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Obesity, Cardiovascular Risk Factors, and Weight Loss in a Population of Adult Mexican Americans

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OBESITY, CARDIOVASCULAR DISEASE RISK FACTORS AND WEIGHT LOSS IN A POPULATION OF ADULT MEXICAN AMERICANS

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To: Dean Michele Ciccazzo
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This dissertation, written by Janisse Rosario, and entitled Obesity, Cardiovascular Disease Risk Factors, and Weight Loss in a Population of Adult Mexican Americans, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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ABSTRACT OF THE DISSERTATION

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The study of obesity has evolved into one of the most important public health issues in the United States (U.S.), particularly in Hispanic populations. Mexican Americans, the largest Hispanic ethnic subgroup in the U.S., have been significantly impacted by obesity and related cardiovascular diseases. Mexican Americans living in the Lower Rio Grande Valley (the Valley) in the Texas-Mexico border are one of the most disadvantaged and hard-to-reach minority groups. Demographic factors, socioeconomic status, acculturation, and physical activity behavior have been found to be important predictors of health, although research findings are mixed when establishing predictors of obesity in this population. Furthermore, while obesity has long been linked to cardiovascular disease (CVD) risk factors such as hypertension, type 2 diabetes, and dyslipidemia; information on the relationships between obesity and these CVD risk factors have been mostly from non-minority population groups. Overall, research has been mixed in establishing the association between obesity and related CVD risk factors in this population calling attention to the need for further research. Nevertheless, identifying predictors of success for weight loss in this population will be important if health disparities are to be addressed. The overall objective of the findings presented in this dissertation was to attain a more informed profile of obesity and CVD risk factors in this population. In particular, we examined predictors of obesity, measures of obesity and association with cardiovascular disease risk factors in a sample of 975 Mexican Americans participating in a health promotion program in the Valley region. Findings suggest acculturation factors to be one of the most important predictors of obesity in this population. Results also point to the need of identifying other possible risk factors for predicting CVD risk. Finally, initial body mass index is an important predictor of weight loss in this population group. Thus, indicating that this population is not only amenable to change, but that improvements in weight loss are feasible. This finding strengthens the relevance of prevention programs such as Beyond Sabor for Mexican populations at risk, in particular, food bank recipients.

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ABBREVIATIONS AND ACRONYMS

AHB	Alliance for a Healthy Border
AHA	American Heart Association
ADA	American Diabetes Association
BMI	Body Mass Index
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CHIS	California Health Interview Survey
CI	Confidence Interval
CVD	Cardiovascular Disease
DBP	Diastolic Blood Pressure
DPP	Diabetes Prevention Program
DSMP	Diabetes Self-Management Program
FPG	Fasting Plasma Glucose
FPL	Federal Poverty Level
FRBD	Federal Reserve Bank of Dallas
HDL-c	High-Density Lipoprotein Cholesterol
HTN	Hypertension
IFG	Impaired Fasting Glucose
LDL-c	Low-Density Lipoprotein Cholesterol
M	Mean
NIH	National Institutes of Health
NHANES	National Health and Nutrition Examination Survey
NHIS	National Health Interview Survey

NHLBI	National Heart, Lung, and Blood Institute
NLSY	National Longitudinal Survey of Youth
OR	Odds Ratio
PAHO	Pan American Health Organization
PAR	Physical Activity Recall
RR	Relative Risk
SES	Socioeconomic Status
SBP	Systolic Blood Pressure
SD	Standard Deviation
TDSHS	Texas Department of State Health Services
USDHHS	United States Department of Health and Human Services
WC	Waist Circumference
WHO	World Health Organization
WHR	Waist-to-Hip Ratio
U.S.	United States

CHAPTER I

INTRODUCTION

Obesity has evolved into one of the most important public health issues in the United States (U.S.), particularly in Hispanic populations (National Heart, Lung, and Blood Institute, 2003). Globally, an estimated 205 million men (range: 193–217 million) and 297 million women (range: 280–315 million) 20 years and older were obese in 2008; and an additional 1.46 billion (1.41–1.51 billion) adult men and women were overweight (Finucane et al., 2011). Nationally, more than 68.8% of adults are overweight or obese, with obesity rates exceeding 30% for most age and sex groups (Flegal, Carroll, Ogden, & Curtin, 2012). Past projections have suggested that by 2015 the majority of U.S. adults (75%) and nearly a quarter (24%) of U.S. children and adolescents will be overweight or obese (Wang & Beydoun, 2007), with estimates reaching 87% of all American adults by 2030 (Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008). A more recent analysis shows lower forecasts than those of past studies (Wang & Beydoun, 2007; Wang et al., 2008); with more current trends suggesting that by 2030, 51% of the population will be obese (Finkelstein et al., 2012). National campaigns by the National Institutes of Health (NIH), Centers for Disease Control and Prevention (CDC), as well as local community efforts focused on implementing effective programs and policies may account for the slowing trend in obesity. One example supporting this national effort is found in the parent study that generated the data examined here. The parent study, the Beyond Sabor (Spanish word for “flavor”) intervention, clearly illustrates this focus in its community based participatory research approach aimed at providing low income Food Bank recipients with the educational tools necessary to improve their eating and physical activity behaviors.

Research has proven the negative impact of obesity on longevity, reducing the length of life of individuals by an estimated 5 to 20 years (Fontaine, Redden, Wang, Westfall, & Allison, 2003). The adverse outcomes related to obesity include a number of serious health consequences, psychological disorders, and limitations in socioeconomic success (Cossrow & Falkner, 2004). Health complications include, but are not limited to, type 2 diabetes, atherosclerosis, coronary heart disease, arthritis, depression, and cancer among others (Must et al., 1999). Abdominal obesity, or central obesity, has been associated with the metabolic syndrome- the clustering of risk factors including insulin resistance, hyperinsulinemia, hyperglycemia, dyslipidemia, and hypertension- which leads to an elevated risk for heart disease (Boulé, Haddad, Kenny, Wells, & Sigal, 2001). Consequently, national medical care costs of obesity-related illness in adults are an estimated $209.7 billion, representing 20.6% of U.S. national health expenditures (Cawley & Meyerhoefer, 2012).

Trend studies demonstrate obesity prevalence rates have steadily increased over the past three decades with significant disparities between racial groups (Cossrow & Falkner, 2004; Osei-Assibey, Adi, Kumar, & Matyka, 2010; Pan et al., 2009). With the changing demographics in the U.S. population, including the rapid growth of the Hispanic population, it is important to understand the health risks and disease disparities impacting this population. This growth has presented challenges to the healthcare system and the nation's prevention agenda for eliminating racial and ethnic disparities, considering the inequalities observed in prevalence of chronic diseases including obesity and type 2 diabetes (Hertz, Unger, & Ferrario, 2006). As a result, native-born and Hispanic immigrants have become an increasingly important population for health promotion efforts (Ayala et al., 2004). Hispanics tend to be younger, of lower income, less educated, unemployed or working in high-risk occupations, and tend to live in larger households than their non-Hispanic counterparts (Therrien & Ramirez, 2000). Together these factors present a profile commonly associated with poorer health status (Singh & Siahpush, 2002). Mexican Americans, comprising more than two-thirds of the U.S. Hispanic population, represent the largest Hispanic ethnic subgroup (Grieco, 2010; Ramirez & de La Cruz, 2003).

Mexican Americans have the second highest age-adjusted rate of obesity (40.4%) in the U.S. compared to non-Hispanic blacks (49.5%), but the highest when compared to all Hispanics (39.1%) and non-Hispanic whites (34.3%) (Flegal et al., 2012). Although non-Hispanic blacks have higher prevalence of obesity compared to non-Hispanic whites and Hispanics, Hispanics and Mexican Americans have a higher prevalence of overweight compared to non-Hispanic blacks (Flegal et al., 2010). Mexican American men aged 20 and older experience the highest rates of overweight and obesity (82.4%) among all ethnic/racial groups, with Mexican American women having the second highest prevalence (78.5%) (Flegal et al., 2012). According to 2030 projections by Wang and colleagues (2008), close to 91% Mexican American men and 87% of women will be overweight or obese.

Of equal concern is the high prevalence of type 2 diabetes in Hispanics which has increased parallel to the obesity epidemic (CDC, 2004a). The percentage of Hispanics diagnosed with diabetes between 1997 and 2007 increased from 6.3% to 25.4%, while diagnosis increased by 40.6% among Mexican Americans during the same time period (Wallace & Castañeda, 2010). Mexican Americans have been found to be twice as likely to have diabetes as non-Hispanic white adults (CDC, 2004a; Cowie et al., 2010; Hunt et al., 2003); and worse glycemic control (Brown et al., 2003; Harris et al., 1999). The importance of preventing individuals from becoming overweight has been illustrated by studies by Burke et al. (2003) and Kanaya & Narayan (2003), showing a 62% reduction of incidence of type 2 diabetes among Mexican Americans.

In the context of limited resources, it is crucial to determine the population groups for whom priority action should be taken at the local level for obesity prevention, as well as identifying approaches for management of obesity (Nichols & Swinburn, 2010). It has been noted Mexican Americans living in the Lower Rio Grande Valley (the Valley) in the Texas-Mexico border and in *colonias*- unincorporated, impoverished settlements with substandard living conditions along the Valley- are one of the most disadvantaged, worse off in terms of physical health, and hard-to-reach minority groups in the U.S. (Mier et al., 2007). Furthermore, Salinas and colleagues (2013) highlight the importance of geographic location when it comes to evaluating disease burden in Mexican Americans, in particular, in border communities. To better inform health promotion programs aimed at improving the health status of minority population subgroups, such as Mexican Americans living in the Valley, a better understanding of correlates of obesity as well as the public health effect, specifically on cardiovascular disease (CVD) risk factors, is needed. In addition, identifying predictors of weight loss success or what factors influence response to obesity prevention and management interventions will aid in the tailoring and implementation of more effective health promotion programs.

Statement of the Problem

In order to successfully reduce health disparities and address the obesity epidemic it is important to understand the demographic, socioeconomic and lifestyle factors that place individuals at risk of becoming overweight and obese. Given the limited resources for obesity prevention interventions, priority groups should be identified and interventions tailored to the largest extent possible to sociodemographic and lifestyle characteristics of targeted groups (Anderson, Winett, & Wojcik, 2007; Nichols and Swinburn, 2010). Research has revealed inconsistent sociodemographic risk factors for weight gain (Brown & Siahpush, 2007). Previous studies have found sociodemographic factors such as age, gender, and socioeconomic status (SES) to be associated with obesity (Ball, Mishra, & Crawford, 2002; Baum & Ruhm, 2009; Karlamangla, Merkin, Crimmins, & Seeman, 2010; Roeters van Lennep, Westerveld, Erkelens, & Van Der Wall, 2002); however, the literature is mixed in establishing associations and few studies have been conducted in the Mexican American population, and less so among Mexican Americans living in the border region. Furthermore, a number of studies have assessed marital status, number of children and nativity as correlates of obesity among specific minority groups (Goel, McCarthy, Phillips, & Wee, 2004; Gordon-Larson, Harris, & Poplin, 2003; Kaplan, Huguet, Newsom, & McFarland, 2004); but very few studies have been specific to the Mexican American population (Bowie et al., 2007; Fisher-Hoch et al., 2010).

In addition to sociodemographic factors, the obesity epidemic has also led to considerable attention to behavioral risk factors such as diet and physical inactivity. Newby et al. (2003) found smaller gains in body weight when consuming a diet that is high in fruit, vegetables, reduced-fat dairy products, and whole grains, while low in red and processed meat, fast food, and soft drinks. Although Mexican Americans have a relatively high intake of fiber relative to other groups, mainly because of a greater use of legumes and tortillas, they also have a high cholesterol intake (Warrix, 2010). Despite benefits associated with engaging in physical activity, lifestyle indicators show Hispanics fall short of recommended guidelines and have the highest rates of physical inactivity (53.2%) in the U.S. (Adams & Schoenborn, 2006). Considering the lack or limited engagement in recommended physical activity levels among Hispanic subgroups there is an urgent need to pay greater attention to underserved and minority populations (Neighbors, Marquez, & Marcus, 2008). However, studies have found weak evidence that physical inactivity is a determinant of obesity (Fox & Hillsdon, 2007). The present study would significantly contribute to a better understanding of predictors of obesity in the Mexican American population, including those living in the Valley region. By identifying the most important predictors of BMI and waist circumference (WC), limited resources can be used in targeting those at higher risk of obesity as well as inform the development of health promotion programs that are tailored to the characteristics of the population.

As might be expected, the high prevalence of obesity in the Mexican American population is of concern given associated health consequences, including CVD risk factors. Although a number of studies show obese individuals have an increased risk of several adverse health outcomes and despite the scope and magnitude of the observed increases in obesity, some argue the health implications of these obesity trends remain unclear (Gregg et al., 2005). Increases in obesity have been accompanied by increases in type 2 diabetes, while the association between obesity trends and other CVD risk factors remains less certain (Gregg, Cheng, Narayan, Thompson, & Williamson, 2007). Furthermore, information on the relationships between measures of obesity and abdominal obesity with a cluster of metabolic disorders including type 2diabetes, hypertension, and dyslipidemia (high triglyceride levels and low high density lipoprotein cholesterol levels) has largely been obtained from studies involving Caucasian or populations of European descent (Denke, Sempos, & Grundy, 1993; Denke, Sempos, & Grundy, 1994; Després et al., 1990; Huxley, Mendis, Zheleznyakov, Reddy, & Chan, 2010; Seidell et al., 1991). Davidson et al. (2007) highlighted the need for additional research to fully determine the best predictors of CVD risk factors in Latino/Hispanic individuals. By better understanding the prevalence of CVD risk factors in this population subgroup, and association with BMI and WC, public health professionals will be able to develop prevention programs and services targeted toward risk burdens specific to the population subgroup (Kurian & Cardarelli, 2007).

A wide range of obesity management and treatment regimens are available, including diet, exercise, behavioral modification, pharmacological treatment and surgery (Galani & Schneider, 2007). Of these diet and physical activity behavior modification programs have been found to result in improvements in body weight and associated CVD risk factors, including dyslipidemia and type 2 diabetes (Pritchett, Foreyt, & Mann, 2005). These types of health intervention programs, such as Beyond Sabor, might reduce the need for pharmacological treatments. However, few weight-loss or nutrition/exercise behavior change interventions have targeted Hispanic populations (Lindberg & Stevens, 2007). As a result, traditional approaches to obesity prevention and managing diabetes in the U.S. have been perceived by Mexican Americans, in some instances, as culturally insensitive and ineffective (Alcozer, 2000). Understanding factors that predict success in programs aimed at reducing or managing weight is imperative if progress is to be made tackling obesity and its related health consequences. To this end, studies have tried to identify the characteristics that will predict weight loss success in individuals who are obese and are undergoing treatment or participating in a lifestyle intervention but few, if any, variables have been found to consistently predict weight loss (Wadden et al., 1992). For example, factors such as sex, SES, and baseline clinical indicators have been found to influence an individual's response to lifestyle intervention programs aimed at reducing obesity and improving glycemic control (Wang, Ghaddar, Brown, Pagán, & Balboa, 2012). Others have found people with varied educational backgrounds may respond differently to a lifestyle intervention for weight management and diabetes control (Gurka et al., 2006). Given the dearth of research examining the potential disparate effects of weight-related interventions across levels of factors such as those aforementioned, more research is needed to explore the possible differences in response to a weight-related intervention among possible predictors such as age, gender, SES, lifestyle, and baseline health status.

Significance of Study to the Health Promotion Field

This study will make a contribution to the literature by providing a better understanding of correlates of BMI and WC among Mexican American adults living in the Valley region, in particular, those who experience food insecurity. First, findings from this study will provide information on important risk factors in this border population and can inform delivery of future health promotion programs for this minority group which might be more successful to the extent they are tailored to the age, household SES, and family characteristics such as number of children. Second, the present study will add to the literature by providing an epidemiological profile of obesity, type 2 diabetes, and related CVD risk factors based on clinical assessments rather than self-reported data for this population. Third, this research will add to the literature by providing information on the relationships between two measures of obesity, BMI and WC, with CVD risk factors in an understudied population. Fourth, identifying who is most likely to benefit from health promotion programs aimed at preventing, reducing, or managing obesity will make better use of limited resources by informing the development and tailoring of future health promotion interventions in this Mexican American population subgroup living in the Texas-Mexico border. Lastly, findings from this study may be cautiously applied to the general Mexican American population adding to the limited literature on predictors of obesity, associations with CVD risk factors, and predictors of weight loss success in this minority population.

Summary

This chapter supports the real and significant problem of obesity and its deleterious health consequences in Mexican Americans living in the Valley region of the Texas-Mexico border. The necessity of understanding correlates of BMI and WC and association with CVD risk factors is needed to better inform health promotion programs targeting this Hispanic subgroup. Developing successful and targeted strategies for obesity prevention will depend on the identification of important risk factors in this Hispanic subgroup as well as predictors of weight loss success for the future development of effective interventions. Obesity-related research is a high priority for this population subgroup if health disparities are to be reduced.

Dissertation Organization

The overall purpose of this dissertation is to provide a comprehensive epidemiological profile of Mexican Americans living in the Texas-Mexico border region as it relates to obesity and related CVD risk factors while exploring relationships and associations amongst a wide number of factors. The dissertation has been organized using the three manuscript format. The first manuscript of this dissertation assessed correlates of BMI and WC in this high-risk population subgroup. Given the mixed literature on the association between measures of obesity with CVD risk factors, especially hypertension and dyslipidemia, in Mexican Americans, the second manuscript aimed to assess the relationships between BMI and WC with CVD risk factors including type 2 diabetes, hypertension, and dyslipidemia. Lastly, the purpose of the third manuscript was to assess predictors of weight loss success to better identify who is most likely to benefit from a health promotion program, such as Beyond Sabor*,* the parent study of this dissertation.

Given the three manuscript format, steps have been taken to ensure a cohesive transition from the more traditional components of the dissertation to the three publishable manuscripts. The dissertation has been organized in a way that the reader is first provided with an overview of the problem of obesity, the primary focus of this dissertation, and its sociodemographic and lifestyle correlates, i.e. physical activity, for the population of interest. This forms the basis of the first manuscript. From this overview of the literature on obesity and its risk factors, the dissertation then shifts towards providing the reader with an overview of the cardiovascular profile of the population subgroup which highlights the associations between BMI and WC with CVD risk factors such as type 2 diabetes, hypertension, and dyslipidemia, forming the basis of manuscript 2. The third manuscript aimed to identify who is most likely to benefit from a health promotion program targeting management and reduction of obesity in the target population based on factors studied in manuscript 1 and baseline health factors assessed in manuscript 2. Thus, there is a logical progression to the dissertation intended to provide some cohesiveness for the reader.

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CHAPTER II

LITERATURE REVIEW

The Lower Rio Grande Valley Region of South Texas

The population studied in the present study is from the Lower Rio Grande Valley in South Texas. The Valley region borders the Gulf of Mexico at Texas' southern tip and spans roughly 100 miles along the Rio Grande River which separates the United States (U.S.) from Mexico. The region is made up of the four counties of Hidalgo, Cameron, Starr, and Willacy in the Texas-Mexico border. More than 1.2 million live in the Valley region representing about 5% of Texas' general population (U.S. Census Bureau, 2011). The Valley population grew at an average of 31% across counties from 1999 to 2000, compared to 13% nationally (Perkins et al., 2001). The Valley region has the highest Hispanic (i.e. Mexican American) concentration in the U.S. ranging from 86% in Willacy to 97% in Starr County (Texas Lower Rio Grande Valley Fact Sheet, 2009). The population is relatively younger than the population of the state as a whole. At least forty percent of individuals residing in each of the four counties are between the ages of 15-44; more than 25% are 14 years of age or younger (U.S. Census Bureau, 2010).

The culture of the Valley region is a coming together of Mexican American and mainstream U.S. ways of life that converge to create a unique regional culture. According to Day (2004), the Valley region is one of the most dynamic cultural areas in the nation, where cultural exchange with Mexico occurs at all levels of society, formally and informally. Today, bi-nationalism reigns and Mexican traditions permeate the language, food, music and religion. The Hispanic culture overall, including that of residents in the Valley region, is family-centered with women playing an important role, especially as it pertains to health care (Perkins et al., 2001).

The Valley region is one of the most disadvantaged areas in the country with low educational levels, low per capita income, and high poverty levels (Wehrly et al., 2010). Census figures indicate the region has a lower percentage of high school graduates ranging from 46.5% in Starr County to 62.4% in Cameron County, compared to the state's average of 79.3% and a national average of 84.6% (U.S. Census, 2010). Census data also shows per capita income is among the lowest in the country with Starr County having the lowest ($9,717) and Cameron the highest ($13,130), both well below the state's average ($24,318) and national average ($27,041).

Given the low educational attainment and low per capita income observed, a high percentage of Valley residents live below the federal poverty level (FPL). The percentage of people over the age of 55 living below the 100% FPL ranges from 25% in Cameron and Hidalgo counties to 39% and 41% in Starr and Willacy counties, respectively (Texas Lower Rio Grande Valley Fact Sheet, 2009). The Texas Commission Workforce (2010) reports unemployment rates exceeded 9% for all four counties, higher than the state's average of 8.3%. Residents primarily speak another language other than English at home ranging from 46% in Willacy to 96% in Starr County (U.S. Census Bureau, 2010).

Settlements or *colonias* abound in the Valley region. *Colonias* represent a challenge to the health status of its residents with many of these unincorporated subdivisions lacking paved roads, adequate sewage disposal systems and clean water. Although there are no census data for *colonias* collectively, studies estimate there are over 1800 *colonias* in Texas with almost 500,000 inhabitants, an estimated 60% of them located in Hidalgo county (Ramos, May, & Ramos, 2001). A non-probability sample of 271 Mexican Americans living in *colonias* in the counties of Starr and Hidalgo found 80% of respondents in the *colonias* had family incomes less than $15,000, compared to 45.7% of the residents of Starr County; nearly 70% didn't have a high school diploma and 42% were uninsured (Ortiz, Arizmendi, & Cornelius, 2004). Among *colonia* residents, fieldwork represents 29.5% of the jobs, construction work 24.4% and factory work 14.9% (Federal Reserve Bank of Dallas [FRBD], 1995). Because of the seasonal nature of some of these industries, unemployment rates in *colonias* have been reported to range from 20% to 60% (FRBD, 1995). It is not surprising Mexican Americans living in *colonias* in the Valley region are one of the most disadvantaged minority populations in the U.S. (Mier et al., 2007).

Access to health care for residents in the Valley is limited. According to 2007 Behavioral Risk Factor Surveillance System (BRFSS) data, 47% of adults had no medical insurance (Texas Department of State Health Services (TDSHS), 2007). Part of Cameron County and all of Hidalgo, Starr, and Willacy Counties have been designated medically underserved areas (Perkins et al., 2001). All four Lower Rio Grande Valley counties have been designated primary care, mental health, and dental care health professional shortage areas (Perkins et al., 2001). Two of the four counties have no county health departments (Day, 2004). The situation in *colonias* is even direr with very few health clinics and almost no private physicians (Ortiz, Arizmendi, & Cornelius, 2004). As a result, many Valley residents cross the border for health care and to purchase medications (Macias & Morales, 2002). Other than lack of infrastructure, barriers to proper health care include lack of money, insurance, and transportation, as well as child care, language, and culture (Bowden et al., 2006).

Heart disease was the leading cause of death among the four (TDSHS, 2008). In a randomly selected sample of 386 Mexican Americans living in Hidalgo County, more than half of the respondents reported fair/poor health (Mier et al., 2008). Obesity and type 2 diabetes are high in the region (Bastida, Cuellar, & Villas, 2001). The high prevalence of diabetes and of obesity in the Valley region puts the population at risk for cardiovascular disease (CVD). Day (2004) concluded the high prevalence of these nutrition-related chronic diseases, exacerbated by poverty, low educational attainment, the socioeconomic challenges of single parenting, and unemployment, along with impaired food insecurity pose serious threats to the health of the Valley's residents.

The Problem of Obesity

Definition of Obesity

Overweight and obesity is related to a person's total body weight. Obesity specifically refers to an excess amount of body fat or adipose tissue (National Heart Lung and Blood Institute (NHLBI), 2008). Because fat is stored throughout the body, it cannot be measured directly. Body weight itself can provide an indication of fat stores, but because body build and composition are extremely variable, there is no ideal body weight. Instead, measurements have been developed to better estimate body fat and quantify health risk (Stein & Colditz, 2004).

Currently, overweight and obesity is assessed using several anthropometric measurements, such as body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR). For practical purposes, BMI is most widely used. As aforementioned, BMI is calculated as weight in kilograms divided by the square of height in meters (kg/m^2) (NIH, 1998). The NHLBI defines a BMI of less than 18.5 kg/m^2 as underweight, 18.5 to 24.9 kg/m^2 as normal weight, and a BMI over 25 kg/m^2 as overweight. Overweight is further classified into pre-obese (BMI 25.0 – 29.9 kg/m^2), obese class I (BMI 30.0 – 34.9 kg/m^2), obese class II (BMI 35.0 – 39.9 kg/m^2) and obese class III (BMI $\geq$ 40 kg/m^2). A limitation of BMI is its inability to distinguish between fat mass and lean mass and, therefore, does not provide an accurate indication of body fat in extremely muscular individuals or people who have lost significant muscle mass (Stein & Colditz, 2004). In addition, BMI may not be a sensitive indicator of the health risks associated with moderate weight gain (10–20 pounds) in individuals that fall within the normal BMI range. Despite these limitations, BMI is highly correlated (coefficient of correlation from 0.7 to 0.9) with body fat percentage and is commonly used as a predictor of morbidity and mortality due to its association with numerous chronic diseases, including type 2 diabetes and CVD (NHLBI, 1998; World Health Organization (WHO), 2000).

Other techniques including magnetic resonance imaging and computed tomography provide an accurate quantification of body fat compartments, but the application of these are relatively expensive, complex and inadequate for routine clinical settings and population-based studies (Chan, Watts, Barrett, & Burke, 2003). Measures of WC or WHR are indicative of visceral adipose tissue, or intra-abdominal fat, which may be more deleterious than overall overweight or obesity in some cases (Kumanyika et al., 2008). Several researchers recommend the use of WC, a measurement of abdominal obesity, as a better predictor of obesity-related diseases compared to BMI (Janssen, Katzmarzyk, & Ross, 2004; Wang, Rimm, Stampfer, Willet, & Hu, 2005; Zhu et al., 2005). Lean and colleagues (1995) has recommended the use of WC for health promotion interventions to identify individuals who should seek and should be offered weight management. The NHLBI suggests cut-off points for WC of 40 inches (102 cm) for men and 35 inches (88 cm) for women to define central obesity in most adults with a BMI of 25 to 34.9 kg/m^2 (NHLBI, 1998). However, the International Diabetes Federation (IDF) suggests lower cut-off points, ≥ 94 cm in men and ≥ 80 cm in women, for ethnic groups (Alberti, Zimmet, & Shaw, 2005). For WHR, a measure of the ratio of the circumference of the waist to that of the hips measured in centimeters or inches, WHO recommends cut-off points for WHR of ≥ 0.90 in men and ≥ 0.85 in women (WHO, 2000). De Koning and colleagues (2007) argue WHR alone may be inappropriate to assess obesity or weight loss in health promotion programs but that compared to BMI, WHR together with WC, appears to be more strongly associated with CVD risk factors.

General Overview of Health Consequences

Despite the ongoing debate on whether obesity should be considered a disease, obesity, directly and indirectly, has become a burden to society. In June 2013, the American Medical Association officially designated obesity a disease (Fox, 2013). Obesity, or excessive body fat, is a problem of concern because of its relationship with chronic diseases. Obesity and its related behavioral risk factors of poor nutrition and physical inactivity are major causes of mortality. In the U.S., estimates of annual deaths attributable to obesity have varied from 112,000 (Flegal, Graubard, Williamson, & Gail, 2005) to as high as 400,000 (Mokdad, Marks, Stroup, & Geberding, 2005). However, despite the relatively wide margin in estimates, Mokdad et al. (2005) conclude that poor diet and physical inactivity contributed to the largest number of deaths in 2000, second only to tobacco. Thus, efforts to prevent and reduce obesity, given its substantial lifetime health and economic consequences, are an important public health research agenda (Thompson, Edelsberg, Colditz, Bird, & Oster, 1999).

The financial burden of obesity is the result of the need to treat the accompanying health consequences of obesity, such as type 2 diabetes, CVD, hypertension, and cancer (Kopelman, 2000). Several studies have shown associations between obesity and high blood pressure, high blood cholesterol, and low levels of high density lipoprotein (HDL) cholesterol, which are important CVD risk factors (Brown et al., 2000; Must et al., 1999; Thompson et al., 1999). Obesity is a risk factor for the development of the metabolic syndrome (Park et al., 2003). The metabolic syndrome is characterized by the clustering of metabolic disorders including high blood pressure, a high triglyceride level, a low level of HDL cholesterol, and high plasma glucose concentrations. The deleterious effects of obesity are not limited to type 2 diabetes and CVD but include a whole host of other adverse health outcomes including sleep apnea, hernia, depression, asthma, psychological problems, Alzheimer's disease, and arthritis (Haslam & James, 2005; Wellman & Friedberg, 2002).

Prevalence of Obesity in the Valley Region

Overweight and obesity is of particular concern in the Mexican American population, especially those living in the Texas-Mexico border. According to the 2009 Texas BRFSS, over 72% of residents 18 years and older in the Texas-Mexico border counties are overweight and/or obese (TDSHS, 2009). Border wide data (2004-2005) showed less than 1% of the border population was underweight, 23.6% was normal weight, 36.9 % was overweight and 38.3% was obese (Pan American Health Organization (PAHO), 2007). Men showed higher rates of overweight prevalence compared to women (40.9% vs. 35.6%), but women surpassed men in the obesity category (34.4% vs. 33.0%) (PAHO, 2007).

Limited prevalence data for the Valley shows the region is particularly hit with high obesity rates. A study by Mier et al. (2008), which examined the health profile of Mexican Americans living in *colonias* in Hidalgo County, showed almost half of those surveyed were obese or severely obese. Similar prevalence rates of obesity were reported by Fisher-Hoch et al. (2010) in Cameron County with over 55% of individuals falling in the BMI obese category. The Border Epidemiological Study of Aging, which provides region-wide epidemiologic data for Mexican Americans 37 years and older, reported overweight and obesity prevalence rates above 75% (Bastida & Soydemir, 2009).

Risk Factors of Obesity

It is generally recognized that obesity is most commonly caused by excess energy ingested (dietary intake) relative to energy expenditure (energy loss via metabolic and physical activity) (Bray, 2003). However, the etiology of obesity is highly multifaceted and includes genetic, physiologic, environmental, psychological, social, economic, and even political factors that interact in varying degrees to promote the development of obesity (Wright & Arrone, 2012). The prevalence of obesity is increasing worldwide, which indicates the primary cause of obesity lies in environmental and behavioral changes, rather than in genetic modifications (Martínez, Kearney, Kafatos, Paquet, & Martínez-González, 1999). This suggests our understanding of conditions like obesity would be enhanced by simultaneously examining social determinants of health and lifestyle practices.

Obesity and Sociodemographic Factors

Demographic factors

Age is considered one of the strongest predictors of disease in humans. Baum & Ruhm (2009) analyzed age-related change in body weight utilizing data from the National Longitudinal Survey of Youth (NLSY) and found BMI and obesity prevalence grew rapidly with age. Average BMI rose from 21.6 to 26.9 kg/m^2 between the ages of 18 and 40, while obesity prevalence increased from 1.0% to 23.2%. Baum and Ruhm (2009) concluded body weight rises during the transition from early to middle adulthood and predicted a BMI growth pattern of about 0.12 kg/m^2 per year. The association observed in the NLSY cohort between BMI and age is almost linear across all ages examined, although some concavity is observed among the older age groups. Study findings, however, have to be interpreted with caution given the self-reported height and weight measurements. Also, the NLSY categorizes racial/ethnic groups into Blacks, Whites, and Hispanics thus limiting any inferences to Hispanic population subgroups.

A cross-sectional, population-based prevalence study among 6,038 non-institutionalized, primarily urban Mexican Americans older than 40 years of age living in Los Angeles, California were studied to estimate the prevalence and risk factors of obesity in this population (Torres, Azen, & Varma, 2006). The 6,038 individuals (78% participation rate) completed an in-home questionnaire, a clinical examination, and had anthropometric measurements taken at a local examination center by trained technicians. Torres et al. (2006) found prevalence of obesity was greatest in participants 50-69 years

(52%) as compared to the younger (40-49 years) or older ($\geq$ 70 years) participants ($p <$ .001). However, contrary to the almost linear trends observed by Baum and Ruhm (2009), significant gender differences were found providing evidence of gender as a potential correlate of obesity. Prevalence of obesity was greatest in the 50- and 60- year old age groups (57%) among Mexican American women while prevalence was highest in the 40-year old age group (44%) among Mexican American men. Study limitations included lack of collection of dietary and physical activity data from participants which are important correlates of obesity and study findings about prevalence and associations observed are limited to an older age group (above 40 years of age). Furthermore, its cross-sectional design does not allow for causation inferences.

A cross-sectional analysis of data from the 2001 California Health Interview Survey (CHIS) was conducted to estimate prevalence of overweight and obesity among 8,304 Mexican Americans (Bowie, Juon, Cho, & Rodriguez, 2007). Results showed those aged 30 to 39 (Odds Ratio (OR) = 2.12; 95% Confidence Interval (CI), 1.54-2.92), 40 to 49 (OR = 2.35; 95% CI, 1.58-3.48), and 50 to 64 (OR = 2.52; 95% CI, 1.57-4.05) were more likely to be overweight than those aged 19 to 29. Similarly, Bowie and colleagues (2007) also found those aged 30 to 39 (OR = 1.97; 95% CI, 1.44-2.70), 40 to 49 (OR = 2.58; 95% CI, 1.88-3.53), and 50 to 64 (OR = 3.69; 95% CI, 2.56-5.31) were more likely to be obese than those aged 19 to 29. However, the associations observed should not be taken as proof of causation given the cross-sectional study design. A further limitation included reliance on self-reported height and weight which may lead to misclassification of participants into the overweight or obese categories. Nevertheless, given the relatively consistent results, increasing age seems to have a linear association with overweight and obesity, except in the latter stages of life.

Another important demographic factor is gender. Even though obesity prevalence has increased among both genders, disparities exist. Across all racial groups, women have higher obesity rates than men (36.3% vs. 35.5%, respectively) (Flegal et al., 2012). This gender disparity is also observed within the Mexican American population with 44.3% of Mexican American women categorized as obese compared to 35.6% of Mexican American men (Flegal et al., 2012). Significant sex differences were also found by Torres et al. (2006) in their cross-sectional, population-based analysis of urban Mexican Americans. Their analysis revealed that obesity was positively associated with being of the female sex (OR = 1.3, $p < .001$). Overall, more Mexican American females were obese compared to their male counterparts (54% vs. 43%, $p < .001$).

Overweight prevalence, however, has been reported to be higher among Mexican American men than women. Bowie et al. (2007) found Mexican American men were much more likely to be overweight than Mexican American women (44% vs. 29%, respectively) though women were slightly more likely to be obese (25% vs. 23%). Supporting the findings by Bowie and colleagues (2007), Salinas et al. (2011a) conducted a multi-cluster design study among community-residing, Mexican-origin adults 18 years of age and older in a U.S.-Mexico border city and found a greater proportion of men than women were overweight with BMI values in the 25 to 29 range (36.9% versus 30.2%, $p < .001$), but a significantly higher proportion of women than men were obese (i.e. BMI ≥ 30). The study had several limitations including its cross-sectional design, lower representation of men, and potential bias related to the "healthy worker effect" where men who declined to participate may be healthier and socioeconomically better off than those who participated in the study. Thus, it can be deduced from reported findings that gender is associated with overweight and obesity.

Family characteristics such as marital status and number of children have been researched for their potential correlations with obesity. Several cross-sectional studies of marital status and weight report that for both women and men, married or previously married individuals are more likely to weigh more than their single counterparts (Hahn, 1993; Sobal, Rauschenbach, & Frongillo, 1992). Study findings of a number of longitudinal studies showed weight gain during marriage and weight loss when leaving marriage among both men and women (Kahn & Williamson, 1990; Kahn, Williamson, & Stevens, 1991; Meltzer & Everhart, 1995). Sobal and colleagues (2003) further supported findings of associations between marital status and changes in body weight, in particular, weight gain. In their longitudinal study, they found women who were unmarried at baseline and married before the follow-up survey had greater weight gain than those who were married in both time periods, while in contrast, men who remained divorced/separated and widowed lost more weight than men married at both baseline and follow-up.

Only one study was found that examined the association between marital status and obesity in Mexican Americans. In a cross-sectional study, researchers found Mexican American men's marital status was associated with overweight and obesity (Bowie et al., 2007). Single men were less likely than married men to be overweight (OR = 0.71; 95% CI, 0.52 - 0.97) and obese (OR = 0.68; 95% CI, 0.46 - 0.99). However, no associations were found for Mexican American women. Nevertheless, it can be expected being married will be associated with a higher likelihood of being overweight and obese (Averett, Sikora, & Argys, 2008).

Having children has also been found to increase likelihood of obesity in women (Rossner, 1992). Other studies, however, show women with one or two live births having a lower mean body weight and BMI, and a lower overweight prevalence (BMI greater than 27 kg/m2), than women with no children or those with three or more lifetime births (Brown, Kaye, & Folsom, 1992). In the Nurses' Health Study, a prospective cohort study of more than 100,000 registered nurses, increase in BMI was found with increasing number of children among women aged 42-67 (Manson et al., 1992). Similar results were observed among women in the Framingham Heart Study (Ness et al., 1993). In a case-control study, women ages 45-69 with five or more births were more frequently obese compared with women with no births (Palmer, Rosenberg, & Shapiro, 1992).

A fewer number of studies have examined the association between obesity and number of children among men. A study on 1,039 men, 50 to 89 years of age, revealed men with five or more biological children were significantly more obese than men without any children (Kritz-Silverstein, Barrett-Connor, & Friedlander, 1997). In the Rancho Bernardo cohort, a positive association was observed among both men and women (Barrett-Connor, 1997). However, the aforementioned studies were among older adults 55 to 84 years of age which limits comparisons to younger, middle age adults.

Only a couple recent studies have focused on examining the relationship between obesity and number of children among married couples. Results from the Health and Retirement Study showed that among women, a 7% increase in risk of obesity was attributed to each additional child, while among men there was a 4% increase in risk of obesity, although these differences were not significant (Weng et al., 2004). This last study was the first to assess the relationship between number of children and risk of overweight and obesity among middle-age, married couples. However, a limitation of this study was it used self-reported weight and height which could have resulted in measurement bias.

Only one study was found to assess the relationship between obesity and number of children among the Mexican American population. Bowie et al. (2007) reported an association between number of children and obesity in Mexican American women, but not in men. Women with three children (OR = 1.61; 95% CI, 1.18 - 2.78) and more than four children (OR = 1.78; 95% CI, 1.11 - 2.85) were more likely to be overweight; and those with more than four children were more likely to be obese than those with no children (OR = 1.91; 95% CI, 1.20 - 3.04). Study limitations included its cross-sectional design which limits conclusions regarding causation. Another limitation is potential measurement bias given BMI was calculated based on self-reported height and weight which may have led to misclassification of overweight and obese participants. However, it is the only study found to assess the relationship of this risk factor among the Mexican American population.

Socioeconomic Status

Socioeconomic status (SES) is a complex, multidimensional construct, based on numerous major components (e.g. education, employment status, income) which represent different facets of socioeconomic status. These SES measures, including income (Chang & Lauderdale, 2005), education (Zhang & Wang, 2004a), and occupational status (Kotler & Wingard, 1989) have been shown to impact health outcomes. It has been recommended mechanisms relating SES to obesity should investigate the individual components separately (Ball, Mishra, and Crawford, 2002). A review of the literature by Sobal and Stunkard (1989) and subsequently by McLaren (2007) on the association between SES and obesity showed prevalent negative associations (lower SES associated with a larger body weight) for women in highly developed countries (as measured by education and occupation). Studies have provided substantial evidence of the inverse relationship between SES characteristics and obesity (Baum & Ruhm, 2009; McLaren, 2007); although over the course of the past three decades obesity has increased at all levels of income (Chang & Lauderdale, 2005; Zhang & Wang, 2004a). SES has been an important factor associated with obesity, particularly, in women (Sundquist & Johansson, 1998). However, while some studies show a similarly inverse relationship for men, others find a positive relationship or no relationship at all (Sundquist & Johansson, 1998; Wardle, Waller, & Jarvis, 2002; Zhang & Wang, 2004b).

Studies assessing the relationship between SES measures and Hispanics, including Mexican Americans, have conflicting results. A study by Khan, Sobal, and Martorrel (1997) of obesity in U.S. Hispanics found no association between two conventional SES indicators, income and education, and obesity as measured by BMI, regardless of gender, in the Mexican American population. By comparison, other studies have illustrated gender-specific associations whereas for Mexican American men, SES had no significant effect on obesity but in Mexican-American women, increased SES was accompanied by statistically significant, linear declines in both obesity and type 2 diabetes (Haffner, Stern, Mitchell, & Hazuda, 1991; Hazuda, Mitchell, Haffner, & Stern, 1991; Stern, Rosenthal, Haffner, Hazuda, & Franco, 1984). A cross-sectional analysis of the 2001 CHIS showed educational attainment was associated with obesity among men with those who had not completed high school being more likely to be obese than were those who had graduated from college (OR = 2.34; 95% CI, 1.39 - 3.94); however, similar associations were not found among women (Bowie et al., 2007).

In assessing the relationship between income and obesity among Mexican Americans in Cameron County, one of the counties of the Valley region, no differences were observed between income strata and prevalence of obesity (Fisher-Hoch et al., 2010). Despite the narrow range of income in this population, people in the lower SES stratum were significantly more likely to have undiagnosed diabetes but no differences between strata were observed in prevalence of obesity. The strengths of this particular study included that it's the first to exclusively recruit a Mexican American cohort in a border city, the use of cluster random sampling, and clinical data collection. However, limitations included underrepresentation of men and lack of collection of important variables related to length of residence and other acculturation related variables.

In a multivariate analysis of risk for overweight and obesity among Mexican Americans living in California no statistically significant associations were observed between employment status and obesity (Bowie et al., 2007). However, Torres et al. (2007) reported a positive association between obesity and being unemployed (OR = 1.5, $p < .001$) in a cross-sectional, population-based sample of 6,038 non-institutionalized self-identified Latinos of primarily Mexican American ancestry aged 40 years and above in California. The mixed findings of the aforementioned studies highlight the importance of investigating different components of SES domains and body weight in the same sample, since associations may differ depending on the domain used (Ball, Mishra, &

Crawford, 2002). The importance of studying the relationships between different SES status domains and body weight is to provide insights into the specific SES indicators which may impact obesity in a particular population subgroup.

Acculturation

One of the social mechanisms linked to risk for obesity are the migration and acculturation processes. Immigrants from Mexico have been found to have the highest rates of obesity (Kaplan, Huguet, Newsom, & McFarland, 2004). After living in the U.S. for three years or more, changes in health risk have been noted in Mexican-Americans (Evenson, Sarmiento, & Ayala, 2004; Wilkinson et al., 2005). This observation has linked, what is commonly referred to as acculturation, to unhealthy changes in physical activity and dietary behaviors, two important risk factors for obesity (Crespo, Smit, Andersen, Carter-Pokras, & Ainsworth, 2000; Gordon-Larsen, Harris, Ward, & Popkin, 2003). The effects of acculturation are often examined in terms of the individual's country of birth, age of arrival, and years living in the U.S. (Ayala, Baquero, & Klinger, 2008). Ayala and colleagues (2008) state "Acculturation is a bi-dimensional process in which individuals may learn and/or adopt certain aspects of the dominant culture and in some cases retain most or some aspects of their culture of origin".

A cross-sectional study of 2,420 foreign-born Hispanic adults aged ≥ 18 years based on the 1998 National Health Interview Survey (NHIS) provided strong support for the hypothesis that there is a direct, linear association between length of residence in the U.S. and rate of obesity (Kaplan et al. 2004). Mexican immigrants were 1.8 (95% CI= 0.81-4.00), 2.8 (95% CI= 1.22 – 6.64), and 4.2 (95% CI = 2.08-8.76) times more likely to be obese according to length of residence from 5 to 9, 10 to 14, and ≥ 15 years, respectively. However, the study's cross-sectional design, reliance on self-reported weight and height, and lack of data regarding potential confounding factors such as dietary practices limit the generalizability of findings.

In a study of 1,387 Mexican American women and 1,404 Mexican American men, ages 25-64, both country of birth and, to a lesser degree, acculturation status (indicated by primary language spoken) were significantly associated with body fatness (Sundquist & Winkleby, 2000). The study found U.S.-born, Spanish-speaking women and men had the highest levels of abdominal obesity as measured by waist circumference (68.7% and 39.5% obese, respectively), U.S.-born English-speaking women and men had intermediate levels (58.6% and 31.8% obese), and Mexican-born women and men had the lowest levels (55.6% and 21.4% obese). This study, based on a large national sample of Mexican-American women and men living in the U.S., identified country of birth (for both men and women) and acculturation status as measured by language (for women) as strong predictors of obesity. Limitations of this study included its cross-sectional design, and lack of measures of physical activity at work which may influence gender differences found for leisure-time physical activity.

Bowie et al. (2007) in their cross-sectional analysis of data from the 2001 CHIS of 8,304 Mexican Americans also found country of birth and U.S. residency of 15 years or more was a strong correlate of obesity. Among Mexican American men, those who were born in the U.S. or had lived more than 15 years in the U.S. were more likely to be obese than those who had lived there for less than 5 years (OR = 1.36; 95% CI, 1.01-1.87). However, a similar association was not found among Mexican American women. Limitations included the use of self-reported measures and its cross-sectional design.

Barcenas et al. (2007) examined the association between birthplace (Mexico or U.S.) and obesity in men and women as well as the relationship between duration of U.S. residency and prevalence of obesity in Mexican immigrants. Cross-sectional data from 7,503 adults of Mexican descent residing in Harris County, Texas, was analyzed. Forty-four percent of all participants were obese (BMI ≥ 30.0 kg/m^2), with a higher proportion of the U.S. born participants being obese compared with the Mexican-born participants (49% vs. 41%, respectively). Furthermore, differences were observed in the most severe obese category (9% U.S.- born vs. 4% Mexican-born). The authors reported the overall effect of U.S. birthplace on BMI was highly significant for each gender (men, $p < 0.05$; women, $p < 0.001$). Study findings also found the proportion of Mexican-born immigrants who were obese (BMI ≥ 30 kg/m^2) increased incrementally in 5-year intervals of U.S. residency. Study limitations included its cross-sectional design, use of self-reported height and weight which resulted in misclassification (14.2% subjects were misclassified on obesity status), and lack of information on dietary and lifestyle changes made by Mexican-born participants after moving to the United States. Despite significant research establishing the connection between acculturation (country of birth, length of years in U.S., language spoken) and obesity, little research has focused on border regions that are culturally distinct from the rest of the U.S., such as the Lower Rio Grande Valley (Montoya, Salinas, Barroso, Mitchell-Bennett, & Reininger, 2010).

Obesity and Physical Activity

Regular physical activity is an important component of public health efforts addressing the obesity epidemic and its associated health risks and one of the leading indicators in the nation's prevention agenda (U.S. Department of Health and Human

Services (USDHHS), 2008). Physical inactivity, along with poor nutrition, have been found to contribute to the high rate of obesity in Hispanics (Colberg et al., 2010; Fulton-Kehoe, Hamman, Baxter, & Marshall, 2001; Wilbur, Chandler, Dancy, & Lee, 2003). Physical activity is believed to play a major role in preventing obesity, and perhaps type 2 diabetes, in genetically susceptible populations, such as Mexican Americans (Esparza et al., 2000). According to Ravussin and Bogardus (2000), the most likely successful therapy for obesity, aside from regulating food intake, is an environment conducive to engaging in physical activity. Although high-quality studies establishing the importance of physical activity and fitness in diabetes were lacking until recently, it is now well recognized participating in regular daily physical activity improves blood glucose levels, along with lipids, blood pressure, cardiovascular events, mortality and quality of life (Colberg et al., 2010).

The 2008 Physical Activity Guidelines for Americans recommend adults obtain at least 150 minutes per week of moderate-intensity physical activity, 75 minutes per week of vigorous-intensity physical activity, or a combination of moderate and vigorous physical activity (USDHHS, 2008). The guidelines are aligned with previous recommendations (Haskell et al. 2007; Lichtenstein et al., 2006). It has been reported Hispanics fall short of recommended guidelines and have the highest rates of physical inactivity (53.2%) (Adams & Schoenberg, 2006). At the national level, data from NHANES III Survey reported little or no leisure-time physical activity among Mexican Americans with 37% of Mexican Americans reporting being physically inactive with prevalence rates higher in women than men (45.7% vs. 29.3%) (Crespo et al., 2000). Some studies have shown that compared to non-Hispanic Whites, Mexican Americans have a higher prevalence of physical inactivity during leisure time regardless of socioeconomic status (Crespo, Keteyian, Heath, & Sempos, 1996; Crespo et al., 2000). A recent 2010 study challenged previous findings concluding nearly 27% of Mexican Americans meet the national goal of getting at least 30 minutes of moderate physical activity five days a week or vigorous activity for 20 minutes at least three days a week; higher than non-Hispanic whites (20%) and blacks (15%) (Ham and Ainsworth, 2010). One plausible explanation is Hispanics may be engaging in more occupational-related physical activity than non-Hispanic Whites (CDC, 2000; Crespo et al., 2000). Compared to their Hispanic counterparts, Mexican Americans have been reported to have the highest levels of leisure-time physical activity (Neighbors, Marquez, & Marcus, 2008).

Despite these findings at the national level, the limited data available for Mexican Americans living in the Valley region shows engagement in physical activity is extremely low. Mier et al. (2007) found more than half (52%) of Mexican Americans residing in the border do not exercise at all. A previous study in the Valley region reported even higher levels of physical inactivity with 65% of men and 74% of women not engaging in physical activity (Bastida & Assefa, 2005). Hence, a better understanding of engagement in physical activity in this subgroup is important.

While physical activity has become a targeted lifestyle behavior in addressing obesity prevention and treatment efforts, findings on the association between physical activity and obesity are mixed. Results by Hallal and colleagues (2008) of a population-based, cross-sectional study of 3,100 adults aged 20 and over showed no association between physical activity and obesity. Another cross-sectional study among 2,891 adults in Morocco found prevalence of obesity to be lower among subjects who engaged in at least 30 minutes of physical activity per day compared to other groups (10.4% vs. 15.6%, $p < .001$) (Rhazi et al., 2010). However, this association disappeared after adjusting for socio-demographic factors such as income. In a national sample of Australian adults, risk for overweight and obesity was significantly reduced with participation in moderate and high levels of physical activity for females, whereas for males it only reduced risk for being obese (Brown & Siahpush, 2007).

A cross sectional study of Latinos, mainly of Mexican origin in California, identified low levels of moderate/vigorous physical activity to be independent contributors to obesity in women and men (Hubert, Snider, & Winkleby, 2005). However, the study was from a community and agricultural labor camp sample with limited generalizability beyond this homogeneous population. Bowie and colleagues (2007) found not engaging in vigorous physical activity was associated with being overweight in Mexican American women, although associations were not observed among Mexican American men. No studies examining the relationship between this lifestyle factor and obesity were found for Mexican Americans living in the Valley region. Given the potential role of physical activity in preventing and managing obesity, it is important to understand its prevalence and role as a risk factor in this population subgroup.

There has been a shortage of evidence and high-quality studies in relation to physical activity and obesity including, until recently, the difficulties of measurement of physical activity and the challenges set by its multifaceted nature (Fox & Hillsdon, 2007). The consequence of this paucity of evidence has led to the lack of a comprehensive understanding of physical activity patterns and trends at a national level. According to

Fox and Hillsdon (2007), there is only weak evidence physical inactivity is a determinant of obesity. Similarly, there is still little known about the effectiveness of increasing activity on obesity prevention. The present dissertation will add to the knowledge by exploring whether physical activity is associated with anthropometric measures of obesity and whether engagement of physical activity at baseline was a predictor of weight loss success in a largely understudied population.

Obesity and Cardiovascular Disease Risk Factors

The increasing epidemic of obesity in the U.S. is of concern because of its potential impact on morbidity and mortality. One of the major causes of morbidity and mortality is CVD (Howard, Ruotolo, & Robbins, 2003). Given CVD is a leading cause of death and disability for men and women in the U.S., assessing CVD risk factor prevalence is warranted (Hertz, Unger, & Ferrario, 2006). Obesity has long been recognized as an independent risk factor for CVD (Hubert, Feinleib, McNamara, & Castelli, 1983). However, information on the relationships between measures of obesity and abdominal obesity with a cluster of metabolic disorders including type 2diabetes, hypertension, and dyslipidemia (high triglyceride levels and high density lipoprotein cholesterol levels) has largely been obtained from studies involving Caucasian or populations of European descent (Denke, Sempos, & Grundy, 1993; Denke, Sempos, & Grundy, 1994; Després et al., 1990; Huxley, Mendis, Zheleznyakov, Reddy, & Chan, 2010; Seidell et al., 1991). A more limited number of studies have been conducted in diverse race/ethnic groups with most studies focusing on Blacks and Hispanics and few on subgroups within these race groups (Brown et al., 2000; Cannon, 2007; Dalton et al., 2003; Fisher-Hoch et al., 2010; Han et al., 2002; Must et al., 1999).

It has been noted that even with the increasing obesity prevalence in the U.S. observed in the past few decades, a decline in CVD risk factors has occurred perhaps as a result of the influence of lifestyle changes and therapies (Romero, Romero, Shlay, Ogden, & Dabelea, 2012). Although a number of studies have shown obese individuals have an increased risk of several adverse health outcomes and despite the scope and magnitude of the observed increases in obesity, some argue the health implications of these obesity trends remain unclear (Gregg et al., 2005). Increases in obesity have been accompanied by increases in type 2 diabetes, while the association between obesity trends and other CVD risk factors remains less certain (Gregg, Cheng, Narayan, Thompson, & Williamson, 2007). National mortality data indicate Hispanics have lower age-adjusted mortality rates than non-Hispanic whites or non-Hispanic blacks despite high levels of diabetes, obesity, and socioeconomic disadvantage -referred to as the Hispanic paradox- while the San Antonio Heart Study found Mexican Americans enjoyed no mortality advantage, not for overall mortality or for mortality from heart disease, over non-Hispanic whites (NHLBI Working Group, 2003). Day (2004) suggested more research is needed before specific data can be reported about CVD in Mexican Americans in the Lower Rio Grande Valley. Understanding the impact of obesity on CVD risk factors is important if health disparities are to be addressed and improvement in overall health status of the Mexican American population living in the Valley region are to be made.

Type 2 Diabetes

Type 2 diabetes, formerly called adult-onset diabetes or noninsulin-dependent diabetes, is the most common form of diabetes accounting for 90 to 95% of the incidence of diabetes (Cheng, 2005). Although it has a strong genetic predisposition, it is unlikely that the gene pool has changed substantially over the short period of time during which the prevalence of type 2 diabetes has been increasing (Magkos, Yannakoulia, Chan, & Mantzoros, 2009). A fasting plasma glucose (FPG) test measures blood glucose in a person who has not eaten anything for at least 8 hours. The FPG test is the preferred test for diagnosing diabetes because of its convenience and low cost. A fasting glucose level of 100 to 125 milligrams per deciliter (mg/dL) is classified as pre-diabetes, and a level of 126 mg/dL or above is classified as diabetes (Shaw, Zimmet, McCarty, & de Courten, 2000). By 2050, the number of people diagnosed with diabetes in the U.S. is expected to increase by 165%, from 11 million in 2000 to 29 million (Boyle et al., 2001). The annual economic burden of diabetes in 2007 was estimated at $174 billion, including $116 billion in excess medical expenditures and $58 billion in reduced national productivity (Dall et al., 2008).

Pre-diabetes typically develops between the ages of 40 and 60 years of age in the general U.S. population but occurs usually between the ages of 20 and 30 years in Hispanics (Umpierrez, Gonzalez, Umpierrez, & Pimentel, 2007). The highest estimated lifetime risk for diabetes observed in the U.S. is in Hispanics (Narayan, Boyle, Thompson, Sorensen, & Williamson, 2003). Because the group with the highest lifetime risk is Hispanics—a risk of 45% to 53%—and Hispanics are the largest ethnic or racial group in the Lower Rio Grande Valley—from 84.3% to 97.5% of the population—diabetes is a major health concern in the Valley region (Narayan et al., 2003).

Diabetes prevalence rates in the Border States (15.7%) are 1.5 times greater compared to the U.S. as a whole (9.6%) (CDC, 2005). Type 2 diabetes is significantly more prevalent in Mexican Americans (13%) than in non-Hispanic whites (8%) (Hertz et al., 2006). Mexican Americans have the highest rate of diabetes among Hispanics. As reported by Murphy (2010), the number of Texas adults with diabetes is set to quadruple over the next three decades, from roughly 2 million to nearly 8 million, with those hardest hit expected to be Latinos in South Texas and the Rio Grande Valley. A survey employing the capture–recapture method estimated the prevalence rate for Mexican Americans of all ages for Starr County to be 39% (Villas, 1999). In a randomly selected community-based sample of Mexican Americans, age 45 and older living in Hidalgo County, self-reported prevalence rates were 25.9% (Bastida, Cuéllar, & Villas, 2001). In Cameron County, among a group of 810 Mexican Americans ages 35-64, Fisher-Hoch et al. (2010) found prevalence rates for diabetes to be around 15%; furthermore, an additional 10% of participants had undiagnosed diabetes. BESA 2004-2006 data showed rates of 28.5% (Bastida & Soydemir, 2009). It has been estimated pre-diabetes affects 13.6% of people living in the U.S. - Mexico border (PAHO, 2007). Higher rates of pre-diabetes were observed in the BESA study with over 55% of individuals identified in this category (Bastida & Soydemir, 2009).

The role of obesity in the subsequent development of type 2 diabetes has long been recognized (Barrett-Connor, 1989; Burke et al., 2003; Colditz, Willett, Rotnitzky, & Manson, 1995; Ford, Williamson, & Liu, 1997; Stein & Colditz, 2004; Stevens et al., 2001). A study of 1,929 overweight, non-diabetic adults demonstrated that for each kg of weight gained annually over 10 years there was a 49% increase in risk of developing diabetes in the subsequent 10 years (Resnick, Valsania, Halter, & Lin, 2000). Conversely, Resnick et al. (2000) also found that even a modest weight loss was associated with significantly reduced diabetes risk. Gregg and colleagues (2007) showed the prevalence of diabetes was about three times as high among those with class I obesity, four to five times as high among those with class II obesity, and six to ten times as high among those with class III obesity compared to those in the normal weight. Statistically significant pooled risk ratios (RRs) of 1.87 (95% CI: 1.67, 2.10), 1.87 (95% CI: 1.58, 2.20), and 1.88 (95% CI: 1.61, 2.19) per standard deviation of BMI, WC, and WHR were observed (Vazquez, Duval, Jacobs, & Silventoinen, 2007).

Environmental factors such as excess calorie intake and a sedentary lifestyle, together with obesity, are the most important risk factors for the development of type 2 diabetes, although genetics and other factors including efficiency of energy storage and expenditure may also play a role (Umpierrez et al., 2007). A study by Schulz and colleagues (2006) among Pima Indians showed the risk of diabetes is significantly lower among Pima Indians living in Mexico who practice a traditional lifestyle (greater energy expenditure in physical labor and consumption of less animal fat and more complex carbohydrates) than among Pima Indians living in Arizona. These findings provided support to the general notion that although genetic factors provide a fertile background for the development of diabetes in some ethnic/minority groups, the high prevalence of diabetes observed in Hispanics is mostly due to environmental circumstances (Umpierrez et al., 2007).

Obesity is present in 80% to 90% of Hispanics with diabetes in the U.S. (Shai et al., 2006). An 8-year follow-up study of a cohort of Mexican Americans in the San Antonio Heart Study demonstrated subjects who developed type 2 diabetes had greater overall adiposity and more central adiposity (Haffner, Stern, Mitchell, Hazuda, &

Patterson, 1990). Although the association between obesity and type 2 diabetes has been well established, assessing the impact of BMI and WC in Mexican Americans living in the Valley region, one of the fastest growing minority groups, is still an important public health research issue.

Hypertension

Hypertension, or high blood pressure, is a serious public health challenge in the U.S., affecting approximately 30% of adults, and increasing the risk of heart disease and stroke, the first and third leading causes of death in the nation (Keenan & Rosendorf, 2011). Hypertension is defined as systolic blood pressure (SBP) ≥ 140 millimeter of mercury (mmHg) and/or diastolic blood pressure (DBP) ≥ 90 mmHg (NHLBI, 2003b). The prevalence of hypertension has dramatically increased, affecting more than 68 million U.S. adults over 18 years of age (Gillespie, Kuklina, Briss, Blair, & Hong, 2011). Given the increase in obesity and the aging population, this rising trend of hypertension is not unexpected.

Hypertension has been deemed the most important CVD risk factor worldwide (Cutler et al., 2008). It is also the most prevalent modifiable risk factor for CVD among U.S. adults surpassing the prevalence of smoking, obesity and diabetes (Greenland et al., 2003; Ong, Cheung, Man, Lau, & Lam, 2007). Because of the fundamental role of hypertension in cardiovascular health, Healthy People 2020 includes national objectives to reduce the proportion of adults aged ≥ 18 years with hypertension to 26.9% from a baseline of 29.9% (USDHHS, 2010). Substantial differences (>10%) in hypertension by age group, race/ethnicity, education, family income, foreign-born status, health insurance status, diabetes, obesity, and disability status have been reported (Keenan & Rosendorf, 2011).

Racial and ethnic disparities have long been observed in hypertension prevalence, awareness, and treatment (Zhao, Ford, & Mokdad, 2008). Over the last decade, data shows awareness, treatment, and control of hypertension have increased in the U.S., but improvements have not been equal across all racial/ethnic groups (Egan, Zhao, & Axon, 2010). Most recent prevalence data from the NHANES show African-Americans/non-Hispanic Blacks in the U.S. have an overall higher prevalence of hypertension (42.0%) than non-Hispanic whites (28.8%) and Mexican Americans (25.5%) (Keenan & Rosendorf, 2011). Over the years, published studies have reported the prevalence of hypertension being lower among Mexican Americans than non-Hispanic whites (Lorenzo et al., 2002), lower or similar (Haffner et al., 1993), or even higher in Mexican American women (Winkleby, Kraemer, Ahn, & Varady, 1998). A cross-sectional analysis of nationally representative data collected from 2,256 Mexican American and 4,624 non-Hispanic white adults aged 20 years and over who participated in the 1999-2002 NHANES showed no significant difference in the adjusted prevalence of hypertension at 28% for non-Hispanic whites compared to 26% for Mexican Americans (Hertz, Unger, & Ferrairo, 2006). Hertz et al. (2006) did find treatment rates among Mexican Americans were significantly lower (42% vs. 61%). Of concern is the high prevalence of prehypertension among Mexican American adults (40.1% among men and 25.5% among women) (Bersamin, Stafford, and Winkleby, 2009).

Despite inconsistencies in whether or not Mexican Americans have a disparate burden of hypertension, some researchers have suggested the burden of hypertension and other related conditions are likely to increase in Mexican-Americans (Bersamin et al., 2009). First, the number of older Mexican Americans are growing particularly fast, which is of concern given this is the age group experiencing highest burden of hypertension (Vasan et al., 2002). Second, Mexican Americans are disproportionately uninsured with approximately 49% of foreign-born Mexican Americans and 21% of U.S.-born Mexican Americans in the uninsured category which impacts their access to preventive treatment and chronic disease management (DeNavas-Walt, Proctor, & Smith, 2011). Given the high prevalence of overweight and obesity and type 2 diabetes observed in the Mexican American population, high hypertension prevalence rates are expected. In the Valley region, Hanis (1996) documented hypertension is prevalent among Mexican-American men and women living in Starr County and the frequency of high blood pressure increases with age among Mexican-Americans; however, awareness of hypertension in the south Texas population is lower than it is in the national population (Jones, Ricard, Sefcik, & Miller, 2001). A study which examined data from the U.S.-Mexico Border Diabetes Prevention and Control Project, a prevalence study of type 2 diabetes and its risk factors, showed almost half of those surveyed had high blood pressure (Vijayaraghavan, He, Stoddard, & Schillinger, 2010).

Among men and women, hypertension is one of the most common conditions linked to overweight and obesity (Krauss, Winston, Fletcher, & Grundy, 1998; Must et al., 1999; Wolf et al., 1997). A strong linear relation between BMI and blood pressure has been documented (Frisoli, Schmieder, Grodzicki, & Messerli, 2011; Hajjar & Kotchen, 2003). Brown et al. (2000) evaluated the relationship between BMI and blood pressure and found mean SBP and DBP increased with increasing BMI in both men and women.

SBP was about 9 mmHg higher for men (131 vs. 121 mmHg) and about 11 mmHg higher for women (116 vs. 127 mmHg) in the highest BMI category (> 25 kg/m^2). A cross-sectional analysis of pooled data from NHANES, 1999-2004, showed in a nationally representative sample of Mexican American adults the proportion of individuals classified as obese increased with each progressive stage of hypertension; 24% of normotensives were classified as obese compared with 42% among Stage 2 hypertensives (Bersamin et al., 2009). However, ethnic differences in the strength of association between BMI and hypertension and in underlying prevalence have been reported (Bell, Adair, & Popkin, 2002). Hence, studying the association between measures of overall and central adiposity in a disadvantaged Mexican American population subgroup is important to better inform the extent of the public health effect of obesity and inform health promotion efforts.

Dyslipidemia

Cholesterol is a fat-like substance (lipid) that is present in cell membranes and travels in the blood in distinct particles containing both lipid and proteins (lipoproteins). As aforementioned, one of the major causes of increased morbidity and mortality in people with obesity is CVD, of which one of the main determinants is the adverse effect of obesity on lipoproteins (Howard, Ruotolo, & Robbins, 2003). The best way to measure cholesterol is with a blood test called a lipid panel or lipid profile (Birtcher & Ballantyne, 2004). The test determines the amounts of total cholesterol, low-density lipoprotein cholesterol (LDL-c), also called "bad" cholesterol, high-density lipoprotein cholesterol (HDL-c), also called "good" cholesterol, and triglycerides (fats carried in the blood from food consumed by an individual). Total cholesterol is made up of LDL-c, HDL-c, and other lipid components. Dyslipidemia is when any of these lipid levels are abnormal, i.e. too high or low. The classification of lipids is as follows: total cholesterol is defined as desirable if less than 200 mg/dL, borderline high if 200 – 239 mg/dL and high if 240 mg/dL and above; LDL-c is considered normal if less than 100 mg/dL, near optimal/above optimal if 100 – 129 mg/dL, borderline high if 130 – 159 mg/dL, high if 160 – 189 mg/dL, and very high if 190 mg/dL or higher; triglycerides is classified as normal if less than 150 mg/dL, borderline high if 150 – 199 mg/dL, high if 200 – 499 mg/dL, and very high if above 500 mg/dL; and HDL-c is classified as high/optimal if 60 mg/dL or above, and low/risk factor if lower than 40 mg/dL in men and lower than 50 mg/dL in women (National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, Adult Treatment Panel III, 2002).

Prevalence data on dyslipidemia has been inconsistent when comparing Mexican Americans with other racial groups. For example, a cross-sectional analysis of nationally representative data collected from 2,256 Mexican American and 4,624 non-Hispanic whites adults aged 20 years and older found Mexican Americans have a slightly lower adjusted prevalence of dyslipidemia compared to non-Hispanic whites (31% versus 35%) (Hertz et al, 2006). Similarly, Mexican Americans from San Antonio, Texas were shown to have lower plasma concentrations of total cholesterol than non-Hispanic whites (Bermudez, Velez-Carrasco, Schaefer, & Tucker, 2002), while other studies have shown a higher prevalence (Kamboh, Rewers, Aston, & Hamman, 1997; Winkleby, Kraemer, Ahn, & Varady, 1998), but lower treatment (Nelson, Norris, & Mangione, 2002). NHANES data seems to support findings that Mexican Americans have lower prevalence rates with non-Hispanic whites (26.9%) having significantly higher prevalence of total serum cholesterol levels above 240 mg/dL compared with non-Hispanic blacks (21.5%) and Mexican-Americans (21.8%) (Fryar, Hirsch, Eberhardt, Yoon, & Wright, 2010). However, a recent study showed Mexican American men (50.1%) had the highest prevalence of total blood cholesterol levels over 200 mg/dL (Roger et al., 2012). Mexican Americans living in south Texas have been reported to have significantly higher fasting plasma triglyceride levels, which is consistent with a greater frequency of obesity in this population group (Hanis, Hewett- Emmett, Douglas, & Schull, 1991). One of the challenges in assessing prevalence of dyslipidemia is that significantly fewer border residents report ever getting their cholesterol checked (60%) when compared to Texas (74%) and the nation (79%) (TDSHS, 2007). Among border residents who have had their cholesterol checked, well over a third (37%) has been told they have high cholesterol (TDSHS, 2007). Studies are lacking in this population subgroup and are needed to better understand the overall burden of dyslipidemia.

Dyslipidemia, as it relates to obesity, is characterized by increased triglycerides, decreased HDL-c levels, and abnormal LDL composition (Brown et al, 2000; Pi-Sunyer, 2002). Brown et al. (2000) found the prevalence of high blood cholesterol and mean levels of cholesterol were higher at BMI levels over 25 rather than below 25 but did not increase consistently with increasing BMI above 25. While obesity has been consistently associated with decreases in HDL-c and increases in plasma triglycerides among white populations (Denke, Sempos, & Grundy, 1994; Denke, Sempos, & Grundy, 1993), less data is available for ethnic groups (Howard, Ruotolo, & Robbins, 2003). Limited studies do show similar associations between anthropometric measures of obesity and plasma triglycerides in Hispanics (Haffner, Stern, Hazuda, Pugh, & Patterson, 1987). In contrast to the consistent changes observed in triglycerides and HDL-c with obesity, a less consistent effect on LDL-c concentrations has been reported (Howard et al., 2003). Abdominal obesity, as measured by WC, is strongly associated with dyslipidemia across several populations (Paccaud, Schlüter-Fasmeyer, Wietlisbach, & Bovet, 2000).

Factors Associated with Weight Loss Success

Obesity plays such a big role in the prevention of CVD that Rexrode and colleagues (1996) concluded that prevention of CVD will not occur unless decreases in the rising prevalence of obesity are achieved and overweight individuals are provided with the tools to achieve and sustain weight loss. A wide range of obesity management and treatment regimens are available, including diet, exercise, behavioral modification, pharmacological treatment and surgery (Galani & Schneider, 2007). Of these, lifestyle programs have been found to safely lead to improvements in metabolic disorders such as increased body weight, dyslipidemia, elevated blood pressure, and glucose control (Pritchett, Foreyt, & Mann, 2005). Although obesity is highly prevalent in Hispanics/Latinos (Flegal et al., 2012), Hispanics have largely been underrepresented in this type of research (Lindberg & Stevens, 2007). A number of randomized controlled trials evaluating the effectiveness of interventions for reducing or treating obesity have been conducted, but few have focused on Hispanics/Latinos and a lesser number on Mexican Americans (Galani & Schneider, 2007; Glenny, O'Meara, Melville, Sheldon & Wilson, 1997; Lindberg & Stevens, 2007).

In addition to being underrepresented in this type of research, and despite the promising evidence of the effectiveness of lifestyle programs on achieving weight loss and subsequent improvement in related CVD risk factors, ethnic minorities have been found to be less successful than whites in achieving weight loss (Kumanyika, Obarzanek, Stevens, Hebert, & Whelton, 1991). Kumanyika and colleagues concluded racial differences in weight loss may have resulted from a combination of behavioral, sociocultural, biological, and programmatic factors. To date, the majority of dietary and lifestyle interventions for weight management with more than 6 month duration conducted in the U.S. have primarily focused on the African American population (Osei-Assibey, Adi, Kumar, & Matyka, 2010). Most of the dietary and lifestyle interventions for weight management in adults from ethnic/non-White groups, while they proved relatively effective, had significant limitations including small sample size, high attrition rates, inadequacy of randomization and lack of follow-up data (Osei-Assibey et al., 2010). Galani & Schneider (2007) question whether lifestyle programs could accomplish equivalent beneficial effects in ethnically diverse populations.

Given the limited number of well-designed, culturally- tailored obesity interventions targeting minority ethnic groups it is no surprise results of behavioral weight loss programs for ethnic minorities have been mixed in their success. As aforementioned, ethnic minorities tend to have higher attrition and lose less weight than non-minorities in behavioral weight loss trials (Carlos Poston et al., 2003). A focus group conducted by Montoya (2009) revealed obese Mexican-American adults view national weight loss strategies as not being culturally sensitive. Focus group participants further recommended interventions promoting healthy and sustainable weight loss should take into account their cultural health beliefs including use of a family-centered approach in a group setting. The importance in studying correlates of weight loss success among

Mexican Americans participating in community-based health promotion programs might shed some light on the factors to consider when developing and implementing programs aimed at weight reduction and management.

There has been a substantial effort to identifying patient characteristics that will predict weight loss in obese individuals undergoing treatment, with three broad classes of variables examined including psychological, behavioral, and biological (Wadden et al., 1992). However, findings have been mixed and few, if any, variables have consistently been found to predict weight loss (Abildso, Zizzi, & Fitzpatrick, 2013; Wadden et al., 1992; Wang, Ghaddar, Brown, Pagán, & Balboa, 2012). Factors such as gender, SES, acculturation as measured by country of birth, and baseline BMI have been found to influence an individual's response to lifestyle intervention programs aimed at reducing obesity and improving glycemic control (Wang, Ghaddar, Brown, Pagán, & Balboa, 2012). However, others have reported demographic factors were not predictive of clinical weight loss or participant retention; suggesting the program was effective in promoting clinically significant weight loss across multiple age, BMI, physical activity level, and weight loss history groups (Abildso et al., 2013). A limitation of the latter study included its reliance on retrospective data and the lack of diversity in the population which was mainly composed of White, married women older than 45 years of age.

As aforementioned, a limited number of health promotion interventions targeting chronic disease prevention and control in Mexican Americans have been implemented in border communities. *Pasos Adelante* (Spanish for Steps Forward) is a lifestyle intervention program facilitated by *promotoras* (Spanish word for community health workers) targeting chronic disease prevention and control in Mexican Americans living in a U.S.-Mexico border community in Arizona (Staten et al., 2012). Program participants ($N = 255$) demonstrated significant improvements in physiological measures linked to diabetes and CVD risk factors after participating in the 12-week *promotora*-led program that combined interactive educational sessions with walking groups. Participants showed decreases in BMI ($p = .04$), WC and hip circumference ($p < .001$), SBP and DBP ($p < .001$), and total cholesterol ($p = .008$) from baseline to program conclusion. However, differences were observed between participants at the two sites (i.e. Santa Cruz and Yuma) where the program was implemented. The authors suggested demographic differences (i.e. age, education, country of birth, and health insurance) may have explained the fewer significant changes observed in the Santa Cruz participants. According to their results, the Santa Cruz participants who experienced less significant changes were significantly younger and more educated; fewer were born in Mexico, and more had health insurance. Study limitations included lack of a randomized control group and recruitment methods based on convenience sampling which may have introduced selection bias. The overrepresentation of older women also limits generalizability to other age groups. Nevertheless, it demonstrated the importance of pre-treatment factors which may impact successful outcomes in weight management and weight loss programs among Mexican Americans in a border population.

Another study which targeted the border population was the Alliance for a Healthy Border (AHB), a chronic disease prevention program (2006–2008) which provided resources for nutrition and physical activity education programs at 12 federally qualified community health centers located along the U.S.-Mexico border in Texas, New Mexico, Arizona, and California (Wang et al., 2012). The AHB initiative goals were to reduce modifiable risk factors associated with diabetes and CVD, to develop or modify existing prevention programs that targeted the Hispanic population, and to identify and promote best practices in the prevention of these diseases. The researchers included 23 predictor variables in the study that were categorized into sociodemographic factors, baseline health conditions, center and program characteristics, and dietary and physical activity factors. Results showed that for sociodemographic factors, participants were more likely to be successful in achieving weight loss and glycemic control if they were younger, employed, high school graduates or those with some high school education, and/or with incomes of $30,000 or more. For baseline health factors, successful participants reported being free of disease and/or being in the normal ranges for various CVD risk factors. Specifically, participants with better baseline health conditions (i.e., no diabetes diagnosis or family history of diabetes; normal BMI; normal Hemoglobin A1c level; no hypertension; and/or no high cholesterol) were more likely to be successful in weight loss and glycemic control. Finally, participants who improved their fruit and vegetable intake and physical activity levels achieved higher rates of success.

Although the parent study which forms the basis of the present dissertation is not a diabetes self-management program (DSMP), one DSMP intervention study is worth mentioning. The Starr County Border Health Initiative is a prospective, randomized clinical investigation of the efficacy of a culturally-specific, community-based intervention for diabetes care among Mexican Americans, considered the landmark intervention for Mexican Americans living in the Valley region (Brown & Hanis; 1995; Brown & Hanis; 1999; Brown, Upchurch, Garcia, Barton, & Hanis, 1998; Brown et al., 2002). Experimental groups showed significantly lower levels of Hemoglobin A_{1c} and fasting blood glucose at 6 months and at 12 months and higher diabetes knowledge scores. In a follow-up study, Brown and colleagues (2002) tested whether age and gender of study participants affected outcome measures, but results were not statistically significant.

Another landmark lifestyle intervention study, the Diabetes Prevention Program (DPP), focused on two of the modifiable risk factors for diabetes, sedentary lifestyle and overweight (DPP Research Group, 2002). All participants in the intensive lifestyle arm of DPP were given the goal of losing 7% of their body weight and achieving at least 150 min/week of moderate. The DPP showed that an intensive lifestyle intervention reduced the risk of diabetes by 58%. In a follow-up study of the DPP, researchers examined demographic, psychosocial, and behavioral factors that were related to success at achieving the two target goals of weight loss and increased physical activity (DPP Research Group, 2004). The study showed no significant effects of gender, initial BMI, any of the socioeconomic variables (income, marital status, number of persons in the household), or depressive symptoms on success at achieving the weight loss goal after adjusting for other demographic factors. The strongest predictor of success at meeting the weight loss goal was older age. Given the mixed findings of the existing literature, predicting weight loss outcomes from information collected from program participants before they start an obesity prevention or management program is an important research goal (Teixeira et al., 2004).

Further research should adapt lifestyle interventions to the specific needs and characteristics of each population group (Galani & Schneider, 2007). If this is to be achieved, then assessing the effectiveness of program interventions according to the particular characteristics of the population being targeted might inform program development and/or refinement to achieve better outcomes. Given the dearth of research examining the potential disparate effects of weight-related interventions across levels of factors such as sociodemographic factors, SES, acculturation, baseline health indicators, and lifestyle factors; more research is needed to explore the possible differences in response to a weight-related intervention among these factors to better inform the development and tailoring of more effective interventions. To this end, the present research will add to the literature by identifying predictors of weight loss success in an adult Mexican American population subgroup.

Theoretical Framework

The following section describes the theoretical and/or conceptual frameworks that guided the analysis in each of the three manuscripts. Components of several theoretical frameworks were used to guide the identification of variables and exploration of associations.

No single factor or set of factors adequately accounts for why people engage in lifestyle behaviors which might increase their risk for obesity and related chronic diseases. Koh (2011) stated many Americans cannot reach their full health potential because of unnatural causes linked to economic, social, or environmental disadvantage. Such conditions limit opportunities for good health choices. Koh (2011) further illustrated the importance of including measures related to education, employment, income, family status and social support, among others. Many social, cultural, and economic factors contribute to the development, maintenance, and change of health behavior patterns (Glanz & Bishop, 2010). Hence, reasons for the differences in prevalence of obesity among groups are complex, likely involving genetics, physiology, culture, SES, environment, and interactions among these variables as well as others not fully recognized (Caprio et al., 2009). When studying obesity individual factors as well as families, social relationships, SES, and culture are all important influences.

Many studies have looked at quantitative aspects of SES and obesity and its related health behaviors, such as diet and physical activity, but fail to include alternative social status variables, the only exception being gender (Roos, Lahelma, Virtanen, Prättälä, Pietinen, 1998). As stated by Cockerham et al. (1997), "*any concept of healthy lifestyles needs to go beyond an emphasis on socioeconomic status to focus on alternative status variables such as age and gender, which provide a structure to health practices*". Furthermore, as illustrated by Roos et al. (1998), studies typically use a qualitative approach with a small number of selected subjects. The present study examines, in a quantitative design, the social patterning of measures of obesity using a multidimensional framework taking into account simultaneously social structural position as well as age, gender, acculturation, and physical activity. Specifically, the following sets of social determinants of obesity were identified: age, gender, family status (i.e. marital status and number of children), SES (i.e. years of education, household income, and employment status), acculturation (years of residence in the U.S. and country of birth), and a lifestyle factor (physical activity behavior). One model, which captures the interrelationships between these factors, is the Dahlgren and Whitehead (1991) 'Social Determinants of Health Model', which describes the layers of influence on an individual's potential for health. Whitehead (1995) described these factors as those that are fixed (core non-modifiable factors), such as age, sex and genetic and a set of potentially modifiable factors expressed as a series of layers of influence including: personal lifestyle, the physical and social environment and wider socio-economic, cultural and environment conditions.

The inclusion of SES indicators such as income, education, and employment status were further selected based on social stratification principles. Social stratification is the unequal distribution of privileges among population subgroups (Caprio et al., 2009). Social disadvantage can be based on material conditions, determined by access to resources and services that affect health such as adequate nutrition, sanitation, housing, and access to health care. Neighborhood of residence may influence access to healthy foods, opportunities for physical activity, and access to medical care, with low neighborhood SES most strongly associated with greater cumulative biological risk profiles (Merkin et al., 2009). Numerous studies have shown living in low SES neighborhoods is associated with negative health outcomes, including obesity and CVD (Lee et al., 2007; Merkin et al., 2009). Material disadvantage (e.g., resulting from inadequate income) can affect obesity by influencing the ability to purchase nutritious food or to live in a neighborhood with safe, pleasant places to exercise and markets that sell affordable fresh produce (Robert & Reither, 2004). Low educational attainment could increase the risk of obesity by limiting economic opportunities or one’s ability to understand and act on health information. Hence, an individual’s educational level, income, and employment status are important determinants of health and were included in the present study as either predictors or covariates.

The marriage market hypothesis (Becker, 1981) and the uni-dimensional model of acculturation (Gordon, 1995) informed the identification of both marital status and proxy measures of acculturation as important predictors of BMI and WC. The marriage market hypothesis suggests married individuals, who are no longer concerned with attracting a mate, may allow their BMI to rise (Averett, Sikora, & Argys, 2008). Acculturation refers to changes that groups and individuals undergo as a result of contact with a different culture (Abraído-Lanza, Armbrister, Flórez, & Aguirre, 2006). Early theoretical models of acculturation supported a linear and directional process by which loss of the original culture occurs through greater acculturation (Gordon, 1995). Acculturation has been associated with obesity in Hispanics; for instance, length of time in the U.S. as a proxy measure for acculturation with those having lived in the U.S. longer taking on a more American diet and lifestyle (Himmelgreen et al., 2004)

Further informing the selection of variables was the concept of risk factors for CVD, which was first introduced in the Framingham Heart Study and linked the presence of specific precursor conditions such as elevated cholesterol, hypertension, diabetes mellitus, and tobacco use to future CVD development (Balagopal et al., 2011). Balagopal and colleagues (2011) suggested these traditional risk factors can be categorized in the following four groups: 1) constitutional (e.g. age, gender), 2) behavioral lifestyle (e.g. nutrition, physical activity), 3) physiological (e.g. blood pressure, lipids, obesity), and 4) medical diagnosis (e.g. type 2 diabetes). Similarly, Murray et al. (2003) referred to a taxonomy of risk factors broadly classified into categories of physiological, behavioral, environmental, and socio-economic in their conceptual framework of theoretical minimum risk. Both of these conceptual frameworks were used to inform the selection of variables to include in the models analysed in the second manuscript.

Further informing the statistical analysis conducted in manuscript 2 was the concept of distal and proximal determinants of health. The proximal determinants have direct effects on health, and the distal determinants have indirect effects (Arah, Westert, Delnoij, & Klazinga, 2005). Murray and Lopez (1999) described a "causal-web" which includes the various distal (such as cultural factors), proximal (behavioral or environmental), and physiological and patho-physiological causes of disease, in a structural model.

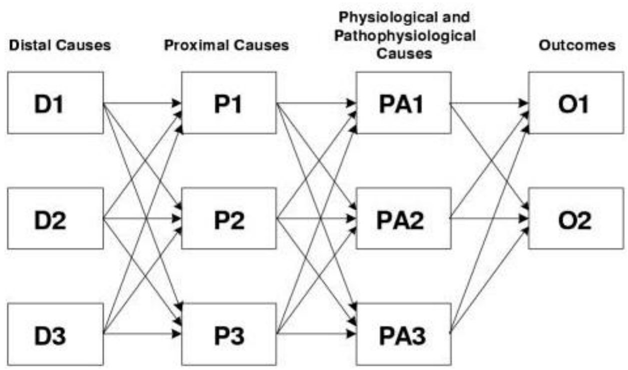

Figure 1 Causal web illustrating various levels of disease causality
Source: Murray, C.J.L., Ezzati, M., Lopez, A.D., Rodgers, A., & Vander Hoorn, S. (2003).

Given the multiple complex interactions (as depicted in Figure 2), assessing the relationships between physiological measures such as obesity and central obesity and other CVD risk factors may be best predicted using a structural (causal-web) approach (Murray et al., 2003). While analyses in the present dissertation did not test interactions amongst the different variables, a modified version of Murray’s (2003) multi-risk model guided the analysis conducted in the present dissertation. For example, the model formed the basis for the decision to use hierarchical multiple regression analyses which allowed for the inclusion of multiple risk factors which could impact the CVD risk factors being assessed and the concept of distal and proximal determinants of health informed the ordering of how predictor blocks were entered into the regression analyses. This will be explained in more detail in each of the manuscripts.

Research Questions

The following research questions and hypothesis statements form the basis of this dissertation:

Research Question 1: What is the association between sociodemographic characteristics, acculturation factors, and physical activity with anthropometric measures of BMI and WC in a sample of Mexican American adults living in the Lower Rio Grande Valley? For purposes of the analysis presented here and the hypotheses formulated below the socio-demographic factors included are: (i) age, (ii) gender, (iii) marital status, (iv) number of children, (v) years of education, (vi) annual household income, (vii) employment status, (viii) years of residence in the U.S., and ix) country of birth. Physical activity was defined as engagement in the recommended 150 minutes of physical activity a minimum of 5 days per week.

Hypothesis 1a: Acculturation factors account for a significant amount of variance in BMI over and above that accounted for by socioeconomic status and demographic factors. Hypothesis $1a_1$: Participation in at least 150 minutes of physical activity per week account for a significant amount of variance in BMI over and above that accounted for by acculturation, socioeconomic, and demographic factors.

Hypothesis 1b: Acculturation factors account for a significant amount of variance in WC over and above that accounted for by socioeconomic status and demographic factors. Hypothesis $1b_1$: Participation in at least 150 minutes of physical activity per week account for a significant amount of variance in WC over and above that accounted for by acculturation, socioeconomic, and demographic factors.

Research Question 2: What is the association between BMI and WC with clinical indicators of type 2 diabetes, hypertension, and dyslipidemia among Mexican Americans adults in the Lower Rio Grande Valley controlling for socio-demographic characteristics, acculturation, medication use and physical activity?

Hypothesis 2a: BMI accounts for a significant amount of the variance observed in CVD risk factors (systolic blood pressure, diastolic blood pressure, fasting blood glucose, total cholesterol, LDL-cholesterol, triglycerides, and HDL-cholesterol) over and above that explained by physical activity, medication use, acculturation, socioeconomic, and demographic factors.

Hypothesis 2b: WC accounts for a significant amount of the variance observed in CVD risk factors (systolic blood pressure, diastolic blood pressure, fasting blood glucose, total cholesterol, LDL-cholesterol, triglycerides, and HDL-cholesterol) over and above that explained by physical activity, medication use, acculturation, socioeconomic, and demographic factors.

Research Question 3: What are important individual and site level predictors of weight loss in Mexican American adults participating in a community-based, health promotion program aimed at reducing or maintaining a healthy weight?

Hypothesis 3a: Baseline health characteristics account for a significant amount of variance in weight loss over and above that accounted for by a lifestyle variable (i.e. physical activity), socioeconomic, and demographic characteristics;

Hypothesis $3a_1$: Site level variables such as site location and leadership involvement account for a significant amount of variance in weight loss over and above that accounted for by baseline health characteristics, a lifestyle variable (i.e. physical activity), socioeconomic, and demographic characteristics in Mexican Americans participating in a community-based health promotion program.

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CHAPTER III

METHODS

Overview

The primary purpose of this study was to assess predictors of body mass index (BMI) and waist circumference (WC), describe the burden of cardiovascular disease (CVD) risk factors and association with BMI and WC, and examine predictors of weight loss at 12 weeks among a Mexican American adult population participating in a community-based health promotion program in the Texas-Mexico border. This chapter will provide the reader with a general context of the methods in the parent study from which data were obtained for each of the studies conducted for this dissertation. A more detailed methods section specific to each manuscript is provided within each of the manuscripts.

Data Source

The data used for the present dissertation is from a larger intervention study, Beyond Sabor (Spanish word for flavor), conducted in the Lower Rio Grande Valley of the Texas-Mexico border region, from 2009-2012. The larger study, headed by Dr. Elena Bastida, was focused on assessing the effectiveness of a culturally-tailored, community-based health promotion program on promoting dietary behaviors and physical activity to maintain or reduce overweight and obesity in a sample of Mexican American adults recruited from the Valley Region. The overarching long term goals of the parent study were: 1) the prevention or reduction of overweight and obesity classifications; and 2) the prevention, delay of onset, or improved management of diabetes in a population of urban and rural adult Mexican Americans. This larger study employed a group randomized pretest-posttest design in which sites were randomized to receive either the Beyond Sabor program (intervention sites) or the Healthy Living program (control sites).

Study Design

All research conducted within this dissertation is secondary analysis. The study design of manuscripts 1 and 2 utilized a cross-sectional design using epidemiological data collected at baseline, and prior to randomization, from the parent study. Manuscript 3 is a secondary data analysis of intervention data based on the randomized cluster design at baseline and 12 week post-test. All research activities of the parent study were approved by the Institutional Review Board of the University of North Texas Health Science Center at Fort Worth. The present dissertation was reviewed by Florida International University's Office of Research Integrity who determined the study was Not Subject Human Research. Letter can be found in the Appendices.

Participant Selection Process

Sampling Method

A one-stage cluster sampling was utilized in the parent study. The sampling frame consisted of 156 sites throughout the Valley region, of which 32 sites were randomly selected. The sample sites were drawn from community partners with whom the study researchers had worked during the pilot phase of the Sabor program as well as a new regional partner, the Lower Rio Grande Valley Food Bank.

Inclusion and Exclusion Criteria

Inclusion criteria for the parent study included men and women, residing in a family context, e.g. married, living with a partner, or raising children (single parent, grandparent or guardian, or other possible family arrangement, as determined by participants), Mexican American in origin, no medical or physical conditions reported that precluded involvement either in moderate physical activity or eating a low-fat, low carbohydrate, moderately high fiber diet, and had no plans of moving away in the next twelve months. Adults that lived alone, with a BMI > 40 (unless they had a doctor's written authorization), and unable to commit to regular attendance throughout the 12-week program were excluded from parent study. Inclusion and exclusion criteria specific to each of the manuscripts is described within each manuscript.

Study sites

The parent study was conducted in the Valley region, a heavily populated Mexican-American region in the Texas-Mexico border. The Valley region has been described in greater detail in Chapter 2. The sampling frame included 156 sites across the Valley region. The majority of the sites (150) were from the Lower Rio Grande Valley Food Bank network of 222 sites. The Food Bank serves over 300,000 people annually through its network of 222 sites. Seventy-two sites were excluded from the Food Bank network because their clients did not meet the inclusion criteria of the parent study. In addition to the 150 sites from the food bank network, 6 sites from a chapter of the United Farm Workers Union were included in the sampling frame for a total of 156 potential sites. A total of 32 sites were randomly selected.

Recruitment and Enrollment

Researchers of the parent study were able to recruit 1,273 subjects. About four weeks prior to the start of an intervention cycle, the Principal Investigator informed staff of the forthcoming cycle's sites and flyers were posted announcing the study at each of the sites as well as throughout the neighborhoods. The flyers did not specify study conditions, but identified the goals and objectives of the study and the day and time for an initial meeting with the study team to discuss the proposed research project. After the initial visit, new flyers were posted detailing the day and time of a second study team visit during which formal recruitment took place. During this visit, participants were signed up for the program which included signing the consent form. The consent form informed participants there would be two types of programs offered but at the time of signing the consent form it was not known which program they would receive given randomization was to take place after all baseline assessments were completed.

During the formal recruitment visit, a minimum of 20 participants were recruited based on an expected attrition rate of 30% per site. At larger sites, participants were divided into two or more sub-groups although they were still considered as one site. Once the 35-45 subjects were recruited at each site, all baseline measurements were conducted. Following baseline measures and site randomization to either the intervention or control program, a site meeting was held to discuss the intervention. At this time, initial site participants received further information as to which program would be delivered and procedural guidelines. Before proceeding with any further discussion a second consent form was explained and signed by all present participants who were free to stay or leave the program if not satisfied with the guidelines for either the treatment or control arm of the study. Following this step, the intervention sites held a free flowing discussion to choose the physical activity of preference, the format, and other issues as they arose. Likewise, the Food Bank health educator held an orientation meeting at the control sites to explain the Healthy Living program to be conducted at control sites. Transportation and child care was provided to participants to eliminate any barriers to conduct baseline assessments.

Program Description

Because analyses conducted in Manuscript 3 were based on the pretest-posttest group randomized intervention data for Beyond Sabor, a brief program background is being provided. Beyond Sabor was designed to reduce the major risk factors for obesity and diabetes. The 2-hour per week, 12-week health education program was designed to promote weight control through healthy dietary and physical activity behaviors that contribute to risk reduction for these conditions. The parent study had six outcomes targeted through the delivery strategies: 1) reduction or control of BMI; 2) reduction in the consumption of animal fats and refined carbohydrates; 3) reduction in the consumption of soda and other sugared beverages; 4) increase in consumption of fiber; 5) increase in water intake; and 6) increase in physical activity. The program was designed to encourage substitution of flour tortillas with corn tortillas and once or twice a week of Mexican rice (which is cooked with lard) with a green salad. Beyond Sabor focused on moderation in portion size and a balanced diet. Physical activity was encouraged through a family context with a recommendation of 150 minutes of physical activity per week, preferably walking.

Each week during the course of the 12-week intervention program, a different topic was covered through three differently timed segments. The parent researchers originally had organized the session to start with 20 minute segments presenting factual information on obesity, diabetes, or CVD, its risk factors and related co-morbidities. A 50-minute segment followed which included a cooking demonstration and food sampling with special attention that the recipe reinforced the educational lesson of the day. The session then was expected to end with a 60 minute walking session; the last 15 minutes were optional, although participants were encouraged to complete the hour long walk. It is important to note sites were provided with the flexibility to implement the program how they thought would be best and some sites began with the walking or physical activity component.

The program's delivery strategies and messages were developed in full collaboration with participants at each site and in consultation with literacy experts; although researchers relied heavily on visual and auditory channels to deliver the messages. There was no "fixed menu or established order for the lecture material." Investigators worked with each of the sites to determine segment strategies. Program objectives guided the strategies and messages, but participants were encouraged to fully participate in all aspects of decision-making. Cooking presentations differed at each site, but the weekly message remained the same. Lesson plans included: 1) The Walking Club, 2) Diabetes: What do you need to know?, 3) Diabetes: Risk factors and complications, 4) The Kidneys and Water Essential to Live, 5) Cholesterol; 6) Blessed Calories, 7) Fat, 8) Reading Nutrition Labels, 9) Portions, 10) Sweeteners, 11) Traditional Quesadilla goes Healthy, and 12) Eating and Taking Out.

The control group sites received the Healthy Living program which was a nutrition program the food banks had been delivering to their program sites. The Healthy Living program is a 30-minute, six-session program, offered once a week. Healthy Living is a lecture only program, with no food sampling or interaction time although similar in content to Beyond Sabor. Control sites were not included in the present analyses.

Measures

Once 32 sites were selected randomly from the pool of 156 sites and individuals recruited, pretest measurements were conducted. Research staff for the parent study conducted a sociodemographic survey of all individuals, a modified 24-hour physical activity recall questionnaire and clinical assessments at the site location during baseline assessments. Clinical assessments were conducted at baseline during a 1-2 week pre-intervention period and later repeated at 12 and 24 weeks. Clinical assessments were analyzed by the Valley Baptist Medical Center Community Reference Laboratory.

Sociodemographic Questionnaire: Demographic data were collected using a standard sociodemographic questionnaire developed by the Principal Investigator of the parent study. Information regarding personal data including date of birth, gender, marital status, family composition (i.e. number children), and country of origin were asked. Other information about socioeconomic-related factors such as years of education, employment status, and household income was included.

Seven-day modified physical activity recall questionnaire: Physical Activity was measured using a modified version of the Seven-day Physical Activity Recall (PAR) (Blair et al., 1985). The PAR is an interviewer-administered instrument that estimates energy expenditure in physical activity over one week. The method has acceptable reliability and validity (Blair et al., 1985; Sallis et al., 1985). A series of closed-ended questions was used to estimate the level of participation in walking and other activities. Physical activity was defined as engagement in any type of activity including low-to-moderate physical activity (e.g. housework, gardening, taking care of children) and moderate-to-vigorous physical activity (e.g. biking, aerobics).

Independent and Dependent Variables

All information utilized for this dissertation was retrieved from data collected in the parent study. Following is a list of variables utilized in the analyses. It is important to highlight that while some variables were considered as independent variables in one manuscript they may have been considered as a dependent variable in the other. While BMI and WC were dependent variables in Manuscript 1, they were treated as independent variables in Manuscript 2. This was based on the research question being studied. For example, the purpose of Manuscript 1 was to assess whether physical activity explained a greater variance of BMI and WC over and above that explained by other factors. Thus, BMI and WC were dependent variables. The purpose of Manuscript 2 was to assess whether BMI and WC explained a greater amount of the variance observed in a number of CVD risk factors, over and above other predictor variables. Thus, BMI and WC were independent variables. For this chapter, BMI and WC will be described within the dependent variable subsection.

Independent Variables

Sociodemographic variables

The sociodemographic questionnaire assessed age, gender, marital status, number of children, socioeconomic characteristics such as education, annual household income, and employment status, and country of birth. Age was calculated from the question "What is your date of birth?" on the questionnaire. Gender was based on a selection for gender: 1) female, and 2) male. Marital Status was assessed based on the question: "Are you: 1) single, 2) married, 3) divorced, 4) widowed, or 5) separated". Marital status was then recoded into a dichotomous variable: 1) married (married and/or living together), and 2) not married (single, divorced, widowed, and separated). It was recoded into a dichotomous variable to allow for point-biserial correlations and regression analyses. Number of children was assessed based on answers to the following question: "How many children do you have?" Socioeconomic characteristics including years of education was assessed based on the question "Tell us a bit about your education? For example, what is the highest grade you completed?" with potential responses from 1 through 17 and higher. Household income was based on the question "What is your household income?" Employment status was based on the answer to the question "Are you employed?" with potential responses of yes or no and recoded to: 1) employed and 2) unemployed.

The years living in the U.S. variable was created based on various assumptions of the data collected on the sociodemographic questionnaire. The questionnaire items used to create the variable of time living in the U.S. included: age of survey respondent, country of birth, country of birth of children, country of education, number of children, and age of children. Some of the assumptions made included but are not limited to: 1) if survey participant was born in the U.S. then their age equaled number of years living in the U.S.; 2) if survey participant was born in Mexico, all children born in the U.S., and educated in the U.S. then time living in the U.S. was the age of the oldest child plus one year (assumed they arrived in the U.S. one year before first child was born); 3) if born in Mexico, educated in Mexico, with children born in both U.S. and Mexico, then used the number of children born in U.S. to determine the age of child to subtract one year from; and 4) if born in Mexico, educated in U.S., then time living in the U.S was age of respondent – 6 (assumed they came to the U.S. when they entered school).

Country of birth was based on the question “Were you born in the U.S. or Mexico?” Country of birth was defined as a dichotomous variable of born in the U.S. or not.

Self-Reported Physical Activity Behavior

Engagement in moderate physical activity was calculated using information collected from the modified 24-hour physical activity recall questionnaire. The questionnaire asked survey participants whether they walked or not, how many times a week (once, twice, three times, four times, five to six times, and every day) and for how long (15-20 minutes, 20 to 30 minutes, 30 to 45 minutes, 45 to 60 minutes, and over one hour). Participants were also asked to identify a second type of activity they might prefer to engage in, how many times, and for how long utilizing the same metric as for the walking-related question. Answers to these two questions were then summed to calculate the total number of minutes individuals engaged in physical activity per week. If an individual checked off the 30-45 minute category, the more conservative number (i.e., 30 minutes) was used for the calculation. Physical activity was dichotomized (yes, no) and measured as meeting 150 minutes per week of moderate physical activity on most days of the week, per current national recommendations (USDHHS, 2008).

Site-level variables

Two site level variables were used in the present analysis. Data collection for location of site (urban or rural) was obtained from U.S. Census categories. Location was used as a dichotomous variable in the analyses. Leadership involvement was coded and assessed by the research team of the parent study and was based on extensive ethnographic data collected by two ethnographers at each of the sites throughout the twelve weeks and groups discussions that resulted in final scores for each of these variables. Formal leadership involvement was measured on a Likert scale and classified as detached, somewhat active, active, and very active. Formal leadership involvement consisted of the "official" food bank pantry manager, priest or pastor where the church served as the food bank pantry. For the present analyses, leadership involvement was dichotomized into active (active and very active) and not active (detached and somewhat active).

Dependent Variables

Body Mass Index (BMI)

Body weight was measured on a calibrated balanced scale and height was measured using a stadiometer. BMI was calculated as weight in kg/height in m^2 (kg/m^2). BMI was treated as continuous variable for all regression analyses. However, a categorical variable was created to further describe the sample. The categorical BMI variable was defined as: underweight/normal (BMI < 25 kg/m^2), overweight (BMI 25.0 - 29.9 kg/m^2), and obese (BMI ≥ 30 kg/m^2). BMI was based on the obesity definition of the NIH (1998). Given the low number of individuals in the underweight category (7), the underweight individuals were placed in the normal category.

Waist circumference

Waist circumference was measured using a Gulick tension tape. A nurse professional faced the participant and placed the measuring tape around his or her horizontal plane at the level of the natural waist or the narrowest part of the torso. Measurement was taken at the end of the normal expiration without the tape compressing the skin. The measurement was taken to the nearest 0.1 centimeter (cm), according to the

Anthropometric Standardization Reference Manual (Lohman, Roche, Martorell, 1988). Waist circumference was treated as a continuous variable in regression analyses. A categorical variable was created to further describe the sample. High waist circumference was defined as ≥ 94 cm for men and ≥ 80 for women and optimal waist circumference as < 94 cm for men and < 80 cm for women, based on the definition provided by the International Diabetes Foundation (Alberti, Zimmet, & Shaw, 2005).

Glucose

Blood glucose levels were measured using the overnight fasting plasma glucose (FPG) test which measures blood glucose in a person who has not eaten anything for at least 8 hours. Glucose level was treated as a continuous variable in regression analysis but was also categorized for descriptive statistics. The categorical variable for glucose was defined as: normal (70 - 99 mg/dL), pre-diabetes (100 - 125 mg/dL), and diabetes (≥126 mg/dL).

Blood pressure

Blood pressure measurements were taken in the right arm with the person seated following 10 minutes of quiet rest. The first measurement was disregarded and the average of three measurements taken 10 minutes apart was recorded. Blood pressure levels were treated as a continuous variable for all regression analyses. Blood pressure was categorized as normal if the systolic blood pressure (SBP) was < 120 millimeters of mercury (mmHg) and the diastolic blood pressure (DBP) was < 80, pre-hypertension if SBP was 120-139 mmHg or DBP was 80-89, and hypertension if SBP ≥ 160 mmHg or DBP was ≥ 100 mmHg, according to NHLBI guidelines (2003) guidelines.

Cholesterol

An overnight fasting blood test or a lipid profile[1] was used to measure cholesterol. Total cholesterol, low-density lipoprotein cholesterol (LDL-c), high-density lipoprotein cholesterol (HDL-c), and triglycerides were all treated as continuous variables for regression analyses. These variables were also categorized, based on the National Cholesterol Education Program Guidelines (2002) into the following: 1) Total cholesterol was classified as normal (< 200 mg/dL), borderline/high risk (200-239 mg/dL), and very high risk (≥ 240 mg/dL); 2) LDL-c was classified as normal (<100 mg/dL), near optimal/above optimal (100-129 mg/dL), borderline high (130-159 mg/dL), high/very high (≥ 160 mg/dL); 3) HDL-c was classified as high/optimal if ≥ 60 mg/dL and low if < 40 in men and < 50 in women; and 4) Triglycerides were classified as normal (< 150 mg/dL), borderline (150-199 mg/dL), high risk (200-499 mg/dL), and ≥ 500 mg/dL as very high.

Weight loss at 12 weeks

Body weight was measured on a calibrated balanced scale in kg. Weight loss at 12 weeks was calculated by subtracting weight at 12 weeks from weight at baseline.

Statistical Analysis

The data analyzed for the three manuscripts presented in this dissertation involved the use of descriptive statistics, Pearson and biserial correlations, and hierarchical

[1] Although a more advanced blood test, the Vertical Auto Profile (VAP) that can more accurately gauge risk of heart disease has become available, the researchers of the parent study had to make cost considerations given the large number of program participants. The standard lipid panel was deemed appropriate for the study which has been used to identify individuals at risk of CVD. All those who were identified with abnormal levels were referred to a physician for further evaluation.

multiple linear regressions. Descriptive statistics (means, standard deviations, frequencies, percentages) were used to describe the sample in each of the three manuscripts. Correlations, χ^2 tests, and one-way analysis of variance were used to examine associations between variables. Log transformations were used to correct for non-normality where needed.

Manuscript 1& 2

Pearson correlations and hierarchical multiple linear regressions were conducted to assess associations between demographic factors including family characteristics, SES characteristics, proxy measures for acculturation, and physical activity engagement with BMI and WC as well as associations between BMI and WC with CVD risk factors (i.e. glucose levels, blood pressure, and cholesterol).

Manuscript 3

Research question in manuscript 3 was first addressed by using mixed model analysis to account for the randomized cluster sampling design of the parent study. Mixed model analysis is used to account for intraclass (i.e. individuals within sites) and within-subject correlation (i.e. repeated measurements on each subject over time). The random factor was site. The total variance was explained fully by person-to-person variance. The site-to-site variance was zero. Thus, the model was re-run using hierarchical multiple regression analysis. Predictors were entered in blocks, as follows: (1) demographic factors: age, gender, marital status, number of children; (2) SES factors: years in education, household income, and employment status; (3) lifestyle factor: physical activity; (4) baseline health indicators: BMI, blood pressure, fasting glucose, total cholesterol; and (5) site level variables: site location and leadership involvement.

Sample Size and Power Analysis

The parent study had a sample size at recruitment and pre-randomization of 1273 participants. Sample sizes differed across the three manuscripts from 227 to 946. A post hoc power analysis was conducted with G*Power 3 software (Faul, Erdfelder, Lang, & Buchner, 2007) to identify the study power for each of the manuscripts. Sample size for Manuscript 1 consisted of complete cases (n = 974) across all variables of interest for which data was available at the start of this dissertation. A power analysis calculation based on a two tailed alpha value of .05, with 10 predictors, and a small effect size of .02 (R^2 > 2.0%) yielded a power of 88%.

The lowest sample size used for the regressions conducted in Manuscript 2 was 946. A power analysis calculation to detect an R^2 increase of a small effect size of at least 2% in the multiple regressions for each dependent variable using α of .05 with 11 predictors resulted in a study power of 86%.

For Manuscript 3, the sample size was 227. A power analysis calculation based on a two tailed alpha value of .05, 15 predictors, and a medium effect size of .03 (R^2 > 3.0%) yielded a study power of 85%.

Software

The statistical software utilized for the analyses conducted in the studies presented was IBM SPSS Statistics 20 (IBM Corporation).

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CHAPTER IV

MANUSCRIPT 1

CORRELATES OF BODY MASS INDEX AND WAIST CIRCUMFERENCE IN A MEXICAN AMERICAN ADULT POPULATION IN THE TEXAS-MEXICO BORDER

ABSTRACT

Objectives: Obesity is highly prevalent in Mexican Americans, the largest ethnically distinct subgroup among Hispanics. The present study aimed to identify predictors of body mass index (BMI) and waist circumference (WC) by examining sociodemographic characteristics, acculturation factors, and physical activity in a sample of Mexican American adults living in the Texas-Mexico border region.

Methods: Cross-sectional analyses of baseline data collected from 974 Mexican American adults, aged 20-89, during the recruitment phase of the Beyond Sabor pre-post intervention study in the Texas-Mexico border were analyzed. A post hoc subgroup analysis of predictor variables within weight categories was conducted. Correlations and hierarchical multiple regression analysis was used to assess associations between predictor and outcome variables.

Results: Approximately 86% of study participants were overweight or obese. Acculturation accounted for a significant amount of the variance observed in both BMI ($p < .001$) and WC ($p < .001$) over and beyond that accounted by socioeconomic and demographic factors. Together the predictor variables accounted for 4% of the variation in BMI and 7% of the variation in WC.

Discussion: The findings reported here contribute to the identification of 'high risk' individuals for whom health promotion and intervention programs should be targeted. The role of acculturation is important in predicting obesity and should be included when designing health promotion programs as well as identifying individuals who might be at greater risk (e.g. those who have lived longer in the U.S.). Further research is needed to identify and explain important predictors of obesity, given its alarming presence in the Mexican American population in general and particularly along the U.S.–Mexico border.

Key Words: Mexican Americans, obesity, acculturation, socio-demographic factors

MANUSCRIPT 1

CORRELATES OF BODY MASS INDEX AND WAIST CIRCUMFERENCE IN A MEXICAN AMERICAN ADULT POPULATION IN THE TEXAS-MEXICO BORDER

INTRODUCTION

Obesity, a well-recognized risk factor for several chronic diseases including cardiovascular disease, type 2 diabetes, hypertension, elevated blood lipids, and some types of cancer (as cited in Must et al., 1999), has become an equal, if not greater, contributor to the burden of disease than smoking (Jia & Lubetkin, 2010). Current prevalence of excess weight is alarming with an estimated 68.8% of U.S. adults aged 20 years and older overweight or obese (Flegal, Carroll, Kit, & Ogden, 2012). Adding to the problem of obesity is the increasing trends observed in abdominal obesity which is associated with insulin resistance, hyperinsulinemia, hyperglycemia, dyslipidemia, and hypertension, which tend to cluster and are often referred to as the "metabolic syndrome" (Ervin, 2009). National medical care costs of obesity-related illness in adults is an estimated $209.7 billion, with a staggering 20.6% of U.S. national health expenditures spent treating obesity-related illness (Cawley & Meyerhoefer, 2012).

Mexican Americans are the largest and fastest growing Hispanic ethnic minority subgroup in the U.S., with more than 64% of the 45.4 million U.S. Hispanics being of Mexican origin (Grieco, 2010). This growth presents challenges to the healthcare system and the nation's prevention agenda for eliminating racial and ethnic disparities, considering the current inequalities observed in prevalence of obesity, abdominal obesity, and associated chronic conditions (Hertz, Unger, & Ferrario, 2006).

The prevalence of obesity has increased among Americans of all ages, races, ethnicities, socioeconomic levels, and geographic areas in the past few decades (Wang & Beydoun, 2007). Of great concern is the 80% increase observed among U.S. Hispanics in the past two decades (Flegal, Carroll, Ogden, & Curtin, 2010), though increasing trends seem to have stabilized in the last few years (Flegal et al., 2012). Of all Hispanic subgroups, Mexican Americans have the second highest age-adjusted rate of obesity (40.4%) in the country compared to non-Hispanic blacks (49.5%), all Hispanics (39.1%) and non-Hispanic whites (34.3%) (Flegal et al., 2012). Mexican American men aged 20 and older experience the highest rates of overweight and obesity (82.4%) among all ethnic/racial groups, with Mexican American women having the second highest prevalence (78.5%) (Flegal et al., 2012). Projections stipulate that by 2030 close to 91.1% Mexican American men and 86.7% of Mexican American women will be overweight or obese (Wang et al., 2008). Comparisons of mean waist circumference (WC) from 1999-2000 to 2007-2009 show the largest increase in mean WC levels was among Mexican American women, while Mexican American men showed the second highest increase when compared to non-Hispanic whites and non-Hispanic blacks (Ford et al., 2011).

In the context of limited resources, it is crucial to determine the population groups for whom priority action should be taken at the local level for obesity prevention and management approaches (Nichols & Swinburn, 2010). While national data supports obesity prevention and management interventions in the Mexican American population, it might be even more strategic to identify subgroups that may be at higher risk of overweight and obesity, taking into account the local context in which they live. To this end, Mexican Americans living in the Lower Rio Grande Valley of South Texas (the

Valley region) and within *colonias* – unincorporated, impoverished settlements with substandard living conditions - have been identified as one of the most disadvantaged, worse-off in terms of physical health, and hard-to-reach minority groups in the U.S. (Mier et al., 2008). More than 75% of Mexican Americans 37 years and older living in the Valley region are estimated to be overweight or obese (Bastida & Soydemir, 2009). Of equal concern is the high prevalence rate for type 2 diabetes observed which has ranged from 15% to 29% (Fisher-Hoch et al., 2010; Bastida & Soydemir, 2009). Furthermore, pre-diabetes rates of over 55% have been reported (Bastida & Soydemir, 2009).

Research has revealed inconsistent sociodemographic risk factors for weight gain (Brown & Siahpush, 2007). Sociodemographic factors such as age, gender, and socioeconomic status (SES) have been found to be associated with obesity (Ball, Mishra, & Crawford, 2002; Baum & Ruhm, 2009; Karlamangla, Merkin, Crimmins, & Seeman, 2010; Roeters van Lennep, Westerveld, Erkelens, & van der Wall, 2002). However, the literature is mixed in establishing associations among the various predictors and there are limited studies specific to the Mexican American population, especially those living in the Valley region. A number of studies have assessed marital status, number of children, and proxy measures for acculturation such as years of residence in the U.S. and country of birth as correlates of obesity among specific minority groups (Goel, McCarthy, Phillips, & Wee, 2004; Gordon-Larsen, Harris, & Poplin, 2003; Kaplan, Huguet, Newsom, & McFarland, 2004); but few studies, if any, have been specific to the Mexican American population (Bowie et al., 2007).

Given the role of physical activity in preventing obesity, it is important to also understand behavioral indicators of body weight in population groups (Esparza et al., 2000). To promote and maintain health, all healthy adults aged 18–65 years of age need moderate-intensity physical activity for a minimum of 30 minutes on five days each week or vigorous-intensity activity for a minimum of 20 minutes on three days each week with at least 2 days dedicated to muscle strengthening (Haskell et al., 2007). Mexican Americans have been found to be the most active group in the U.S. with 27% meeting national physical activity recommendations (Ham & Ainsworth, 2010); however, 65% of Mexican American men and 74% of Mexican American women living in the Valley region have been found to report little or no leisure-time physical activity (Bastida & Assefa, 2005).

The present study aimed to identify predictors of body mass index (BMI) and waist circumference (WC) by examining a wide range of socio-demographic, proxy measures of acculturation, and physical activity in a sample of Mexican American adults living in the Texas-Mexico border region who are food bank recipients and thought to be at high-risk for obesity given their social and economic background. This is a subgroup for which limited literature has been published. The objectives of this study were to: 1) describe the mean BMI and WC levels in a Mexican American adult population living in the Texas-Mexico border; 2) test for correlations and associations between BMI, WC, and a number of covariates including demographic, socioeconomic, acculturation factors, and physical activity; and 3) assess the unique contribution of demographic, socioeconomic status, acculturation, and physical activity to the amount of variance observed in BMI and WC in this population.

CONCEPTUAL FRAMEWORK

Many social, cultural, and economic factors contribute to the development, maintenance, and change of health behavior patterns which may lead to an increased risk of obesity (Glanz & Bishop, 2010). Koh (2011) illustrated the importance of including measures related to education, employment, income, family status and social support, among others. Cockerham et al. (1997) highlighted the importance of including variables such as age and gender, which provide a structure to health practices.

The present study examined measures of obesity using a multidimensional framework taking into account simultaneously social structural position as well as age, gender, acculturation, and physical activity. One model, which captures the interrelationships between these factors, is the Dahlgren and Whitehead (1991) 'Social Determinants of Health Model', which describes the layers of influence on an individual's potential for health. The model describes factors as those that are fixed (core non-modifiable factors), such as age and gender and a set of potentially modifiable factors expressed as a series of layers of influence including: personal lifestyle, the physical and social environment and wider socioeconomic, cultural and environment conditions. Furthermore, to inform the statistical analysis, the concept of distal (indirect effects) and proximal (direct effects) determinants of health were used to identify the order in which factors would be entered in the multiple regression analysis (Arah, Westert, Delnoij, & Klazinga, 2005).

METHODS

Study Design and Population

The present cross-sectional analysis was based on information collected at baseline for individuals participating in a larger intervention study, Beyond Sabor (Spanish word for "flavor"), conducted in the Lower Rio Grande Valley region in the Texas-Mexico border, from 2009- 2012. The main long term goal of the parent study was the prevention or reduction of obesity; and the prevention, delay of onset, or improved management of diabetes in a population of urban and rural adult Mexican Americans. The sampling frame consisted of 156 sites, mainly from the local food bank network, of which 32 were randomly selected.

Inclusion criteria for the present analysis included men and women, ages 20 – 89, residing in a family context, e.g. married, living with a partner, or raising children, and Mexican American in origin. Exclusion criteria included participants who responded being born in another country outside of U.S. or Mexico. For purposes of the data analysis, the sample was treated as a non-probability sample.

Measures

BMI and WC. The following measurements were performed by trained nurse professionals in the parent study: body weight (kilograms [kg]), height, and waist circumference (cm). Body weight was measured on a calibrated balanced scale with the person wearing light clothes and no shoes. Body weight was expressed in kilograms and rounded to the nearest 0.1kg. Height was measured using a stadiometer in cm and rounded to the nearest 0.1cm. BMI was calculated as weight in kg/height in m^2 (kg/m^2). Three BMI groupings were created according to the National Institutes of Health definition (1998): underweight/normal (BMI < 25 kg/m^2), overweight (BMI = 25 – 29.9 kg/m^2), and obese (BMI ≥ 30 kg/m^2). Since only 7 individuals were classified as underweight (0.7%) in the total sample, underweight individuals were grouped with the normal weight individuals.

WC was measured using a Gulick tension tape. A nurse professional faced the participant and placed the measuring tape around his or her horizontal plane at the level of the natural waist or the narrowest part of the torso. Measurement was taken at the end of the normal expiration without the tape compressing the skin. WC measurements were stratified into two sex-specific groups with cut-off points of 94 cm for males and 80 cm for females, as recommended by the International Diabetes Federation (Alberti, Zimmet, & Shaw, 2005). Because of the high correlation between BMI and WC, $r = .81$, $p < .001$, and given BMI is a measure of overall adiposity and WC of central obesity both measures were used in the data analyses but were not included in the same regression.

Sociodemographic factors. Age in years, gender, marital status (married/living together as married, single/divorced/widowed/separated as not married), number of children, years of education, annual household income, and employment (employed/unemployed) were collected through a sociodemographic questionnaire in the parent study. Continuous variables were recoded into categorical variables to allow for post hoc tests. Age was recoded into 5 categories: < 35, 35-44, 45-54, 55-64, and ≥ 65 years or older. Number of children was recoded as: no children, 1-2 children, 3-4 children, ≥ 5 children. Education was recoded as: (1) 0-8 years, (2) 9-12 years, and (3) 13 years or more. Individuals completing a GED were included in the 9-12 year category.

Household income was recoded as: (1) ≤ $10,000, (2) $10,001-$20,000, (3) $20,001-$30,000, and (4) ≥ $30,001.

Acculturation variables. Years of residence in the U.S. was computed using several questionnaire items including age of survey respondent, country of birth, country of birth of children, country of education, number of children, and age of children (refer to Note at end of paper for assumptions). Years of residence in U.S. was recoded into: ≤ 15, 16 - 30, and ≥ 31 years. Country of birth was defined as a dichotomous variable (born in the U.S. or not).

Lifestyle factor. Physical activity data was collected using a modified seven-day physical activity recall questionnaire (Sallis et al., 1985). To create the physical activity variable answers to several questions were used including whether individuals walked, and if so for how long, and number of times per week. Individuals were also asked to identify a second activity they engaged in. To calculate the number of minutes in which individuals engaged in physical activity the more conservative number was used. For example, if a person stated they walked 30-45 minutes then 30 minutes was used for the calculation. Physical activity was then dichotomized (yes, no) and measured as meeting 150 minutes per week of moderate physical activity on most days of the week (at least 5 days), per current national recommendations (U.S. Department of Health and Human Services, 2008). Any type of activity, whether household-related chores or occupational-related physical activity as well as intentional physical activity (e.g. aerobics) was included in the creation of the physical activity variable.

Statistical analysis

Descriptive statistics (means, standards deviations, frequencies, percentages) were used to describe the sample. Chi-square test was used to test for association between categorical variables, and the two sample t-test was used for continuous variables. Post hoc tests using Bonferroni procedure were used to control for the probability of making a type I error in multiple comparisons when describing the proportion of individuals according to their BMI and WC across the different covariates. Associations between the predictor variables (age, gender, marital status, number of children, years of education, household income, employment status, years of residence in the U.S., country of birth, and level of physical activity) and the dependent variables, BMI and WC, were examined first through correlations and then hierarchical multiple linear regression analysis. Dummy variables were created for all dichotomous predictor variables to be able to run correlations and multiple regression analyses. Pearson correlations were run when both the independent and dependent variables were continuous and point-biserial correlations when the independent variable was a dichotomous variable and the dependent variable continuous. Like Pearson correlations, point-biserial correlations allow the assessment of the strength of the relationship but not its direction between two variables, one of which is dichotomous and the other continuous. Hierarchical multiple regression analysis was used over other types of multiple regression analysis because of the researcher's interest in selecting variables for inclusion in the model that were based on theory rather than just on statistical associations. The predictors were entered simultaneously in 4 blocks (1. demographic/family characteristics; 2. socioeconomic factors; 3. proxy measures of acculturation; 4. level of physical activity).

All statistical testing was conducted at $p < .05$ significance level with *SPSS* Version 20 (IBM Corporation, Chicago).

RESULTS

Description of total sample

The mean age of participants was 48.10 years (*SD* = 13.90) (see Table 1.1). The sample was largely composed of females (81%). A high percentage of individuals were married (73%), and mean number of children was 3.27 (*SD* = 1.80). Mean years of education was 9.22 (*SD* = 4.28) or equivalent to secondary education (junior high school). Mean BMI level (*M* = 31.24, *SD* = 6.28) was in the obese range (BMI > 30 kg/m^2).

Table 1.1 (1)

Baseline Characteristics of Total Sample (*n* = 974)

Characteristics	Total Sample	Females (n=787) (80.8%)	Males (n=187) (19.2%)
Age**			
(*M*±*SD*)	48.10 ± 13.90	47.44 ± 13.65	50.88 ± 14.61
Marital status *n* (%)			
Married†	711 (73.0)	565 (71.8)	146 (78.1)
Not married	263 (27.0)	222 (28.2)	41 (21.9)
Number of Children			
(*M*±*SD*)	3.27 ± 1.80	3.25 ± 1.78	3.36 ± 1.89
Household income*			
(*M*±*SD*)	13,011.45 ± 12,324.35	12,559.25 ± 12,344.12	14,914.53 ± 12,088.79
Education in years			
(*M*±*SD*)	9.22 ± 4.28	9.11 ± 4.21	9.70 ± 4.57
Employment status*** *n* (%)			
Employed	466 (47.8)	330 (41.9)	136 (72.7)
Not employed	508 (52.2)	457 (58.1)	51 (27.3)
Years in the U.S.			
(*M*±*SD*)	28.44 ± 18.28	28.16 ± 18.12	29.64 ± 18.94
Country of birth *n* (%)			
Mexico	741 (76.1)	607 (77.1)	134 (71.7)
US	233 (23.9)	180 (22.9)	53 (28.3)
Physical Activity***			
Yes	208 (21.4)	151 (19.2)	57 (30.5)
No	766 (78.6)	636 (80.8)	130 (69.5)
BMI			
(*M*±*SD*)	31.24 ± 6.28	31.49 ± 6.70	31.25 ± 6.88
BMI Category *n* (%)			
Underweight/Normal	139 (14.3)	118 (15.0)	21 (11.2)
Overweight	313 (32.1)	252 (32.0)	61 (32.6)
Obese	522 (53.6)	417 (53.0)	105 (56.1)
WC			
(*M*±*SD*)	99.72 ± 14.61	98.57 ± 14.58	104.57 ± 13.75
WC *n* (%)***			
Optimal	100 (10.3)	63 (8.0)	37 (19.8)
High	874 (89.7)	724 (92.0)	150 (80.2)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$ based on chi square tests or independent sample t-tests.
†Individuals in the not married category include those that identified themselves as single, divorced, widowed, and separated; those in the married category include those that identified themselves as married or living together.

Distribution of BMI and WC categories across socio-demographic factors, acculturation variables, and physical activity

Post-hoc tests of row proportions adjusting for alpha using Bonferroni's method (IBM SPSS Advanced Statistics Manual, 2011) showed significant differences for a number of subcategories of the predictor variables according to obesity status. For example, post hoc tests showed the proportion of married individuals (34%) who were overweight was greater than the proportion of unmarried individuals (26%) who were overweight. However, the proportion of married individuals who were obese could not be differentiated from unmarried individuals who were obese. For years living in the U.S., the proportion of individuals who had lived for more than 31 years in the U.S. (93%) who were classified in the high risk WC category was greater than those who had lived for 15 years or less (87%). Results are displayed in Table 1.2

Table 1.2 (2)

Distribution of BMI and WC across Sociodemographic Factors, Acculturation Variables, and Physical Activity (n=974)

	BMI				WC		
	Normal	Overweight	Obese		Optimal	High Risk	
Characteristics	Frequency (%)	Frequency (%)	Frequency (%)	*p*	Frequency (%)	Frequency (%)	*p*
Age				.055			**<.001**
Less than 35	38 (22.8)	52 (31.1)	77 (46.1)		31 (18.6)[a]	136 (81.4)[a]	
35-44	40 (14.8)	84 (31.1)	146 (54.1)		35 (13.0)[a,b]	235 (87.0)[a,b]	
45-54	24 (11.0)	75 (34.2)	120 (54.8)		12 (5.5)[b]	207 (94.5)[b]	
55-64	20 (10.5)	64 (33.7)	106 (55.8)		14 (7.4)[b]	176 (92.6)[b]	
65 and older	17 (13.3)	38 (29.7)	73 (57.0)		8 (6.2)[b]	120 (93.8)[b]	
Gender				.407			**<.001**
Male	21 (11.2)	61 (32.6)	105 (56.1)		37 (19.8)[a]	150 (80.2)[a]	
Female	118 (15.0)	252 (32.0)	417 (53.0)		63 (8.0)[b]	724 (92.0)[b]	
Marital status				**.001**			.154
Married/Living Together	85 (12.0)[b]	244 (34.3)[b]	382 (53.7)[a]		67 (9.4)	644 (90.6)	
Not married †	54 (20.5)[a]	69 (26.2)[a]	140 (53.2)[a]		33 (12.5)	230 (87.5)	
Number of children				**<.001**			**.009**
No children	6 (17.1)[a,b]	3 (8.6)[a]	26 (74.3)[a,b]		4 (11.4)[a,b]	31 (88.6)[a,b]	
1-2	53 (18.2)[b]	103 (35.3)[b]	136 (46.6)[c]		44 (15.1)[b]	248 (84.9)[b]	
3-4	65 (13.7)[a,b]	164 (34.5)[b]	247 (51.9)[b,c]		41 (8.6)[a]	435 (91.4)[a]	
5 or more	15 (8.8)[a]	43 (25.1)[a,b]	113 (66.1)[a]		11 (6.4)[a]	160 (93.6)[a]	
Household income (annual)				**.035**			.197
≤ $10,000	89 (17.5)[a]	171 (33.6)[a]	249 (51.7)[a]		61 (12.0)	448 (88.0)	
$10,001-$20,000	31 (10.3)[b]	92 (30.6)[a]	178 (59.1)[b]		27 (9.0)	274 (91.0)	
$20,001-$30,000	10 (10.6)[a,b]	27 (28.7)[a]	57 (60.6)[a,b]		5 (5.3)	89 (94.7)	
≥ $30,001	9 (12.9)[a,b]	23 (32.9)[a]	38 (54.3)[a,b]		7 (10.0)	63 (90.0)	
Education				**.031**			.495
≤ 8 years	54 (13.5)[a]	119 (29.8)[a]	227 (56.8)[a]		36 (9.0)	364 (91.0)	
9-12 years	65 (17.1)[a]	134 (35.3)[a]	181 (47.6)[b]		44 (11.6)	336 (88.4)	
≥13 years	20 (10.3)[a]	60 (30.9)[a]	114 (58.8)[a]		20 (10.3)	174 (89.7)	
Employment status				**.049**			.085
Employed	56 (12.0)[a]	143 (30.7)[a]	267 (57.3)[b]		56 (12.0)	410 (88.0)	

Table 1.2 (Cont)

	BMI				WC		
	Normal[†]	Overweight	Obese		Optimal	High Risk	
Characteristics	Frequency (%)	Frequency (%)	Frequency (%)	*p*	Frequency (%)	Frequency (%)	*p*
Unemployed	83 (16.3)[a]	170 (33.5)[a]	255 (50.2)[a]		44 (8.7)	464 (91.3)	
Country of birth				**.003**			.446
Mexico	110 (14.8)[a]	256 (34.5)[a]	375 (50.6)[a]		73 (9.9)	668 (90.1)	
United States	29 (12.4)[a]	57 (24.5)[b]	147 (63.1)[b]		27 (11.6)	206 (88.4)	
Years of Residence in US				**.016**			**.036**
≤ 15	50 (17.2)[a]	105 (36.1)[a]	136 (46.7)[a]		39 (13.4)[a]	252 (86.6)[a]	
16-30	44 (15.0)[a]	96 (32.8)[a]	153 (52.2)[a,b]		32 (10.9)[a,b]	261 (89.1)[a,b]	
≥ 31	45 (11.5)[a]	112 (28.7)[a]	233 (59.7)[b]		29 (7.4)[b]	361 (92.6)[b]	
Physical Activity				.683			.868
Yes	32 (15.4)	70 (33.7)	106 (51.0)		22 (10.6)	186 (89.4)	
No	107 (14.0)	243 (31.7)	416 (54.3)		78 (10.2)	688 (89.8)	

Significance levels based on Chi-squared tests.
[†]Individuals classified as underweight were included in the normal BMI category.
[†] Not married individuals include those that identified themselves as single, divorced, widowed, and separated; those in the married category include those that identified themselves as married or living together.
[a,b,c] Each superscript letter denotes a subset of the subcategories within each characteristic whose row proportions do not differ significantly from each other using Bonferroni's procedure, $p < .05$.

To further explore the relationship between age and BMI, which resulted in a marginal significant p-value of 0.055, correspondence analysis (CA) was performed. CA is a multivariate descriptive technique, similar to principal components, which can be used to summarize a contingency table data in a two dimensional graphical form by decomposing the *Chi-square* statistic associated with the contingency table into orthogonal factors. The graphical display for using CA for age by BMI showed that normal weight was significantly different from both overweight and obese when taking age into consideration (see *Figure 1.1*).

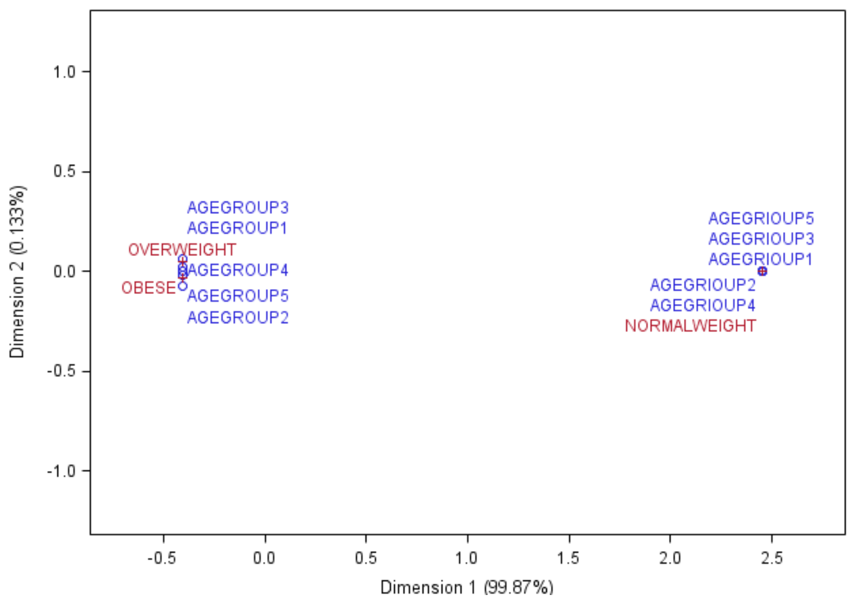

Figure 1.1 Correspondence Analysis of Age by BMI

Demographic predictors of body mass index and waist circumference

Table 1.3 shows the values and significance of the Pearson (r) and point-biserial (r_{pb}) correlation coefficients. Significant correlations for BMI were observed with age, number of children, annual household income, years of residence in the U.S., and born in the U.S. The strongest correlations were years living in the U.S., $r = .17$, $p < .01$, and born in the U.S., $r_{pb} =.14$, $p < 0.01$. Higher BMIs were associated with being older, having more children, higher annual household income, living in the U.S. longer, and being born in the U.S. For WC, significant correlations were observed for age, number of children, gender, number of children, annual household income, years living in the U.S., and born in the U.S. The strongest correlation was for years in the U.S., $r =.20$, $p < 0.01$. Higher WC was associated with being older, being male, having more children, higher household income, being in the U.S. longer, and being born in the U.S.

Table 1.3 (3)

Correlation between BMI and WC with Sociodemographic Characteristics, Acculturation, and Physical Activity (n=974)

Characteristics	BMI	Waist circumference
Age	$.08^{*}$	$.14^{**}$
Gender	.01	$-.16^{**}$
Marital status	.00	.02
Number of children	$.07^{*}$	$.08^{*}$
Education	.02	.00
Annual household income	$.08^{*}$	$.08^{**}$
Employment status	.05	.05
Years in the U.S.	$.17^{**}$	$.20^{**}$
Country of birth	$.14^{**}$	$.16^{**}$
Moderate physical activity	-.05	-.03

$^{*}p<.05$, $^{**}p< .01$

As aforementioned, hierarchical regression analysis was done to explore the association between BMI and ten predictor variables. Predictors were entered in 4 blocks (Block 1: age, gender, marital status, number of children; Block 2: years of education, annual household income, employment status; Block 3: years living in the U.S.; and Block 4; physical activity.

In general the regression equation to predict the average of the outcome Y given a set of 10 predictors will take the form:

$$\hat{Y}_i = b_0 + b_1X_{1i} + b_2X_{2i} + b_3X_{3i} + b_4X_{4i} + b_5X_{5i} + b_6X_{6i} + b_7X_{7i} + b_8X_{8i} + b_9X_{9i} + b_{10}X_{10i}$$

where $\hat{Y}_i$ is the variable being predicted (i.e. BMI or WC), b_0 is the intercept (when value of X=0), the remaining b values are the estimated coefficients for each of the predictor variables, and X is the value for each independent variable.

The hierarchical multiple regression with BMI as the outcome variable revealed Block 1, which contained the demographic characteristics, did not contribute to the regression model. Introducing the SES variables in Block 2 explained 1% of variation in BMI and this change in R^2 was statistically significant, $F = 3.10$, $p = .026$. Adding acculturation variables explained an additional 2.3% of the variation in BMI and this change in R^2 was significant, $F = 11.70$, $p < .001$. Finally, the addition of physical activity to the regression model explained an additional 0.3% of the variation in BMI and the change in R^2 approached significance, $F = 3.37$, $p = .067$. The most important predictor of BMI was acculturation variables which uniquely explained 2% of the variation in BMI. Together the demographic, SES, acculturation, and physical activity variables accounted for 4% of the variation in BMI.

Alternatively, the hierarchical multiple regression with WC as the outcome variable revealed demographic factors entered in Block 1 contributed significantly to the regression model, $F = 11.46$, $p < .001$ and accounted for 4.5% of the variance observed in WC. Introducing the SES variables in Block 2 did not explain any of the variance observed in WC. Adding acculturation variables explained an additional 2.3% of the variation in WC and this change in R^2 was significant, $F = 12.21$, $p < .001$. Finally, the addition of physical activity to the regression model explained an additional 0.1% of the variation in WC and the change in R^2 approached significance, $F = 3.23$, $p = .073$. The most important predictor of WC was Block 1, the demographic factors, which uniquely explained 5% of the variation in WC. Together the demographic, SES, acculturation, and physical activity variables accounted for 7% of the variation in WC. The results for both regressions are displayed in Table 1.4.

Table 1.4 (4)

Hierarchical Regression Analysis for Sociodemographic Characteristics, Acculturation, and Physical Activity Behavior Predicting BMI and WC (n= 974)

	BMI				WC			
Predictor	*B*	*SE*	*β*	ΔR^2	*B*	*SE*	*β*	ΔR^2
Block 1: Demographic factors				.008				**.045*****
Age	-.020	.024	-.044		.054	.056	.051	
Gender	.301	.531	.019		-5.541	1.214	**-.149*****	
Marital status	.508	.471	.036		1.710	1.079	.052	
Number of children	.272	.121	**.078***		.441	.277	.054	
Block 2: Socioeconomic factors				**.009***				.005
Education (yrs.)	-.010	.054	-.007		-.070	.124	-.020	
Household income	.000	.000	.012		.000	.000	.014	
Employment status	.665	.424	.053		.129	.969	.004	
Block 3: Acculturation Variables				**.023*****				**.023*****
Years in the US	.057	.023	**.167***		.083	.053	.104	
Country of birth	.741	.758	.050		3.479	1.733	**.102***	
Block 4: Lifestyle Factor				.003^{+}				.003^{+}
Moderate physical activity (150min/wk)	-.896	.488	-.058		-2.006	1.117	-.056	

$^{+}p < .10$, $^{*}p < .05$, $^{***}p < .001$
Overall model for BMI: $R^2 = .05$, $R^2_{adj} = .04$; $F_{(10,963)} = 4.49$, $p < .001$
Overall model for WC: $R^2 = .08$, $R^2_{adj} = .07$; $F_{(10,963)} = 7.96$, $p < .001$

DISCUSSION

Prevalence of overweight, obesity, and abdominal obesity

The percentage of overweight and obese individuals (86%) observed in this study was higher than that reported for Mexican Americans in the 2009-2010 NHANES (Flegal et al., 2012), and the 2009 statewide BRFSS for Texas (TDSHS, 2009), which are based on self-reported height and weight measurements and tend to underestimate prevalence compared to direct measures of obesity (Gorber, Tremblay, Moher, & Gorber, 2007; Nawaz, Chan, Abdulrahman, Larson, & Katz, 2001). Rates observed were also higher compared to studies previously conducted in the Valley region (Bastida & Soydemir, 2009; Fisher-Hoch et al., 2010; Mier et al., 2008). This is of particular concern given the plausibility of certain Mexican American population subgroups, such as food bank recipients, experiencing alarmingly higher rates than those observed in Mexican Americans in other geographic regions. Prevalence of abdominal obesity was also higher when compared to national data (Beydoun & Wang, 2009; Ford et al., 2011). The greater prevalence of obesity and abdominal obesity in this population subgroup may suggest a geographic difference and living context which is unlike those sampled in national studies and even from within the Valley region. The current sample consisted of about 90% food bank recipients and, hence, of low-income Mexican Americans adults who may have different lifestyles and may be exposed to a variety of environmental factors that contribute to higher rates of obesity.

For WC, a greater proportion of middle-aged and older-aged adults (45 to 54 years of age and above) were classified in the high WC category than those in the lower age category (i.e., less than 35) supporting research stating prevalence of obesity is highest in middle-aged individuals as compared to their younger counterparts (Torres Azen, Varma, & LALES group, 2006); suggesting health promotion programs in the Valley region should target this age group. Aligned with other study findings which have reported higher obesity rates in Mexican American women than men (Bowie et al., 2007; Flegal et al., 2012; Salinas et al., 2011; Torres et al., 2006); a greater proportion of women were classified in the high risk WC category. However, results reported here also support the long-term finding that men have the largest adipose tissue thickness in the abdominal region (Krotkiewski, Björntorp, Sjöström, & Smith, 1983). Thus, findings suggest the importance of public health intervention programs to successfully recruit and retain men in obesity prevention and management programs. The present study also supported previous findings of married individuals being more overweight than their unmarried counterparts (Bowie et al., 2007). Likewise, it corroborates previous studies showing individuals with more children tend to be obese (Bowie et al., 2007; Palmer, Rosenberg, & Shapiro, 1992), which is of concern here given the higher than average number of children in this population subgroup (see Table 1.1).

The proportion of individuals considered obese was high among those who lived in the U.S. longer and those who were born in the U.S., which lends further support to other studies conducted in Hispanics, including Mexican Americans (Barcenas et al., 2007; Goel et al., 2004; Kaplan et al., 2004; Khan, Sobal, & Martorell., 1997; Sundquist & Winkleby, 2000). Although no significant differences were observed in the proportion of individuals who were born in the U.S. or Mexico and whether they had a high or low risk WC, correlations and regression results showed that being a U.S.-born Mexican American was associated with abdominal obesity. This supports previous research that finds U.S.-born Mexican Americans tend to have significantly higher WC than their Mexican-born counterparts (Sundquist & Winkleby, 2000),

Predictors of BMI

The first hypothesis that acculturation factors would account for a significant amount of variance in BMI over and beyond that accounted for by demographic and socioeconomic status factors was supported. Trends in obesity among immigrants may reflect acculturation and adoption of a Western lifestyle, such as increased sedentary behavior and poor dietary patterns (Goel et al., 2004). As reported here, longer residence in the U.S. was a significant predictor for higher BMI, which is supported by other research studies (Barcenas et al., 2007; Bowie et al., 2007; Kaplan et al., 2004; Sundquist & Winkleby, 2000). However, others have reported less acculturated Mexican Americans tend to be more obese than their more acculturated counterparts (Ayala et al., 2004; Khan et al., 1997; Hazuda et al., 1988), while others report no association (Torres et al., 2006). These conflicting results are indicative of the mixed findings on the association between acculturation and obesity in Mexican Americans reported in the literature. The latter findings might reflect variations in how acculturation is measured making it difficult to make direct comparisons among study results. However, results from this analysis point to the relevance of acculturation when examining predictors of BMI in this population subgroup.

The second hypothesis that participation in at least 150 minutes of physical activity per week would account for a significant amount of variance in BMI over and beyond that accounted for by demographic, SES, and acculturation factors was not supported, although, it approached significance. A relationship between physical activity and BMI has been observed in previous studies showing strong inverse associations between BMI and moderate physical activity in Mexican Americans (Ayala et al., 2004; Hubert, Snider, & Winkleby, 2005; Rutt & Coleman, 2005). However, similarly to mixed findings on acculturation for BMI, research findings on physical activity and BMI also show conflicting results with some studies reporting no association between physical activity and risk of obesity in Hispanic immigrants (Kaplan, Huguet, Newsom, &

McFarland, 2004). The weak association observed between physical activity and BMI may be due to limitations inherent in self-reported measures of physical activity as well as the conservative approach used in calculating the number of minutes an individual engaged in physical activity. Taking the more conservative approach implied that in some instances the time reduction may have been as high as a third of the time alluded to by the respondent. This could prove to be an important limitation since it has been reported that small differences in physical activity (5 - 10 minutes) are associated with relatively large differences in risk of obesity (Maher, Mire, Harrington, Staiano, & Katzmarzyk, 2013). More studies are needed to better understand the relationship between physical activity and BMI among Mexican Americans.

Other notable findings include the positive association between number of children and obesity. Few studies have included number of children as a predictor of obesity in Mexican Americans (Bowie et al., 2007). Thus findings reported here underscore the importance of family size and add to the limited literature.

Despite the narrow range in socioeconomic status, SES factors contributed significantly to the BMI regression model in the present analysis which aligns with past studies which have shown a positive association between obesity in the Mexican American population (Bowie et al., 2007). However, other studies have illustrated increased SES is accompanied by statistically significant, linear declines in obesity (Haffner, Stern, Mitchell, & Hazuda, 1991; Hazuda, Mitchell, Haffner, & Stern, 1991; Stern, Rosenthal, Haffner, Hazuda, & Franco, 1984). One potential explanation for not finding a stronger contribution by SES might be the relatively homogenous population and shared residential space; yet some studies find significant differences in spite of the narrow range in SES characteristics in the study sample (Fisher-Hoch et al., 2010). Finally, it is noted that individual components of SES were not significant predictors of BMI in the regression analyses; however, as a block, SES contributed to the prediction of BMI above and beyond demographic factors although the contribution was very small. As stated earlier, SES gradients may be diminished in minority ethnic groups (Karlamangla et al., 2005).

Predictors of WC

The third hypothesis that acculturation factors would account for a significant amount of variance in WC over and beyond that accounted for by demographic and socioeconomic status factors was supported. This is reaffirmed in other studies in Mexican Americans (Sundquist & Winkleby, 2000; Hazuda et al., 1991). Though it has been suggested that genetic susceptibility may play a role in some ethnic groups, the current association observed between country of birth and WC is more likely due largely to environmental influences, either directly or indirectly via an interaction with genetic influences (Sundquist & Winkleby, 2000).

Within the demographic factors, only gender (being male) was a significant predictor. The finding that being male is a predictor or risk factor of high WC is supported by studies in other population groups (Després & Lemieux, 2006; Stewart-Knox et al., 2012). This is of concern given the increasing trends observed in WC among men (Ford et al., 2011), and low engagement of men in health promotion programs (Salinas et al., 2011).

As observed for BMI, engagement in physical activity did not account for a significant amount of the variance observed in WC, although it approached significance.

Previous reports of a significant negative association between physical activity levels and abdominal obesity, including studies among Mexican Americans have been reported (Ayala et al., 2004; Ford, Li, & Zhao, 2010; Stamatakis, Hirani, & Rennie, 2009; Stewart-Knox et al., 2012). As aforementioned, calculation of the physical activity variable may have impacted the results observed. Given the high percentage of participants not engaging in recommended levels of physical activity (see Table 1.1.) and given previous research findings it would be important to better understand the role of physical activity in obesity risk in this population subgroup.

Limitations

The present analysis has some important limitations. For purposes of the current analysis only baseline data were used. Hence, this cross-sectional analysis does not allow for causal inferences to be made. Low representation of men in the study sample limited gender comparisons. While diet-related behavior was collected in the parent study, it was not included in the current analyses. Thus it is difficult to assess its possible contribution in explaining findings presented here. Another limitation of the study is that, though widely used in minority health studies, it employed a unidimensional proxy measure for acculturation. While simple and convenient, these unidimensional measures fail to account for numerous individual differences and other factors affecting the rate of adaptation to the new culture, such as premigration exposure to the mainstream culture, willingness to seek language education, and frequency of contact with individuals from the mainstream culture (Ryder, Alden, & Paulhus, 2000). As acculturation encompasses a wide range of attributes that influence people's identity, multidimensional acculturation models would be ideal for capturing the effect of immigration factors on health (Lee, Nguyen, & Tsui, 2011). Lastly, the physical activity measure was based on self-report. This might have introduced some measurement bias. As noted in the literature, longitudinal studies are needed to tease out the direction of association between physical activity and measures of obesity; it is expected upon the termination of the parent study, findings of the longitudinal study will help contribute to this gap in research.

The intervention research literature and especially programs that address overweight and obesity tend to have a self-selectivity bias in that those who need it the most are likely to be motivated to attend. There are two sources of bias in the present analyses. The first is noted above, that is motivational bias that responds to the greater interest that the overweight and obese in participating in such programs might exhibit. The second, as may be expected, is directly related to the target of the intervention, mostly food bank recipients, since the Food Bank was the major partner in the community-based participatory research approach that framed the parent study. Thus, a narrow range of variability is to be expected in SES related variables that contribute to the homogeneity of the sample as aforementioned. However, data from two representative samples from the Valley and border region provide an important comparative perspective. With respect to the first bias, the motivational factor that tends to attract those who most need it to the intervention, we note that data from the Border Epidemiologic Study of Aging (BESA), a stratified by age and ethnicity (Hispanic) sample of Valley residents, reported that 46.4% of this population fell in the obese category (Bastida & Soydemir, 2009); while a Pan American Health Organization (PAHO) study (2007) of the entire U.S. border area reported that 33.6% of their participants were obese. In the PAHO study, 36.8% were overweight while in the BESA

35.4% were in this weight category. Similarly, the BESA study reports an annual income of $15,000 and under for 59% of their respondents for the year 2006; and 54% of this population indicated 7 years of education or less. Thus, despite the two sampling bias described, when comparing the Beyond Sabor sample to these two representative samples of the region, the Beyond Sabor population is strikingly similar to that obtained in representative samples.

Among the study strengths, anthropometric measures of obesity and abdominal obesity were based on direct measures and not on self-reported measurements. This reduces the potential for bias associated with under-reporting, which could lead to an underestimation of obesity prevalence (Nawaz et al., 2001). Furthermore, few studies have been able to include such a large array of potential predictors of BMI and WC, including clinical indicators, demographic factors, SES, acculturation, and physical activity all at once in this population subgroup of food bank recipients, which is largely understudied subgroup.

Though some studies in Mexican Americans have found no association between dietary patterns and obesity (Carrera, Gao, & Tucker, 2007); still future analyses of the parent study, Beyond Sabor, should include data from the comprehensive dietary assessment collected to assess the role of diet in predicting BMI and WC in this population subgroup. Greater effort is needed to include a higher representation of men to allow for more detailed comparisons by gender. For example, some suggest that increased susceptibility to higher BMI with U.S. length of residence among women compared to men may be due to gendered patterned roles (Sanchez-Vaznaugh, Kawachi, Subramanian, Sánchez, & Acevedo-Garcia, 2008).

The present analysis highlights differences in the prevalence of obesity for Mexican Americans living in the Valley region compared to national data, thus highlighting the need to examine further the heterogeneity of this population, particularly regional variations. Findings presented here can inform future public health promotion programs for this minority subpopulation group, of which the majority are part of the food bank network in the Valley region. The findings reported contribute to the identification of 'high risk' individuals within the population subgroup for whom health promotion and intervention programs should be targeted. Specifically, adults of middle and older age, both men and women, married, and with children should be targeted for health promotion programs aimed at reducing, managing, or preventing obesity. The fact that acculturation was a significant predictor in both models suggests programs for this population group may try to emphasize lifestyle practices which may have been part of Mexican culture traditions that may have changed once individuals became more acculturated to Western culture (e.g. daily intake of fruits and vegetables). If public health programs are to be effective in preventing and/or reducing obesity and abdominal obesity, they need to be tailored, to the extent possible, to the particular characteristics of the target population.

In conclusion, despite limitations in generalizability to Mexican Americans residing in other states and regions resulting from the data used in this analysis, it is suggested that findings presented here have implications for Mexican Americans everywhere. In particular, it is anticipated that Mexican Americans residing beyond the border area are as likely to exhibit a high prevalence of obesity and central obesity as those reported here for the Valley Mexican American population, especially those with similar socioeconomic characteristics. To this extent, it is important that public health professionals and the health care system are prepared to address the impact of high obesity and central obesity on the health and quality of life of Mexican Americans nationwide, particularly as this population grows older.

Note: A number of assumptions were made such as: if the survey participant was born in the U.S. then their age equaled years of residence in the U.S.; if the survey participant was born in Mexico, but all children were born in the U.S., then years of residence in the U.S. was the age of the oldest child plus one year (assumes they arrived in the U.S. one year before first child was born); if the survey participant was born in Mexico, educated in Mexico, with children born in both U.S. and Mexico, then years of residence in the U.S. was the age of the first child born in the U.S. plus one year; and if the survey participant was born in Mexico, but educated in U.S., then years of residence in the U.S was the age of respondent minus 6 years (assumes they came to the U.S. when they entered school).

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CHAPTER V

MANUSCRIPT 2

ASSOCIATION OF BODY MASS INDEX AND WAIST CIRCUMFERENCE WITH CARDIOVASCULAR DISEASE RISK FACTORS IN MEXICAN AMERICAN ADULTS LIVING IN THE TEXAS-MEXICO BORDER

ABSTRACT

Objectives: Diabetes, hypertension, and dyslipidemia are common chronic diseases among Hispanics, a group projected to comprise 30% of the U.S. population by 2050. Mexican Americans account for more than two-thirds of the Hispanic population. The present analysis aimed to describe the mean levels and prevalence of cardiovascular disease (CVD) risk factors and to assess the association of measures of obesity with clinical indicators of type 2 diabetes, hypertension, and dyslipidemia.

Methods: Data used for this cross-sectional analysis were baseline measurements collected from individuals at the recruitment phase of a larger intervention study, Beyond Sabor, conducted in the Valley region of the Texas-Mexico border, from 2009-2012. A total of 974 Mexican Americans were included in the analysis. Correlations and hierarchical multiple regression analysis was used to assess associations between measures of obesity and CVD risk factors controlling for demographic, socioeconomic, acculturation, medication use, and physical activity.

Results: More than 27% of individuals were diabetic in the sample. More than half (56%) of individuals were pre-diabetic and 41% were pre-hypertensive. Both body mass index (BMI) and waist circumference (WC), which were highly prevalent in the population, accounted for a significant amount of the variance observed in both measures of blood pressure, fasting glucose, and measures of dyslipidemia; with the exception of total cholesterol.

Discussion: Given the association observed in the present analysis of obesity measures with CVD risk factors and given the high prevalence of obesity in this population, it is important that public health professionals and the health care system are prepared to address the impact of obesity on the health and quality of life of Mexican Americans who experience food insecurity and are of low socioeconomic status, particularly as this population grows older.

Key Words: Mexican Americans, cardiovascular disease, body mass index, waist circumference

MANUSCRIPT 2

ASSOCIATION OF BODY MASS INDEX AND WAIST CIRCUMFERENCE WITH CARDIOVASCULAR DISEASE RISK FACTORS IN MEXICAN AMERICAN ADULTS LIVING IN THE TEXAS-MEXICO BORDER

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death in the United States (U.S.) and a public health concern (Mensah & Brown, 2007). Among Mexican-American adults aged 20 and older, 30.7% of men and 30.9% of women have CVD (Roger et al., 2012). Differences in the incidence and prevalence of modifiable CVD risk factors such as obesity, type 2 diabetes, hypertension, and dyslipidemia vary considerably by race/ethnicity (Kurian & Cardarelli, 2007). Assessing CVD risk factor prevalence in different race/ethnic groups is needed to better understand and explore opportunities to narrow health-related racial and ethnic disparities (Hertz, Unger, & Ferrario, 2006).

Hispanics are expected to constitute 30 percent of the U.S. population by 2050; Mexican Americans account for more than two-thirds of the Hispanic population (Ennis, Ríos-Vargas, & Albert, 2011). It has been noted the health of Hispanics living in the Texas-Mexico border may differ from other Hispanic populations living in the U.S., including those living in other parts of Texas (Anders et al., 2010). The Lower Rio Grande Valley (the Valley region) in the Texas-Mexico border with the highest Mexican American concentration in the U.S. (Texas Lower Rio Grande Valley Fact Sheet, 2009) is one of the most economically disadvantaged regions in the nation. And as may be expected it ranks high in health disparities (Mier et al., 2008).

In general, Hispanics in the U.S. have higher prevalence of CVD risk factors than do non-Hispanic whites, because of high prevalence of obesity and type 2 diabetes (Flegal, Carroll, Ogden, & Curtin, 2012; Wallace & Castañeda, 2010). An alarmingly high rate of obesity among Mexican Americans in the Valley region has been reported (Bastida & Soydemir, 2009; Fisher-Hoch et al., 2010; Mier et al., 2008). Estimated prevalence of diabetes in the Texas-Mexico border was 14.7%, considerably higher than the national prevalence among Mexican Americans (13.3%) and non-Hispanic whites (7.1%) (Centers for Disease Control and Prevention (CDC), 2012; Díaz-Apodaca, Ebrahim, McCormack, & de Cosio, 2010). While the overall age-adjusted national prevalence of hypertension is higher among Blacks (42%) compared to non-Hispanic whites and Mexican Americans (28.8% and 25.5%, respectively) (Keenan & Rosendorf, 2011), rates in the U.S.-Mexico border region have been reported to be as high as 47.6% (Vijayaraghavan, He, Stoddard, & Schillinger, 2010). Elevated low-density lipoprotein (LDL) cholesterol affects about 33.5% of the U.S. population overall but only about 20.3% of Mexican Americans (Kuklina, Shaw, & Hong, 2011), although rates were found to be higher in Mexican Americans in the Valley region (22.6% of women and 26.1% of men) (Fisher-Hoch et al., 2012). Hence, it is no surprise CVD is the leading cause of death in Mexican Americans (Davidson et al., 2007; Miniño & Murphy, 2012); despite some arguing Mexican Americans paradoxically have lower CVD-related morbidity and mortality than their non-Hispanic White counterparts (Borrell & Lancet, 2012).

Information on the relationships between measures of obesity and abdominal obesity with a cluster of metabolic disorders including type 2diabetes, hypertension, and dyslipidemia has largely been obtained from studies involving Caucasian or populations of European descent (Denke, Sempos, & Grundy, 1994; Huxley, Mendis, Zheleznyakov, Reddy, & Chan, 2010; Seidell et al., 1991). Of these, only a few studies have included minority group representation; and fewer still have been done on minority population subgroups (Brown et al., 2000; Cannon, 2007; Dalton et al., 2003; Fisher-Hoch et al., 2010; Han et al., 2002). Gregg and colleagues (2005) argue that despite studies supporting obesity and its association with increased risk for a number of health outcomes, the health implications remain unclear. For instance, increases in obesity have been accompanied by increases in type 2 diabetes; however, the association between obesity and other CVD risk factors remains more elusive (Gregg, Cheng, Narayan, Thompson, & Williamson, 2007).

Studies of CVD risk factors have highlighted geographic differences in prevalence of risk factors and suggest the living context of individuals may be different from those sampled in national studies; hence, the importance of studying subgroups within racial/ethnic groups (Pickle & Gillum, 1999). Davidson et al. (2007) highlighted the need for additional research to fully determine the best predictors of CVD risk factors in Latino/Hispanic individuals. By better understanding the predictors of CVD in specific ethnic subgroups, public health professionals will be able to develop prevention programs and services specifically targeted towards the risk burdens in each of these population subgroups (Kurian & Cardarelli, 2007). The paucity of research in the Mexican American population, in particular those in the Valley region, as well as the inconsistencies in study findings call for research to focus on the public health effect of increased BMI and WC in this population subgroup.

The primary aims of this analysis were to: 1) describe the mean levels and prevalence of CVD risk factors in a sample of Mexican American adults living in the Texas-Mexico border region, and 2) assess the association of BMI and WC with clinical indicators of type 2 diabetes, hypertension, and dyslipidemia controlling for demographic factors (age, gender, marital status, and number of children), socioeconomic status (education, annual household income, and employment status), acculturation (years of residence in the U.S. and country of birth), medication use, and a lifestyle factor (engagement in physical activity at least 150 minutes per day). Based on several studies demonstrating associations between obesity and high blood pressure, high blood cholesterol, and type 2 diabetes (Brown et al., 2000; Sánchez-Castillo et al., 2005), it was hypothesized BMI and WC would significantly contribute to the proportion of variance explained for each of the CVD risk factors over and beyond the variance accounted for by socio-demographic factors, acculturation, medication use, and physical activity behavior.

METHODS

Study Design and Population

Data used for this cross-sectional analysis were baseline measurements collected from individuals participating in a larger intervention study, Beyond Sabor (Spanish word for "flavor"), conducted in the Valley region of the Texas-Mexico border, from 2009-2012. The parent study aimed to prevent, reduce or manage obesity by improving dietary behaviors and engagement in physical activity in a population of urban and rural adult Mexican Americans. Individuals were recruited from a sampling frame of 156 sites at 32 sites, mainly from the local food bank network. For statistical purposes, the sample was treated as a non-probability sample. A total of 1,273 individuals were recruited at baseline in the parent study. However, because of the ongoing nature of the parent study, only cases for which there were complete data at the time of the current analysis were used.

Inclusion criteria for the present investigation included men and women, 20 years and older (range: 20-89), residing in a family context, e.g. married, living with a partner, or raising children (single parent, grandparent or guardian, or other family arrangement), and Mexican American in origin. Exclusion criteria included those who were born outside of the U.S. or Mexico, and two cases with extreme values for total cholesterol and BMI.

Measures

Independent variables

In the parent study, body weight (in kilograms [kg]) was measured on a calibrated balanced scale and height (meters [m]) was measured using a stadiometer. BMI was calculated as weight in kg/height in m^2 (kg/m^2), according to the National Institutes of Health (1998). BMI category was defined as: underweight/normal (BMI < 25 kg/m^2), overweight (BMI 25.0 -29.9 kg/m^2), and obese (BMI ≥ 30 kg/m^2) (National Institutes of Health, 1998). WC in centimeters (cm) was measured using a Gulick tension tape. A nurse professional faced the participant and placed the measuring tape around his or her horizontal plane at the level of the natural waist or the narrowest part of the torso. Measurement was taken at the end of the normal expiration. High WC was defined as ≥ 94 cm for men and ≥ 80 cm for women and optimal WC as < 94 cm for men and < 80 cm for women, based on the definition provided by the International Diabetes Federation (Alberti, Zimmet, & Shaw, 2005).

Dependent variables

Blood pressure measurements were taken in the right arm with the person seated following 10 minutes of quiet rest. The first measurement was disregarded and the average of three measurements taken 10 minutes apart was recorded. Blood pressure was measured with a standard mercury sphygmomanometer using the first and fifth Korotkoff sounds, recorded to the nearest even digit. Blood pressure was categorized as normal if the systolic blood pressure (SBP) was < 120 millimeters of mercury (mmHg) and the diastolic blood pressure (DBP) was < 80, pre-hypertension if SBP was 120-139 mmHg or DBP was 80-89, and hypertension if SBP ≥ 140 mmHg or DBP was ≥ 90 mmHg. This definition is based on the National Heart, Lung, Blood Institute (NHLBI) guidelines (2003) for hypertension.

A blood sample was collected for plasma glucose, LDL cholesterol, triglycerides, and HDL cholesterol. All blood samples were sent to the Valley Baptist Regional Medical Center Laboratory for analysis. Blood glucose levels were measured using the overnight fasting plasma glucose test. An overnight fasting blood test or a lipid profile was used to measure cholesterol. Plasma glucose and cholesterol measures were determined enzymatically. Diabetes status was classified using the American Diabetes Association guidelines: normal (70 - 100 milligrams per deciliter [mg/dL]), pre-diabetes (100 to 125 mg/dL), and diabetes (≥ 126 mg/dL) (Genuth et al., 2003). Individuals were classified, based on the National Cholesterol Education Program Guidelines (2002) into the following: 1) total cholesterol was classified as normal (< 200 mg/dL), borderline/high risk (200 - 239 mg/dL), and very high risk (≥ 240 mg/dL); 2) LDL cholesterol was classified as normal (< 100 mg/dL), near optimal/above optimal (100-129 mg/dL), borderline high (130 - 159 mg/dL), and high/very high (≥ 160 mg/dL); 3) triglycerides was classified as normal (< 150 mg/dL), borderline (150 - 199 mg/dL), and high risk/very high risk (≥ 200 mg/dL); and 4) HDL cholesterol was classified as high/low risk (≥ 40 mg/dL in men and ≥ 50 mg/dL in women) and low/high risk (< 40 mg/dL in men and < 50 mg/dL in women).

Covariates

Demographic data in the parent study was collected using a standard socio-demographic questionnaire. Socio-demographic factors included age in years, gender, marital status (married/living together as married, single/divorced/widowed/separated as not married), number of children, years of education, household income, and employment status (employed and not employed).

Proxy measures for acculturation included years living in the U.S. and country of birth. Years of residence in the U.S. was computed using several questionnaire items including age of survey respondent, country of birth, country of birth of children, country of education, number of children, and age of children. Country of birth was defined as a dichotomous variable of born in the U.S. or not. Medication use was measured as a dichotomous variable (yes/no).

Physical activity was measured using a modified version of the Seven-day Physical Activity Recall (Sallis et al., 1985). The questionnaire asked survey participants whether they walked or not, how many times a week (once, twice, three times, four times, five to six times, and every day) and for how long (15-20 minutes, 20 to 30 minutes, 30 to 45 minutes, 45 to 60 minutes, and over one hour). Participants were also asked to identify a second type of activity they might prefer to engage in, how many times, and for how long utilizing the same metric as for the walking-related question. Answers to these two questions were then summed to calculate the total number of minutes individuals engaged in physical activity per week. If an individual checked off the 30-45 minute category, the more conservative number (i.e., 30 minutes) was used for the calculation. Physical activity was dichotomized (yes, no) and measured as meeting 150 minutes per week of moderate physical activity on most days of the week, per current national recommendations (U.S. Department of Health and Human Services, 2008).

Statistical analysis

The present analysis used hierarchical multiple regression to model the relationship between BMI and WC with CVD risk factors controlling for a set of covariates. Regression assumptions were tested by 1) examining sample size requirements which was met with more than 20 observations per independent variable, 2) assessing multicollinearity which was met as the independent variables were not highly correlated, and 3) normal probability plots (i.e. histograms, Q-Q plots) of residuals and scatter diagrams of residuals versus predicted residuals. No violations of normality, linearity, or homoscedasticity of residuals were detected except for the residuals of fasting glucose and triglycerides which were not normally distributed. Natural logarithm (ln) transformations were performed and produced normal distributions of the residuals.

All categorical variables were dummy coded to allow for correlations and regression analysis. Chi-square test and independent two sample t-tests were used to examine differences according to gender for all independent variables, including covariates and dependent variables. Associations between predictor variables and covariates with the dependent variables were examined first through Pearson (*r*) and point-biserial (r_{pb}) correlations and then hierarchical linear multiple regression analysis. Pearson correlations were run when both the independent and dependent variables were continuous and point-biserial correlations when the independent variable was a dichotomous variable and the dependent variable continuous. For the regression analysis, following a modified version of Murray's (2003) risk model, predictors were entered in blocks, as follows: (1) demographic factors: age, gender, marital status, number of children; (2) SES factors: years in education, household income, and employment status; (3) proxy measures of acculturation: years living in the U.S. and country of birth, (4) medication use; (5) lifestyle factor: physical activity; and (6) anthropometric measure: BMI or WC. All statistical testing was conducted at $p < .05$ significance level with *SPSS* Version 20 (IBM Corporation, Chicago).

RESULTS

Descriptive statistics

Males represented a smaller proportion of the sample (19%, $n = 187$) than females (81%, $n = 788$). The average age for adults in the sample was 48.11 ($SD = 13.90$). The majority of individuals were married (73%). Mean years of education was equivalent to junior high school ($M = 9.22$, $SD = 4.28$). A high percentage of individuals (79%) did not engage in the recommended 150 minutes of physical activity per week. Mean BMI was in the obese range ($M = 31.29$, $SD = 6.45$).

Table 2.1 (5)

Descriptive Statistics of Sample Characteristics (n=975)

	Total Sample (n=975)	Females (n=788)	Males (n=187)
Age (*M*±*SD*) **	48.11 ± 13.90	47.46 ± 13.66	50.88 ± 14.61
Marital status *n* (%)			
Married	711 (72.9)	565 (71.7)	146 (78.1)
Not married †	264 (27.1)	223 (28.3)	41 (21.9)
Number of children (*M*±*SD*)	3.27 ± 1.80	3.25 ± 1.78	3.36 ±1.89
Household income* (*M*±*SD*)	13,001.79 ± 12,317.51	12,547.88 ± 12,335.21	14,914.53 ± 12,088.79
Education (*M*±*SD*)	9.22 ± 4.28	9.11 ± 4.21	9.70 ± 4.57
Employment status n (%)***			
Employed	467 (47.9)	331 (42.0)	136 (72.7)
Not employed	508 (52.1)	457 (58.0)	51 (27.3)
Years in the U.S. (*M*±*SD*)	28.48 ± 18.31	28.20 ± 18.16	29.64 ± 18.94
Country of birth			
Mexico	741 (76.0)	607 (77.0)	134 (71.7)
U.S.	234 (24.0)	181 (23.0)	53 (28.3)
Moderate PA (%)***			
Yes	208 (21.3)	151 (19.2)	57 (30.5)
No	767 (78.7)	637 (80.8)	130 (69.5)
BMI (*M*±*SD*)	31.29 ± 6.45	31.32 ± 6.60	31.18 ± 5.80
WC (*M*±*SD*)***	99.75 ± 14.91	98.61 ±14.95	104.57 ±13.75

*$p<0.05$, **$p<0.01$ ***$p<0.001$ based on independent two sample t-tests and χ^2 tests.
†Individuals in the not married category includes those that identified themselves as single, divorced, widowed, and separated.
Note: PA= Physical Activity, BMI= Body Mass Index, WC= Waist Circumference

Descriptive statistics for CVD risk factors

Table 2.2 describes the mean levels of CVD risk factors in the sample. According to NHLBI guidelines (2003) for hypertension, mean SBP was in the pre-hypertension stage, $M = 127.05$ ($SD = 18.67$), though mean DBP was in the normal range (< 80 mmHg). Fasting glucose levels were high ($M = 125.88$, $SD = 47.78$) with mean levels at the threshold for diabetes (≥ 126 mg/dL) (Genuth et al., 2003). Clinical indicators of dyslipidemia were mostly in the normal to near optimal range. Medication use for each of the three conditions varied. Highest use of medication was reported for hypertension with 20% of individuals reporting being on medication to control their blood pressure.

Table 2.2 (6)

*Numerical CVD Risk Factors and Medication Use of Sample Population (n = 946-975)**

CVD Risk Factors and Medication Use	n	Total sample	Female	Male
SBP (mmHg)*** (*M*±*SD*)	954	127.05 ± 18.67	125.58 ± 18.29	133.09 ± 19.08
DBP (mmHg)*** (*M*±*SD*)	950	77.00 ± 11.89	76.06 ± 11.31	80.90 ± 13.37
Blood pressure***	950			
Normal, n (%)		303 (31.9)	267 (34.9)	36 (19.5)
Pre-hypertension, n (%)		392 (41.3)	310 (40.5)	82 (44.3)
Hypertension, n (%)		255 (26.8)	188 (24.6)	67 (36.2)
Blood Pressure Medication	975			
Yes, *n* (%)		192 (19.7)	153 (19.4)	39 (20.9)
No, *n* (%)		783 (80.3)	635 (80.6)	148 (79.1)
Fasting Glucose (mg/dL) (*M*±*SD*)	962	125.88 ± 47.78	125.49 ± 48.41	127.49 ± 45.15
Normal, *n* (%)		163 (16.9)	135 (17.3)	28 (15.0)
Pre-diabetes, *n* (%)		539 (55.9)	434 (55.8)	105 (56.5)
Diabetes, *n* (%)		262 (27.2)	209 (26.9)	53 (28.5)
Insulin Medication	975			
Yes, *n* (%)		79 (8.1)	61 (7.7)	18 (9.6)
No, *n* (%)		896 (91.9)	727 (92.3)	169 (90.4)
Total cholesterol (mg/dL) (*M*±*SD*)	966	186.48 ± 39.41	186.88 ± 40.42	184.82 ± 34.94
Normal, *n* (%)		641 (66.4)	514 (65.9)	127 (68.3)
Borderline/High risk, *n* (%)		236 (24.4)	190 (24.4)	46 (24.7)
Very high risk, *n* (%)		89 (9.2)	76 (9.7)	13 (7.0)
Triglycerides (mg/dL)*** (*M*±*SD*)	968	150.27 ± 92.20	143.50 ± 86.37	178.72 ± 109.26
Normal, *n* (%)		601 (62.1)	505 (64.6)	96 (51.6)
Borderline, *n* (%)		165 (17.0)	132 (16.9)	33 (17.7)
High risk/Very high risk, *n* (%)		202 (20.9)	145 (18.5)	57 (30.7)
LDL-c (mg/dL) (*M*±*SD*)	946	109.46 ± 32.97	109.61 ± 33.29	108.82 ± 31.62
Normal, *n* (%)		400 (42.3)	328 (42.7)	72 (40.4)
Near optimal/above optimal, *n* (%)		314 (33.2)	248 (32.3)	66 (37.1)
Borderline high, *n* (%)		167 (17.7)	138 (18.0)	29 (16.3)
High risk/Very high risk, *n* (%)		65 (6.9)	54 (7.0)	11 (6.2)
HDL-c (mg/dL)*** (*M*±*SD*)	965	47.13 ± 11.03	48.30 ± 10.86	42.25 ± 10.42
Low/High risk, *n* (%)		574 (59.4)	485 (62.1)	89 (47.8)
High/Low risk, *n* (%)		393 (40.6)	296 (37.9)	97 (52.2)
Cholesterol Medication	975			
Yes, *n* (%)		115 (11.8)	88 (11.2)	27 (14.4)
No, *n* (%)		860 (88.2)	700 (88.8)	160 (85.6)

*Varying n's due to missing values.
*** $p<0.001$ based on independent two sample t-tests and chi-square tests.
SD= standard deviation. Valid percentages shown.
Note: Percentages of individuals classified within clinical sub-categories does not include disease diagnosis based on medication use. Percentages are based on blood pressure measurements and blood results.

Correlates of CVD risk factors

The respective Pearson (r) and point-biserial correlations (r_{pb}) between covariates, predictor variables and CVD risk factors are provided in Table 2.3. Among the covariates, age and years in the U.S. were correlated with all CVD risk factors. BMI and

WC both had similar correlations with CVD risk factors in that they were correlated with all risk factors except total cholesterol and LDL-cholesterol. The strongest correlation for BMI was with DBP, $r = .30$, $p < .001$, while the strongest correlation for WC was with SBP, $r = .31$, $p < .001$.

Table 2.3 (7)

Correlations between Covariates, Predictor Variables and CVD Risk Factors (n = 946-968)

Independent variables	SBP (n=954)	DBP (n=950)	Log Fasting glucose (n=962)	Total cholesterol (n=966)	Log Triglycerides (n=968)	LDL-c (n=946)	HDL-c (n=965)
Age	.402***	.116***	.310***	.185***	.169***	.126***	.084**
Gender	-.160***	-.161***	-.027	.021	-.141***	.009	.217***
Marital status†	-.029	.039	-.055	-.010	-.027	.017	-.047
Number of children	.115***	-.004	.155***	.012	.050	.017	-.022
Education	-.129***	-.021	-.163***	.048	.002	.062	-.023
Annual household income	.026	.059	-.028	.085**	.022	.099**	-.016
Employment status†	.088**	.126***	-.025	.084**	.050	.106**	-.040
Years in US	.289***	.135***	.183***	.168***	.120***	.109**	.088**
Country of birth†	.066*	.078*	-.008	.045	.052	.015	-.011
Medication use†	.306***	.105**	.514***	.008	.128***	-.078*	.007
Moderate PA†	.038	.011	.030	.058	-.011	.046	.063
BMI	.285***	.295***	.161***	-.011	.186***	-.051	-.146***
WC	.312***	.280***	.183***	.018	.247***	-.026	-.176***

*p<0.05, **p<0.01 ***p<0.001

† Point-biserial correlations.

Note: Gender, marital status, employment status, country of birth, medication use, and moderate physical activity were recoded into dummy variables. Reference categories were as follows: gender (male), employment status (not employed), country of birth (not born in the U.S.), medication use (not on medication), and moderate PA (no moderate PA).

SBP= systolic blood pressure, DPB= diastolic blood pressure, LDL-c= low-density lipoprotein cholesterol,
HDL-c= High-density lipoprotein cholesterol, BMI= Body Mass Index, WC=Waist circumference

Association between BMI and WC with CVD risk factors

Table 2.4 displays the regression results for BMI and the dependent variables, after accounting for demographic factors, SES measures, acculturation, medication use, and physical activity behavior. The hypothesis tested in each of the models was whether BMI explained a significant proportion of the variance, over and above those explained by covariates included in the model.

BMI accounted for the most variance in DBP over and above other predictor variables. The hierarchical multiple regression revealed demographic factors added in Block 1 contributed significantly to the regression model, $F = 9.88$, $p < .001$, and accounted for 4% of the variation in DBP. Introducing SES measures, explained an additional 0.9% ($p = .027$). Medication use added .5% ($p = .025$) to the model after proxy measures for acculturation were added ($\Delta R^2 = .008$, $p = .016$). Physical activity did not explain any of the proportion of the variance observed, ($\Delta R^2 = .000$, $p = .715$). Adding BMI to the regression model explained an additional 7.2% ($p < .001$) of the variation in DBP over and above all other predictor variables. This change in R^2 was significant, $F = 77.95$, $p < .001$, thus supporting the hypothesis BMI would account for a significant proportion of the variance over and above previously added predictor variables. As indexed by the R^2 statistic, together all predictor variables accounted for 12% of the total variability in the criterion variable. The most important predictor of DBP was BMI.

BMI also accounted for a significant amount of the variance over and above other predictor variables for all CVD risk factors, with the exception of total cholesterol. However, the amount of variance accounted for by BMI and all covariates for indicators of dyslipidemia like LDL-cholesterol, triglycerides, and HDL-cholesterol were all below 10%.

Table 2.5 shows the regression statistics for WC and CVD risk factors. As with BMI, WC accounted for a significant amount of the variance in DBP. Demographic factors entered in Block 1 contributed significantly to the regression model, $F = 9.88$, $p < .001$ and accounted for 4% of the variance observed in DBP. Introducing the SES variables explained an additional 0.9% and this change in R^2 was significant, $F = 3.07$, $p= .027$. Adding acculturation variables explained an additional 0.8% of the variation in DBP and this change in R^2 was significant, $F = 4.14$, $p= .016$. The addition of medication use accounted for an additional 0.01% of the variation in WC and the change in R^2 approached significance, $F = 5.05$, $p = .025$. Physical activity did not significantly contribute to the model. Finally, adding WC explained 5.1% of the variance and this change in R^2 was significant, $F = 54.43$, $p < .001$. The most important predictor of DBP was WC, which uniquely explained 5% of the variation in DBP. Together the demographic, SES, acculturation, medication use, and physical activity variables accounted for 10% of the variation in DBP.

In general the regression equation to predict the average of the outcome Y given a set of 12 predictors will take the form:

$$\hat{Y}i= b_0 + b_1X_{1i} + b_2X_{2i} + b_3X_{3i} + b_4X_{4i} + b_5X_{5i} + b_6X_{6i} + b_7X_{7i} + b_8X_{8i} + b_9X_{9i} + b_{10}X_{10i\ldots}.$$

where $\hat{Y}_i$ is the variable being predicted (i.e. each CVD risk factor), b_0 is the intercept (when value of X=0), the remaining b values are the estimated coefficients for each of the predictor variables, and X is the value for each independent variable.

Table 2.4 (8)

Hierarchical Multiple Regression Analysis for BMI Predicting Clinical Measures of Hypertension, Diabetes, and Dyslipidemia Controlling for Sociodemographic, Acculturation, Medication Use, and Physical Activity Variables

	SBP				DBP				Fasting Glucose (ln)			
Predictor	*B*	*SE*	β	ΔR²	*B*	*SE*	β	ΔR²	*B*	*SE*	β	ΔR²
Block 1: Demographic factors				**.177*****				**.040*****				**.100*****
Age (yrs.)	.385	.067	**.287*****		.030	.046	.035		.004	.001	**.190*****	
Gender	-5.263	1.390	**-.112*****		-4.071	.965	**-.136*****		.007	.020	.010	
Marital status	1.618	1.243	.038		1.706	.861	**.064***		.011	.018	.018	
Number of children	-.412	.323	-.039		-.441	.223	**-.066***		.008	.005	.051	
Block 2: Socioeconomic factors				**.007***				**.009***				**.006***
Education (yrs.)	-.317	.144	**-.072***		-.154	.100	-.055		-.004	.002	-.059	
Household income ($)	-.000	.000	-.038		-.000	.000	-.011		-.000	.000	-.024	
Employment status	2.782	1.129	**.074***		1.956	.781	**.082***		.017	.016	.031	
Block 3: Acculturation Variables				**.006 ***				**.008***				.000
Years in the US	.052	.061	.051		.052	.042	.080		.000	.001	-.015	
Country of birth	-.140	2.003	-.003		-.330	1.385	-.012		-.029	.029	-.045	
Block 4: Medication				**.022*****				**.005***				**.216*****
Medication Use	6.147	1.529	**.129*****		.984	1.057	.032		.495	.029	**.473*****	
Block 5: Lifestyle Factor				.000				.000				.000
Moderate PA	.527	1.291	.012		.080	.894	.003		.013	.018	.019	
Block 6: Anthropometric measure				**.053*****				**.072*****				**.011*****
BMI	.691	.084	**.239*****		.513	.058	**.278*****		.005	.001	**.107*****	

* $p < .05$ ** $p < .01$ *** $p < .001$

Overall model for SBP: $R^2 = .265$, $R^2_{adj} = .256$; $F_{(12,941)} = 28.30$, $p < .001$

Overall model for DBP: $R^2 = .135$, $R^2_{adj} = .124$; $F_{(12,937)} = 12.17$, $p < .001$

Overall model for fasting glucose (ln): $R^2 = .334$, $R^2_{adj} = .325$; $F_{(12,949)} = 39.64$, $p < .001$

Note: Log transformed values used for fasting glucose.

Table 2.4 (8)

Hierarchical Multiple Regression Analysis for BMI Predicting Clinical Measures of Hypertension, Diabetes, and Dyslipidemia Controlling for Sociodemographic, Acculturation, Medication Use, and Physical Activity Variables

	Total cholesterol				Triglycerides (ln)				LDL-c			
Predictor	*B*	*SE*	β	ΔR^2	*B*	*SE*	β	ΔR^2	*B*	*SE*	β	ΔR^2
Block 1: Demographic factors				**.039*** **				**.044*** **				**.019** **
Age (yrs.)	.498	.154	**.175*** **		.007	.002	**.171** **		.348	.131	**.147** **	
Gender	6.883	3.321	**.069***		-.171	.046	**-.121*** **		4.594	2.836	.054	
Marital status	3.176	2.954	.036		-.001	.041	-.001		3.030	2.495	.041	
Number of children	-.284	.756	-.013		.000	.011	.007		.274	.638	.015	
Block 2: Socioeconomic factors				**.016** **				.002				**.022*** **
Education (yrs.)	.656	.340	**.**071		.005	.005	.038		.597	.289	**.077***	
Household income	.000	.000	.023		-.000	.000	-.027		.000	.000	.055	
Employment status	6.395	2.665	**.081***		.021	.037	.019		6.166	2.258	**.093** **	
Block 3: Acculturation Variables				.002				.001				.001
Years in the US	.196	.145	.091		-.002	.002	-.064		.119	.122	.066	
Country of birth	-3.824	4.745	-.042		.061	.066	.047		-4.142	3.999	-.053	
Block 4: Medication				.002				**.007***				**.012** **
Medication Use	-5.341	4.067	-.044		.132	.057	**.076***		-11.797	3.452	**-.115** **	
Block 5: Lifestyle Factor				.003				.001				.002
Moderate PA	4.661	3.057	.048		-.037	.043	-.027		3.216	2.603	.040	
Block 6: Anthropometric measure				.001				**.028*** **				**.005***
BMI	-.222	.196	-.036		.015	.003	**.172*** **		-.359	.166	-.070	

*$p < .05$ ** $p < .01$ *** $p < .001$

Overall model for total cholesterol: $R^2 = .062, R^2_{adj} = .050; F_{(12,953)} = 5.22, p < .001$

Overall model for triglycerides (ln): $R^2 = .083, R^2_{adj} = .072; F_{(12,955)} = 7.23, p < .001$

Overall model for LDL-c: $R^2 = .061, R^2_{adj} = .049; \mathrm{F}_{(12,933)} = 5.04, p < .001$

Note: Log transformed values used for triglycerides.

Table 2.4 (8)

Hierarchical Multiple Regression Analysis for BMI Predicting Clinical Measures of Hypertension, Diabetes, and Dyslipidemia Controlling for Sociodemographic, Acculturation, Medication Use, and Physical Activity Variables

	HDL-c			
Predictor	*B*	*SE*	β	ΔR^2
Block 1: Demographic factors				**.061*** **
Age (yrs.)	.028	.042	.035	
Gender	6.404	.910	**.229*** **	
Marital status	-.084	.813	-.003	
Number of children	-.275	.207	-.045	
Block 2: Socioeconomic factors				.000
Education (yrs.)	-.008	.094	-.003	
Household income	-.000	.000	-.018	
Employment status	.415	.732	.019	
Block 3: Acculturation Variables				.004
Years in the US	.095	.040	**.157***	
Country of birth	-2.083	1.308	-.081	
Block 4: Medication				.000
Medication Use	-.375	1.121	-.011	
Block 5: Lifestyle Factor				**.006***
Moderate PA	1.882	.840	**.070***	
Block 6: Anthropometric measure				**.024*** **
BMI	-.262	.052	**-.159*** **	

$^{*}p < .05$ $^{***}p < .001$

Overall model for HDL-c: $R^2 = .096$, $R^2_{adj} = .084$; $F_{(12,952)} = 8.39$, $p < .001$

Table 2.5 (9)

Hierarchical Multiple Regression Analysis for WC Predicting Clinical Measures of Hypertension, Diabetes, and Dyslipidemia Controlling for Sociodemographic, Acculturation, Medication Use, and Physical Activity Variables

	SBP				DBP				Fasting Glucose (ln)			
Predictor	*B*	*SE*	β	ΔR²	*B*	*SE*	β	ΔR²	*B*	*SE*	β	ΔR²
Block 1: Demographic factors				**.177*****				**.040*****				**.100*****
Age (yrs.)	.346	.067	**.258*****		.001	.047	.001		.004	.001	**.177*****	
Gender	-3.433	1.409	**-.073***		-2.933	.985	**-.098****		.022	.020	.031	
Marital status	1.262	1.250	.030		1.432	.873	.053		.008	.018	.013	
Number of children	-.326	.324	-.031		-.377	.226	-.056		.008	.005	.054	
Block 2: Socioeconomic factors				**.007***				**.009***				.006
Education (yrs.)	-.307	.144	-.070		-.148	.101	-.053		-.004	.002	-.058	
Household income ($)	-.000	.000	-.038		-.000	.000	-.011		-.000	.000	-.024	
Employment status	3.329	1.130	**.089****		2.331	.789	**.098****		.021	.016	.037	
Block 3: Acculturation Variables				**.006***				**.008***				.000
Years in the US	.069	.061	.068		.066	.043	.101		.000	.001	-.010	
Country of birth	-.786	2.015	-.018		-.677	1.404	-.024		-.035	.029	-.054	
Block 4: Medication				**.022*****				**.005***				**.216*****
Medication Use	6.594	1.529	**.138*****		1.430	1.066	.047		.497	.029	**.476*****	
Block 5: Lifestyle Factor				.000				.000				.000
Moderate PA	.445	1.295	.010		-.050	.904	-.002		.013	.018	.020	
Block 6: Anthropometric measure				**.047*****				**.051*****				**.015*****
WC	.287	.037	**.229*****		.190	.026	**.238*****		.002	.001	**.128*****	

*$p < .05$ **$p < .01$ ***$p < .001$

Overall model for SBP: $R^2 = .260$, $R^2_{adj} = .250$; $F_{(12,941)} = 27.49$, $p < .001$

Overall model for DBP: $R^2 = .114$, $R^2_{adj} = .103$; $F_{(12,937)} = 10.08$, $p < .001$

Overall model for fasting glucose (ln): $R^2 = .342$, $R^2_{adj} = .333$; $F_{(12,949)} = 40.39$, $p < .001$

Note: Log transformed values used for fasting glucose.

Table 2.5 (9)

Hierarchical Multiple Regression Analysis for WC Predicting Clinical Measures of Hypertension, Diabetes, and Dyslipidemia Controlling for Sociodemographic, Acculturation, Medication Use, and Physical Activity Variables

	Total cholesterol				Triglycerides (ln)				LDL-c			
Predictor	*B*	*SE*	β	ΔR²	*B*	*SE*	β	ΔR²	*B*	*SE*	β	ΔR²
Block 1: Demographic factors				**.039***				**.044***				**.019**
Age (yrs.)	.505	.154	**.178**		.006	.002	**.152**		.362	.131	**.153**	
Gender	6.672	3.354	**.067*		-.123	.046	**-.087*		3.946	2.870	.047	
Marital status	3.138	2.960	.035		-.012	.041	-.009		3.106	2.502	.042	
Number of children	-.333	.755	-.015		.001	.010	.004		.206	.638	.011	
Block 2: Socioeconomic factors				**.016**				.002				**.022***
Education (yrs.)	.657	.340	.071		.005	.005	.039		.596	.289	**.077*	
Household income	.000	.000	.023		-.000	.000	-.027		.000	.000	.054	
Employment status	6.208	2.662	**.079*		.031	.037	.028		5.881	2.257	**.089**	
Block 3: Acculturation Variables				.002				.001				.001
Years in the US	.185	.144	.086		-.002	.002	-.056		.106	.122	.058	
Country of birth	-3.879	4.757	-.042		.041	.066	.032		-3.994	4.011	-.052	
Block 4: Medication				.002				.007				**.012**
Medication Use	-5.510	4.073	-.045		.123	.056	**.071*		-11.813	3.460	**-.115**	
Block 5: Lifestyle Factor				.003				.001				.002
Moderate PA	4.838	3.058	.050		-.036	.042	-.026		3.404	2.606	.042	
Block 6: Anthropometric measure				.000				**.040***				.002
WC	-.023	.087	-.009		.008	.001	**.209***		-.095	.073	-.043	

$^{*}p < .05$ $^{**}p < .01$ $^{***}p < .001$

Overall model for total cholesterol: $R^2 = .060$, $R^2_{adj} = .049$; $F_{(12,953)} = 5.11$, $p < .001$

Overall model for triglycerides (ln): $R^2 = .095$, $R^2_{adj} = .084$; $F_{(12,955)} = 8.37$, $p < .001$

Overall model for LDL-c: $R^2 = .058$, $R^2_{adj} = .046$; $F_{(12,933)} = 4.77$, $p < .001$

Table 2.5 (9)

Hierarchical Multiple Regression Analysis for WC Predicting Clinical Measures of Hypertension, Diabetes, and Dyslipidemia Controlling for Sociodemographic, Acculturation, Medication Use, and Physical Activity Variables

	HDL-c			
Predictor	*B*	*SE*	β	ΔR^2
Block 1: Demographic factors				**.061*****
Age (yrs.)	.041	.042	.052	
Gender	5.738	.919	**.206*****	
Marital status	.100	.814	.004	
Number of children	-.283	.207	-.046	
Block 2: Socioeconomic factors				.000
Education (yrs.)	-.006	.093	-.002	
Household income	-.000	.000	-.017	
Employment status	.282	.731	.013	
Block 3: Acculturation Variables				.004
Years in the US	.088	.040	**.146***	
Country of birth	-1.836	1.310	-.071	
Block 4: Medication				.000
Medication Use	-.226	1.122	-.007	
Block 5: Lifestyle Factor				**.006***
Moderate PA	1.840	.840	**.068***	
Block 6: Anthropometric measure				**.024*****
WC	-.121	.024	**-.163*****	

$^{*}p < .05$ $^{***}p < .001$

Overall model for HDL-c: $R^2 = .096, R^2_{adj} = .084$; $F_{(12,952)} = 8.41$, $p < .001$

DISCUSSION

CVD risk profile of the sample

One of the aims of the present analysis was to provide a CVD risk factor profile for a sample of Mexican Americans, primarily of low SES status and food bank participants, in the Valley region of the Texas-Mexico border. The population sampled here showed a higher risk CVD profile than national estimates for Mexican Americans. It has been reported that national data may underestimate the prevalence of diabetes and other CVD risk factors in border communities (Cowie et al., 2006). Recent national estimates for Mexican Americans showed rates of 13.3% for diabetes and 36% for pre-diabetes (CDC, 2011). These rates are considerably lower than those observed here where 27% of individuals were diabetic and 56% of individuals were pre-diabetic. Similarly, a substantially higher percentage of individuals in this study were pre-hypertensive compared to Mexican Americans nationwide (41% vs. 30%, respectively) (Keenan & Rosendorf, 2011; Roger et al., 2012). Mean levels for blood pressure and fasting glucose were higher than those reported in the Cameron County Hispanic Cohort, a cohort representative of Mexican Americans living in one of the counties of the Valley region (Fisher-Hoch et al., 2010); and measures of blood pressure and dyslipidemia were also higher than those reported for Mexican Americans in the San Antonio Heart Study (Mitchell et al., 1996).

The percentage of individuals who were pre-hypertensive is of concern given previous research has demonstrated pre-hypertension is associated with an elevated risk for CVD (Kshirsagar, Carpenter, Bang, Wyatt, & Colindres, 2006; Qureshi, Suri, Kirmani, & Divani, 2005). Furthermore, it has been shown in individuals of Mexican origin, the probability of progressing from pre-hypertension to hypertension was several times higher than the probability of progressing from normal blood pressure to hypertension (Jimenez-Corona, López-Ridaura, Stern, & González-Villalpando, 2007), indicating this population subgroup is at high risk for future development of hypertension and its associated complications.

This cross-sectional analysis shows this subgroup of Mexican Americans in the Valley region is at increased risk of future potential CVD development. It has been reported food bank recipients, a significant majority of the sample, who are experiencing food insecurity, have significantly higher odds of reporting poor/fair health, of having poor functional health, restricted activity and multiple chronic conditions, highlighting the relationship between SES and health disparities (Vozoris & Tarasuk, 2003). The high percentage of adults with untreated CVD risk factors and high percentage of adults with prehypertension, prediabetes, and borderline cholesterol levels suggests an epidemic of CVD is well on its way as Mexican Americans in the Valley region become older. Culturally appropriate health promotion programs should engage Mexican Americans living in the Valley region, including those that are food bank recipients, in CVD risk reduction programs. Present findings align with conclusions made by Laing (2012) of the Cameron County Hispanic Cohort, who highlights the impending epidemic of CVD in this relatively young minority population.

BMI and WC as predictors of CVD risk factors

As already noted, the primary objective of the present analyses was to explore the association of measures of obesity and abdominal obesity with clinical measures of blood pressure, type 2 diabetes, and dyslipidemia after controlling for a number of factors including sociodemographic factors, acculturation measures, medication use, and physical activity. The analysis supported the hypothesis that BMI and WC both explained a significant amount of the variance over and above other factors taken into account in all models, except for total cholesterol. These findings strengthen the previously observed positive relationships of BMI and WC with systolic and diastolic blood pressures, fasting glucose levels, LDL-cholesterol, and triglycerides, as well as the negative relationship of BMI and WC with HDL cholesterol reported in different populations and countries (Dalton et al., 2003; Ghandehari, Le, Kamal-Bahl, Bassin, & Wong, 2009; Huxley, Mendis, Zheleznyakov, Reddy, & Chan, 2010; Lara, Bustos, Amigo, Silva, & Rona, 2012; Menke et al., 2007); and in the limited number of studies among adults of diverse ethnic/racial groups (Brown et al., 2000; Han et al., 2002; Fisher-Hoch et al., 2010; Haffner, Stern, Hazuda, Pugh, & Patterson, 1987; Mueller et al., 1991; Warren, Wilcox, Dowda, & Baruth, 2012).

On the other hand, the present analysis did not support previous findings indicating a positive association between BMI and WC with total cholesterol, and for WC with LDL-cholesterol (Brown et al., 2000; Lins et al., 2012; Wilson, Anderson, Harri, Kannel, & Castelli, 1994; Zhu et al., 2002). The lack of a relationship between WC with LDL cholesterol has been reported by others (Howard, Ruotolo, & Robbins, 2003; Shamai et al., 2011). Howard and colleagues (2003) argued that in comparison to the consistent changes in triglycerides and HDL with obesity, a less consistent effect on LDL concentrations is observed. One potential explanation is that the association between BMI and LDL cholesterol becomes weaker in higher age groups, with no statistically significant association found in females aged 50-64 years old (Gostynski et al., 2004). Given the mean age of men and women in the present study, this might explain the lack of positive associations observed with LDL cholesterol.

The consistency of the positive association observed between obesity and type 2 diabetes across populations in cross-sectional and prospective studies– despite differences in measures of body fatness– reflects the strength of this relationship (Burke et al., 2003; Colditz, Willett, Rotnitzky, & Manson, 1995; Haffner et al., 1990; Ford, Williamson, & Liu, 1997; Stein & Colditz, 2004; Stevens et al., 2001). BMI and WC, while independent predictors of log fasting glucose in the current study, did not explain a high percentage of the variance observed. Past studies have suggested in Mexican

Americans, obesity by itself, does not explain the entire excess prevalence rate of type 2 diabetes (Stern et al., 1983). For example, Haffner et al. (1997) concluded Mexican Americans have an increased risk of type 2 diabetes relative to non-Hispanic whites which is only partially explained by their excess overall obesity and unfavorable body fat distribution and found other independent predictors were stronger than BMI. It has been suggested genetic predisposition plays a role in the development of type 2 diabetes, but though genetic factors provide a fertile background for the development of diabetes in some minority groups, Umpierrez and colleagues (2007) argue the high prevalence of diabetes in Hispanics is determined mostly by environmental circumstances. These inconsistent findings call for more longitudinal studies among Mexican Americans that are able to assess the temporal relationship between BMI and WC with fasting glucose levels but also include a number of other predictors such as genetic predisposition.

Similarly, BMI and WC did not explain a significant percentage of the variance observed in indicators of dyslipidemia (high triglycerides, low HDL cholesterol). Overall, the regression models in the present study accounted for less than 10% of the variability observed in lipid and lipoprotein phenotypes, similar to findings by Mitchell et al. (1996). Mitchell and colleagues (1996) found in the San Antonio Heart Study that for the lipid and lipoprotein phenotypes, age, gender, and other environmental covariates accounted in general for <15% of the total phenotypic variance, whereas genes accounted for 30% to 45% of the phenotypic variation. Family history, a proxy measure of genetic susceptibility, was strongly associated with components of the metabolic syndrome including dyslipidemia in Mexican Americans (Nelson, Perez, Alcaraz, Talavera, & McCarthy, 2008). Future studies should include information on family history of these

CVD risk factors to better assess relationships and associations between and across variables.

Although overall correlations and observed associations between CVD risk factors and anthropometric adiposity measures were small, they were significant. Given the extent of the CVD burden in Mexican Americans, it is important that public health professionals and the health care system are prepared to address the impact of high obesity and central obesity on the health and quality of life of Mexicans in general and particularly those residing along the 2000 mile border corridor. From this study, it was concluded that not only are Mexican Americans living in the Valley region at increased risk of future CVD development; but also Mexican Americans in other regions under similar socioeconomic circumstance and similar high mean levels of obesity and central obesity and high fasting glucose and blood pressure.

Findings also showed high percentages of untreated or poorly managed CVD risk factors, especially among the young- and middle-aged adults. While the current study also demonstrated WC had slightly higher correlations and explained a higher percentage of the variance in CVD risk factors, WC did not appear to offer any clear advantage over BMI as a predictor variable. While some researchers have concluded central obesity measurements are superior to BMI (Dalton et al., 2003; Janssen, Katzmarzyk, & Ross, 2004; Lee et al., 2008; Menke et al., 2007), a recent meta-analysis concluded the evidence is still conflicting, in particular, across ethnic groups (Huxley et al., 2010). Huxley and colleagues (2010) argued that for diabetes there was some evidence to indicate measures of central obesity were more strongly associated with risk compared with BMI, but this was not the case for hypertension and dyslipidemia where the relationships with BMI and WC were similar.

The present analysis supported the conclusions made by Huxley et al. (2010) in that there was little evidence to indicate that the magnitude of the associations between BMI and WC with presence of CVD risk factors was appreciably different. However, the evidence is based on a cross-sectional analysis and thus requires evidence from prospective studies.

Strengths and weaknesses of this study

The strengths of the present analysis includes the availability of direct clinical measurements taken by trained professionals; the inclusion of two measures of obesity one of which assesses overall adiposity and the other central obesity; and the inclusion of a number of covariates including demographic, SES measures, acculturation variables, and physical activity. However, current findings are limited by the cross-sectional analysis of baseline data described here. Some of the conclusions needed to better understand the health implications and associations between BMI and WC with CVD risk factors in this population subgroup would be better served by long-term, longitudinal data. Although cross-sectional studies do not provide information on the temporal associations or sequence of risk factor development and cause-and-effect relationships cannot be inferred, these findings are consistent with the cross-sectional, longitudinal, and clinical studies that show CVD risk factors are positively associated with obesity and abdominal obesity. Another limitation is the low representation of men in the parent study; not unexpected in a community where most men are on hourly wages. This has been a common challenge in developing a cohort in minority communities, including in the Valley region (Murphy, Wickramaratne, & Weissman, 2009; Salinas et al., 2011). Alcohol consumption and smoking behaviors were not assessed in the parent study and these have been found to be confounding factors (Aubin, Farley, Lycett, Lahmek, & Aveyard, 2012; Park et al., 2003; Yusuf et al., 2004). Lastly, health care access variables are important as demonstrated in studies of CVD risk factors and medication adherence among Mexican Americans living in the Texas-Mexico border which were lacking in the present study (Anders et al., 2008). Inclusion of these covariates and potential predictors may provide more insight into the association of BMI and WC with CVD risk factors.

Future studies

Future studies should consider: 1) increasing representation of men to better examine differences between men and women in the relationships between BMI and WC and CVD risk factors, though the parent study, it is noted, did a superb job of retaining men participants in the 12 week intervention; 2) increasing the number of prospective designs to examine the degree to which BMI and WC is predictive of disease incidence in this population subgroup given mixed findings in Mexican Americans, and 3) expanding data analysis to include information on other factors such as dietary behaviors, smoking, and alcohol intake to assess their contributions to the relationship between CVD risk factors and anthropometric measures. In conclusion, despite limitations in generalizability to Mexican Americans residing in other states and regions resulting from the data used in this analysis, it is suggested that findings presented here have implications for Mexican Americans everywhere. In particular, it is anticipated that Mexican Americans residing beyond the border area are as likely to exhibit similar risk factors for CVD as those reported here for the Valley Mexican American population, especially those with similar socioeconomic characteristics. To this extent, it is important that public health professionals and the health care system are prepared to address the impact of high obesity and central obesity on the health and quality of life of Mexicans in the border region, in particular those that are experiencing food insecurity.

Note: A number of assumptions were made such as: if the survey participant was born in the U.S. then their age equaled years of residence in the U.S.; if the survey participant was born in Mexico, but all children were born in the U.S., then years of residence in the U.S. was the age of the oldest child plus one year (assumes they arrived in the U.S. one year before first child was born); if the survey participant was born in Mexico, educated in Mexico, with children born in both U.S. and Mexico, then years of residence in the U.S. was the age of the first child born in the U.S. plus one year; and if the survey participant was born in Mexico, but educated in U.S., then years of residence in the U.S. was the age of respondent minus 6 years (assumes they came to the U.S. when they entered school).

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CHAPTER VI

MANUSCRIPT 3

PREDICTORS OF WEIGHT LOSS AT 12 WEEKS POST INTERVENTION IN A COMMUNITY-BASED HEALTH PROMOTION PROGRAM AMONG MEXICAN AMERICANS IN THE TEXAS-MEXICO BORDER

ABSTRACT

Objectives: Obesity affects ethnic minority communities at disproportionately high levels, with Mexican Americans among the Hispanic subgroups most at risk for obesity and its consequences. The purpose of the present analysis was to examine baseline predictors, including sociodemographic, behavioral, health, and site level characteristics among Mexican American adults living in the Texas-Mexico border region.

Methods: The present investigation is a secondary data analysis of a pre-post cluster randomized study. Beyond Sabor, a community-based health promotion program, was conducted in the Texas-Mexico border, from 2009- 2013. A total of 516 Mexican Americans participated in the intervention arm of the parent study. Chi square test and independent sample t-test were used to assess differences between those who lost weight and those who did not at 12 week posttest. Correlations and hierarchical multiple regression analysis was then used to model the relationship between sociodemographic, behavioral, health, and site level characteristics and weight loss at 12 weeks.

Results: Of the 419 individuals in the treatment arm of the parent study that completed the 12-week intervention, 262 (63%) lost weight. Participants who lost weight were significantly older (M = 48.45, SD = 13.86) than those who did not lose weight (M = 45.33, SD = 16.34; t = -2.00, p = .046). Participants who lost weight were also less educated ($M = 8.46$, $SD = 4.40$) than those who did not ($M = 9.71$, $SD = 4.53$; $t = 2.76$, $p = .006$). Regression analysis showed baseline health characteristics explained 9% of variation in weight loss and this change in R^2 was significant, $F = 4.18$, $p < .001$.

Discussion: The findings reported here contribute to the identification of predictors in weight loss. The present analysis suggests individuals with a high BMI or unfavorable health profile can benefit from community-based health promotion programs such as Beyond Sabor, the parent study. Furthermore, older individuals, females, and those with elementary level school education benefitted from the program, suggesting lifestyle programs aimed at improving nutrition and physical activity behaviors can be successful for these groups. Given current alarming rates of obesity for Mexican Americans in this sample, future research expanding the identification of predictors of weight loss is suggested**.**

Key Words: Mexican Americans, weight loss, socio-demographic factors

MANUSCRIPT 3

PREDICTORS OF WEIGHT LOSS AT 12 WEEKS POST INTERVENTION IN A COMMUNITY-BASED HEALTH PROMOTION PROGRAM AMONG MEXICAN AMERICANS IN THE TEXAS-MEXICO BORDER

INTRODUCTION

Obesity is a major public health problem given its health and economic consequences. In the United States (U.S.), approximately 68.8% of adults are overweight or obese, with obesity rates exceeding 30% for most age and sex groups (Flegal, Carroll, Ogden, & Curtin, 2012). Previous estimates have stipulated that by 2015, the majority of U.S. adults (75%) will be overweight and obese (Wang & Beydoun, 2007), with estimates reaching 87% of all American adults by 2030 (Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008). More recent projections estimate that by 2030, 51% of the population will be obese, with a severe obese prevalence rate of 11% (Finkelstein et al., 2012). Obesity affects ethnic minority communities at disproportionately high levels (Flegal et al., 2012; Wang & Beydoun, 2007), with Hispanics among the ethnic groups most at risk for obesity and its consequences. Mexican Americans, the largest and fastest growing Hispanic subgroup in the U.S., are of particular concern with an age-adjusted obesity prevalence of 40% (Flegal et al., 2012). Obesity rates are expected to soar by 2030 among this Hispanic subgroup, with close to 91.1% Mexican American men and 86.7% of Mexican American women estimated to be overweight or obese (Wang et al., 2008). The increasing trends of obesity along with related health consequences threaten the long-term health of Mexican Americans living in the U.S.

One of the highest rates of obesity is observed in the Texas-Mexico border region. Prevalence rates for overweight and obesity in Mexican Americans living in the Lower Rio Grande Valley (the Valley region) of the Texas-Mexico border have been estimated to be as high as 75% (Bastida & Soydemir, 2009). Culturally-competent and community-based intervention approaches are needed to combat obesity in this minority population (Allison et al., 2008; Balcazar et al., 2009). A wide range of obesity prevention, management and treatment regimens are available, including diet, exercise, behavioral modification, pharmacological treatment and surgery (Galani & Schneider, 2007). Of these, lifestyle programs have been found to safely lead to improvements in metabolic disorders including obesity, dyslipidemia, elevated blood pressure, and glucose control (Artinian et al., 2010; Pritchett, Foreyt, & Mann, 2005). Effective lifestyle interventions are not only required for the prevention of obesity, type 2 diabetes and related cardiovascular disease (CVD) risk factors but also for management of these conditions which are already highly prevalent among Mexican American adults (Amundson et al., 2009). However, a recent review found few weight-loss or nutrition/exercise behavior change interventions have targeted Hispanic populations; and few have been successful (Lindberg & Stevens, 2007).

In order to design effective health promotion and management programs, a better understanding of the elements that contribute to certain individuals being more or less successful than others should be examined to take into account the particular characteristics of those who are most likely to improve their modifiable risk factors. Substantial effort has been devoted to the identification of characteristics that predict weight loss in individuals who are obese and undergoing treatment or participating in a lifestyle intervention but few, if any, variables have been found to consistently predict weight loss (Wadden et al., 1992). Factors such as sex, socioeconomic status (SES), and baseline clinical indicators have been found to influence an individual's response to lifestyle intervention programs aimed at preventing or reducing obesity and improving glycemic control (Wang, Ghaddar, Brown, Pagán, & Balboa, 2012). This is further supported by other studies which have shown older age and being unemployed were significant predictors of weight loss (Wing et al., 2004). Others have found people with varied educational backgrounds may respond differently to a lifestyle intervention for weight management and diabetes control (Gurka et al., 2006). In the Finnish National Diabetes Prevention Program, employment status, education, and body mass index (BMI) explained the success of a lifestyle intervention (Rautio, Jokelainen, Saaristo, Oksa, & Keinänen-Kiukaanniemi, 2013). However, much of the research to date on weight loss lifestyle change program success has been conducted within the confines of efficacy trials conducted in clinical and university settings in an attempt to better define the characteristics for who randomized clinical trials work, limiting the translation to the general population (Stubbs et al., 2011). It has been suggested the inconsistent findings observed are due to differences in the populations studied, differences in sets of predictors employed and how they are measured, and differences in treatments (Stubbs et al., 2011; Wang et al., 2012). Other limitations of previous studies include small sample sizes, use of convenience sampling, and use of self-reported data which limit the power of the study and may produce biased estimates. Thus, to date, evidence shows individual weight change cannot be accurately predicted, with only a few variables showing positive results (Stubbs et al., 2011).

If individual variability in obesity management remains as high as it is presently, identifying variables that predict outcomes (i.e., that explain for whom lifestyle programs works and under what conditions) will justifiably continue to deserve attention from researchers (Teixeira et al., 2004). Given the mixed research on the potential disparate effects of weight-related interventions across levels of factors such as those aforementioned and the lack of studies in ethnic minority populations such as Mexican Americans, more research is needed to explore the possible differences in response to weight-related interventions among a number of predictors ranging from socio-demographic to site-level characteristics. The purpose of this study was to examine baseline predictors, including sociodemographic, behavioral, health indicators, and site level variables of weight loss at 12 weeks post-intervention among Mexican American adults who participated in a community-based health promotion program implemented in the Lower Rio Grande Valley aimed at improving nutrition and physical activity behaviors to reduce or manage obesity.

METHODS

Study Design and Population

The present investigation is a secondary data analysis of a randomized pre-post intervention study. Data used included pre- and 12-week post-test measurements collected for individuals participating in Beyond Sabor (Spanish word for "flavor"), conducted in the Valley region of the Texas-Mexico border, from 2009- 2012. The long term goals of the parent study were: 1) the prevention or reduction of overweight and obesity; and 2) the prevention, delay of onset, or improved management of obesity and diabetes in a population of urban and rural adult Mexican Americans. A probability sampling method, one-stage cluster sampling, was utilized in the parent study. Thirty two sites were randomly selected from a sampling frame of 156 sites, mainly from the local food bank network. Individuals were then recruited at the 32 sites. Participants in the present analysis (n = 513) were those who participated in the intervention arm of the parent study.

Inclusion criteria included men and women, 19 to 87 years of age, residing in a family context, e.g. married, living with a partner, or raising children (single parent, grandparent or guardian, or other family arrangement), Mexican American in origin, and who participated in the treatment sites.

Procedures

Beyond Sabor, a 2-hour, 12-week health education program, was designed to promote weight control through healthy dietary and physical activity behaviors that contribute to risk reduction for these conditions. One of the primary outcomes was reduction in weight and BMI for those who were overweight or obese. It is important to note, however, that Beyond Sabor was not developed as a weight loss program but was rather developed as a health promotion program where individuals were provided with education to improve nutrition and physical activity behavior, both important in preventing, managing, and treating obesity.

Each week during the course of the 12-week intervention program, a different topic was covered through three differently timed segments. The parent researchers originally had organized the session to start with 20 minute segments presenting factual information on obesity, diabetes, or CVD, its risk factors and related co-morbidities. A 50-minute segment followed which included a cooking demonstration and food sampling with special attention that the recipe reinforced the educational lesson of the day. The session then was expected to end with a 60 minute walking session; the last 15 minutes were optional, although participants were encouraged to complete the hour long walk. It is important to note sites were provided with the flexibility to implement the program how they thought would be best and some sites began with the walking or physical activity component.

The program's delivery strategies and messages were developed in full collaboration with participants at each site and in consultation with literacy experts; although researchers relied heavily on visual and auditory channels to deliver the messages. There was no "fixed menu or established order for the lecture material." Investigators worked with each of the sites to determine segment strategies. Program objectives guided the strategies and messages, but participants were encouraged to fully participate in all aspects of decision-making. While cooking presentations were sometimes adjusted to correspond to the needs or requests of the sites, the weekly message and presentation content remained the same.

Measures

Independent variables

Sociodemographic factors. Age in years, gender, marital status (married/living together as married, single/divorced/widowed/separated as not married), and number of children were collected using a standard sociodemographic questionnaire. Years of education, annual household income, and employment (employed/unemployed) were used as SES measures.

Behavioral factor. Physical activity data was collected using a modified seven-day physical activity recall (PAR) questionnaire (Sallis et al., 1985). The PAR is an interviewer-administered instrument that estimates energy expenditure in physical activity over one week. The method has acceptable reliability and validity (Sallis et al., 1985). To create the physical activity variable answers to several questions were used including whether individuals walked, and if so for how long, and number of times per week. Individuals were also asked to identify a second activity they engaged in. To calculate the number of minutes in which individuals engaged in physical activity the more conservative number was used. For example, if a person stated they walked 30-45 minutes then 30 minutes was used for the calculation. Physical activity was then dichotomized (yes, no) and measured as meeting 150 minutes per week of moderate physical activity on most days of the week (at least 5 days), per current national recommendations (U.S. Department of Health and Human Services, 2008).

Baseline health indicators. Height and body weight were measured by trained nurse professionals in the parent study. Body weight was measured on a calibrated balanced scale with the person wearing light clothes and no shoes. Body weight was expressed in kilograms (kg) and rounded to the nearest 0.1kg. Height was measured using a stadiometer in cm and rounded to the nearest 0.1cm. BMI was calculated as weight in kg/height in m^2 (kg/m^2).

Blood pressure measurements were taken in the right arm with the person seated following 10 minutes of quiet rest. The first measurement was disregarded and the average of three measurements taken 10 minutes apart was recorded. Blood pressure was measured with a standard mercury sphygmomanometer using the first and fifth Korotkoff sounds, recorded to the nearest even digit. Blood pressure was measured in millimeters of mercury (mmHg).

A blood sample was collected for plasma glucose. Blood glucose levels were measured using the overnight fasting plasma glucose test**.** Fasting glucose levels were expressed in milligrams per deciliter (mg/dL).

An overnight fasting blood test or a lipid profile was used to measure cholesterol. Cholesterol measures were determined enzymatically. Total cholesterol levels were expressed in mg/dL.

Site level variables. Two site level variables were used in the present analysis. Data collection for location of site (urban or rural) was obtained from U.S. Census categories. Location was used as a dichotomous variable in the analyses. Leadership involvement was coded and assessed by the research team based on extensive ethnographic data collected by two ethnographers at each of the sites throughout the twelve weeks and group discussions that resulted in final scores for each of these variables. Leadership involvement was measured on a Likert scale and classified as detached, somewhat active, active, and very active. For the present analyses, leadership involvement was dichotomized into active (very active and active) and not active (somewhat active and detached).

Dependent variable

12-week weight loss. To calculate weight loss at 12 weeks, the 12-week weight measure was subtracted from baseline weight.

Statistical analysis

A total of 15 predictors were included in the study that were categorized into demographic, SES status, lifestyle, baseline health characteristics, and site level variables. Descriptive statistics were calculated for the demographic (i.e. age, gender, marital status, number of children), SES status (i.e. years of education, annual household income, employment status), lifestyle (150 minutes of physical activity), baseline health variables (i.e. BMI, fasting glucose, blood pressure measures, and total cholesterol), and site level variables (i.e. site of location and leadership involvement). To assess associations between those who lost weight versus those who either maintained or gained weight, chi-square test was used to test for association between categorical variables, and the two sample t-test was used for continuous variables. Chi square test and independent sample t-test were also used to compare those who completed the 12-week program versus those who didn't.

Assumptions were tested by examining normal probability plots (i.e. histograms, Q-Q plots) of residuals and scatter diagrams of residuals versus fitted values. No violations of normality, linearity, or homoscedasticity of residuals were detected. Categorical variables were dummy coded to allow for correlations and regression analysis to be estimated. Associations between predictor variables and covariates with the dependent variables were examined first through Pearson (r) and point-biserial (r_{pb}) correlations. Pearson correlations were run when both the independent and dependent variables were continuous and point-biserial correlations when the independent variable was a dichotomous variable and the dependent variable continuous.

Since the study employed a randomized cluster sampling design, appropriate analysis required accounting for intraclass (i.e. individuals within sites) and within-subject correlation (i.e. repeated measurements on each subject over time). Mixed model analysis was first used to model associations. The fixed factors included the 15 predictors aforementioned and the random factor was site. The total variance was 6.292 of which all was person-to-person variance. The site-to-site variance was zero. This suggests any variation in the site means is explained by the two site-level variables included in the model.

As a result, the model was re-run using hierarchical multiple regression analysis. For the regression analysis, predictors were entered in blocks, as follows: (1) demographic factors: age, gender, marital status, and number of children; (2) SES factors: years in education, household income, and employment status; (3) lifestyle factor: physical activity; (4) baseline health indicators: BMI, blood pressure, fasting glucose, total cholesterol; and (5) site level variables: site location and leadership involvement. All analyses were performed using the IBM SPSS Statistics 20 (IBM Corporation).

RESULTS

Baseline characteristics of the 513 individuals who participated in the intervention arm of the Beyond Sabor program and met inclusion criteria for the present analysis are shown in Table 3.1. The majority of participants were female (82%, $n = 421$) and mean age was 46.58 ($SD = 14.86$). The majority of individuals were married (68%, $n = 346$) and the mean number of children was 3.29 ($SD = 2.00$). Mean years of education was equivalent to middle school ($M = 8.70$, $SD = 4.47$). Mean BMI was in the obese range ($M = 31.30$, $SD = 6.65$). Mean fasting glucose levels were above the diabetes threshold (≥

126 mg/dL). Mean levels for SBP were in the prehypertension level (*M* = 128.00, *SD* = 17.91). Other baseline clinical indicators were in the normal range.

It is important to note the total sample size for some of the descriptive indicators in the tables may vary given the inclusionary policy established by the Advisory Council that led the Community Based Participatory Research effort that governed the parent study. This required that all participants who presented were given the opportunity to participate in all assessments, even when data on some items were not collected, and none were rejected. Given the cost of laboratory assessments, all data once cleaned were preserved. However, it is noted that variations in total sample size for each indicator did not exceed 5% of the final sample size.

Table 3.1 (10)

Baseline Sociodemographic, Lifestyle, and Health Characteristics of Participants

Characteristic	Total Sample Values*
Age (*M*±*SD*)	46.58± 14.86
Gender	
Female *n* (%)	421 (82.1)
Male *n* (%)	92 (17.9)
Marital status	
Married *n* (%)	346 (67.6)
Not married *n* (%)	166 (32.4)
Number of children (*M*±*SD*)	3.29 ± 2.00
Household income (*M*±*SD*)	$13,180.19 ± $12,196.63
Education (*M*±*SD*)	8.70 ± 4.47
Employment status	
Employed *n* (%)	228 (44.8)
Not employed *n* (%)	281 (55.2)
Moderate PA 150	
Yes *n* (%)	89 (18.2)
No *n* (%)	400 (81.8)
BMI (*M*±*SD*)	31.30 ± 6.65
Fasting glucose (*M*±*SD*)	128.07 ± 48.71
SBP (*M*±*SD*)	128.00 ± 17.84
DBP (*M*±*SD*)	77.25 ± 11.32
Total cholesterol (*M*±*SD*)	183.78 ± 41.29
Location of site	
Urban *n* (%)	334 (66.5)
Rural *n* (%)	168 (33.5)
Leadership Involvement	
Active *n* (%)	180 (35.1)
Not active *n* (%)	333 (64.9)

*Valid percentages are shown.

BMI= Body Mass Index, SBP= Systolic Blood Pressure, DPB= Diastolic Blood Pressure

Loss to follow up

Of the 513 individuals who were included in the present analysis, 94 (18%) were lost to follow-up. Significant differences were observed between those who completed the 12-week program and those who left the program. An independent samples t-test revealed those who stayed in the program were significantly older (M = 47.28, SD = 14.90) than those who were lost to follow up (M = 43.33, SD = 14.36; t = -2.28, p = .023). Those who stayed in the program were also more educated (M = 8.93, SD = 4.48) than those lost to follow up (M = 7.69, SD = 4.26; t = -2.43, p = .015). A significant difference was also found for fasting glucose. Those who completed the program had a lower mean level for fasting glucose (*M* = 123.97, *SD* = 39.67) than those lost to follow up (*M* = 143.73, *SD* = 74.78; *t* = 2.48, *p* = .015).

Differences observed between those who lost weight versus those that gained or maintained their weight

As aforementioned, Beyond Sabor was not designed as a weight loss program. However, of the 419 individuals who participated in the treatment arm of the parent study and completed the 12-week program, 262 (63%) lost weight. Table 3.2 displays the descriptive characteristics for those who lost weight versus those who gained or maintained their weight. Independent sample t-tests revealed participants who lost weight were significantly older (*M* = 48.45, *SD* = 13.86) than those who did not lose weight (*M* = 45.33, *SD* = 16.34; *t* = -2.00, *p* = .046). A significant difference was also found between the two groups and years of education such that those who were less educated (*M* = 8.46, *SD* = 4.40) lost weight compared to those with a higher mean number of years in education (*M* = 9.71, *SD* = 4.53; *t* = 2.76, *p* = .006).

Table 3.2 (Table 11)

Description of Participants who Lost Weight and Didn't Lose Weight

Characteristic	Lost Weight	Did Not Lose Weight
Sociodemographic characteristics		
Age (*M*±*SD*) *	48.45 ± 13.86	45.33± 16.34
Gender *		
Female *n* (%)	223 (85.1)	121 (77.1)
Male *n* (%)	39 (14.9)	36 (22.9)
Marital status		
Married† *n* (%)	183 (70.1)	104 (66.2)
Not married *n* (%)	78 (29.9)	53 (33.8)
Number of children (*M*±*SD*)	3.38 ± 1.95	3.20 ± 1.95
Household income (*M*±*SD*)	$13,972.11 ± $13,433.90	$13,178.45± $11,442.11
Education (*M*±*SD*)***	8.46 ± 4.40	9.71 ± 4.53
Employment status		
Employed *n* (%)	114 (44.0)	71 (45.2)
Not employed *n* (%)	145 (56.0)	86 (54.8)
Lifestyle factor		
Moderate PA		
Yes *n* (%)	46 (18.5)	29 (19.1)
No *n* (%)	203 (81.5)	123 (80.9)
Baseline health characteristics		
BMI (*M*±*SD*)	31.59 ± 6.78	30.49 ± 6.37
Fasting glucose (*M*±*SD*)	126.91 ± 43.59	119.04 ± 31.56
SBP (*M*±*SD*)	128.89 ± 18.08	127.26 ± 18.14
DBP (*M*±*SD*)	77.42 ± 11.51	77.54 ± 11.61
Total cholesterol (*M*±*SD*)	182.68 ± 40.03	185.65 ± 45.16
Site level variables		
Location of site		
Urban *n* (%)	176 (68.5)	97 (64.2)
Rural *n* (%)	81 (31.5)	54 (35.8)
Leadership Involvement		
Active *n* (%)	90 (34.4)	49 (31.2)
Not active *n* (%)	172 (65.6)	108 (68.8)

* p <0.05, *** p <0.001 based on chi square tests or independent sample t-tests.
Valid percentages are shown.

Figure 3.1 further describes who lost weight according to BMI at baseline. For example, 65% (*n*=142) of those who were obese and 61% (*n*=81) of those who were overweight lost weight.

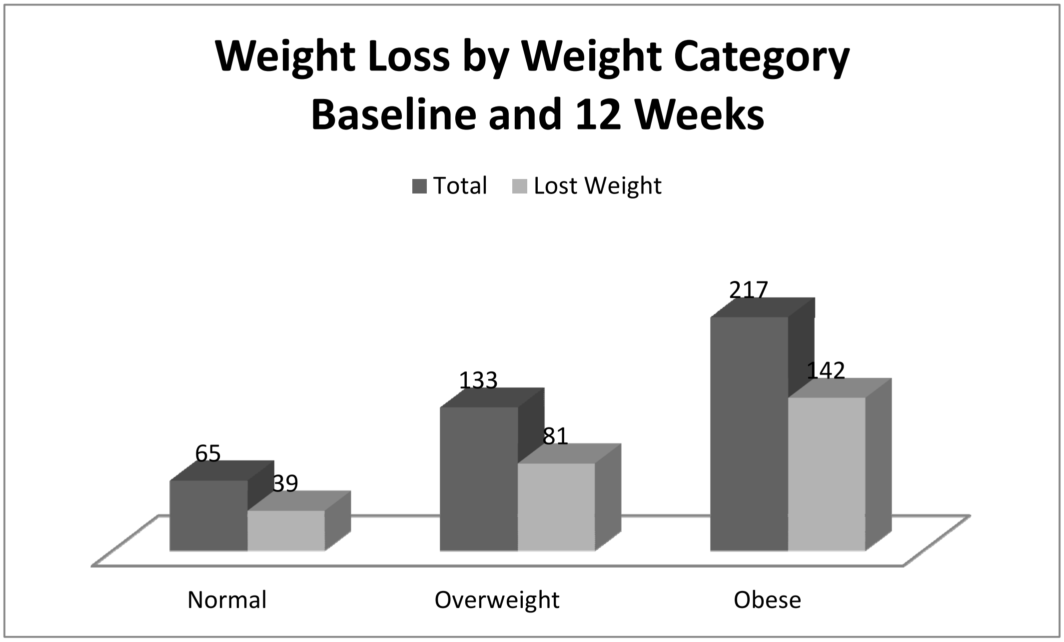

Figure 3.1 Weight Loss by Weight Category from Baseline to 12 Week Posttest
Note: Two cases were included in the normal category that were in the underweight category.

Correlates of weight loss at 12 weeks

The respective Pearson (*r*) and point-biserial correlations (r_{pb}) between predictor variables and weight loss at 12-weeks are provided in Table 3.2. Baseline health indicators, with the exception of total cholesterol, were the only correlates of weight loss at 12 weeks. The strongest correlations for weight loss at 12 weeks were baseline BMI, $r = .22$, $p < .01$ and DPB, $r = .22$, $p < .01$. A higher weight loss at 12 weeks was associated with higher clinical values for BMI and fasting glucose at baseline.

Table 3.2 (12)

Correlations between Predictors and 12-Week Weight Loss (n =227)

Independent variables	Weight loss at 12 weeks
Age	-.056
Gender †	.026
Marital status †	.005
Number of children	.061
Household income	-.013
Education	.039
Employment status †	-.021
Moderate physical activity †	-.028
BMI	.223**
Fasting glucose levels	.093
SBP	.092
DBP	.224**
Total cholesterol	-.020
Site location †	-.050
Leadership involvement†	.061

* $p<0.05$ ** $p<0.01$
† Point-biserial correlations.
Note: Gender, marital status, employment status, moderate physical activity, site location, and leadership involvement were recoded into dummy variables.
BMI= Body Mass Index, SBP= Systolic Blood Pressure, DPB= Diastolic Blood Pressure

Association between socio-demographic, lifestyle, baseline health characteristics, and site-level variables with weight loss at 12 weeks

Hierarchical multiple regression analyses was used to model the relationship between weight loss at 12 weeks and criterion variables of interest (Table 3.3). It was postulated baseline health characteristics would account for a significant amount of the variance in weight loss at 12 weeks over and beyond physical activity, SES characteristics, and demographic factors; it was also hypothesized site level variables would account for a significant amount of variance in weight loss at 12 weeks over and beyond baseline health characteristics, physical activity, SES variables, and demographic factors.

In general the regression equation to predict the average of the outcome Y (i.e. weight loss) given a set of 15 predictors will take the form:

$\hat{Y}_i = b_0 + b_1X_{1i} + b_2X_{2i} + b_3X_{3i} + b_4X_{4i} + b_5X_{5i} + b_6X_{6i} + b_7X_{7i} + b_8X_{8i} + b_9X_{9i} + b_{10}X_{10i\ldots}$ where $\hat{Y}_i$ is the variable being predicted (i.e. weight loss), b_0 is the intercept (when value of X=0), the remaining b values are the estimated coefficients for each of the predictor variables, and X is the value for each independent variable.

The hierarchical multiple regression revealed the first three blocks, demographic, SES, and physical activity, did not contribute significantly to the regression model and did not account for any of the variance observed. Introducing the baseline health characteristics explained 9% of variation in weight loss and this change in R^2 was significant, $F = 4.18$, $p < .001$, supporting the postulated hypothesis that baseline health characteristics would account for a significant amount of the variance in weight loss at 12 weeks over and beyond physical activity, SES characteristics, and demographic factors. Adding site level variables did not account for any additional variance; thus rejecting the hypothesis that site level variables would account for a significant amount of variance in weight loss at 12 weeks over and above all other predictors. In terms of individual relationships between independent variables and 12-week weight loss, significant predictors included baseline BMI ($\beta = .160$, $p = .032$) and DBP ($\beta = .233$, $p = .005$). Together the 15 predictors accounted for 4% of the variance observed in weight loss, and the full model approached significance ($p = .056$).

Table 3.3 (13)

Hierarchical Multiple Regression Analysis for Sociodemographic, Lifestyle, Baseline Health Characteristics, and Site Level Variables Predicting Weight Loss at 12 weeks (n=227)

	Weight loss at 12 weeks			
Predictor	*B*	*SE*	*β*	ΔR^2
Block 1: Demographic factors				.010
Age	-.012	.012	-.085	
Gender	.037	.401	.007	
Marital status	-.047	.291	-.011	
Number of children	.072	.073	.073	
Block 2: Socioeconomic factors				.003
Education (yrs.)	.023	.033	.053	
Household income	-.000	.000	-.007	
Employment status	-.256	.268	-.067	
Block 3: Lifestyle Factor				.000
Moderate physical activity (150 min/week)	.163	.336	.033	
Block 4: Baseline health characteristics				**.088*** **
BMI	.045	.021	**.160***	
Fasting glucose	.002	.003	.056	
SBP	-.006	.009	-.056	
DBP	.038	.013	**.233****	
Total cholesterol	-.002	.004	-.038	
Block 5: Site level variables				.006
Location site	-.182	.278	-.044	
Leadership involvement	.266	.273	.066	

$^{*}p < .05$ $^{**}p < .01$

Overall model: $R^2 = .106$, $R^2_{adj} = .043$; $F_{(15,211)}=1.68$, $p = .056$

NOTE: Missing value analysis was conducted to understand the missing data mechanisms and patterns. Analysis showed the data were missing completely at random (MCAR). Listwise deletion was used given the MCAR assumption was met.

DISCUSSION

The present analysis examined the association between several individual and site level predictors at baseline and change in weight loss at 12 weeks among Mexican American men and women participating in a pre-post intervention study aimed at improving lifestyle behaviors to prevent, reduce or manage obesity. Only baseline health characteristics were significant contributors to the overall model, with initial BMI and DBP the only two predictor variables with significant individual relationships with weight loss at 12 weeks. Site level variables were considered important predictors by Abildso and colleagues (2012), but they were not statistically significant in this study.

The present study corroborates previous findings which have found no association between demographic factors and weight loss success, suggesting the program was effective in promoting weight loss across multiple age and physical activity level groups (Abildso, Zizzi, & Fitzpatrick, 2013). Similarly, Hansen et al. (2001) reported no significant associations between gender and weight loss success. However, other studies have identified demographic factors such as age and gender to be important predictors of weight loss (Stubbs et al., 2011; Wang et al., 2012; Wing et al, 2004). The lack of an association between demographic factors and weight loss in the present research suggests there might be other important pre-treatment predictors in the Mexican American population that transcend demographic factors, given the surprising high percentage of individuals, 63%, who lost some weight at the end of the twelve week program. The results observed may have also been a result of significant differences between those who completed the 12-week program and those that were lost to follow-up, which could have introduced bias. However, further exploration into pre-treatment predictors provides a more reasonable alternative given, as already suggested, that 63% of participants who completed the intervention lost some weight.

In a study examining correlates of weight loss, Wadden et al. (1992) concluded initial weight, highly correlated with initial BMI, appeared to be the most clinically useful biological correlate of weight loss. The present research findings further support the work by Wadden et al. (1992). That heavier individuals typically lose more weight than lighter patients is in agreement with a number of studies (Hansen et al., 2001; Rautio et al., 2013; Wang et al., 2012). However, some studies have indicated an inverse relationship. In the Alliance for a Healthy Border program, participants with better baseline health indicators (i.e. no diabetes diagnosis or family history of diabetes; normal BMI; normal HbA1c level; no hypertension; and/or no high cholesterol) were more likely to be successful in achieving weight loss (Wang et al, 2012). Specifically, participants diagnosed with diabetes were less likely to achieve weight reduction success than those not diagnosed with this chronic health condition. Similarly, both overweight and obese participants were less likely to succeed in weight reduction than normal weight participants. The results described here show the opposite results, since those with a more at-risk health profile, as evidenced by a higher initial BMI and DBP, experienced greater weight loss at 12 weeks.

The findings reported here pointing to opposite results yielded by two border populations in terms of who is more likely to benefit from a health education intervention and existing inconsistencies in the literature suggest the need to conduct more studies regarding predictors of successful weight loss, in particular, in minority ethnic groups such as Mexican Americans. The present analysis contributes to and expands the current literature on pretreatment predictors of weight loss after participation in a health promotion program, especially in a non-clinical setting. As Stubbs et al. note (2011), the pre-treatment predictors of weight loss are relatively few, as identified in the current literature where predictors are heterogeneous and predictive models are weak. The present model approached significance explaining 4% of the variance, which is lower than models from past studies that explain 25–30% of the variance in weight that is lost (Teixeira, Going, Sardinha, & Lohman, 2005). The difference may be explained by differences in the sets of predictors used; alternatively, given that almost two thirds of participants exhibited some weight loss at 12 weeks, it may also suggest that aside from pre-treatment predictors, intervention components were important predictors of weight loss. Future studies should include additional predictors such as other individual factors (e.g. self-efficacy and resting metabolic rate), process variables (e.g. initial weight loss), program characteristics (e.g. social support), and behavioral changes (e.g. diet, self-monitoring, and goal-setting). The latter have been found to show a positive correlation with weight loss in other studies (Stubbs et al., 2011). Nevertheless, as Teixera and colleagues (2005) point out in their review of correlates of weight loss, most predictors fall in the category of mixed or suggestive evidence.

Limitations

There are some important limitations to the present analysis. First, the data was based on complete case analysis which reduces statistical power because it lowers the sample size. This was due to how some of the variables were created using other parent variables for which there might have been missing data. Nevertheless, there was enough statistical power (84%) to detect a significant effect size in the medium range. Second, the sample was composed of more females than males limiting gender comparisons. Third, since the current model included site level variables, only the treatment group was included in the analysis given data was not collected for the control sites. Fourth, significant differences were observed between those for whom there was 12-week posttest data or who completed the program and those lost to follow up. While attrition was 19%, considered fairly low in community-based participatory research, it may have introduced some bias. Thus, results have to be interpreted with caution.

Conclusion

From a public health perspective, lifestyle interventions will be important in addressing the obesity epidemic and its related health consequences. Identification of adequate predictors of weight loss is important if improvements are to be made in obesity management efforts (Hansen et al., 2001). It would be reasonable to target effective interventions to carefully selected participants who are deemed to respond successfully (Kong et al., 2010). Researchers have concluded that if obesity interventions are to be effective, then treatments need to be developed with a more individualized approach that is sensitive to patients' needs and individual differences (Stubbs et al., 2011). For example, that those who lost weight had higher BMI, older, less educated, and females suggests Beyond Sabor was very effective for individuals with these characteristics. That it was not as effective for younger adults provides insights to changes that may need to be made to the program if these individuals are to be successful in achieving weight loss through a program like Beyond Sabor. While a significant difference was observed between males and females, results need to be interpreted with caution given the higher representation of females in the sample, thus limiting any gender comparisons. Nevertheless, the present analysis also provides support for the community-based participatory research framework in lifestyle program development and implementation. Findings reported here provide the rationale for further exploring this topic for similar interventions targeting obesity.

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CHAPTER VII

OVERALL CONCLUSIONS

The main purpose of the findings presented in this dissertation was to attain a better understanding of predictors of obesity, measures of obesity and association with cardiovascular disease (CVD) risk factors, and correlates of weight change and weight loss in a minority population. Previous research has been mixed in determining associations between an array of predictors and obesity as well as the impact of obesity on CVD risk factors such as indicators of diabetes, high blood pressure, and dyslipidemia. Previous studies have also been inconclusive in identifying predictors of weight loss which is important if obesity prevention and management programs are to be effective. Thus, the research questions studied were meant to address gaps in the literature, especially among a largely understudied and disadvantaged population group of Mexican Americans living in the Texas-Mexico border region.

The population sample across the three studies was part of a pretest-posttest group randomized intervention study conducted in the Lower Rio Grande Valley in South Texas. Beyond Sabor (Spanish word for "flavor") was designed to reduce the major risk factors for obesity and diabetes. The 2-hour, 12-week health education program aimed to promote weight control through healthy dietary and physical activity behaviors that contribute to risk reduction for these conditions. The sampling frame for the parent study included 156 sites across the Valley region, of which the majority of the sites (i.e. 150) were from the Lower Rio Grande Valley Food Bank network of 222 sites. A total of 32 sites were then randomly selected using a cluster random sampling design.

The first research question addressed in Manuscript 1 examined mean levels of body mass index (BMI) and waist circumference (WC), tested for correlations among a number of demographic, socioeconomic status (SES), acculturation, and a lifestyle factor with BMI and WC, and then examined the relationship between the predictors aforementioned and BMI and WC. The cross-sectional analysis was conducted among men and women, ages 20 – 89, residing in a family context, and of Mexican origin. Statistical analyses included descriptive statistics, Pearson and biserial correlations and hierarchical multiple regression analysis. Hierarchical regression analysis was used to explore the theoretical assumptions that guided the current research and to examine the influence of several predictor variables in a sequential way, such that the relative importance of a predictor was judged on the basis of how much it adds to the prediction of a criterion, over and above that which can be accounted for by other important predictors. The analyses revealed acculturation factors were important in accounting for a significant amount of the variance observed for both BMI and WC, over and above that accounted by SES and demographic factors. For BMI, SES was a significant predictor although it accounted for a very small amount of the variance while for WC, demographic factors accounted for the largest variance observed. Important individual relationships included number of children for BMI and gender for WC. Physical activity approached significance in both models. These findings highlight the importance of both proximal and distal determinants of health in predicting BMI and WC and also suggest other factors need to be included in the model to account for a higher amount of the variance. Some of the factors which have been identified in previous studies include genetics and diet. In addition, from the data examined here results revealed important individual relationships in this population subgroup which have been largely understudied such as number of children and its association with BMI. To the extent predictors of measures of obesity are identified that are specific to population groups, health promotion programs can be developed and be more effective.

The second research question examined mean levels and prevalence of CVD risk factors and assessed the association of BMI and WC with clinical indicators of type 2 diabetes, hypertension, and dyslipidemia controlling for demographic, socioeconomic, acculturation, medication use, and a lifestyle factor. Previous research has suggested positive associations between obesity and high blood pressure, high blood cholesterol, and type 2 diabetes; but studies have been limited in minority populations. It was hypothesized that BMI and WC would significantly contribute to the proportion of variance explained by each of the CVD risk factors studied over and beyond the variance accounted for by socio-demographic factors, acculturation, medication use, and physical activity behavior. Descriptive statistics, Pearson and biserial correlations, and hierarchical regression analyses were used to test relationships between predictor and outcome variables. Study findings demonstrated both BMI and WC were significant predictors, over and above other predictor variables for clinical indicators of blood pressure, type 2 diabetes, and dyslipidemia with the exception of total cholesterol. BMI also accounted for a significant amount of the variance observed in LDL-cholesterol. These findings are consistent with previously described positive relationships of BMI and WC with systolic and diastolic blood pressures, fasting glucose levels, LDL-cholesterol, and triglycerides, as well as the negative relationship of BMI and WC with HDL cholesterol reported in different populations and countries. These findings are strengthened by the clinical data employed in the analysis, rather than self-reported data, as used in a large number of studies examining these associations. Previous research has suggested WC is a superior indicator of CVD risk factors compared to BMI, however no major differences were observed in the relationships reported here and hence, it can be concluded BMI is a good predictor of CVD risk factors. In addition, men were found to generally have a poorer CVD risk profile which highlights the importance of engaging men in health promotion programs. The models explained approximately 5 to 35% of the variance observed in CVD risk factors suggesting other factors should be considered such as genetic predisposition and environmental factors.

The third research question, addressed in Manuscript 3, aimed to examine predictors of weight loss among individuals participating in a health promotion program. The literature is not only mixed and inconsistent in identifying predictors of weight loss success but is also very limited in minority populations, including Mexican Americans. The study looked at demographic, SES, baseline health characteristics, physical activity, and site-level characteristics and their association with weight loss at 12 weeks post intervention. It was hypothesized site level predictors would predict a significant amount of the variance observed in weight loss; however, this hypothesis was not supported. On the other hand, significant contributions to the model included baseline health characteristics, which accounted for a significant amount of variance (4%) observed in weight loss at 12 weeks over and above that accounted by other predictors. Thus, other variables should be included in predictive models to better ascertain predictors of weight loss success.

The three studies and analyses conducted here aimed to provide a better picture of the problem of obesity and abdominal obesity and its predictors in a minority, disadvantaged population living in the border; it then examined the public health effect of obesity and abdominal obesity on CVD risk factors; and, finally, it assessed potential predictors of weight loss success. A limited number of community based health promotion programs have been effective in preventing or reducing weight, especially among minority populations and the present dissertation provides a glimpse to important individual characteristics that could be taken into account when identifying target populations and developing obesity reduction and management programs. Given limited resources, the study results may inform the targeting of health promotion programs and increase likelihood of success to the extent they are tailored to characteristics identified as important in the analyses.

In examining the overall goals of the study and its successful outcomes, it behooves to highlight the relevance of the community based participatory research effort guiding the parent intervention study. As illustrated by the latter, there was close interaction between community partners, advisory council, study participants and investigators in designing and conducting all phases of the intervention study. Given its overall success in reducing attrition over a 14 week period to less than 20% and the numbers (63%) who reduced their weight, though not primarily a weight reduction study, it is suggested that community based participatory research may indeed provide a yet important but relatively unexplored mechanism for improving health outcomes at the community level. Particularly emphasized are the disadvantaged conditions and overall lack of laboratory facilities in which the study sites were located, far from research clinical laboratories and far from academic settings. Laboratory staff, nurse and trained staff traveled to the community to meet in local churches and food bank pantries to conduct laboratory intakes, collect data and present the intervention to community residents.

Limitations

There were a number of limitations which are described in greater detail in each of the studies. For purposes of the three studies presented here, secondary data were obtained from the parent study. Thus, the original data were not necessarily collected to respond to the particular research questions or hypotheses statements posited here. This may have impacted the associations and relationships observed, given the parent study's purpose was not to test the research questions of the present dissertation. However, one of the advantages of using the dataset of the parent project was that clinical data was directly measured and not based on self-report. Two of the studies presented here rely on cross-sectional data which don't allow causal inferences to be made. Low representation of men limited gender comparisons and generalizability. The use of cluster random sampling in the parent study as compared to simple random sampling may limit generalizability to the general population. Similarities among subjects in clusters can reduce the variability of responses from a cluster sample compared with those expected from a simple random sample (Killip, Mahfoud, & Pearce, 2004).

Physical activity, which has been demonstrated by numerous studies to reduce risk of a number of health outcomes including obesity-related CVD risk factors, was not a significant predictor in the models tested across the three studies, perhaps with the exception of HDL-cholesterol. The results observed may have been due to the use of self-reported physical activity data which is subject to response bias. Imprecise measurement of activity variables can lead to a diminution of the apparent effects of activity on health-related outcomes due to regression dilution bias (Celis-Morales et al., 2012).

Future studies

Mexican Americans are the fastest growing Hispanic subgroup in the United States. Furthermore, Mexican Americans living in the border region of Texas-Mexico are a particularly disadvantaged and hard-to-reach population. This presents challenges to public health professionals as Mexican Americans have one of the highest obesity rates observed among all population groups, placing them at risk of future CVD development. Understanding risk factors of obesity, its public health effect, and predictors of weight loss success is important if improvements are to be made in the success of community-based obesity prevention and management programs in this at-risk population.

The study of obesity, its association with CVD risk factors, and predictors of weight loss success has received national attention given the current obesity epidemic. However, while a number of studies have been conducted which have tried to answer the research questions tested in the present dissertation, the literature is mixed and inconclusive. More studies, especially longitudinal in nature, are needed to answer the research questions tested in the present analysis to allow for temporal relationships to be established. Public health researchers should aim to better understand the associations between an array of predictors and obesity, CVD risk factors, and weight loss success to develop prevention programs that are better suited and more effective for this population.

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APPENDICES

Appendix 1: Correlations for Independent Variables (Multicollinearity)

Table Appendix 1.1

Multicollinearity Values for Independent Variables in Manuscript 1

	Age	Gender	Marital status	Number of children	Education	Annual Household Income	Employment status	Years in the US	Country of Birth	Moderate Physical Activity
Age	1									
Gender†	-.098**	1								
Marital status†	-.162***	-.056	1							
Number of children	.301***	-.023	.048	1						
Education	-.239***	-.055	-.013	-.332***	1					
Annual Household Income	.064*	-.075*	.125***	-.118***	.335***	1				
Employment status†	-.007	-.243***	-.047	-.093**	.149***	.246***	1			
Years in the US	.629***	-.032	-.213***	.084**	.092**	.280***	.060	1		
Country of Birth†	.043	-.051	-.141***	-.131***	.285***	.285***	.080*	.636***	1	
Moderate Physical Activity†	.081*	-.109**	-.039	.006	-.027	-.027	.022	.072*	.037	1

†Point-biserial correlations.

p* <0.05, ** *p* <0.01, * *p* <0.001

Table Appendix 1.2

Multicollinearity Values for Independent Variables in Manuscript 2

	Age	Gender	Marital status	Number of children	Education	Annual Household Income	Employment status	Years in the US	Country of Birth	Cholesterol Medication
Age	1									
Gender†	-.097**	1								
Marital status†	-.160***	-.056	1							
Number of children	.299***	-.023	.046	1						
Education	-.238***	-.055	-.012	-.333***	1					
Annual Household Income	.064*	-.076*	.125***	-.118***	.335***	1				
Employment status†	-.006	-.242***	-.049	-.094**	.149***	.245***	1			
Years in the US	.630***	-.031	-.211***	.081*	.092**	.279***	.062	1		
Country of Birth†	.045	-.050	-.139***	-.133***	.286***	.285***	.081*	.637***	1	
Cholesterol medication†	.366***	-.056	-.095**	.108**	-.109**	.045	-.096**	.283***	.083*	1
Insulin medication†	.217***	-.029	-.108***	-.034	-.063	.011	-.085**	.212***	.119***	.366***
Blood pressure medication†	.458***	-.016	-.060	.174***	-.150***	.016	-.130***	.320***	.077*	.440***
Moderate Physical Activity†	.081*	-.109***	-.038	.006	-.027	-.038	.022	.071*	.036	.041

Table Appendix 1.2 (Cont'd)

	Age	Gender	Marital status	Number of children	Education	Annual Household Income	Employment status	Years in the US	Country of Birth	Cholesterol Medication
BMI	.078*	.009	-.005	.064*	.018	.071*	.062	.173***	.143***	.084*
WC	.149***	-.158***	.029	.065*	.007	.081*	.048	.205***	.169***	.142***
SBP	.402***	-.160***	-.029	.115**	-.129***	.026	.088**	.289***	.066*	.175***
DBP	.116***	-.161***	.039	-.004	.033	.059	.126***	.135***	.078*	.045
Triglycerides	.111**	-.140***	-.001	.033	.006	.014	.028	.071*	.041	.121***
HDL-C	.080*	.209***	-.043	-.026	-.044	-.014	-.033	.081*	-.002	.032
LDL -C	.129***	.014	.023	.015	.067*	.113***	.112***	.121***	.031	-.098**
Blood Sugar	.237***	-.010	-.036	.132***	-.143***	-.033	-.033	.132***	-.009	.201***
Cholesterol	.185***	.021	-.010	.012	.048	.085**	.084**	.168***	.045	-.003

Table Appendix 1.2 (Cont'd)

	Insulin Medication	Blood Pressure Medication	Moderate Physical Activity	BMI	WC
Insulin medication†	1				
Blood pressure medication†	.293***	1			
Moderate Physical Activity†	.011	-.031	1		
BMI	.093**	.164***	-.053	1	
WC	.086**	.180***	-.027	.805***	1

†Point-biserial correlations.
*p <0.05, ** p <0.01, *** p <0.001

Table Appendix 1.3
Multicollinearity Values for Independent Variables in Manuscript 3

	Age	Gender	Marital status	Number of children	Education	Annual Income	Employment status	Moderate Physical Activity	BMI	SBP	DBP
Age	1										
Gender†	-.078	1									
Marital status†	-.080	-.016	1								
Number of children	.342***	.032	.025	1							
Education	-.299***	.036	-.030	-.380***	1						
Annual Income	.075	-.038	.109*	-.115*	.326***	1					
Employment status†	-.010	-.142**	-.043	-.156**	.145**	.191***	1				
Moderate Physical Activity†	.054	-.138**	-.109*	-.042	-.058	-.063	.054	1			
BMI	.117**	.068	-.052	.056	.079	.085	.034	-.110*	1		
SBP	.436***	-.154**	-.029	.124**	-.179***	-.011	.090*	.040	.316***	1	
DBP	.116*	-.129*	.020	-.047	.007	.047	.159***	-.057	.305***	.585***	1
Blood Sugar	.230***	.011	-.045	.165***	-.138**	-.029	.007	-.021	.146**	.214***	.118**
Cholesterol	.155***	.113*	.060	-.028	.025	.055	.036*	.051	.022	.086	.097*
Site location†	.100*	-.038	-.033	-.004	.066	-.002	.002	.013	.025	-.032	-.045

Table Appendix 1.3 (Cont'd)

	Blood sugar	Cholesterol	Site location	Leadership engagement
Blood sugar	1			
Cholesterol	.181***	1		
Location of site[†]	.012	.076	1	
Leadership engagement[†]	.068	.064	.049	1

[†]Point-biserial correlations.
p* <0.05, ** *p* <0.01, * *p* <0.001

Appendix 2: *Mixed Model Analysis for Socio-demographic, Physical Activity Behavior Predicting Weight Loss at 12 Weeks*

Table Appendix 2.1

Mixed Model Analysis for Socio-demographic, Physical Activity Behavior Predicting Weight Loss at 12 Weeks

Predictor	*Estimate*	*SE*	*t*	*p*
Intercept	-1.000	1.253	-.800	.425
Gender = 1	-.029	.400	-.072	.943
Marital status = 0	.077	.285	.268	.789
Employment status = 1	-.259	.266	-.973	.332
Moderate PA 150 = 0	-.160	.336	-.475	.635
Age	-.012	.012	-1.007	.315
Education	.022	.033	.685	.494
Number of children	.073	.073	1.000	.319
Household income	-.000	.000	-.070	.944
BMI	.044	.021	2.154	.032
Blood sugar	.002	.003	.785	.433
SBP	-.006	.009	-.611	.542
DBP	.038	.013	2.848	.005
Cholesterol	-.002	.004	-.528	.598
Urban = 0	.181	.274	.653	.514
Active = 0	-.268	.277	-.979	.329

Note: BMI= Body Mass Index, SBP= Systolic Blood Pressure, DBP= Diastolic Blood Pressure

Table Appendix 2.2

Estimates of Covariance Parameters

Parameter	Estimate	Standard error
Residual	3.428	.334
Intercept [subject=location] variance	.000	.000

Appendix 3: Institution Review Board

FLORIDA INTERNATIONAL UNIVERSITY

Office of Research Integrity
Research Compliance, MARC 270

MEMORANDUM

To:	Dr. Elena Bastida
CC:	File
From:	Maria Melendez-Vargas, MIBA, IRB Coordinator
Date:	September 6, 2013
Protocol Title:	"Obesity: Correlates, Impact on Cardiovascular Risk Factors and Predictors of Weight Loss Success in a Mexican American Population"

The Florida International University Office of Research Integrity has reviewed your study and has determined that it is **Not Human Subject Research (NHSR)**. Therefore, your project will not require the submission to and approval of the FIU Institutional Review Board (IRB).

IRB Protocol NHSR #:	13-0358	**NHSR Review Date:**	09/06/13
TOPAZ Reference #:	101598		

Research *means a systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalizable knowledge.*

Human subject *means a living individual about whom an investigator (whether professional or student) conducting research obtains (1) Data through intervention or interaction with the individual, or (2) Identifiable private information.*

Special Conditions: N/A

For further information, you may visit the IRB website at http://research.fiu.edu/irb.

VITA

JANISSE ROSARIO

Born, Ponce, Puerto Rico

1994-1999	B.S., Biology University of Puerto Rico, Mayagüez Campus Boca Raton, Florida
1999-2001	Master of Public Health Certificate of Environmental Health Florida International University Miami, Florida
2001	Award for academic achievement, GPA: 4.0 Florida International University Miami, Florida
2001-2004	Program Coordinator Partnership against Lead Project Janvier Gasana, PhD Florida International University Miami, Florida
2004 – Present	Sr. Program Officer and Director of Research & Policy Health Foundation of South Florida Miami, Florida
2012	Fellow Terrance Keenan Institute for Emerging Leaders in Health Philanthropy Washington, D.C.
2011 – 2014	Doctoral Candidate in Public Health Florida International University Miami, Florida

PUBLICATIONS AND PRESENTATIONS

Pann, J. Yehl, A., Wood, P., Rosario-Schoepp, J., Solomon, G., & Enders, C. (2014). Implementation and Evaluation of a Multidimensional Nutrition and Physical Activity Initiative Funded by a Community Health Foundation. *Foundation Review*. DOI: 10.4087/FOUNDATIONREVIEW-D-13-00015.1

Rosario, J. A review of the Children's Health Insurance Program Reauthorization and KidCare. Florida Philanthropic Network Annual Summit, January 22-23, 2009, Orlando, Florida.

Rosario, J. The Impact of a Tobacco Tax Increase in Florida. Florida Philanthropic Network Annual Summit, January 22-23, 2009, Orlando, Florida.

Rosario, J. Providing Healthy Food for Lower Income Populations: Issues of Nutritional Equity. 7th Annual South Florida Environmental Ethics Conference, February 15, 2008, Virginia Key, FL

Gasana, J., Siegel, K.A., Hlaing, W.M., Rosario, J., Dummula, K., and Owens, E.A. Establishment of Partnership Against Lead Project following pilot study of environmental lead levels in the inner-city of Miami, Florida, Poster Presentation at APHA 132nd Annual Meeting and Exposition: Public Health and the Environment , November 6-10, 2004, Washington, D.C

Gasana, J., Siegel, K.A., Rosario, J., and Owens, E.A. Procedural description and limitations of collaborating with health care providers in lead poisoning screening in Miami-Dade County, Poster Presentation at APHA 132nd Annual Meeting and Exposition: Public Health and the Environment , November 6-10, 2004, Washington, D.C.

Gasana, J., Siegel, K.A., Hlaing, W.M., Rosario, J., Dummula, K., and Owens, E.A. Assessing the Risks and Knowledge of Economically-Disadvantaged, Minority Urban Population in Preventing and Reducing Childhood Lead Poisoning, Poster Presentation at APHA 132nd Annual Meeting and Exposition: Public Health and the Environment , November 6-10, 2004, Washington, D.C.