Examining the Association Between Acculturation Indicators and Metabolic Syndrome Among Hispanic Adults

Authors:
Alejandra Quezada Ochoa, PhD, MPH, CHES®, NBC-HWC
School of Health Promotion and Kinesiology
Texas Woman's University
PO Box 425647
Denton, Texas 76204-5647
Telephone: (940) 898-2575
Email: AQuezada2@twu.edu

Marilyn Massey-Stokes, EdD, CHES®, CWHC
School of Health Promotion and Kinesiology
Texas Woman's University
PO Box 425647
Denton, Texas 76204-5647
Telephone: (940) 898-2863
Email: MMasseyStokes@twu.edu

Abstract

Purpose: *To examine the relationship between acculturation indicators and metabolic syndrome among Hispanic adults living in the Dallas-Fort Worth-Arlington, Texas metropolitan area.* ***Methods:*** *This study utilized secondary data collected from a larger 2014 study among 128 Hispanic adults living in Dallas-Fort Worth-Arlington. The current study examined two research questions: (1) Is there a relationship between acculturation indicators (nativity, duration in the United States, and the Short Acculturation Scale for Hispanics score) and metabolic syndrome among Hispanic adults living in Dallas-Fort Worth-Arlington? (2) Is there a relationship between acculturation indicators and the individual markers associated with metabolic syndrome (high waist circumference, high blood pressure, elevated fasting blood glucose, elevated blood triglycerides, and reduced high-density lipoprotein cholesterol among Hispanic adults living in Dallas-Fort Worth-Arlington?* ***Results:*** *Most participants were female (aged 40 and older) born outside of the United States. More than half of the participants had been in the United States fewer than 20 years and revealed lower acculturation scores. More than one-third of the participants also had metabolic syndrome. Prevalence of metabolic syndrome was higher among females compared to males. Most participants had abnormal high-density lipoprotein and waist circumference. Acculturation scores and nativity were not associated with abnormal metabolic syndrome markers. Duration in the United States was not associated with metabolic syndrome markers of high waist circumference, reduced high-density lipoprotein, and elevated blood triglycerides. However, duration in the United States was associated with metabolic syndrome markers of high blood pressure and elevated fasting blood glucose.* ***Conclusions and Recommendations:*** *Acculturation is a multifaceted, dynamic phenomenon that influences health at multiple levels. Future studies can explore a range of social-ecological factors that interact with acculturation and health. Because metabolic syndrome is considered a "lifestyle syndrome," there is an additional need to examine behavioral health and relationships among diet, physical activity, and acculturation. Through a social-ecological and culturally relevant lens, health education specialists can lead*

interprofessional efforts to promote health literacy and healthy lifestyle behaviors among Hispanic individuals and communities. These action steps can be integral components of professional preparation programs that offer students opportunities to engage in service learning and develop core competencies in their disciplines.

Key Words: Metabolic Syndrome, Acculturation, Hispanics, Health Education/Promotion, Social-ecological

INTRODUCTION

Metabolic syndrome (MetS) is a prevalent and rapidly growing public health problem in the United States. MetS is a condition characterized by the manifestation of a cluster of risk factors associated with an increased risk for cardio-vascular disease (CVD) and diabetes mellitus type two (diabetes); these risk factors include enlarged waist circumference (WC), elevated blood pressure (BP), elevated fasting blood glucose (FBG), and reduced high-density lipoprotein (HDL) cholesterol (Eckel et al., 2010; National Heart, Lung, and Blood Institute, n.d.). Overall prevalence of MetS among U.S. adults (aged 20 and older) increased from 32.5% in 2011-2012 to 36.9% in 2015-2016 (Hirode & Wong, 2020). Studies have found that individuals with MetS are at a two-fold to six-fold increased risk for developing CVD and a three-fold to 33-fold increased risk of developing diabetes when compared to healthy individuals. Findings vary depending on the criteria used, number of factors present, and the study population (O'Neill & O'Driscoll, 2015).

Heart disease is the leading cause of death in the United States and the leading cause of death among African Americans, American Indians, Alaska Natives, Hispanics, and White males (Centers for Disease Control & Prevention [CDC], n.d.b). Lifestyle-related risks associated with heart disease include high blood pressure, high blood cholesterol, diabetes, overweight and obesity, unhealthy dietary behaviors, physical inactivity, excessive alcohol use, and smoking (CDC, n.d.b). 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 (CDC, n.d.c). CVD is the leading cause of death among those living with diabetes, and individuals with diabetes are twice more likely to experience heart disease or stroke than those without diabetes (American Diabetes Association, 2022). Diabetes rates have more than doubled in the last 20 years. Currently, 37.3 million U.S. adults have diabetes, yet one in five are unaware they have it (CDC, n.d.c).

Chronic conditions such as MetS, CVD, and diabetes are increasingly prevalent in the United States; however, certain ethnic groups are disproportionately affected. Hispanics have the second highest prevalence of MetS among any ethnic group in the United States (40.4% vs. 37.6% in non-Hispanic Whites; Hirode & Wong, 2020). Among Hispanics aged 60 years or older, more than 57.3% have MetS versus 48.6% in all groups (Hirode & Wong, 2020). Diabetes is also more prevalent among Hispanics (11.8%) compared to non-Hispanic Whites (7.4%; CDC, n.d.c; U.S. Department of Health and Human Services, Office of Minority Health, n.d.). When compared to non-Hispanic White adults, Hispanic adults are 70% more likely to be diagnosed with diabetes by a physician (U.S. Department of Health and Human Services, Office of Minority Health, n.d.). Studies have noted that Hispanics experience several barriers to health care services, including lack of health insurance and preventative medical care, low health literacy, limited cultural sensitivity, and an insufficient number of Hispanic health care providers (Aguayo-Mazzucato et al. 2019; Funk & Lopez, 2022; Velasco-Mondragon et al., 2016). Thus, attention to these multiple health needs among the U.S. Hispanic population is warranted.

Hispanic Population

According to U.S. Census Bureau population estimates for July 2022, the Hispanic population represented 18.9% of the total U.S. population (U.S. Census Bureau, n.d.). More than one-third of the U.S. Hispanic population is foreign-born (Flores, 2017; Lopez & Moslimani, 2022), and Hispanics are the second-fastest-growing racial/ethnic group in the United States (Noe-Bustamante et al., 2020). The U.S. Census Bureau (2018) projected that Hispanics will comprise 28% of the entire U.S. population by 2060. In addition, Texas ranks second in total Hispanic population within the United States (Texas Demographic Center, n.d.). In Texas, Hispanics represent 39.3% of the state's

population (U.S. Census Bureau, 2021a). The Hispanic population in Texas grew 21% from 2010-2020 (versus 13% growth among non-Hispanic or Latino populations; U.S. Census Bureau, 2021a). In 2020, there were 2.16 million Hispanics (29%) living in the Dallas-Fort Worth-Arlington metropolitan area of Texas (Data USA, n.d.); approximately 38% of the Hispanic population living in Dallas-Fort Wort Worth-Arlington is foreign-born (Pew Research Center, 2016).

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 (Aguayo-Mazzucato et al., 2019; Boen & Hummer, 2019; 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; Hummer & Gutin, 2018). 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 fewer than 10 years (Daviglus et al., 2012). Hispanics with higher acculturation levels have higher hypertension prevalence in comparison with Hispanics with lower acculturation levels (Fryar et al., 2020; McIntire et al., 2022). Additionally, studies have shown an increase in obesity and diabetes prevalence among those who immigrated to the United States at earlier ages compared to those who immigrated later (Aguayo-Mazzucato et al., 2019). A study by Ahmed and colleagues (2009) also found that diabetes prevalence doubled among Hispanics who had been in the United States for over 25 years compared to those who immigrated within the past 10 years.

Acculturation

Acculturation is a dynamic process that occurs among groups and individuals of autonomous cultures when they come in contact with one another (Abraído-Lanza et al., 2016; Aguayo-Mazzucato et al. 2019; Berry, 2017). Individuals from the receiving culture as well as the migrating individuals are assumed to both experience some cultural change because of this contact; however, most health research has examined the cultural changes that occur within 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 (Aguayo-Mazzucato et al. 2019; Berry, 2017). As immigrants and subsequent generations are exposed to the U.S. mainstream culture, the process of acculturation affects their lifestyle behaviors pertaining to diet, physical activity, and their overall health. Thus, 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 (Aguayo-Mazzucato et al. 2019; Thomson & Hoffman-Goetz, 2009), including their risk for MetS and other chronic diseases. Liu et al. (2021) analyzed data from National Health and Nutrition Examination Surveys 2009-2016 and found that total fruit intake "partially mediated the associations of acculturation with MetS and central obesity and fully mediated the association between acculturation and high blood pressure among Hispanic adults" (p. 6475). Nevertheless, few studies have examined the association between acculturation indicators and MetS among Hispanics; furthermore, the existing studies have reported inconsistent and conflicting findings (e.g., Carabello & Wolfson, 2021; Vella et al., 2011). There is also insufficient literature concerning associations between acculturation and MetS among Hispanics living in highly population metropolitan areas within the United States. The current study adds to the existing literature by examining the relationship between acculturation indicators and MetS among Hispanics living in the Dallas-Fort Worth-Arlington area of Texas, the fourth largest metro area in the United States (U.S. Census Bureau, 2021b).

PURPOSE

The purpose of this study was to examine the relationship between acculturation indicators and MetS among Hispanic adults living in the Dallas-Fort Worth-Arlington metropolitan area. The following research questions were posited: (1) Is there a relationship between acculturation indicators (nativity, duration in the United States, and the Short Acculturation Scale for Hispanics score) and metabolic syndrome among Hispanic adults living in Dallas-Fort Worth-Arlington? (2) Is there a relationship between acculturation indicators and the individual markers associated with metabolic syndrome (high WC, high BP, elevated FBG, elevated blood triglycerides [TG],

and reduced HDL cholesterol) among Hispanic adults living in Dallas-Fort Worth-Arlington? Results from this study can help health care providers, health education specialists, and other public health professionals raise awareness of MetS and associated risk factors that can lead to the recommended lifestyle modifications to reduce risk. Additionally, the study results can assist in the design and implementation of tailored programming geared towards preventing MetS and related chronic conditions among Hispanics in Texas.

METHODS

Procedures and Data Collection

This study utilized secondary data collected from a larger 2014 study investigating health outcomes among Hispanic adults living in Dallas-Fort Worth-Arlington. The primary study included 128 Hispanic adults recruited from Hispanic-serving community centers, churches, and health fairs in Dallas-Fort Worth-Arlington in 2014. Participants completed a self-report questionnaire developed by the researchers for this particular study. The questionnaire assessed demographics, 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 health screenings consisting of body composition (e.g., height, weight, WC), BP, and blood draw via venipuncture for laboratory analysis (e.g., HDL, TG, FBG). The health screenings were conducted by research assistants trained in these procedures. Although the laboratory analysis consisted of several measures, the current study targeted specific MetS-related assessments (WC, BP, FBG, TG, and HDL) to examine the relationship between acculturation indicators (nativity, duration in the United States, and acculturation orientation) and MetS among Hispanic adults living in the Dallas-Fort Worth-Arlington metropolitan area.

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 (Hallajzadeh et al., 2017). 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, 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).

There is no universally accepted method for measuring acculturation (Ellison et al., 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). In addition, the Short Acculturation Scale for Hispanics (SASH) was used to measure acculturation. The SASH is a 12-item scale developed by Marin and colleagues as an acculturation scale that can be used with any Hispanic subgroup (Marín et al., 1987). The SASH has been utilized in multiple research studies (e.g., Pérez, 2015; Santiago-Torres et al., 2022; 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). Ellison et al. (2011) assessed the validity of SASH and determined that among their study sample, the SASH scale was highly correlated with variables commonly used as proxies for acculturation; inter-scale correlations and alpha scores were high. The SASH consists of three factors: language use, media, and ethnic social relations. To arrive at a total acculturation score, responses across the 12 items are averaged and can range from 1 to 5. 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).

Data Analysis

Secondary data analysis was performed using IBM SPSS Statistics (Version 25). The key independent variables of this study were nativity, acculturation orientation, SASH score, and duration in the United States. The key dependent variables of this study were MetS status (categorical) and the five MetS markers (WC, BP, FBG, TG, and HDL; categorical). Frequencies and percentages were calculated for all categorical-level data: sex, age categories, education categories, nativity, acculturation

orientation (SASH score; categorized as less/more acculturated), duration in the United States (categorized as ≥20 years/<20 years), MetS status (present/not present), and the five MetS markers (WC, BP, FBG, TG, and HDL; categorized as normal/abnormal). 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 in years, SASH score (5-point scale), and age and dichotomous MetS status (present/not present). *T*-tests were conducted to determine if there were differences in 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).

The data were bootstrapped to check for the stability of the results. 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 in years, and SASH score. The factor scores (i.e., acculturation factor) was 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 in years, 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.

RESULTS

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%). 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%). 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%).

Acculturation Indicators and Metabolic Syndrome

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 (present/not present) 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 a statistically significant difference in MetS status based on level of education, $\chi^2 = 8.27$ (2), $p = 0.016$. 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 in years, and SASH Score. The two groups, participants without MetS and with MetS 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 and with MetS — did not differ on their mean years in the United States, $t(108) = .38$, $p = .704$. Results also indicated that participants without MetS and participants with MetS did not differ on their mean SASH score, $t(103) = 1.55$, $p = .126$.

Four logistic regression models were conducted to predict MetS status (present/not present) by nativity, duration in the United States in years, SASH score, acculturation factor, and covariates (sex, age, and education); see Table 3. Logistic regression model 1 was not statistically significant at the .05 level of significance, χ^2 (3) = 7.04, p = .071. The three predictor variables (nativity, duration in the United States, and SASH score) were not significant at the .05 level of significance. 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 3, Models 3 and 4).

Acculturation Indicators and Metabolic Syndrome Markers

Chi-square tests for association were performed to examine the relationship between categorical variables of nativity, sex, level of education, age, and the five MetS markers (WC, BP, FBG, TG, and HDL). There was a statistically significant difference in abnormal WC status based on sex, χ^2 = 15.91 (1), p < .001; Hispanic women were more likely to have an abnormal WC status than Hispanic men. There was a statistically significant difference in abnormal BP status based on age, χ^2 = 10.85 (3), p = .013. Participants with abnormal BP were more likely to be older (aged 50 or older). There was a statistically significant difference in abnormal FBG status based on level of education, χ^2 = 8.92 (2), p = .012; and age, χ^2 = 8.36 (3), p = .039. Participants with a college degree or higher and participants aged 18-29 were less likely to have abnormal FBG. There were no statistically significant differences in abnormal TG or HDL status based on nativity, sex, level of education, and age.

Independent samples *t*-tests were conducted to determine whether there were differences in duration in the United States in years, 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 those with 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. Participants with normal BP (M = 41.25, SD = 10.63) and abnormal BP (M = 49.03, SD = 12.84) along with those 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.

Logistic regression modeling was conducted to predict abnormal MetS markers (WC, BP, FBG, TG, and HDL) by acculturation indicators (nativity, duration in the United States in years, and SASH score) and acculturation factor. 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% in the unadjusted model (1) (p < .01) and adjusted model (2) (p < .05; see Table 4). 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% in the unadjusted model (p < .05; see Table 5).

CONCLUSIONS

Acculturation is a multifaceted and dynamic aspect to consider when examining health behavior and chronic health conditions such as MetS among Hispanics. There is evidence indicating that longer duration in the United States has been associated with increased risk of MetS and related conditions such as obesity, CVD, and diabetes (Abraído-Lanza, et al., 2016; Afable-Munsuz & Perez-Stable, 2017; Aguayo-Mazzucato et al. 2019; Ahmed et al., 2009; Berry, 2017; Daviglus et al., 2012; Schwartz & Unger, 2017). Nevertheless, results from the current study indicated nativity was not significantly associated with the five MetS markers among Hispanics living in Dallas-Fort Worth-Arlington. In

other research, Vella et al. (2011) found that nativity was not associated with BG, HDL, systolic BP, and WC but was correlated with abnormal TG and diastolic BP. 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, the researchers 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, the Moran et al. (2007) study showed that longer duration in the United States was associated with higher risk of hypertension in Hispanics. Additional research supports that immigrants are healthier upon arrival to the United States, but their health tends to deteriorate with longer duration, often referred to as the "immigrant paradox" (Afable-Munsuz & Perez-Stable, 2017; Schwartz & Unger, 2017). The results of this study align with the broader literature examining acculturation and health among U.S. Hispanics wherein mixed findings are common. These inconsistent results indicate that additional research is needed to tease out the role acculturation plays in health outcomes.

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-environmental factors that influence health and health behaviors are important to consider (Abraído-Lanza, et al., 2016; Aguayo-Mazzucato et al., 2019; Williams et al., 2011), such as familial influence, social networks, the built environment, and broader neighborhood and community impact. Potential mediators or moderators between duration in the United States (acculturation) and risk of disease (e.g., MetS) may involve changes in dietary habits such as food choices and food preparation behaviors, physical activity levels, and social and built environments (Abraído-Lanza, et al., 2016; Afable-Munsuz & Pérez-Stable, 2017; Aguayo-Mazzucato et al. 2019). In addition, cultural beliefs and values that can influence acculturation and health include fatalism (belief that all events are due to fate and cannot be controlled), religiosity (religious orientation), marianismo (tendency of Hispanic women to prioritize their family's needs ahead of their own), personalismo (guiding value that emphasizes establishing rapport and connection with others), and machismo or masculinity (Wallace et al., 2010). Another important element to consider is health literacy, which is interconnected with cultural beliefs and values and influences health outcomes. For example, health literacy may affect an individual's perceived susceptibility and perceived severity of a condition such as MetS, which, in turn, can affect their ability to understand how to effectively reduce their health risks and manage their condition (Aguayo-Mazzucato et al., 2019; Pérez, 2015).

There are several limitations of this study that must be considered. 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. 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, n.d.c; Moran et al., 2007). Additionally, 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). Finally, the correlational analysis results indicate a relationship between acculturation indicators and MetS markers among Hispanics, but no causal relationship between the two factors can be determined.

Despite these limitations, the study fills a gap in the literature by shedding light on the relationship between acculturation indicators and MetS among Hispanic adults living in Dallas-Fort Worth-Arlington, one of the most populous metro areas in the country. 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 and other public health professionals in planning, implementing, and evaluating health education and promotion programs to prevent MetS and related chronic conditions among Hispanics in Texas.

RECOMMENDATIONS

Several recommendations for research and practice arise from the current study. In moving forward, it is important to incorporate theoretically

sound acculturation constructs appropriate for health research (Schwartz et al., 2010). According to Thomson and Hoffman-Goetz (2009), it is also "important to acknowledge the contribution of acculturation on the health of minorities despite uncertainty as to the exact mechanism(s) of influence" (p. 983). Thus, future studies can examine a range of sociocultural and social-environmental factors that interact with acculturation and health, including cultural beliefs and values, health literacy, and the effects of the environment on immigrant health. For example, environmental factors such as access to affordable, healthy food and safe areas for physical activity can affect health attitudes, beliefs, and behaviors. Better understanding and insight regarding these interrelated factors can assist certified health education specialists and community health workers, such as promotoras, in their efforts to educate and empower local communities to advocate for health-promoting change.

There is also a need for researchers to examine factors underlying changes in key lifestyle behaviors during the acculturation process, which can lead to 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 considered a "lifestyle syndrome," there is an additional need to further examine the relationships among diet, physical activity, and acculturation. Thoughtfully and intentionally incorporating multiple, multi-dimensional acculturation variables in future research can provide researchers and pract-itioners valuable insight regarding the design, implementation, and evaluation of effective interventions and health communication campaigns aimed at preventing and more effectively managing MetS among Hispanics. For example, the evidence-based National Diabetes Prevention Program ([NDDP], CDC, n.d.a) can be incorporated into these activities to promote healthy lifestyle changes involving nutrition, physical activity, and stress management. Studies have demonstrated that those with prediabetes who participate in the NDDP can reduce their risk of developing type 2 diabetes by 58%; and this percentage increases to 71% for individuals over the age of 60 (CDC, n.d.a). A key aspect of the NDDP involves Lifestyle Coaches who are trained to effectively deliver a CDC-approved curriculum. The NDDP Lifestyle Coaches promote self-efficacy and problem-solving skills and also provide support and guidance to participants, all of which contribute to the program's success (CDC, n.d.a). The NDDP is also available in Spanish, which adds a layer of cultural relevance to Spanish-speaking Hispanics living in the United States. In addition, time-restrictive eating (intermittent fasting) may show promise as a dietary intervention to prevent metabolic disorders such as MetS. More research is needed to better understand the effects of time-restrictive eating on metabolic markers and determine the applicability of personalized life-style interventions (Schuppelius et al., 2021). By extension, there is a need to examine how acculturation may factor into interventions featuring time-restrictive eating options with lifestyle management plans and health coaching relevant to Hispanics with MetS.

Through a social-ecological and culturally relevant lens, health education specialists can lead interprofessional efforts to promote health literacy and healthy lifestyle behaviors among Hispanic individuals, social networks, and communities. These actionable steps can also serve as key components of professional preparation programs that foster student learning through interprofessional engagement. This type of collaboration can occur across multiple academic disciplines such as health education and health promotion, public health, nursing, lifestyle medicine, and health and wellness coaching. Students in these programs can learn to apply various theoretical frameworks (e.g., health belief model, social cognitive theory, social determination theory, PEN-3, social-ecological model) through service-learning endeavors aimed at reducing MetS risk and promoting the health and well-being of Hispanics. Service learning projects can deliver several student benefits, including development of a broad range of personal and professional skills, cultural competence, civic engagement (Held et al., 2019), and marketable skills specific to community-based health education/promotion. These activities can also help students develop core competencies in their respective academic disciplines, such as the Areas of Responsibility for Health Education Specialists (National Commission for Health Education Credentialing, n.d.). Furthermore, students can be encouraged to complete training requirements to become an NDDP Lifestyle Coach, which will broaden their knowledge and skill set and provide them a competitive edge when applying for internships,

graduate assistantships, and jobs. University faculty can also form collaborative partnerships with local YMCAs and medical centers that deliver NDDP classes to foster research and teaching opportunities related to obesity, MetS, and chronic disease prevention. Overall, these wide-ranging efforts can lead to advances in achieving Healthy People 2030's overarching goals that include promoting healthy behaviors and well-being across all life stages in order to eliminate health disparities and support the thriving of all (U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion, n.d.).

REFERENCES

Abraído-Lanza, A. F., Echeverría, S. E., & Flórez, K. R. (2016). Latino immigrants, acculturation, and health: Promising new directions in research. *Annual Review of Public Health, 37*, 219-36. doi:10.1146/annurevpublhealth-032315-021545

Aguayo-Mazzucato, C., Diaque, P., Hernandez, S., Rosas, S., Kostic, A., & Caballero, A. E. (2019). Understanding the growing epidemic of type 2 diabetes in the Hispanic population living in the United States. *Diabetes/Metabolism Research and Reviews*, *35*(2), e3097. http://doi.org/10.1002/dmrr.3097

Ahmed, A. T., Quinn, V. P., Caan, B., Sternfeld, B., Haque, R., & Van Den Eeden, S. K. (2009). Generational status and duration of residence predict diabetes prevalence among Latinos: The California Men's Health Study. *BMC Public Health, 9*, 392-402. https://doi.org/10.1186/1471-2458-9-392

Afable-Munsuz, A. & Pérez-Stable, E. (2017). Acculturation and health: State of the field and recommended directions. In S. Schwartz & J. Unger (Eds.), *The Oxford Handbook of Acculturation and Health* (pp. 357-377). Oxford University Press.

American Diabetes Association. (2022). *Diabetes complications – cardiovascular disease.* https://www.diabetes.org/diabetes/cardiovascular-disease

Berry, J. W. (2017). Theories and models of acculturation. In S. Schwartz & J. Unger (Eds.), *The Oxford handbook of acculturation and health* (pp. 15-28). Oxford University Press.

Boen, C. E., & Hummer, R. A. (2019). Longer but harder—lives?: The Hispanic health paradox and the social determinants of racial, ethnic, and immigrant-native health disparities from mid- through late-life. *Journal of Health and Social Behavior, 60*(4), 434-452. https://doi.org/10.1177/0022146519884538

Carabello, M., & Wolfson, J. A. (2021). Mexican immigrant health advantage in metabolic syndrome? Examining the contributions of demographic, socioeconomic, and health behavior characteristics. *SSM – Population Health,* 16. https://doi.org/10.1016/j.ssmph.2021.100932

Centers for Disease Control and Prevention. (n.d.a). *About the National DDP.* https://www.cdc.gov/diabetes/prevention/about.tm

Centers for Disease Control and Prevention. (n.d.b). *Heart disease facts.* https://www.cdc.gov/heartdisease/facts.htm

Centers for Disease Control and Prevention. (n.d.c). *National diabetes statistics report.* https://www.cdc.gov/diabetes/data/statistics-report/index.html

Data USA. (n.d.). *Dallas-Fort Worth-Arlington, TX.* https://datausa.io/profile/geo/dallas-fort-worth-arlington-tx

Daviglus, M. L., Talavera, G. A., Avilés-Santa, M. L., Allison, M., Cai, J., Criquit, M. H., Gellman, M., Giachello, A. L., Gouskova, N., Kaplan, R. C., LaVange, L., Penedo, F., Perreira, K., Pirzada, A., Schneiderman, N., Wassertheil-Smoller, S., Sorlie, P. D., & Stamler, J. (2012). Prevalence of major cardiovascular risk factors and cardiovascular diseases among Hispanic/Latino individuals of diverse backgrounds in the United States. *JAMA, 308*(17), 1775-1784. https://doi.org/10.1001/jama.2012.14517

Eckel, R. H., Alberti, K. G., Grundy, S. M., & Zimmet, P. Z. (2010). The metabolic syndrome. *The Lancet, 375* (9710), 181-183. https://doi.org/10.1016/S0140-6736(09)61794-3

Ellison, J., Jandorf, L., & Duhamel, K. (2011). Assessment of the Short Acculturation Scale for

Hispanics (SASH) among low-income, immigrant Hispanics. *Journal of Cancer Education, 26*(3), 478-483. https://doi.org/10.1007/s13187-011 0233-z

Flores, A. (2017). *How the U.S. Hispanic population is changing*. Pew Research Center. http://www.pewresearch.org/facttank/2017/09/ 18/how-the-u-s-hispanicpopulation-is-changing/

Fryar, C. D., Fakhouri, T. H., Carroll, M. D., Frenk, S. M., & Ogden, C. L. (2020). The association of nativity/length of residence and cardiovascular disease risk factors in the United States. *Preventive Medicine, 130*. https://doi.org/10.10 16/j.ypmed.2019.105893

Funk, C., & Lopez, M. H. (2022, June 14). *Hispanic Americans' experiences with health care.* Pew Research Center. https://www.pew research.org/science/2022/06/4/hispanic-ame ricans-experiences-with-healthcare/

Grundy, S. M., Cleeman, J. I., Daniels, S. R., Donato, K. A., Eckel, R. H., Franklin, B. A., Gordon, D. J., Krauss, R. M., Savage, P. J., Smith, S. C., Jr., Spertus, J. A., & Costa, F. (2005). Diagnosis and management of the metabolic syndrome: An American Heart Association/National Heart, Lung, and Blood Institute scientific statement. *Circulation, 112*, 2735-2752. https://doi.org/10.1161/CIRCULA TIONAHA.105.169404

Hallajzadeh, J., Safiri, S., Mansournia, M. A., Khoramdad, M., Izadi, N., Almasi-Hashiani, A., Pakzad, R., Ayubi, E., Sullman, M. J., & Karamzad, N. (2017). Metabolic syndrome and its components among rheumatoid arthritis patients: A comprehensive updated systematic review and meta-analysis. *PLoS ONE*, 12(3), e0170361. https://doi.org/10.1371/journal.pone.0170361

Held, F. P., Roberts, C., Daly, M., & Brunero, C. (2019). Learning relationships in community based service-learning: A social network analysis. *BMC Medical Education, 19*, 113. https://doi.org/10.1186/s12909-019-1522-1

Hirode, G., & Wong, R. J. (2020). Trends in the prevalence of metabolic syndrome in the United States, 2011-2016. *Journal of the American Medical Association, 323*(24), 2526-2528. https://doi.org/10.1001/jama.2020.4501

Hummer, R. A., & Gutin, I. (2018). Racial/ethnic and nativity disparities in the health of older US men and women. In M. D. Hayward & M. K. Majmundar (Eds.), Committee on Population, Division of Behavioral and Social Sciences and Education, National Academy of Sciences, Engineering, and Medicine. *Future directions for the demography of aging: Proceedings of a workshop* (pp. 31-66). National Academies Press. https://www.ncbi.nlm.nih.gov/books/NBK 513079/

Liu, J., Fulda, K. G., & Meng-Hua, T. (2021). Association between acculturation and metabolic syndrome in Hispanic adults mediated by fruits intake. *Public Health Nutrition, 24(*18), 6472-6476. https://doi.org/10.1017/S136898002100 3530

Lopez, M. H., & Moslimani, M. (2022, January 20). *Latinos see U.S. as better than place of family's ancestry for opportunity, raising kids, health care access.* Pew Research Center. https://www.pewresearch.org/raceethnicity/2022 /01/20/latinos-see-u-s-as-betterthan-place-of-fa milys-ancestry-for-opportunityraising-kids-health careaccess/#:~:text=In%202019%2C%2019.8m llion%20Hispanics,of%20the%20U.S.%20Hisp nic%20population.

Marín, G., Sabogal, F., VanOss Marín, B., Otero Sabogal, F., & Perez-Stable, E. J. (1987). Development of a short acculturation scale for Hispanics. *Hispanic Journal of Behavioral Sciences, 9*(2), 183-205. https://doi.org/10.1177 /07399863870092005

McIntire, R.K., Scalzo, L., Doran, C., Bucher, K., & Juon, H. (2022). Acculturation and hypertension diagnoses among Hispanics in California. *Journal of Racial and Ethnic Health Disparities, 9*(3), 946-953. https://doi.org/10.1 007/s40615-021-01033-4

Moran, A., Diez Roux, A.V., Jackson, S.A., Kramer, H., Manaolio, T.A., Shrager, S., & Shea, S. (2007). Acculturation is associated with hypertension in a multiethnic sample. American Journal of Hypertension, 20(4), 354-363. http://doi:10.1016/j.amjhyper.2006.09.025

National Commission for Health Education Credentialing. (n.d.). *Health education responsibilities.* https://www.nchec.org/health education-responsibilities

National Heart, Lung, and Blood Institute. (n.d.). What is metabolic syndrome? https://www.nhlbi.nih.gov/health/metabolicsyndrome

Noe-Bustamante, L., Lopez, M. H., & Krogstad, J. M. (2020). U.S. Hispanic population surpassed 60 million in 2019, but growth has slowed. Pew Research Center. https://www.pewresearch.org/facttank/2020/07/07/u-s-hispanic-population surpassed-60-million-in-2019-but-growth-has slowed/

O'Neill, S., & O'Driscoll, L. (2015). Metabolic syndrome: A closer look at the growing epidemic and its associated pathologies. *Obesity Review, 16(*1), 1-12. https://doi.org/10.1111/obr.12229

Pérez, A. (2015). Acculturation, health literacy, and illness perceptions of hypertension among Hispanic adults. *Journal of Transcultural Nursing*, *26*(4), 386-394. https://doi.org/10.1177/1043659614524785

Pew Research Center. (2016, September 6). *Hispanic population and origin in select U.S. metropolitan areas, 2014.* https://www.pewresearch.org/hispanic/interacties/hispanicpopulation-in-select-u-smetropolitan-areas/

Santiago-Torres, M., Contento, I., Koch, P., Tsai, W., Gaffney, A. O., Marín-Chollom, A. M., Shi, Z., Ulanday, K. T., Shen, H., Hershman, D., Greenlee, H. (2022). Associations between acculturation and weight, diet quality, and physical activity among Latina breast cancer survivors: The ¡Mi Vida Saludable! Study. *Journal of the Academy of Nutrition and Dietetics, 122*(9), 1703-1716.

Schuppelius, B., Peters, B., Ottawa, A., & Pivovarova-Ramich, O. (2021). Time restricted eating: A dietary strategy to prevent and treat metabolic disturbances. *Front Endocrinol (Lausanne), 12*, 683140. https://doi.org/10.3389/fendo.2021.683140

Schwartz, S., & Unger, J. (2017). Acculturation and health: State of the field and recommended directions. In S. Schwartz & J. Unger (Eds.), *The Oxford handbook of acculturation and health* (pp. 1-14). Oxford University Press.

Schwartz, S. J., Unger, J. B., Zamboanga, B. L., & Szapocznik, J. (2010). Rethinking the concept of acculturation: Implications for theory and research. *American Psychologist, 65*(4), 237 251. https://doi.org/10.1037/a0019330

Texas Demographic Center. (n.d.). *Hispanic heritage month. Hispanic Americans in Texas.* https://demographics.texas.gov/Resources/Publications/2021/20211004_HispanicHeritageMont.pdf

Thomson, M. D., & Hoffman-Goetz, L. (2009). Defining and measuring acculturation: A systematic review of public health studies with Hispanic populations in the United States. *Social Science & Medicine, 69*, 983-991. https://doi.org/10.1016/j.socscimed.2009.05.011

U.S. Census Bureau. (n.d.). *Quick facts – United States.* https://www.census.gov/quickfacts/fact/table/USPST045222

U.S. Census Bureau. (2018). *Hispanic population to reach 111 million by 2060.* https://www.census.gov/library/visualizations/218/comm/hispanic projected-pop.html

U.S. Census Bureau. (2021a). *Texas added almost 4 million people in last decade.* https://www.census.gov/library/stories/state-by state/texas-population-change-between-census decade.html

U.S. Census Bureau. (2021b). *2020 census statistics highlight local population changes and nation's racial and ethnic diversity*. https://www.census.gov/newsroom/pressreleases/2021/population-changes-nationsdiversity.html

U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. (n.d.). *Healthy People 2030 Framework.* https://health.gov/healthypeople/about/healthypeople-2030-framework

U.S. Department of Health and Human Services, Office of Minority Health. (n.d.). *Diabetes and Hispanic Americans.* https://minorityhealth.hhs.gov/omh/browse.asp?lvl=4&lvlid=63

Velasco-Mondragon, E. Jimenez, A., Palladino Davis, A. G., Davis, D., & Escamilla-Cejudo, J. A. (2016). Hispanic health in the USA: A scoping review of the literature. *Public Health Reviews 37, 31.* https://doi.org/10.1186/s40985-016-0043-2

Vella, C., Ontiveros, D., Zubia, R., & Bader, J. (2011). Acculturation and metabolic syndrome risk factors in young Mexican and Mexican American women. *Journal of Immigrant & Minority Health, 13*(1), 119-126. https://doi.org/10.1007/s10903-009-9299-7

Wallace, P. M., Pomery, E. A., Latimer, A. E., Martinez, J. L., & Salovey, P. (2010). A review of acculturation measures and their utility in studies promoting Latino health. *Hispanic Journal of Behavioral Sciences, 32*(1), 37-54. https://doi.org/10.1177/0739986309352341

Williams, J. E., Kabukuru, A., Mayo, R., & Griffin, S. F. (2011). Commentary: A social-ecological perspective on obesity among Latinos. *Ethnicity & Disease, 21*(4), 467-472. https://pubmed.ncbi.nlm.nih.gov/22428352

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

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 or 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

Table 3: ***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

Table 4: ***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

Table 5: ***Logistic Regression 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