was significant at the .10 level of significance (p = .074) (shown in Table 4). For every one-unit increase in a participant's duration in the United States (measured in years), the likelihood of having MetS increased by 4%. Although not statistically significant, this difference is notable and indicates that longer duration in the United States may have a negative impact on the MetS risk among Hispanics. Longer duration in the United States has been associated with increased risk of MetS and related conditions such as diabetes, CVD, and obesity (Ahmed et al., 2009; Daviglus et al., 2012; Isasi et al., 2015; Nelson et al., 2007; Rodriguez et al., 2012).

No statistically significant relationship was found between the SASH score and the five MetS markers, i.e., WC, BP, FBG, TG, and HDL. This is consistent with Vella et al.'s (2011) findings as their research revealed that the SASH score was not correlated with BG, HDL, TG, and SBP. Additionally, Chang et al. (2015) found that acculturation was not associated with SBP and BG (as assessed using hemoglobin A1c). However, the current study's results are inconsistent with Vella et al.'s (2011) research as their research revealed that the SASH score was positively correlated with WC and DBP.

In the current study, nativity was not significantly associated with the five MetS markers. Similarly, Vella et al. (2011) found in their study that nativity was not associated with BG, HDL, SBP, and WC. In contrast, they found that nativity was correlated with abnormal TG and DBP (Vella et al., 2011). Moran et al. (2007) reported that abnormal BP (hypertension) was associated with nativity as participants born in Mexico or South America had lower prevalence of hypertension. However, they also determined that participants born in the Caribbean or Central America had a higher prevalence of hypertension (Moran et al., 2007). In agreement with the current study, Moran et al. (2007) found that longer duration in the United States was associated with higher risk of hypertension in Hispanics. The relationship between acculturation and

MetS remains unclear as this study along with other studies have reported inconsistent findings with regard to the relationship between acculturation and MetS.

Acculturation Measures

Different measures of acculturation have been associated with conflicting relationships between acculturation and MetS status and MetS markers (de Heer et al., 2011; Espinosa de los Monteros et al., 2008; Gonzalez et al., 2011; Moran et al., 2007; Vella et al., 2011). The variability in the results may be due to the varying use of acculturation measures. Studies examining acculturation and MetS have used acculturation proxies such as language, nativity, and length of time in the United States as well as validated scales such as the SASH and ARSMA-II (de Heer et al., 2011; Espinosa de los Monteros et al., 2008; Gonzalez et al., 2011; Moran et al., 2007; Vella et al., 2011). Additionally, there is variation in the assessment of proxy measures of language and duration in the United States. For example, language acculturation has been measured by the language in which a study survey or questionnaire was completed (Ahmed et al., 2009), language stated as preferred (Daviglus et al., 2012), language spoken at home (Moran et al., 2007), or language proficiency (Joseph et al., 2018). Language is the most commonly used variable in acculturation research. It is used as a proxy measure for acculturation and often included in acculturation scales (Doucerain, Segalowitz, & Ryder, 2017).

The different measures of language assess different constructs, which further adds to the challenge of being able to interpret language acculturation. For instance, language use implies that greater use of one language leads to the reduced use of the other, whereas the question of preference does not have this implication (Doucerain et al., 2017). Additionally, self-reported language proficiency can be difficult to interpret as participants may assess their own proficiency depending on their own personal definitions of proficiency (Doucerain et al., 2017). Objective measures of language proficiency do not take into account an individual's language preference and household language that may better reflect an individual's orientation toward a culture. Duration in the United States and how that translates to acculturation level also varies. To illustrate, Moran et al. (2007) grouped participants into two categories: living in the United States 10 years or less (the lower acculturation group) and living in the United States for more than 10 years (the higher acculturation group). On the other hand, Nelson et al. (2007) did not categorize duration in the United States and kept the variable as continuous. The varying measures used and the variety of how the measures are operationalized further adds to the challenge of determining the relationship between acculturation and MetS (and other chronic conditions).

Acculturation-Health Relationship

The results of this study do not indicate causality as correlation analysis cannot determine cause. However, the association between duration in the United States and MetS warrants greater examination into the relationship between acculturation and health. Evidence indicates that immigrants are healthier upon arrival to the United States, but their health tends to deteriorate with longer duration (i.e., immigrant paradox)

(Afable-Munsuz & Perez-Stable, 2017; Schwartz & Unger, 2017); however, the role of acculturation in this phenomenon is not clear (Alcantara et al., 2017). Examining immigrant behavior changes that lead to poor health during the acculturation process can provide a better understanding as to how acculturation affects health. In addition, social and environmental factors in the receiving culture (United States) that influence health and health behaviors should be examined (Williams, Kubukuru, Mayo, & Griffin, 2011). Potential mediators or moderators between duration in the United States (acculturation) and risk of disease (such as Mets) may be changes in dietary habits including food choices and food preparation behaviors, physical activity level, and the built environment (Afable-Munsuz & Pérez-Stable, 2017).

Diet

Factors affecting dietary habits such as food choices, meal patterns, and meal preparation behaviors include food access, cost, busy schedules, and family structures. Among a focus group of 25 Mexican-American women in Oregon, self-reported changes in eating behavior included eating more processed foods, convenience foods, and dining out more frequently (Lindberg & Stevens, 2011). Explanations for these changes included adapting to the fast-paced culture of the United States, managing busy schedules (which reduces time for grocery shopping and meal preparation), and having less help from extended family (Lindberg & Stevens, 2011).

An interesting observation from this study was that food is perceived as not being very important in American culture, whereas food is very important in Mexican culture.

For the Mexican-American focus group participants, this perception seemed to translate to a "green light" for eating any food, with the only emphasis being on quantity. As one participant stated, "Here, it does not seem to matter what one eats, as long as there's a lot of it! They eat a lot here. We eat a lot here" (Lindberg & Stevens, 2011, p. 157). Other factors affecting dietary behaviors among the Mexican women in the focus group included being exposed to new and palatable foods such as Italian or Chinese food. The focus group participants shared that living in the United States made dining out more accessible and certain foods more affordable, such as ice cream (Lindberg & Stevens, 2011).

Participants also demonstrated awareness of healthy eating and the desire to follow a healthier diet (e.g., more water, less fat and sugar, and more vegetables); however, they had difficulty maintaining dietary changes (Lindberg & Stevens, 2011). Moreover, the desire to implement dietary changes was hindered by the women's concern for the impact their changes may have on the family (Lindberg & Stevens, 2011). For example, children may not like the healthier foods and refuse to eat them, making the women's efforts seem like a waste of time and food (Taverno Ross et al., 2018). In addition, an interesting perception was noted by the Mexican male focus group participants in the Alabama study. They felt that the woman had "absolute power in the kitchen," and it was disrespectful to decline food the woman had prepared (Martinez, Powell, Agne, Scarinci, & Cherrington, 2012, p. 494), implying that the women in the household can make any dietary changes they desire. In summary, the women seem more concerned about the impact they will have on the family, while the family (men) may see that following her dietary lead is the right thing to do. This disconnect may likely point to a need for better communication between family members about their goals and expectations (Martinez et al., 2012).

A focus group of 16 Mexican men in Alabama also shared a similar experience influencing their higher intake of fast/convenience food, including working long hours and losing their normal meal structure (Martinez et al., 2012).   Having set meal times at home and at work are a normal part of the Mexican culture but not the American culture. The male focus group participants believed that this loss of structured meal times is leading to poor dietary behaviors including reliance of convenience/fast food as well as skipping meals (Martinez et al., 2012). The loss of structured meal times can also affect familial and cultural unity as that shared time together (shared meal) is lost. This sentiment was echoed by a group of 29 Dominican women who attributed weight gain to disrupted meal patterns after immigrating to the United States (Weisberg-Shapiro & Devine, 2015). Meal times, food quantities, and food choices were all impacted, and the women believed these factors led to unwanted weight gain (Weisberg-Shapiro & Devine, 2015).

The “festival food syndrome” may also contribute to poor dietary habits and increased risk for MetS. The “festival food syndrome” is characterized by an increased consumption of ethnic festival foods that are typically high in processed carbohydrates, animal protein, sugar, and fat (Azar, Chen, Holland, & Palaniappan, 2013). This means that foods that were traditionally only consumed on special occasions (perhaps a few times a year) are now consumed on a regular basis due to increased access and affordability (Azar et al., 2013). The foods are traditional; however, the frequency in which they are now consumed is not reflective of normative (traditional) meals prepared at home in the country of origin (Azar et al., 2013). It is also important to point out that the intake of Western "junk" food may not necessarily be high in Hispanic immigrants; however, the effects of the Western diet trickle over into traditional foods transforming the traditional diets of immigrants. In other words, typical Western "junk" foods like hamburgers and hot dogs may not be the sole dietary problem, but traditional meals made with much higher animal protein than usual, more processed ingredients, and more frequent intake of "festival" foods like tamales may also be contributing to diet-related negative health outcomes (Azar et al., 2013).

The quality and cost of food accessible to Hispanics also influence dietary choices. Valdez et al. (2016) reported that participants felt that easy access to cheap, unhealthy food was a "bigger threat" to eating healthier foods than access to healthy food (p. 4). This "threat" is also highlighted by Paré, Body, Gilstorf, and Lucarelli's (2018) research in which participants identified ease of accessibility to cheap "junk food" a difficult challenge to overcome. Participants in Valdez et al.'s (2016) study reported having accessible produce; however, many participants felt that the accessible produce was not necessarily affordable. Participants described strategies for improving affordability of healthy foods such as researching cheaper options, looking for sales, and comparing prices among stores (Valdez et al., 2016). Although these may be effective strategies, these practices may be time-intensive; and choosing cheaper, more easily accessible foods, even if unhealthy, may prevail if time and financial constraints are present. There also appears to be a strong inclination towards convenience and ease, which may detract attention from making wise food choices.

Physical Activity

Factors affecting PA among Hispanics include time constraints, work-related PA, access to PA-promoting spaces, costs, social environment (e.g., social support networks [WHO, n.d.-b]), and cultural gender norms. Valdez et al. (2019) conducted a qualitative study in which they interviewed 14 Mexican men in Tucson, Arizona. The men revealed that working strenuous jobs may limit engagement in leisure-time PA, and they perceived the physically-demanding nature of the manual labor work as sufficient PA. In other cases, even if the men wanted to engage in leisure-time PA, they felt too fatigued to do so. Additionally, the focus group participants shared that they recalled engaging in more PA in Mexico outside of work such as playing sports and walking or biking for transportation.

This active lifestyle was facilitated by a more cohesive and active community and a built environment that supported walking and biking for transportation. The men also reported a desire to engage in sports as opposed to an individualized activity like walking. Moreover, they expressed an openness to increasing their PA but only if they had a partner (e.g. spouse, friend, family member) to join them in the activity (Valdez et al., 2019). This may be reflective of the collectivist (emphasis on the well-being of the group versus the individual) and familism (emphasis on immediate and extended family) values of Hispanics (Schwartz et al., 2010). The desire for social support integrated with PA was cited in other studies as well (Larsen, Pekmezi, Marquez, Benitez, & Marcus, 2013). Additionally, access to a gym was perceived as necessary to engage in PA, which creates barriers of access and affordability (Valdez et al., 2019). Similarly, a focus group cohort of 32 Hispanics in Pittsburgh associated PA with gym memberships and home exercise equipment, creating the perception that healthy living is expensive as these options were not affordable for the participants (Taverno Ross et al., 2018). Furthermore, outdoor PA was a challenge to the Pittsburgh residents due to cold weather and possibly dangerous conditions during the winter months (e.g., icy streets) (Taverno Ross et al., 2018).

An environment that is conducive to PA includes access to PA-promoting spaces. In one study, participants living in neighborhoods with more resources to support engaging in PA (determined by density of recreational facilities and neighborhood walkability) had smaller waistlines (Albrecht et al., 2015) that is indicative of a healthier body weight, suggesting that the neighborhood environments fostered physical activity. In addition, a focus group of 20 older Hispanics (age 50 or older) highlighted the importance of safe neighborhoods (as it relates to crime levels and sidewalk quality) to support engaging in regular PA (primarily walking in this particular population) (Marquez et al., 2016). Neighborhood safety was also expressed as a barrier by a focus group cohort of Hispanics (primarily women) in a Midwest urban community (Paré et al., 2018). Providing safe places where Hispanics (particularly women) can be active within their own neighborhood can increase PA engagement (Larsen et al., 2013). Additionally, providing access to culturally appropriate classes such as dance-based PA (e.g., Zumba) and group exercise classes led by a Spanish-speaking instructor can be effective in increasing PA levels among Hispanics (Larsen et al., 2013; Paré et al., 2018).

Gender norms also influence PA level among Latinas. Research indicates that cultural values such as marianismo (tendency of Latinas to prioritize their family's needs ahead of their own) and machismo (i.e., masculinity) serve as barriers to engaging in PA among Latinas. In terms of limiting PA, marianismo may manifest as women being too busy with caregiving and taking care of the home to have time to exercise. Machismo can negatively affect Latina's PA level as some husbands may disapprove of their partner exercising due to jealousy (Larsen et al., 2013). Furthermore, many Latinas perceive sports and vigorous PA as unfeminine or as inappropriate activities for women, thereby presenting a perceived barrier to engaging in PA (Larsen et al., 2013).

Lifestyle Interventions

As described in Chapter Two, the precise metabolic pathways by which MetS occurs are not completely clear. Nevertheless, there is a general consensus among researchers that MetS is a "lifestyle syndrome" (Kelli et al., 2015). In particular, poor dietary behaviors (e.g., excessive caloric intake and consumption of nutrient-poor foods) and sedentary lifestyle increase the risk of developing MetS (Goldberg & Mather, 2012;

Grundy, 2016; Weiss et al., 2013). As MetS is considered a lifestyle syndrome, there are ripe opportunities to address modifiable risk factors such as poor dietary behaviors, physical inactivity, and overweight/obesity. There is strong evidence of the effectiveness of tailoring lifestyle interventions to the Hispanic culture (Bassi et al., 2014; Godos et al., 2017; Markham Risica, McCarthy, Barry, Oliverio, & De Groot, 2018). Additionally, Perez-Escamilla (2011) asserted that "tailoring interventions to the acculturation level of individuals is likely to help reduce health disparities in Latinos" (p. 1166S).

Implementing programs using trained community health workers (CHWs) is an effective approach for implementing culturally competent interventions. For example, Vida Sana is a community- and clinic-based, culturally-tailored intervention designed to promote lifestyle changes to prevent MetS among a predominantly Spanish-speaking community (Buckley et al., 2015; Markham Risica et al., 2018). Vida Sana integrated *Navegantes*, CHWS who are bilingual (English and Spanish) bicultural (Hispanic American) and have an intimate understanding of the community (Markham Risica et al., 2018). The pilot year of the intervention at a free clinic in Providence, Rhode Island was effective as 60% of participants had improved MetS markers (i.e., BG, WC, BP, and cholesterol) (Buckley et al., 2015).

CHWs are also known as *promotoras*. A *promotora*-led lifestyle intervention for overweight, immigrant Latinas aged 35-64 was effective in improving health behaviors and health outcomes within a community setting. The intervention was a randomized clinical trial with an intervention and control group. The women in the intervention group had significant improvements in diet, weight and WC, and PA level when compared to the control group. Additionally, the program had high participation and retention rates, indicating that the program was well-received and supported by the community (Koniak-Griffin et al., 2015). In another study of CHWs, case management combined with CHWs was effective in promoting weight loss but not weight maintenance after 12 and 24-month follow-ups (Goldman Rosas et al., 2015). Overall, the results were promising; however, findings from the follow-up indicate that strategies geared towards facilitating long-term, sustainable health behavior changes are needed to improve health outcomes.

Various factors influence CHW's effectiveness. Challenges to effective CHW-based interventions include unclear roles and expectations, lack of supervision, inadequate training, insufficient knowledge, and ingrained attitudes (Health Communication Capacity Collaborative [HC3], 2015; Kok et al., 2015; Mohajer & Singh, 2018; WHO, 2010). CHWs are more confident in their roles when they are clearly defined, work expectations are appropriate for their role (e.g., part-time volunteer or full-time employee), and they feel supported by their supervisors (HC3, 2015; Mohajer & Singh, 2018). Training curriculums should include scientific knowledge about preventive care and condition management (WHO, 2010). WHO (2010) recommended didactic classroom training such as role-play, group discussions, and field activities. Furthermore, ongoing hands-on training is recommended after classroom training (WHO, 2010). Periodical refresher trainings have also been shown to be effective in improving CHWs effectiveness (HC3, 2015; WHO, 2010). Adequate initial training that includes scientific knowledge and evidence-based practices along with ongoing trainings can help increase knowledge among CHWs and may help address challenges brought by ingrained attitudes that are not conducive to positive health outcomes. However, some research has found that despite training, negative attitudes towards perceived controversial health topics persisted (HC3, 2015). Commonly controversial topics include family planning and reproductive health services and mental health (HC3, 2015).

Effective health promotion/education programs should be tailored to meet language needs and preferences of the priority population. In the United States, there are 37 million Hispanics aged five and older who speak Spanish at home (Flores, 2017). Therefore, health promotion/education programs and campaigns that do not appropriately, respectfully, and effectively reach the Spanish-speaking population may be unsuccessful in inciting behavior change. For instance, Koniak-Griffin and Brecht (2015) found that Spanish-speaking immigrant Hispanic women were unaware that heart disease is the leading cause of death despite public campaigns to increase CVD knowledge and awareness, such as Go Red for Women. In contrast, the *Seamos Saludables* Study was a culturally-tailored Spanish-language intervention targeting adult Latinas. Throughout the six-month intervention period, print materials containing health information and theoretically based motivational messaging were periodically mailed to participants. These materials were tailored to the participant's readiness to change and addressed common barriers to PA such as time constraints, gender roles, and costs

(Marcus et al., 2013). In addition, the intervention included computer-generated and "individually tailored feedback reports and tip sheets on selected topics (e.g., stretching, measuring heart rate)" (p. 600). This program was successful in increasing PA among participants, indicating that culturally tailored, Spanish-language, personalized print materials containing health information and theoretically-based motivational messaging can be effective in promoting healthy lifestyle change. This type of health communication strategy can potentially be used to reach broader audiences in a cost-effective manner, as minimal staff contact was necessary to successfully implement and administer the program (Marcus et al., 2013).

The National Diabetes Education Program (NDEP) (2015) is an example of another culturally-tailored intervention. NDEP utilizes a bilingual (English/Spanish) *fotonovela* (illustrated novel) to promote healthy lifestyle modifications related to diet and physical activity that can be particularly helpful for low-literacy populations. NDEP's (2015) *fotonovela* title "Do it for them! But for you too" and contents convey messages to appeal to the familistic values (as well as *marianismo*) of Latinas. Interventions that encourage family involvement have been found to be effective in improving health habits (e.g., food choices) and health outcomes (e.g., reduced A1C) (Hu, Wallace, McCoy, & Amirehsani, 2014; Hu, Amirehsani, Wallace, McCoy, & Silva, 2016; Rosas et al., 2018). Research findings indicate that when family members are included in health promotion interventions, family members are able to better support participants, help facilitate lifestyle changes at home, and encourage improved condition management for individuals with diabetes (Hu et al., 2014, 2016; Rosas et al., 2018). Considering traditional values of familism and traditional gender roles of marianismo and machismo can also help in designing culturally-appropriate interventions (CDC, 2012a; U.S. Department of Health & Human Services [HHS], 2013). The value of familism means that Hispanics prioritize the family over the individual. Additionally, extended family members (e.g., grandparents, aunts, uncles) are often involved in decision making. It is important to identify the family matriarch and patriarch, as they are often the decision makers in the family and help determine household health behaviors as well as health-seeking behaviors (CDC, 2012a; HHS 2001, 2013).

Additional examples of effective strategies that promote healthy lifestyle change among Hispanics providing opportunities for activity via community fitness programs (Piedra et al., 2018) and encouraging the use of and providing tools for self-monitoring (e.g., fitness trackers or PA logs) (Marcus et al., 2013; Rosas et al., 2018). A promising emerging prevention strategy is the promotion of biculturalism among immigrants (Bacallao & Smokowski, 2017). Biculturalism is defined as "the ability to function within two distinct cultures based on the acquisition of norms, values, and behavioral routines of the dominant culture as well as those of one's own cultural group" (Castro et al., 2017, p. 421). For example, *Entre Dos Mundos* (EDM) is a psychodrama-based intervention targeting immigrant adolescents and their parents that promotes biculturalism to prevent the development of mental health problems such as stress, depression, and anxiety. The principle aim of EDM is to promote biculturalism to decrease acculturation stress and improve outcomes among immigrants and their families. EDM focuses on the individual's or family's cultural assets and how they can be harnessed to positively influence health. Research has shown that bicultural adolescents have demonstrated better behavioral and academic outcomes, indicating that biculturalism can be beneficial (Bacallao & Smokowski, 2017). Although this strategy has not been employed to address MetS among Hispanics, there are clear indications of the possible benefits of promoting biculturalism to improve health outcomes among Hispanics by reinforcing the protective effects of both Hispanic and American cultures.

Health coaching can also play an important role in promoting lifestyle change among Hispanics. Research indicates that health coaching is effective for facilitating healthy dietary changes, increasing in PA, fostering moderate weight loss, and promoting health behavior changes that can lead to improved biomarkers (e.g., BP, BG, A1c) (Jo et al., 2012; Luley et al., 2014; Pludwinski et al., 2016; Willard-Grace et al., 2015). Multiple studies identify "coaching" as an intervention strategy (Koniak-Griffin et al., 2015; Markham Risica et al., 2018; Rosas et al., 2018); however, it is not clear whether the individuals performing the coaching were certified health and wellness coaches (health coaches). Certified health coaches bring a unique set of skills to the field of health promotion and education as well as a patient-centered approach that empowers individuals to make lasting changes (NBHWC, n.d.). Health coaches are trained in motivational interviewing, active listening, appreciative inquiry, and non-judgmental questioning (NBHWC, 2014). Using these skills, health coaches can help individuals explore their goals, elicit motivation for change, explore ambiguity, address challenges and barriers, enhance self-efficacy, develop a realistic action plan for change, and serve as an accountability partner (NBHWC, 2014). On July 1, 2019, the American Medical Association announced the approval of three Category III CPT (Current Procedural Terminology) codes for "Health and Well-being Coaching." The approval of these CPT codes specifically for health and well-being coaching provides an opening for widespread reimbursement and may create opportunities for health educators (and health coaches) in primary care settings in the future (NCHEC, 2019).

Certified health coaches must undergo training to develop the skills necessary to be effective health coaches. It is important to note that cultural competency is not well-addressed in health coach competencies. Although cultural sensitivity is a competency identified by the NBHWC, cultural competence is not (NBHWC, 2019). Cultural sensitivity is an individual's ability to understand his/her own culture and that of others (National Institutes of Health [NIH], 2014). Cultural competence includes cultural sensitivity and describes an individual's ability to go beyond understanding cultural differences to being able to draw on those diverse cultural characteristics (e.g., values, traditions, and customs) to develop health promotion interventions and deliver services that "affirm and reflect the value of different cultures" (NIH, 2014, para. 6). Cultural competence is a necessary skill for health coaches to effectively work with diverse peoples; therefore, cultural competence should be a competency required of all certified health coaches.

Implications for Health Education and Public Health

This study addresses the Seven Areas of Responsibility (AOR) for Certified Health Education Specialists as developed by the National Commission for Health Education Credentialing, Inc. (NCHEC) (NCHEC, 2015). The Seven Areas of Responsibility define the role and responsibilities of Certified Health Education Specialists. According to NCHEC (2015), the Seven Areas of Responsibility are as follows:

Area I: Assess Needs, Resources, and Capacity for Health Education/Promotion
Area II: Plan Health Education/Promotion
Area III: Implement Health Education/Promotion
Area IV: Conduct Evaluation and Research Related to Health Education/Promotion
Area V: Administer and Manage Health Education/Promotion
Area VI: Serve as a Health Education/Promotion Resource Person
Area VII. Communicate, Promote, and Advocate for Health, Health Education/Promotion, and the Profession

This study also connects with the following Master of Public Health Foundational Competencies (FC) from the Council on Education for Public Health ([CEPH], 2016, pp. 17-18):

<u>Planning and Management to Promote Health</u>
7. Assess population needs, assets and capacities that affect communities' health
8. Apply awareness of cultural values and practices to the design or implementation of public health policies or programs
9. Design a population-based policy, program, project or intervention
<u>Policy in Public Health</u>
14. Advocate for political, social or economic policies and programs that will improve health for diverse populations
<u>Communication</u>

18. Select communication strategies for different audiences and sectors
19. Communicate audience-appropriate public health content, both in writing and through oral presentation
20. Describe the importance of cultural competence in communicating public health content

There remains a need for targeted interventions for high-risk individuals as well as whole population-based approaches in order to address the epidemic of chronic lifestyle conditions such as MetS, diabetes, and CVD. Effective primary prevention is ideal but improved secondary prevention strategies are also necessary. Culturally competent interventions that address physical activity, nutrition, and lifestyle behavior modifications can reduce the risk of MetS (Bassi et al., 2014; Godos et al., 2017; Buckley et al., 2015), diabetes and diabetes-related complications (Albright & Gregg, 2013; Li et al., 2008; Kirkman, 2013; Roglic & Unwin, 2010; Smushkin & Vella, 2010), and CVD (Heidenreich et al., 2011).

Findings from the current study can be used to plan, implement, evaluate, and administer interventions tailored to the acculturation level of Hispanic adults. For example, study results can be used as part of a needs assessment to determine MetS, diabetes, and CVD risk among Hispanics in the DFW area (NCHEC AOR I and CEPH FC 7). This study also serves as a reminder to health educators to be mindful of cultural competence when planning, implementing, and administering effective health education/promotion programs as well as when designing culturally appropriate health communication campaigns (NCHEC AOR II, III, V, VI, and CEPH FC 8 and 20). Similarly, findings from this study can be used to assess acculturation level and use that information to inform the development and implementation of culturally-tailored health education/promotion programs and health communication campaigns (NCHEC AOR I, II, III, VI, and CEPH FC 7, 8, 9. 18, 19, and 20). Furthermore, this study highlights health disparities in the DFW Hispanic community. These identified disparities support the need for culturally-tailored, evidence-based interventions to promote behavior change as well as advocacy for social and economic policies and programs that have a broader impact on health outcomes within the Hispanic community (AOR VII and CEPH FC 14).

Implications for Healthcare Providers

MetS may be prevented or treated by lifestyle changes that include engaging in regular physical activity, improving dietary habits, and achieving and maintaining a healthy body weight (Falkner & Cossrow, 2014; Grundy, 2012; Grundy, 2016; Gupta & Gupta, 2010; Huang, 2009; Rochlani et al., 2017). The DPP provided evidence that supports clinical intervention for the reduction of MetS via lifestyle intervention (NIDDK, n.d.). Health care providers can aid in reducing MetS prevalence by raising awareness of the condition and associated risk factors among their patients as well as recommending lifestyle modifications to reduce their risk of developing MetS.

Lifestyle modification can be challenging to implement and maintain (Grundy, 2016; Kaur, 2014). Health care providers often have limited time to address medical issues as the average length of a doctor visit is approximately 10-20 minutes (Harvard Health Publishing, 2018). Under these time constraints, providers are less likely to address health behavior change and provide health education. Therefore, there is a need to add health educators and health coaches to the clinical team as these health professionals can use their expertise in health behavior change and health communication to address modifiable risk factors in patients (Chambliss, Lineberry, Evans, & Bibeau, 2014). Health educators and health and wellness coaches can help individuals set SMART (specific, measurable, attainable, realistic, and time-bound) goals and develop achievable action plans. Moreover, health coaching in a clinical setting is an effective strategy to facilitate healthy lifestyle changes and reduce the risk of MetS and related conditions (Rosas et al., 2018; Sherman & Ganguli, 2017).

Limitations

Due to the modest sample size of the primary study, the findings cannot be generalizable to a larger population. The small sample size may also have limited ability to find statistical significance. The data were limited to participants who self-selected to participate in the primary study. Selection bias may have occurred as participants with specific characteristics may have been more likely to participate in this study. For example, individuals without access to affordable healthcare may have been more likely to participate in this study as a means of receiving a free health screening (Green et al., 2013; Murray et al., 2014). The data collection was performed on weekends; therefore, individuals who were not able to take time off work during the week and did not have access to their doctor on the weekends may have been more likely to participate in this study (Green et al., 2013). Furthermore, this sample included a small population of high acculturated individuals; 12.5% of the sample was born in the United States and 18%

were categorized as high acculturation according to the SASH. The relatively small sample of high acculturated individuals may have affected analysis due to reduced statistical power. Also, only 14.1% of participants had a college education or higher. A larger sample of participants with a higher level of education may have helped disentangle the relationship between health outcomes, acculturation, and education level. Research indicates that education may account for some of the effects of acculturation (Lara et al., 2005; Rudmin et al., 2017). Education is a key area of social determinants of health as higher levels of formal educational attainment create opportunities for better health outcomes across a person's lifespan (Hahn & Truman, 2015; HHS, 2019; Robert Wood Johnson Foundation, 2014). Another limitation of this study is that it did not differentiate between Hispanic subgroups. Research has demonstrated diversity in health outcomes, acculturation levels, and health behaviors among different Hispanic subgroups (CDC, 2017d; Derby et al., 2010; Heiss et al., 2014; Moran et al., 2007; Schneiderman et al., 2014).

Another limitation of this study is that acculturation proxies of nativity and duration are simple acculturation variables that assume acculturation is unidimensional resulting in assimilation. With a simple variable, there is an increased chance of misclassification and potentially biased results (Moran et al., 2007). Additionally, the SASH is a unidimensional scale that assumes assimilation is the only outcome of acculturation and does not account for multi- or biculturalism (Pérez-Escamilla, 2009). Finally, the correlational analysis results indicate a relationship between acculturation indicators and MetS among Hispanics; but it could not identify a causal relationship between the two factors.

Recommendations for Future Research

Based on the author's experience as a researcher in the original study and the experience gained from performing the secondary data analysis, recommendations for improving the primary study include the following:

1. Reduce the number of questions in the original questionnaire (145 questions) as this large volume of questions may have been overwhelming or tiring for some participants to complete.
2. Include questions to assess heritage-culture practices, values, and identifications; and receiving-culture practices, values, and identifications based on the Schwartz et al. (2010) model.
3. Use a multidimensional acculturation scale such as the ARSMA (Cuellar et al., 1995).
4. Have an expert panel review the questionnaire for face and content validity.
5. Pilot the study questions to provide pilot participants the opportunity to provide feedback about questions that are challenging or problematic. Adjust the instrument based on feedback.
6. Aim to recruit more Hispanics of higher acculturation levels.
7. Aim to recruit more Hispanics with higher education levels.
8. Divide the study into a two-day participation event where participants complete the questionnaire one day and the health screening on a second day (with a reasonable

incentive structure to encourage participation). This strategy may also help address the challenge of having participants wait extended periods of time to complete their assessments.

How acculturation influences health among Hispanics is not clear; however, evidence indicates that there is a relationship between acculturation and health. Therefore, it is "important to acknowledge the contribution of acculturation on the health of minorities despite uncertainty as to the exact mechanism(s) of influence (Thomson & Hoffman-Goetz, 2009, p. 983). Challenges in discerning the mechanism(s) of influence include problems with conceptualization and operationalization of acculturation (Fox et al., 2017). Some examples of problems with conceptualization and operationalization include the use of unidimensional measures, over-emphasis on acculturation proxies, and failure to examine values, beliefs, and values aspects of acculturation (Fox et al., 2017).

Future research should incorporate theoretically sound acculturation constructs appropriate for health research. Fox et al. (2017) reasoned that the construct of acculturation should shift to fit the discipline in which it is being studied. For instance, they explained that the acculturation construct underwent "major conceptual and operational change[s] when it was adapted from anthropology to psychology, and . . . another major shift is now required for use of this construct in health research" (p. 123). Schwartz and Unger (2017) argued that researchers must clearly define acculturation (that is, determine what is changing due to acculturation), discern which measures and methods will optimally assess acculturation, and remain consistent in the conceptualization and operationalization of acculturation across health research studies. Schwartz, Unger, Zamboanga, and Szapocznik (2010) offered an expanded model of acculturation with six separate components: heritage-culture practices, values, and identifications; and receiving-culture practices, values, and identifications. Examples of these components are provided by Schwartz and Unger (2017):

> Within the context of Hispanic individuals and groups migrating to the United States, for instance, examples of these components include English language use and consuming US foods (receiving-cultural practices), endorsing individualist and independent belief systems (receiving-cultural values), identifying with the United States (receiving-cultural identifications), Spanish language use and consuming foods from the country of origin (heritage-cultural practices), endorsing collectivist and familistic values (heritage-cultural values), and maintaining a sense of ethnic affirmation and pride (heritage-cultural identifications). (p. 5)

Further examination of these components, how they relate, how they change, and how they affect health can provide deeper insight into the dynamic relationship between acculturation and health. Additional cultural beliefs and values that should be studied in relation to acculturation and health include fatalism (a belief that all events are due to fate and cannot be controlled), religiosity (religious orientation), marianismo (tendency of Latinas to prioritize their family's needs ahead of their own), personalismo (guiding value that emphasizes establishing rapport and connection with others) and machismo (masculinity) (Etnyre et al., 2006; Hamilton, Palermo, & Green, 2015; Lopez et al., 2008; Lopez & Yamashita, 2018; McCloskey & Flenniken, 2010; Wallace et al., 2010). Health literacy should also be assessed to determine the interaction between acculturation, health literacy, and health outcomes. For example, health literacy may affect an individual's perceived susceptibility and perceived severity of a condition and may affect their ability to understand how to effectively reduce their health risks and manage a chronic condition (Perez, 2015).

Additionally, future research should consider the effects of the environment on immigrant health. Neighborhood acculturation may affect the individual's health behaviors and health outcomes (Espinosa de los Monteros et al., 2008; Zhang et al., 2015). For example, Espinosa de los Monteros et al. (2008) assessed neighborhood acculturation using geographic information systems data using census tract level variables (e.g., percentage of foreign-born individuals and percentage of Spanish-speaking household). In this study, higher neighborhood acculturation was associated with lower fat intake among Mexican American women (Espinosa de los Monteros et al., 2008). Furthermore, access to traditional foods (Paré et al., 2018), affordable healthy food (Valdez et al., 2016), and safe and appealing space to engage in physical activity (Larsen et al., 2013; Valdez et al., 2019) may also influence health behaviors and health outcomes.

Finally, future studies should examine factors underlying the change(s) in key behaviors during the acculturation process to promote better understanding regarding what aspects of acculturation lead to increased health-related risks. Consequently, this knowledge can provide insight into the types of interventions that may be effective in reducing those risks. Because MetS is a “lifestyle syndrome,” there is a need to further examine the relationships among diet, physical activity, and acculturation. Thoughtfully and intentionally incorporating multiple and multidimensional acculturation variables in future studies can provide valuable information that can be used to design effective interventions and health communication campaigns to prevent and more effectively treat MetS among Hispanics in Texas.

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APPENDIX A

TWU IRB Exempt Letter

Institutional Review Board
Office of Research and Sponsored Programs
P.O. Box 425619, Denton, TX 76204-5619
940-898-3378
email: IRB@twu.edu
http://www.twu.edu/irb.html

DATE: August 5, 2016

TO: Ms. Alejandra Quezada
Health Studies

FROM: Institutional Review Board (IRB) - Denton

Re: Exemption for Examining the Association Between Acculturation and Metabolic Syndrome Among Hispanic Adults (Protocol #: 19159)

The above referenced study has been reviewed by the TWU IRB (operating under FWA00000178) and was determined to be exempt from further review.

If applicable, agency approval letters must be submitted to the IRB upon receipt PRIOR to any data collection at that agency. Because a signed consent form is not required for exempt studies, the filing of signatures of participants with the TWU IRB is not necessary.

Although your protocol has been exempted from further IRB review and your protocol file has been closed, any modifications to this study must be submitted for review to the IRB using the Modification Request Form. Additionally, the IRB must be notified immediately of any adverse events or unanticipated problems. All forms are located on the IRB website. If you have any questions, please contact the TWU IRB.

cc. Dr. Roger Shipley, Health Studies
Dr. Marilyn Massey-Stokes, Health Studies
Graduate School

APPENDIX B

Short Acculturation Scale for Hispanics (SASH)

ACCULTURATION

Short Acculturation Scale for Hispanics (Marin et. al, 1987) Please circle the number that best represents your response	1: Only Spanish 2: Spanish more than English 3: Both equally 4: English more than Spanish 5: Only English				
98. In general, what language do you read and speak?	1	2	3	4	5
99. What was the language you used as a child?	1	2	3	4	5
100. What language do you speak at home?	1	2	3	4	5
101. In what language do you think?	1	2	3	4	5
102. What language do you speak with friends?	1	2	3	4	5
103. In what language are the TV programs you *usually* watch?	1	2	3	4	5
104. In what language are the radio programs you *usually* listen to?	1	2	3	4	5
105. In what language are the movies, TV shows and radio programs you *prefer* to listen to?	1	2	3	4	5
Please circle the number that best represents your response	1: All Latino 2: More Latino than Anglo 3: Both equally 4: More Anglo than Latino 5: All Anglo				
106. Your close friends are:	1	2	3	4	5
107. You prefer to socialize with:	1	2	3	4	5
108. The people you visit or who visit you are:	1	2	3	4	5
109. You would want your children's friends to be:	1	2	3	4	5