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The Mediating Role Of Dietary Patterns On The Relation Between Acculturation, Psychosocial Factors, And Cardiovascular Disease Risk Factors In The U.S. - Mexico Border

Ximena Burgos
University of Texas at El Paso, xburgos@miners.utep.edu

THE MEDIATING ROLE OF DIETARY PATTERNS ON THE RELATION BETWEEN ACCULTURATION, PSYCHOSOCIAL FACTORS, AND CARDIOVASCULAR DISEASE RISK FACTORS IN THE U.S. - MEXICO BORDER

XIMENA BURGOS-MONZON

Interdisciplinary Health Sciences Doctoral Program

APPROVED:

Joe Tomaka, Ph.D., Chair

María Duarte-Gardea, Ph.D., R.D.

Hector Balcazar, Ph.D.

Thenral Mangadu, Ph.D.

Benjamin C. Flores, Ph.D.
Dean of the Graduate School

Dedication

To my family, who provided support and motivated me to achieve this career goal. It is dedicated to my parents, who taught me the importance of achieving dreams, to my Mother for showing me the path that nurtures the spirit and my Father for showing me the path that nourishes the mind. Thank you for your commitment and loving care. To my brother and sister for their unconditional support; my brother Alex because his example taught me to be strong and build my character, my Sister Gaby for making me smile even in the most difficult times, because her example and advice gave me the strength to continue when I wanted to quit. To my lovely husband Charles because he accepted the challenge of supporting me to pursue this dream and has not given up. Thank you, because despite difficult times, you have given me your support, not only financial but most importantly, moral. Thank you, for your company, support, and dedication because it has been instrumental in achieving this dream.

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BY

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Abstract

Chronic diseases affect both, developed and developing countries around the world. In the U.S., cardiovascular diseases (CVD) are the leading cause of death for all groups including Hispanics (Heron, 2009). Hispanics are disproportionally affected by CVD and experience risk factors at higher rates than non-Hispanic whites (Swenson, 2002). Although CVD are among the most expensive and widespread health problems, they are among the most preventable. Evidence shows that diet plays a very important role in the development of chronic diseases; current dietary changes are partially responsible for the increasing epidemic of chronic diseases worldwide. It is well established that the consumption of a healthy diet can help prevent and control morbidity and mortality (Diet, nutrition and the prevention of chronic diseases.2003).

The study of dietary patterns is a useful method to assess dietary intake focusing on the total intake (Kerver, 2003). Dietary patterns reflect the complexity of the diet providing a more practical way for researchers to evaluate the associations between diet and health outcomes and to evaluate health effects of current dietary guidelines. In addition, the public can better understand and implement research results from the dietary pattern studies.

The overall aim of this study is to examine dietary patterns, psychosocial factors, and dietary heart-healthy behaviors as mediators of CVD risk factors among Hispanics adults participating in the H.E.A.R.T. study. Two studies are proposed. Specific aim for Study 1 was to identify and characterize dietary patterns using factor analysis and to examine its associations with demographic characteristics and CVD risk factors. Specific aim for Study 2 was to examine the associations between acculturation, psychosocial factors with dietary patterns and CVD risk factors among Hispanic adults.

Five dietary patterns were identified by factor analysis; the Western, Prudent, Mexican, Juice, and Sweets. The Western pattern was predominantly consumed by younger adults, males, and by participant born in the U. S. The Prudent pattern was predominantly consumed by older adults, females, and participants being born in Mexico. The Prudent pattern was negatively and significantly associated with reduced CVD risk Index, whereas the Western was positively and significantly associated with waist circumference only. The Juice pattern was the only pattern to be negatively and significantly associated with most CVD risk factors. Results from the mediational analysis showed that only the Prudent and Juice patterns mediated the association between gender, age, and education with two CVD risk factors, BMI and CVD risk Index.

Acculturation levels were positively associated with consumption of the Western pattern and lower consumption of the Mexican pattern. Significant indirect effects indicate that the Prudent pattern has a mediating role between acculturation and CVD risk index. Lastly, four SEM models were tested to identify the effects of several psychosocial factors on two CVD risk factors, obesity and CVD risk Index. Results showed that the Prudent pattern was the only significant mediator in the association between psychosocial factors and CVD risk Index. In addition, lower perceived barriers to eat healthy were the strongest predictor of increased consumption of Prudent pattern, followed by higher self-efficacy and higher perceived benefits. Self-efficacy, followed by perceived barriers predicted the Western pattern. Moreover, perceived barriers were the only factor to have a direct effect on both, obesity and CVD risk Index. In conclusion, the models had an acceptable fit of the data in describing factors associated with CVD risk factors among Hispanics in El Paso, TX. Overall, high homogeneity of the study sample may have limited the strength of many relationships, particularly those between dietary patterns and cardiovascular risk factors.

H.E.A.R.T. Study Abstract

Background: A multilevel ecological approach (*individual/group/community/policy*) has been undertaken to address cardiovascular diseases (CVD) among low-income Hispanics in El Paso Texas through a community based participatory research entitled Health Education and Assessment Research Team (H.E.A.R.T) Project. This research study utilizes Community Health Workers (CHWs) with two purposes: 1) implement the program to at risk participants for CVD, and 2) to explore integration of CHWs in the workforce. H.E.A.R.T. is a partnership of academic (The University of Texas at El Paso, University of Texas Houston School of Public Health, El Paso Community College), government (City of El Paso Parks and Recreation), and community based organizations (YWCA El Paso del Norte Region and Centro San Vicente Clinic) working in collaboration to reduce risks of CVD in Hispanics living in the Mission Valley of El Paso (*community level*).

Methods: A 16-week CHW-led intervention comprises a menu of lifestyle and environmental activities offered to participants. Activities such as Su Corazon Su Vida, *charlas* (support groups), aerobics classes are conducted at the YWCA. Latin dance classes, family sports, and walking groups are conducted at city parks. Demographic, anthropometric, and behavioral measures were taken. Integration of CHWs at partner locations was conducted. Consultations with community leaders were performed using a CBPR approach.

Results to Date: A total of 745 adult Hispanics (*individual/group level*) have participated in the H.E.A.R.T. project. A Community Health Academy and Leadership Council has been developed and has established a policy agenda that promotes integration of CHWs into the local and state workforce. In addition and as a result of this project, the "Paso del Norte CHW/Promotora Workforce Coalition" has been formed. The three Coalition's strategic directions for CHW

workforce advancement include: policy and publicity, training and *capacitation*, and research and evaluation (*policy level)*.

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Introduction

A growing epidemic of chronic diseases is affecting both developed and developing countries around the world. Cardiovascular diseases, in particular, cause around 30% of all deaths in the world (WHO, 2008; Rosamond, 2008). For Hispanics living in the U.S., the leading causes of death are also heart diseases (CDC; Heron, 2009). Moreover, Hispanics are disproportionally affected by cardiovascular disease risk factors and experience them at higher rates than non-Hispanic whites (Swenson, 2002). For example, hypertension, overweight, obesity, and diabetes are increasing at alarming rates in this population (American Heart Association, 2008).

Evidence shows that diet plays an important role in the development of cardiovascular diseases; therefore, special emphasis should be placed on the dietary component of an overall *lifestyle modification strategy* (AHA, 2000) to help reduce morbidity and mortality. Recent studies recommend that people should not only focus on eating specific foods or nutrients to improve health, but that general population should adopt an overall healthier dietary pattern (AHA, 2000) consisting of increased consumption of fruits and vegetables, whole grains, lean meat and poultry, fat-free or low-fat dairy products, beans, peas, and nuts and seeds (USDA, 2010).

The recommendation for people to focus on a healthier dietary pattern, as described above, instead of increasing or eliminating specific nutrients, such as increasing dietary fiber only, has arisen from current studies that use the dietary pattern approach. Several authors have evaluated the use of the dietary pattern over the single nutrient approach because the overall dietary pattern might be easier to interpret by the public and therefore better translated into a healthier diet (Slattery, 1998; Newby, 2004; Hu, 2002; Hoffman, 2004). In addition, the study of

dietary patterns provides a more practical way to evaluate the associations between diet and health outcomes, as wells as the evaluation of the health effects to current dietary guidelines (Hu, 2002; Fung, 2001; Ashima, 2004; Hu, 2008; Kerver, 2003; Iqbal, 2008; Artinian, 2004; Nettleton, 2009).

As mentioned before, previous research studies have identified that diet plays an important role in the development of cardiovascular diseases. Although many have analyzed the relationship between diet and cardiovascular diseases, fewer have examined multivariate associations among dietary patterns, demographic characteristics, acculturation, and psychosocial factors and how they relate to disease risk. Therefore, the proposed studies will investigate the direct and indirect effects of dietary patterns and psychosocial factors as mediators in the development of cardiovascular disease risk factors. Understanding dietary intake patterns among Hispanics living in the U.S- Mexico border and identifying whether they mediate the occurrence of cardiovascular disease risk factors will sharpen interventions aimed at improving dietary patterns, thereby preventing diet-related chronic diseases and ultimately improving quality of life.

Therefore, this study will examine dietary patterns, psychosocial factors, and dietary heart-healthy behaviors as mediators for cardiovascular disease risk factors among Hispanic adults participating in a large cardiovascular disease risk factor intervention study (i.e., the H.E.A.R.T. study). Two specific studies are proposed as part of this dissertation. Study 1 will identify and characterize dietary patterns among Hispanic participants of the H.E.A.R.T. study using exploratory factor analysis and will identify direct and indirect association between demographic characteristic and dietary patterns as mediators of cardiovascular disease risk factors. Study 2 will identify the direct and indirect associations between demographic

characteristics, acculturation, psychosocial factors and dietary patterns among Hispanics adults participating in the H.E.A.R.T. study.

Background of the Study

Cardiovascular Diseases Overview

Cardiovascular diseases refer to a group of diseases that comprise heart disease, stroke, and congestive heart failure. In order to understand the role of dietary intake on cardiovascular disease is important to understand the pathogenesis of heart diseases. The pathological process responsible for coronary heart disease and stoke is called atherosclerosis. This chronic condition begins in childhood and continues to progress during adulthood. Atherosclerosis is caused by the build-up of fibrous-fatty plaques on the walls of the arteries. As we age, the fibrous plaques experience a variety of changes that can led to serious complications such as ulceration of the connective tissue and thrombosis. These pathological processes are responsible for obstruction of the blood flow in the arteries. Fibrous plaques and its consequent lesions located in the coronary artery leads to coronary heart disease, the most common clinical manifestation of atherosclerosis. However, if the fibrous plaques and lesions are located in a cerebral artery it will lead to restriction of blood flow to the brain and possibly stroke (Committee on Diet and Health, National Research Council, 1989).

In the early 1910s, experimental studies conducted in animals demonstrated that *dietary cholesterol* was responsible for higher serum cholesterol and development of atherosclerosis. Later on, studies found that *dietary saturated fats* elevate serum LDL cholesterol and induce atherosclerosis (Anitschkow, 1967). In addition to dietary cholesterol and fats, additional risk factors associated with atherosclerosis include overweight and obesity, physical inactivity, smoking, diabetes, and hypertension (Committee on Diet and Health, National Research Council, 1989). These risks factors are described in greater detail in the sentences below.

Prevalence and Costs of Cardiovascular Diseases

Overall, cardiovascular diseases are among the most widespread and expensive health problems in the Unites States. Similar to the trends seen worldwide, cardiovascular diseases are the leading causes of death in the United States with estimates showing them responsible for more than one third of all deaths in the Nation. Diseases of the heart are more than just a health problem; the disease and its underlying causes have major financial consequences for the individuals and the governments. In the United States, during 2010, the total cost of cardiovascular diseases was estimated to be $444 billion and one of every six dollars spent on health care was used to treat cardiovascular diseases. As the population ages, the economic burden of the disease will increase (Heidenreich, 2011).

Estimates show that more than 2200 American die each day of cardiovascular disease (Roger et al., 2012). Among the cardiovascular diseases, heart disease is the number one cause of death, accounting for over 33% of all deaths (1 of every 3 deaths) in 2010. In the same year, heart disease claimed 47,250 lives in Texas alone (Texas Department of Health, 2010). Stroke is the number 4 cause of death accounting for one of every eight deaths in the U.S. (Roger et al., 2012).

Hispanic Disparities in Cardiovascular Disease

The term Hispanic or Latino can be used interchangeably to define a person of "Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race" (Office of Management and Budget). In 2010, approximately 50.5 million Hispanics were living in the United States, representing 16.3% of the U.S. total population. By 2050, estimates indicate that Hispanics will represent 30% of the U.S. population, reaching 132.8 million. Texas is the fourth state with the largest Hispanic population (38%) in the U.S.

Coronary heart disease and stroke are also the leading causes of death among Hispanics (CDC; Heron, 2009). Moreover, the incidence of cardiovascular disease risk factors including overweight, obesity, and diabetes affects Hispanic at higher rates than non-Hispanic whites (Rosamond, 2008). For example, in 2007, the diabetes death rate for Hispanics was 1.5 times higher than for non-Hispanics whites. Also, data from the NHANES from 2007-2008 indicates that the prevalence of obesity among Mexican American Men increased from 24% to 36% compared to 22% to 32% for non-Hispanic whites. Similarly, Mexican American women are more likely to be obese than non-Hispanic white women; the prevalence of obesity among Mexican American women was 45% compared to 33% non-Hispanic white women (Ogden, 2012).

Along with the higher prevalence of diabetes and obesity, physical inactivity is another existing risk factor in Hispanics. Sedentary lifestyles are more common among Hispanics than among white adults. Indeed, approximately 36% of Hispanics reported being physically inactive during leisure time, compared with 18% for the general population (Liao et al., 2004). Coupled with the high prevalence of cardiovascular disease risk factors, Hispanics are less likely to have access to health care services. For example, only 37% of Hispanics under the age of 65 had private health insurance compared to 73% of non-Hispanic whites. Limited access to regular health care services makes Hispanics less aware of other risk factors for cardiovascular diseases such as high blood pressure or high blood cholesterol (Perez-Stable, 1994). Overall, Hispanic adults have poverty rates twice as high as non-Hispanic whites do, and living in poverty is related to poorer health conditions, being uninsured, and mortality at younger age (CDC/NCHS, 2011).

Cardiovascular Disease Risk Factors

As noted above, several factors increase the risk for cardiovascular diseases; some factors are non-modifiable, whereas others are modifiable. Non-modifiable, risk factors include things such as age, gender, and heredity. Modifiable risk factors, in contrast, include high blood pressure, high cholesterol, smoking, physical inactivity, overweight/obesity, and diabetes. Indeed, the Canadian Heart and Stroke Foundation identified nine modifiable risk factors including those above plus alcohol abuse, malnutrition, and blood glucose (Heart and Stroke Foundation, 2005).

Numerous investigations have studied the effects of modifiable risk factors on cardiovascular diseases. Overall, the evidence shows that cardiovascular diseases can be prevented by lifestyle changes (Yusuf, 2004; Heart and Stroke Foundation, 2005). Of these risk factors, obesity, high blood pressure, and diabetes belong to the WHO's top 10 list of global health problems. These risk factors are described in detail below. In addition, because the emphasis of this project is on dietary patterns, the relationship of each to diet is explicitly noted.

Overweight and Obesity

The World Health Organization defines overweight and obesity as "an abnormal or excessive fat accumulation that might impair health" (WHO, 2000). Obesity is a complex disorder caused by genetic and environmental factors that affect the balance of energy consumption and energy expenditure (Buttar, 2005). The Body Mass Index, obtained by dividing the weight in kilograms by the height in meters squared (i.e., kg/m^2), is a widely used weight-for-height index to classify overweight and obesity in adults. A BMI ≥ 25 is defined as overweight and a BMI ≥ 30 is defined as obesity (WHO, 2000).

Worldwide, the prevalence of obesity has increased among people of all ages and socioeconomic groups in both developing and developed countries. The World Health Organization (WHO) has described this problem as an "escalating global epidemic" (WHO, 2000). Currently, there are 2-3 times more overweight people in the world than there were two decades ago (Speiser et al., 2005). Overweight and obesity are the fifth risk for global deaths and 23% of the burden of heart diseases can be attributable to overweight and obesity (Buttar, 2005).

Overweight and obesity place people at greater risk for heart disease, high blood pressure, and diabetes among other diseases. Excess body weight is associated with higher rates of morbidity and mortality and reduced life quality (National Lung, National Task force). A BMI greater than 35 significantly increases the risk of death (Flegal, 2005). For the period between 1988-1994 and 2007-2010 the percentage of adults overweight but not obese (BMI 25-29.9) remained steady, but the percentage of adults with obesity (i.e., BMI $\geq$30) increased for both men and women (CDC/NCHS, 2011). In addition, the prevalence of obesity is higher among women with lower educational attainment. Reports from the 2009-2010 National Health and Nutrition Examination Survey (NHANES) indicate that the age-adjusted prevalence of obesity is 36% for adults 20 years and older. For Hispanics, the age-adjusted prevalence of obesity is 39%, higher than the nation's age-adjusted prevalence; within the Hispanics group, Mexican-Americans have an age-adjusted obesity prevalence of 40% (Flegal, 2012).

As noted above, energy imbalance is most proximal cause of the overweight and obesity epidemic. The imbalance between the calories eaten and the calories used is mainly influenced by changes in dietary patterns, that include higher intake of energy-dense foods, high in fat, salt, and sugars but low in vitamins and minerals, and changes in the environment and society that promote sedentary lifestyles.

Current guidelines to improve diet and lifestyle are a critical strategy to reduce the risk for cardiovascular diseases in the general population. The American Heart Association recommends that individuals should focus on eating a healthier dietary pattern, identifying the caloric needs to achieve and maintain a healthy weight, and engaging in physical activity to reduce the overweight and obesity epidemic (Buttar, 2005; Lichtenstein, 2006).

High Blood Pressure

High blood pressure belongs to the modifiable category of risk factors for cardiovascular disease. The blood pumped by the heart produces pressure against the walls of the arteries and this force is measured as systolic and diastolic pressure. Systolic pressure reflects the pressure of the arterial pulse (when the heart contracts and pumps blood to the arteries) whereas diastolic pressure reflects the drop in pressure between heartbeats (when the heart refills with blood and ventricles relax). A normal or healthy blood pressure is a systolic BP <120mm Hg and a diastolic BP <80 mm Hg. Hypertension is defined as systolic BP ≥ 140mm Hg or diastolic BP ≥90 mm Hg or being on antihypertensive medication (NHANES, NCHS).

Blood pressures higher than these numbers are considered a serious condition that position people at higher risk for cardiovascular diseases (NHLBI, 2004). In the United States 76.4 million people 20 years and older—or one out of three adults—have high blood pressure. From 2005-2008, high blood pressure was present in more than two thirds of the people who had a heart attack for the first time (69%), had their first stroke (77%), or had congestive heart failure (74%). It is projected that by 2030 there will be a 9.9% increase in the prevalence of high blood pressure from 2010, or an additional 27 million people with hypertension. Hypertension is also an expensive disorder with a total direct cost of over $47 billion in 2008 (NHLBI, 2004).

The prevalence of hypertension among Hispanics is around 28% for both genders, a number that is only slightly higher than non-Hispanic Whites (25%), but lower than African-American (47%). Regardless of the differences in prevalence rates, a recent report by C. Ayala et al., (2005) found that of 21% of Hispanic adults who self-reported having high blood pressure, only 45% reported currently taking medication for high blood pressure compared to 53% of non-Hispanic whites and 53% African-American (C. Ayala et al., 2005). Like obesity, high blood pressure is determined by genetics and environmental factors. Of the environmental factor affecting blood pressure–diet, physical inactivity, and psychosocial factors–the diet has a predominant role in the development of high blood pressure. For example, multiple modifiable dietary factors affecting blood pressure include moderation of sodium intake, induced weight loss, moderated alcohol consumption, increased potassium intake, and the consumption of an overall healthier diet (Appel, 2006; Buttar et al., 2005).

Diabetes

Diabetes is a chronic health condition where the body does not produce enough insulin or cells in the body cannot use the insulin available. Insulin is a hormone secreted by the pancreas and it helps the movement of glucose from the blood into the cells. When the glucose cannot enter the cells, because the insulin is deficient, it cannot be metabolized increasing in the blood and affecting different systems in the body, including the cardiovascular system. Diabetes increases the risk of several cardiovascular problems. For example, people with diabetes have 2 to 4 times higher risk for stroke and the death rate from heart disease is also 2 to 4 times higher risk for people with diabetes (CDC, 2011; ADA, 2011).

In the United States, there are 25.6 million adults 20 years or older diagnosed with diabetes and there were approximately 1.9 million new cases in 2010. Diabetes contributed to

231,404 deaths. Hispanics are at higher risk for developing type 2 diabetes (ADA, 2011). Data from the 2007-2009 national survey indicate that 11.8% Hispanics aged 20 year or older have diabetes compared to 7.1% non-Hispanic whites. In addition, a recent report by Balcazar et al., (2012) found that 13% of Hispanics living in the U.S. –Mexico border had been diagnosed with diabetes (Balcazar et al., 2012). Compared to non-Hispanic, the risk of diagnosed diabetes is 66% among Hispanics (CDC, 2011).

As with other risk factors, the environment, particularly the diet, plays a primarily role in the development and treatment of diabetes. Several studies have investigated the role of specific nutrients in the development of diabetes. For example, higher intake of saturated fat and trans-fatty acids can adversely affect glucose metabolism, whereas higher intake of polyunsaturated fats can be beneficial. Nonetheless, the most important strategy to reduce the risk of diabetes is to prevent overweight and obesity, to engage in regular physical activity, to have a balanced consumption of energy, and to include whole grains and dietary fibers as part of a healthy dietary pattern (Hu, 2001; Meyer, 2000; CDC, 2011).

Physical Inactivity

A sedentary lifestyle is associated with increased risk for developing cardiovascular disease; particularly because being physical inactive can lead to overweight, obesity, and diabetes (Leitzmann et al., 2007; Buttar, 2005). In the U.S., estimates indicate that approximately 61% of adults do not engage in any regular physical activity. The estimated age-adjusted rates of physical inactivity during leisure time range from 10% to 43%. Reports from the Texas Behavioral Risk Factors Surveillance System indicate that the Texas 2007 prevalence of leisure-time physical inactivity is significantly higher than the National average (The Burden Report: Cardiovascular disease and stroke in Texas, 2009). Sedentary lifestyles are more common among

Hispanics than among white adults, approximately 36% of Hispanics report being physical inactive during leisure time compared to 18% for the general population (Liao et al., 2004).

Regular physical activity has favorable effects on the body; several studies have identified associations between being physical active and overall well-being (Yusuf, 2004; Sesso, Paffenbarger, Ha & Lee, 1999; Drygas, 2000). For example, Lee and colleagues (2001) identified in the Women's Health Study that walking at least one hour per week predicted a reduction of coronary heart disease by 50% (Lee et al., 2001). Moreover, in a 30-year follow-up the authors identified that participants that engaged in increased walking distances had a 33% reduction of CDV incidents when compared to those participant that engaged in shorter walking distances (Sesso, Paffenbarger, Ha & Lee, 1999). Overall, being physical active will help achieve and maintain a healthier weight, lower blood pressure, and improve plasma lipid profiles. Consequently, lifestyle recommendations raise awareness about the importance of maintaining physical fitness and encourage people to engage in regular physical activity to reduce cardiovascular risk factors and lower the risk of developing obesity, diabetes, and other chronic diseases (Lichtenstein, 2006).

Dietary Behaviors

The diet plays a very important role in the development of chronic diseases. Unhealthy dietary behaviors including higher intake of saturated fats, added sugars, sodium, and cholesterol are considered a major modifiable risk factor in the development of heart diseases and stroke (Ezzati et al., 2003). A diet low in fruit and vegetable intake is estimated to cause about 31% of coronary heart diseases and 11% of stroke in the world (Mackay & Mensah, 2004). In 2007, only 25% of adults living in Texas reported consuming five fruits and vegetables a day (The Burden Report: Cardiovascular disease and stroke in Texas, 2009). According to Colon-Ramos et al.,

(2009) Hispanics do not meet the national recommendation of fruit and vegetables consumption. Overall, recent studies have documented that healthier dietary patterns are associated with significant reduction of cardiovascular disease risk factors (Appel, 2005; Knoops, 2004).

A balanced diet is essential not only to meet body's growth and energy requirements, but also to protect against disease and to preserve homeostasis (Buttar, 2005). Diet adjustments according to individual caloric needs and physiological conditions are required. For example, the diet for diabetic individuals has specific requirements such as reduced caloric and total saturated fat intake, and increased consumption of dietary fiber. A vast amount of research suggests that healthier dietary patterns including fruits and vegetables, whole grains, low-fat dairy products, and fish can decrease the risk of developing cardiovascular diseases (Katan, 1997; Hu, 1997; Kelly, 2003; Esposito et al., 2004; Knoops et al., 2004). The following section describes the specific role of different nutrients and foods on the development of cardiovascular diseases.

Dietary Fiber

Fiber does not provide energy, but it plays an important role in the process of gastrointestinal and cardiovascular health (Cho & Almeida; 2012). There are two different types of dietary fiber, soluble and insoluble. Soluble fiber includes pectins, mucilages and gums; insoluble fiber includes cellulose and hemicellulose. Each type of fiber has specific properties. For example, soluble fiber forms a gel during digestion that helps to reduce spikes in blood sugar concentrations because it regulates the absorption of glucose in the intestine; it also helps lower blood cholesterol assisting in the prevention of cardiovascular diseases. Soluble fiber is found in out brans, nuts, beans, lentils, and peas. Insoluble fiber helps the gastrointestinal function of the body because it captures a variety of residuals, softening the stools and improving digestion. In addition, dietary fiber allows an optimal digestion and nutrient absorption by delaying gastric

emptying. Because it provides a feeling of fullness, dietary fiber aids to achieve and maintain a healthier weight.

Several studies have investigated the protective effect of dietary fiber on cardiovascular health. Pietinen et al. (1996) found a statistically significant inverse association between consumption of different types of fiber and relative risk of cardiovascular events. Likewise, a six-year cohort study conducted by Rimm et al. (1996) evaluated the association between fiber intake and coronary artery disease. Consumption of dietary fibers was divided into quintiles. The authors identified a statistically significant inverse association between dietary intake and fatal coronary disease. The relative risk of fatal coronary disease for those in the higher quintile was 0.45 compared with participants in the lowest quintile. Epidemiological studies support the consumption of dietary fiber to reduce the risk for cardiovascular diseases, the greater the amount of dietary fiber, the lower the risk.

Fruits and Vegetables

Fruits and vegetables are rich in essential nutrients. They are a perfect example of a nutrient-dense food because they contain dietary fiber, vitamins, trace elements, and antioxidants, but are low in calories. It is believed that the health benefits of fruits and vegetables intake arises from the synergistic effect of the phytochemicals (Liu, 2003). Phytochemicals are compounds found in plants including fruits, vegetables, beans, and grains. Some of the most common phytochemicals are beta-carotene, ascorbic acid, Vitamin E, and folic acid. The consumption of fruits and vegetables rich in antioxidants provides a protective effect against chronic diseases. Antioxidants can slow the process of atherosclerosis because they have the capacity to prevent the oxidation of low-density lipoproteins (LDL); this is important because

endothelial arterial plaques begin with the oxidation of LDL (Committee on Diet and Health, National Research Council, 1989).

The Women's Health Study, a prospective study, observed a statistically significant inverse association between fruit and vegetable intake and risk for cardiovascular diseases in women (Liu, 2000). Another long-term follow-up study looked at the effect of fruits and vegetables intake on the development of cardiovascular disease and identified a strong and inverse association between fruit and vegetable consumption and incidence of stroke mortality and ischemic heart disease mortality (Bazzano et al., 2002).

Evidence supports the recommended daily intake of fruit and vegetables as part of the strategy to reduce risk. The general dietary recommendation includes consumption of at least 2.5 cups of fruits and vegetables to prevent obesity, diabetes, and cardiovascular diseases (USDA, 2010)

Dietary Fats

Dietary fats have been thought to be unhealthy and even harmful for our body; but good fats are an important source of energy, help maintain proper growth and development, and aid our body absorb vitamins. Consequently, individuals should not eliminate all fats from the diet, but should consume the right type and amount of fats that are beneficial for the body. For example, good fats include monounsaturated, polyunsaturated fats, plant sterols, and essential fatty acids; these fats can be found mainly in fish, avocados, walnuts, and liquid vegetables oils, such as olive, corn, canola, and sunflower. Harmful fats include saturated fats, Trans-fatty acids and cholesterol; these fats can be found in butter, solid shortening, lard, partially hydrogenated oils, and foods from plants such as coconut, palm oil, and cocoa butter (Paradis & Fodor, 1999; Buttar et al., 2005).

Trans-fatty acids are the product of a process known as hydrogenation. Highly processed foods, such as cookies, contain this synthetic product; when consumed, the body cannot process it causing harmful effects in the cardiovascular system. Consumption of Tran-fatty acids has been found to be related to increased risk of atherosclerosis and cardiovascular disease (Buttar, 2005). In one meta-analysis, Hooper et al., (2001) showed that dietary modifications such as reduction in the total intake of fat, reduction of saturated fat and dietary cholesterol, or change from saturated to monounsaturated fat reduce cardiovascular mortality by 9%.

Sodium

The consumption of dietary sodium is related to blood pressure and a sodium-reduced diet has been documented to lower blood pressure (He, 1999; Frisoli, 2012). Consumption of high amounts of dietary sodium may directly increase the risk of stroke (Nagata, 2004). The recommended sodium intake is <2,300mg for adults and <1,500mg for individuals age 51 and older or that have hypertension or diabetes. Overall, all Americans consume an average of 3,400mg/day of sodium, that is more sodium than needed.

Sodium is mainly consumed as table salt and used as a food ingredient during food processing, for example in ready-to-eat-cereals, burgers, pizza, soups, yeast breads, chicken and chicken mixed dishes, dessert, and much more. The consumption of sodium is associated with calorie intake, therefore, the more foods and beverages eaten, the more sodium consumed. Reducing calorie intake will help reduce sodium intake. Thus, general recommendation to reduce sodium intake include consuming more fresh foods and fewer processed foods, reading the Nutrition Facts labels and purchasing those foods lower in sodium, and using little salt when cooking and eating foods trying to substitute with different condiments (USDA, 2010).

Given the importance that the diet plays in the development of cardiovascular disease risk factors, the American Heart Association recommends that people eat an overall healthier diet and not only to focus on single nutrients or foods. The healthier the diet, the lower the risk for cardiovascular disease; a healthier diet should include a variety of fruits and vegetable, whole grain products, legumes, lean poultry and meat, fish, and fat-free dairy products (Lichtenstein et al., 2004). A detailed literature regarding dietary patterns and its effect on health outcomes is covered in Study 1.

Statement of the Research Problem

Recently, the analysis of dietary patterns has become an important and widely used approach in nutritional epidemiology to investigate the association between diet and health outcomes (Hu, 2002; Newby, 2004). Unfortunately, little is known about the characteristics of the diet among Hispanics living in the U.S. Mexico border and its association to specific cardiovascular disease risk factors. Therefore, the study of dietary patterns will help understand the characteristics of dietary practices among Hispanics living in the U.S.-Mexico border, which will provide guidance for future nutrition education interventions to prevent cardiovascular disease risk factors in a disproportionally affected population. Because the individual dietary patterns reflects an interaction of several factors including genetics, sociocultural and environmental characteristics, economics, and health status, this study examined dietary patterns, psychosocial factors, and dietary heart-healthy behaviors as mediators for cardiovascular disease risk factors among Hispanics adults participating in a large cardiovascular disease risk factor intervention study (i.e., the H.E.A.R.T. study).

Within the context of the H.E.A.R.T. study, two studies were conducted. The specific aim for *Study 1* aims to characterize dietary patterns using factor analysis. A secondary aim was to examine associations among derived dietary patterns, demographic characteristics, and cardiovascular disease risk factors in Hispanic adults participating in the H.E.A.R.T. Study. A third aim of this study was to explore dietary patterns as mediating pathways between demographic and socioeconomic characteristics and cardiovascular disease risk factors. The specific aim for *Study 2* was to examine the associations between acculturation, various psychosocial factors, and their relationship to dietary patterns and cardiovascular disease risk factors among Hispanic adults participating in the H.E.A.R.T. project.

H.E.A.R.T. Study

The Health Education Assessment Research Team (H.E.A.R.T.) is large scale-NIH funded community-based participatory research project that employs a community health worker/promotoras de salud (CHS/PS) model to promote cardiovascular health among the Hispanic community living on the U.S.-Mexico border. The project has been conducted by four partners with a common goal and includes the University of Texas at El Paso (UTEP), the University of Texas School of Public Health El Paso Regional Campus (UTHSPH-El Paso), El Paso Community College (EPCC), Centro San Vicente (CSV), and the YWCA El Paso del Norte Region. The overall objective of the H.E.A.R.T. project is to reduce risk factors for cardiovascular disease (CVD) in Hispanics in El Paso, Texas (Balcazar et al., 2012).

While the H.E.A.R.T. project aims at targeting four domains to reduce health disparities in CVD risk factors in Hispanics living in the Lower Valley, this research project will focus on the individual level/family domain only.

Purpose of the Purposed Studies

In addition to characterizing dietary patterns in Hispanics living in the U.S. Mexico border and identifying its association to cardiovascular disease risk factors, this study will examine psychosocial factors and dietary heart-healthy behaviors as mediators for cardiovascular disease risk factors among Hispanic adults participating in the H.E.A.R.T. study. Two studies are proposed.

Study 1 aims to characterize dietary patterns using factor analysis. A secondary aim was to examine associations among derived dietary patterns, demographic characteristics, and cardiovascular disease risk factors in Hispanic adults participating in the H.E.A.R.T. Study. A third aim of this study was to explore dietary patterns as mediating pathways between demographic and socioeconomic characteristics and cardiovascular disease risk factors.

Study 2 was to examine the associations between acculturation, various psychosocial factors, and their relationship to dietary patterns and cardiovascular disease risk factors among Hispanic adults participating in the H.E.A.R.T. project.

Methods

H.E.A.R.T. Study Methodology

As described above, the study of dietary patterns offers a more comprehensive approach to identifying associations between diet and health outcomes. Understanding how and why people eat and what factors contribute to individual dietary patters can help focus interventions aimed at improving diet, thereby preventing diet-related chronic diseases and ultimately improving quality of life. Two specific studies are proposed below that (a) characterized dietary patterns and (b) examined the direct and indirect associations between demographic characteristics, acculturation, and psychosocial factors on dietary patterns —and examined the relationship of these variables to cardiovascular disease risk factors— among Mexican Americans living in the border and participating in the H.E.A.R.T. study. Below, the general methods used in the H.E.A.R.T. study are described, followed by the methods and specific measures and statistical approaches used in this dissertation.

The H.E.A.R.T. study began its pilot phase (phase 1) in 2005. The targeted community for phase 1 included the Mission Valley of El Paso, Texas and five zip codes were included. Results from the pilot study showed that the Mission Valley has specific characteristics that distinguish it from the rest of El Paso, including higher proportion of Hispanics (>92%) compared to the greater of El Paso area (78%) (Balcazar et al., 2010). Results from the pilot phase prompted the overall objective and specific aims for the H.E.A.R.T. phase 2 of the NCMHD Community-Based Participatory Research initiative to reduce and eliminate health disparities in the Mission Valley, specifically outlined by the zip code 79915 and 79907, which was the population for phase 2 including approximately 92,000 residents (94% Hispanics).

H.E.A.R.T. Study Phase 2

Project Overview. The H.E.A.R.T. study is large scale-NIH funded community-based participatory research project that employs a Community Health Worker/Promotoras de Salud (CHW/PS) to promote cardiovascular health among the Hispanic community living on the U.S.-Mexico border. Phase 2 of the H.E.A.R.T. study concluded in March, 2013. H.E.A.R.T. Study phase 2 overall objectives were to reduce cardiovascular disease risk factors in Hispanics living in 2 low income areas of El Paso, Texas and to engage the community in a physical activity and nutrition intervention. The intervention was based on an ecological framework targeting five specific change agents: 1) Policy (e.g., policy makers), 2) Community (e.g., community members) 3) Organizational (e.g., YWCA, Parks and Recreation, CHALC, UT-El Paso, UT-SPH, Centro San Vicente, El Paso Community College),4) Interpersonal (e.g., Promotores, family, friends, social networks), and 5) Individual (e.g., H.E.A.R.T. participants). The ecological approach used parks and recreation facilities to implement physical and nutrition programming. Phase 2 incorporated two new partners, the YWCA and Parks and Recreation Department, into the Community Health Academy and Leadership Council (Balcazar et al., 2012).

Community Health Workers/Promotoras de Salud (CHW/PS) were responsible for delivering important elements of the intervention which included a curriculum entitled "Mi Corazon, Mi Comunidad" ("MiCMiC"). The MiCMiC programs were constructed using the social cognitive theory as framework (Bandura, 1986). In addition, MiCMiC curriculum included methods identified by the CDC Task Force Community Preventive Services such as the utilization and creation of 1) self-management education for adults with type 2 diabetes, 2) community-wide campaigns that encourage physical activity, 3) walking groups to offer social

support, 4) individually tailored interventions 5) access to existing local exercise facilities, and 6) improving self-monitoring and goal-setting skills among participants (Balcazar et al., 2012). Specifically, MiCMiC intervention included Su Corazon, Su Vida curriculum (Balcazar et al., 2010) and physical activities and classes at the YWCA and parks. The programs focus was on nutrition or exercise; supplemental activities included 1) coffee talks, 2) heart-healthy cooking demonstrations, 3) heart-healthy grocery shopping tours, 4) Latin dance in the parks, 5) family activities (e.g., playing soccer and swimming), and 6) walking groups. Table 1 presents the minimum expectations required by H.E.A.R.T. participants (Balcazar et al., 2012).

Mi Corazon Mi Comunidad consisted of 5 cohorts, each cohort participating in a 4-month intervention based on a pre-post design and including 3 data collection points: baseline, 4 months, and 8 months. A total of 744 participants included Hispanics adults aged 18 years or older who resided in any of the two selected zip codes (e.g., 79907 and 79915). These areas include approximately 92,000 residents, of whom 94% are Hispanics. Recruitment was conducted by CHW/P; recruitment effort includes participation in health fairs, media and newsletter distribution, mass mailing, and radio and television announcements.

Inclusion and Exclusion Criteria of H.E.A.R.T. Participants

Inclusion. To be eligible, potential participants were adults (18 years or older) living in zip codes 79907 or 79915 and planning to remain at the same residence for the next ten months while the study is ongoing.

Exclusion. Participants were excluded from participating in the study if they had any of the following: were current members of the YWCA; planned to change residence in the next six months; currently pregnant or planning to become pregnant in the next six months; been told by a doctor that they cannot participate in any type of physical activity; history of heart attack, heart

surgery, or stroke; and having an orthopedic or joint problem that prohibits participation in the physical activity/exercise component of the study. Participants were also excluded if, in the last six months, they had suffered any injury that might not allow them to participate in physical activity/exercise component of the study; had any type of surgery on the back, knees, or other joints; or been told that they had a clogged artery or have had an angioplasty. Finally, participants were excluded if they have ever been told that they had a thrombosis.

H.E.A.R.T. Study Procedures for Recruitment and Data Collection

Promotoras de Salud recruited participants at health fairs, using media and newsletter distribution, mass mailings, and radio and television announcements and invited them to participate in the study. Volunteers completed H.E.A.R.T. study questionnaires at baseline and at 4 moths (Time 1), but not at 8 months (Time 2). Questionnaires assessed contextual and psychological variables at baseline and time 1. Questionnaire data included socioeconomic and educational status assessments, demographic status (Balcazar et al., 2010), acculturation (Marin, Sabogal, VanOss-Marin, Otero-Sabogal & Perez-Stable, 1987), self-efficacy, intentions to healthy eating, and a food frequency questionnaire.

Research Assistants collected clinical data at all three time points (e.g., baseline, time 1, and time 2). Clinical variables assessed included weight, height, waist and hip circumference, systolic and diastolic blood pressure, and a 3-minute step test. Research staff used standard protocols to collect weight, height, waist and hip circumference, and blood pressure for all participants (Balcazar et al., 2010). Because the studies described below focus specifically on data from baseline, the remainder of this section focuses on data collection during this session. Readers are referred to Balcázar, Wise, Rosenthal, Ochoa, Rodriguez, Hastings, Flores,

Hernandez & Duarte-Gardea (2012) for details regarding follow-up assessments (Balcazar et al., 2012).

H.E.A.R.T. Study Protection of Research Participants

All research activities for the H.E.A.R.T. study were approved by appropriate IRBs. Promotoras informed participants about the voluntary nature of their participation, answered questions, and obtained written consent. Informed consent forms were given in English or Spanish, depending on the participant's language of preference. The CHW/PS explained the right of the participants to withdraw from the study at any time, clearly stated the risks and the benefits of taking part in the study, and assured that every effort will be done to maintain confidentiality of information provided by research participants. Additionally, data collected from study participants was stored on a computer that is password protected. Questionnaires containing participants' responses are locked away in a secured cabinet and access is limited to the research team. All participants were provided with a copy of the consent form containing contact information of the researcher and UTEP IRB Office.

Table 1.
Minimum expectations by H.E.A.R.T. participants

Activity	Expectations per Month	Total Per Intervention (4 months)
Lifestyle-Nutrition Su Corazon, Su Vida	1 Session	4 Sessions
Environment-Nutrition Coffee Chats		
Heart healthy shopping grocery shopping tours	1 Session	4 Sessions
Cooking Demonstrations		
Lifestyle and Environment-Exercise YWCA Aerobic Classes		
Family Soccer		
Latin dance aerobics in the park	4 Sessions	16 Sessions
Walking groups in the parks		
Swimming in the parks		
Free Choice (any activities from above)	1 Session	4 Sessions
TOTAL	7 Sessions	28 Sessions

Source: Balcazar et al., 2012. Retrieved from http://dx.doi.org/10.5888/pcd9.110100

Dissertation Methodology

This study is a secondary data analysis of the H.E.A.R.T. study. Specifically, study 1 and 2 used cross-sectional data from H.E.A.R.T. study baseline assessments, to characterize current dietary patterns, its mediators, and its association with cardiovascular disease risk factors in Mexican-American adults participating in the H.E.A.R.T. study. These baseline assessments were distributed among four cohorts of H.E.A.R.T. participants which includes a total of n=605 participants.

Sample Size and Power

The present study is a secondary data analysis that includes data from four different cohorts (N = 605) of H.E.A.R.T. participants from 2010-2012. A sample size of 605 is generally sufficient for conducting factor analysis (Tabachnick & Fidell, 2007) and sufficient for structural modeling (Chan, Lee, Kubota, & Allen, 2007). Although many different analyses are planned, as an illustration of power, a sample of 605 adults would have sufficient power (90%) to detect a bivariate standardized regression coefficient of .125 (small effect size) with alpha = .05 (two-tailed).

Institutional Review Board

The proposed studies are a secondary data analysis; participants were not be contacted for the purpose of these studies and their contact information remained confidential. All data assessed as part of the proposed studies contained no identifying information, therefore this study was exempt from IRB review according to federal regulation 45 CFR46.101(b)(4).

Variables

Table 2 presents variables investigated in Study 1 and Study 2.

Measures

Baseline questionnaire included information about demographic and socioeconomic characteristics, acculturation (Marin, Sabogal, VanOss-Marin, Otero-Sabogal, & Perez-Stable, 1987), social support (Cutrona & Russell, 1987), health status, exercise, believes and attitudes, social norms, self-efficacy, intentions to eat healthy, My Habits, and food frequency questionnaire. In addition, baseline measurements included clinical measures. Weight, height, waist, and hip circumference were measured by Promotoras de Salud following standard procedures. In addition, measures included blood pressure and a 3-minute step test for heart rate.

Cardiovascular disease risk factors

Clinical variables such as weight, height, calculated BMI, waist and hip circumference, and systolic and diastolic blood pressure were used as outcome variables in both Studies. The CVD risk index was calculated from information from a CVD risk assessment data, presented in Table 11. Because this paper focuses specifically on data from the H.E.A.R.T. baseline survey, this section focuses on data collection during this session. Readers are referred to Balcázar, Wise, Rosenthal, Ochoa, Rodriguez, Hastings, Flores, Hernandez & Duarte-Gardea (2012) for details regarding follow-up assessments (Balcazar et al., 2012).

Body Mass Index was calculated to classify underweight, overweight, and obesity in adults. It was defined as the weight in kilograms divided by the square of the height in meters (kg/m^2). The international classification of overweight and obesity according to BMI is normal range (18.5-24.99), overweight (25.00-29.99), and obese (class I: 30.00-34.99, class II: 35.00-39.99, and class III: $\geq$ 40.0) (WHO, 2004).

Waist circumference was used to categorizer participant into increased risk > 80cm for females and >94 cm for males and substantially increased risk > 88cm for females and > 102cm for males (WHO, 2008).

Waist to Height ratio was calculated to classify participants into increased health risk (≥0.50) according to Ashwell & Hsieh (2005).

Cardiovascular disease risk index was created using the following assessment questions. 1) Have you ever had your blood cholesterol checked? 2) Have you ever been told by a doctor, nurse, or other heath professional that your blood cholesterol is high? 3) Have you ever been screen for diabetes? 4) Have you ever been told by a doctor, nurse, or other heath professional that you have diabetes? If women, was this only when you were pregnant? 5) Have you taken part in a class to improve your health in the last 3-6 months? 6) Do you exercise for at least 30 minutes 3 times per week? 7) Do you eat at least five fruits and vegetables a day? 8) Is your mean blood pressure, out of the 3 readings taken today, above the normal range? 9) Is your waist circumference measurement taken today above normal range? 10) Is your BMI, based on today's weight and height, above the normal range? and 11) Do you currently smoke cigarettes?. The use of CVD risk Index assisted in classifying participants cardiovascular disease risk. Criteria for evaluation was set at 1= Low CVD risk and 11= High CVD risk (Balcazar et al., 2010).

Data Preparation

Data was entered in SPSS 19.0 (SPSS, version 19.0 Inc., Chicago, IL, USA) and was reviewed for errors that could have influence the study results.

Data Cleaning

Prior to conducting the analyses, the data was reviewed for any errors that could have affected the study results. Data cleaning refers to the process of identifying and correcting errors that could have been introduced despite careful study design, conduct, and implementation of strategies to reduce errors. Data cleaning includes reducing errors that go beyond small technical variations and that could create changes in the distribution of the population, like missing sex, sex misspecification, birth date or examination date errors, merged records, or biologically impossible results. Cleaning the data involved a continuous process of screening, diagnosing, and editing suspected irregularities in the data (Van den Broeck, Cunningham, Eeckels & Herbst, 2005).

Data Screening

Data was screened for incongruities including outliers, lack or excess of data, and strange patterns in the distributions. Descriptive analysis was conducted to determine if data is within plausible ranges. In addition, screening to detect outliers, normality, or multicolinearity among variables was conducted (Tabachnick & Fidell, 2007). Dealing with outliers followed Tabachnick & Fidell (2007) recommendations. Potential univariate were identified with standardized z-scores above 3.29 and multivariate outliers were identified by examining the Mahalanobis distance. Normality was assessed by statistical and graphical methods (Tabachnick & Fidell, 2007).

Procedures for handling missing data included those recommended by Tabachnick & Fidell (2007). If only 5% of the data is missing at random, therefore any procedure for handling missing values will provide similar results (Tabachnick & Fidell, 2007). For the purpose of this dissertation, Hot Deck imputation was used to handle missing data. Hot Deck imputation

replaces the missing value with similar values (e.g. donor) from the data set using "deck variables" assigned by the researcher (Myers, 2011).

Data Diagnosis

The second phase for cleaning the data involved diagnosis of the data. According to Van den Broeck, Cunningham, Eeckels & Herbst (2005) this phase includes clarification of the true nature of the problematic data. During this phase, procedures included looking for information that could confirm the true extreme value of an outlier. For example, if there was an extreme value for one variable we verified if the same extreme value was found in another related variable (i.e., BMI and waist circumference).

Data Editing

The last step in cleaning the data involved editing the data, which includes deciding what should do with problematic data. According to Van den Broeck, Cunningham, Eeckels & Herbst, (2005) the options are correcting, deleting, or leaving data unchanged. However, implausible values should be modified, either by correcting or by deleting if original data is not available. Extreme values were examined and it was determined to retain them in the final analysis (Van den Broeck, Cunningham, Eeckels & Herbst, 2005).

Table 2
Measured variables and role for Study 1 and Study 2

Antecedent Variables	Intermediate Outcomes and Potential Mediators	Outcome
Age[1]	Dietary Patterns[¥,1,2]	BMI[1,2]
Gender[1]	Intentions to eat healthy[2]	Blood pressure[1,2]
Education[1]		Waist Circumference[1,2]
Income[1]		Waist to Height Ratio[1,2]
Place of Birth[1]		CVD Risk Index[2]
Acculturation[2]		Dietary patterns[¥2]
Self-efficacy[2]		
Social support[2]		
Perceived benefits of healthy eating[2]		
Perceived barriers to healthy eating[2]		

[1] Variables include in Study 1
[2] Variables include in Study 2
¥ Derived from Factor Analysis

Study 1

Characterization of Dietary Patterns in Hispanic Adults Participating in the H.E.A.R.T. Study and its association to cardiovascular disease risk factors

Introduction

Diet plays an important role in the development of obesity and diet-related chronic diseases. Unhealthy dietary behaviors, including higher intake of saturated fats, added sugars, sodium, and cholesterol, are considered major modifiable risk factors in the development of many health problems, including heart diseases and stroke (Kant, 2004; Ezzati et al., 2003). Just alone, a diet low in fruit and vegetable intake is estimated to cause about 31% of coronary heart diseases and 11% of stroke in the world (Mackay & Mensah, 2004).

As previously stated, special emphasis has been placed on the dietary component of an overall *lifestyle modification strategy* (AHA, 2000) to help reduce morbidity and mortality. Recent guidelines recommend that people should not only focus on eating specific foods or nutrients to improve health outcomes, but that the general population should adopt an overall healthier dietary pattern- consisting of less consumption of saturated fat, sodium and cholesterol, added sugars, and refined grains; and increased consumption of fruits and vegetables, whole grains, lean meat and poultry, fat-free or low-fat dairy products, beans, peas, and nuts and seeds (AHA, 2000; WHO, 2002; USDA, 2010).

Dietary Patterns

All foods undergo several digestive and metabolic processes when they enter the body. Foods contain different types of nutrients. Macronutrients including carbohydrates, proteins, and fats are either used as sources of immediate energy or stored as fats for later use. Micronutrients such as vitamins and minerals act as cofactors and intermediators in the metabolic process

(Buttar et al., 2005). Overall, the study of diet is very complex, and several methods can be used to analyze it. For example, traditional analyses have included the investigation of single or small sets of nutrients or foods in relation to health problems and outcomes. For example, the importance of vitamin D and its association with increased mortality and cardiovascular diseases was discovered via single nutrient methods (Lee, Gadi, Spertus, Tang, & O'Keefe, 2011; Pilz et al., 2009).

Overall, single nutrient analysis has provided valuable evidence about associations between diet and specific health outcomes; results from these studies have laid the foundation for public health recommendations (Slattery, 1998, Hu, 2002). However, any individual diet is affected by a mixture of factors, including economics, sociocultural, and environmental characteristics. Moreover, evaluating diet requires using methods that capture a broader representation of the diet and its association with health outcomes (Slattery, 2008). Some limitations of using the single nutrient approach include its failure to account for interactions between nutrients and/or to detect intercorrelations among nutrients. In addition, the single nutrient effect might be too small to detect and analyses including a large number of nutrients may produce statistically significant associations by chance (National Research Council, 1989; Hu, 2002). Consequently, the need for understating diet at a broader or more macro level has led scientists to use different approaches. Because people do not eat isolated nutrients, but rather a combination of foods that contribute many nutrients that interact with each other, dietary pattern analysis has emerged as a more meaningful and widely used method to assess associations between diet and chronic diseases (Slattery et al., 1998)

Dietary pattern analysis focuses on the total diet and not exclusively on single foods or nutrients (Kerver, 2003). The concept of reducing dietary data to derive broader dietary patterns

was first introduced in the beginning of the 1980s (Schwerin, 1981; 1982). Researchers identified that distinct patterns existed (e.g., the Mediterranean pattern) and that some of the patterns were significantly associated with better nutritional health outcomes. These findings led scientists to continue using this approach to analyze dietary data, not only to investigate diet and its associations to health outcomes, but also to observe dietary trends and combinations of foods over time in the population (Schwerin, 1981; 1982).

Statistical methods such as principal component analysis, exploratory factor analysis, or cluster analysis can be used to uncovered dietary patterns. Principal component analysis identifies common underlying dimensions of food intake by using information from food consumption, while factor analysis reduces dietary data into patterns based on the intercorrelations between the different food items. Rather than relying on intercorrelations among foods, cluster analysis reduces data into patterns using differences in mean intakes between individuals and by clustering individuals into different groups with similar consumption patterns (Newby, 2004). Previous studies have examined the reproducibility and validity of dietary patterns derived by factor analysis (Hu et al., 1999). Other studies where dietary pattern have been derived by cluster analysis have only examined their validity, but information about their reproducibility remains unclear (Millen et al., 2001). Therefore, factor analysis is the method used in this study and is given special attention below.

Studies of dietary patterns

As noted earlier, the study of dietary patterns is relatively new. Despite their novelty, experts in the area encourage their use when studying diet (Slattery, 1998; Hu, 2002; Newby, 2004; Slattery 2008). This recommendation will help establish dietary patterns as a more comprehensive assessment tool. This section provides a brief introduction to current literature on

the study of dietary patterns and its associations to overall health outcomes with a clear emphasis on cardiovascular disease risk factors. A summary of the studies is presented in Table 3.

Dietary patterns and health outcomes

Over the years, many researchers have investigated the effect of diet on morbidity (Hu et al., 2000; Fung, 2001; McCullough et al., 2002; Slattery, 1998) and mortality (Huijbregts et al., 1997; Osler, 2001; Kumagai, 1999; Menotti et al., 1999). Specific trials have identified the association of certain dietary patterns, such as the Mediterranean pattern, with lower risks of death from all causes, including cardiovascular death (de Lorgeril et al., 1998) and the reduction of cardiovascular disease risk factors, specifically high blood pressure and serum homocysteine (de Lorgeril et al., 1999; Appel et al., 2006; Conlin et al., 2000). Conversely, unhealthy dietary patterns, characterized by higher intake of fats and sugar, have been found to be associated with greater BMI and increased risk of colon cancer (Slattery, 1998; De Stefani et al., 2011). For example, women who increased consumption of the Western dietary pattern (i.e., higher consumption of red and processed meats, refined grains, sweets and desserts, and potatoes) showed greater weight gain than women who increased consumption of the Prudent dietary pattern (i.e., higher consumption of fruits and vegetables, whole grains, fish, poultry, and salad dressing) (Schulze, Fung, Manson, Willet & Hu, 2006).

The Nurses' Health Study characterized dietary patterns using factor analysis. The authors identified two major dietary patterns in a large sample of women aged 30 to 55 years old: the Prudent and the Western pattern. In this study, the authors used logistic regression to examine associations between dietary patterns and the risk for coronary heart disease (CHD) in women. Results showed that the Prudent pattern, characterized by higher intakes of fruits and vegetables, legumes, fish, poultry, and whole grains was associated with a lower risk of total

CHD, even after adjusting for age, BMI, smoking, caloric intake, supplement- vitamin use, and other coronary risk factors. The Western pattern, characterized by higher intake of refined grains, processed and red meats, desserts, high-fat dairy products, and French fries was significantly and positively associated with a higher risk of total CHD after controlling for age, BMI, smoking, caloric intake, supplement vitamin use, and other coronary risk factors. In addition, because different levels within a dietary pattern were identified, the authors found that the risk for CHD increased with increasing scores in the Western pattern. These results suggest that a diet high in fruits and vegetables, legumes, whole grains, poultry, and fish and low in red and processed meats, and refined grains may lower risk of CHD in Women (Fung, 2001).

A similar study conducted in U.S. health professional men investigated the association between dietary patterns and the risk of CHD. Similar patterns were identified using factor analysis, the Prudent and the Western. Higher Prudent pattern scores were associated with healthier behaviors, such as engaging in physical activities, a reduced amount of cigarette smoking, lower consumption of dietary cholesterol and saturated fats. In contrast, the Western pattern was positively associated with most adverse behaviors such as smoking, drinking alcohol, higher intake of cholesterol, saturated fats, and lower intakes of fiber and vitamins. Results from the 8 year follow-up showed that the risk of CHD decreased with higher intake of the prudent pattern, after controlling for specific beneficial nutrients such as folate and dietary fiber. Conversely, the risk of CHD increased with increased consumption of the Western pattern after controlling for specific detrimental nutrients such as cholesterol and saturated fat. These results suggest that independently of specific, beneficial or deleterious, nutrients, major dietary patterns predict risks of CHD in men (Hu et al., 2000).

Kerver, Yank, Bianchi & Wong (2003) investigated dietary patterns among U.S. adults and their associations to risk factors for cardiovascular diseases. The authors used the Food Frequency Questionnaire data from the National Health and Nutrition Examination Survey and employed factor analysis to identify dietary patterns. Overall, they identified six dietary patterns, but only two--the Western and the American-Healthy patterns--were highly prevalent in the population. The Western pattern was characterized by higher intake of high-fat dairy products, processed meats, eggs, and red meats, while the American-Healthy pattern was characterized by higher intakes of green and leafy vegetables, beans and peas, and tea. Cross-sectional analyses indicated that the Western pattern was positively associated with risk factors, such as serum insulin and glycated hemoglobin, whereas the American-Healthy pattern had no association with these cardiovascular disease risk biomarkers. The Western pattern was also associated with socioeconomic and demographic characteristics, including nonwhites and males, lower education attainment, smoking, lower physical activity, and lower income (Kerver, 2003).

Nettleton, Polak, Tracy, Burke & Jacobs (2009) used cross-sectional data from the Multi-Ethnic Study of Atherosclerosis (MESA) to derived dietary patterns also using Principal Component Analysis. The aim of the study was to investigate associations between dietary patterns and cardiovascular disease. The MESA study was a population-based study of white, African American, Hispanic, and Chinese adults. The authors identified four patterns: the fats and processed meat, the vegetables and fish, the beans, tomatoes, and refined grains, and the whole grains patterns. Results showed an association between specific patterns with greater risk for cardiovascular disease (CVD). The high fat and processed meat pattern was associated with a significantly greater relative risk of incident CVD. This pattern was also associated with male sex, younger age, smoking, physical inactivity, higher BMI, waist circumference, and higher

concentrations of inflammatory markers and LDL cholesterol. The whole grain and fruit dietary patterns were associated with a lower relative risk of CVD. This pattern was also associated with female sex, older age, white race-ethnicity, nonsmoking, more time spent in physical activity and lower concentrations of LDL cholesterol, inflammatory markers, and higher concentration of the good, HDL, cholesterol. The authors identified that the relation between the dietary patterns and cardiovascular disease risk in all ethnic groups in the study were in the same direction and same magnitude (Nettleton, 2009).

Another study using factor analysis to derive dietary patterns was conducted by Eilat-Adar, Mete, Fretts, Fabsitz, Handeland, Lee, Loria, Xu, Yeh & Howard (2012). The authors investigated the associations between empirically identified dietary patterns with cardiovascular disease risk factors in an American Indian population. The authors identified four dietary patterns: a Western pattern characterized by higher consumption of fast foods, snack chips, sweet beverages, and animal fats; a traditional AI/Mexican pattern characterized by higher consumption of traditional foods such as dry beans, Mexican foods, stew, meats, processed meats, alcoholic beverages, and hydrogenated vegetable fats; a Healthy pattern, characterized by higher consumption of fruits, vegetables, fish, hot cereal, whole grains, and low-fat milk; and an Unhealthy pattern characterized by coffee, tea, animal fat, and sweetened grains. Those participants reporting greater use of the Western dietary pattern also had higher levels of LDL cholesterol, higher systolic blood pressure, and lower HDL cholesterol. Likewise, the Unhealthy dietary pattern was associated with higher LDL cholesterol. Moreover, although consuming a traditional dietary pattern was associated with higher HDL, a positive outcome; it was also associated with higher BMI and blood pressure. Only the healthy dietary pattern was associated

uniformly with healthier outcomes such as lower systolic blood pressure, LDL cholesterol, and BMI (Eilar-Adar et al., 2012).

Although there has been consistent results that include the Western dietary pattern, dietary behaviors are significantly different in various regions of the world. Iqbal et al., (2008) conducted the INTERHEART study to investigate dietary patterns, using factor analysis, in 52 countries around the world. This standardized case-control study investigated the relationship between dietary patterns and acute myocardial infarction (AMI). Results from the factor analysis derived three major dietary patterns; the Oriental, characterized by higher intake of tofu, soy, and other sauces; the Western, characterized by higher intake of fried foods, eggs, meat, and salty snack; and the Prudent, characterized by higher intake of fruits and vegetables. Logistic regression was used to analyze associations between the different dietary patterns and AMI. Results indicated that higher levels of the prudent pattern were associated with reduced risk of AMI. Moreover, the Western pattern showed a weaker, but statistically significant association with increased risk of AMI. Finally, the Oriental pattern was not associated with AMI. The authors concluded that approximately 30% of the population-attributable risk of AMI was explained by dietary patterns (Iqbal et al., 2008). Additionally, results from this study suggest that increased consumption of a Prudent diet, with increased consumption of fruits and vegetables and reduced consumption of fried and salty foods, is likely to reduce risk of AMI among different population around the globe (Iqbal et al., 2008).

Overall, the studies described earlier have found different types of dietary patterns in different population; but only a few have looked at the dietary patterns of Hispanics. For example, a population-based control study conducted by Murtaugh and colleges (2007) investigated the association between factor analysis derived dietary patterns with overweight and

obesity among women living in the United States. The authors identified five dietary patterns; the first one was labeled the Western diet and was characterized by higher consumption of high-fat dairy foods, refined grains, gravy, fast foods, bacon and sausage, potatoes, margarine, high-fat/high-sugar desserts and red meats. The second factor was labeled the native Hispanic pattern and was characterized by higher consumption of Mexican foods, including cheese, soups, meats, legumes, tomato-based soups and sauces (Murtaugh et al., 2007). The third factor was labeled the prudent diet and was characterized by higher consumption of low-fat dairy, whole grains, vegetable and nuts (Murtaugh et al., 2007). The fourth factor was labeled the Mediterranean pattern and was characterized by higher consumption of fish and poultry, vegetables, salad and high fat dressings. The last and fifth factor was labeled the dieter pattern; this factor was characterized by the use of low-fat dairy, low-fat margarine, low-fat and fat-free dressings, low-fat/high-sugar desserts, diet beverages and sugar substitutes. Results from the analyses indicated that regardless of the type of diet, Hispanic women had higher odds of overweight and obesity than non-Hispanic women. In addition, Hispanic women reported to consume more often a native Hispanic or Prudent type of pattern when compared to the non-Hispanic white women. Overweight and obesity risk was associated with the Western and dieter pattern among Hispanic and non-Hispanic women. The Prudent pattern showed an association with reduced risk of overweight and obesity in both ethnic groups of women (Murtaugh et al., 2007).

Similarly, Lin, Bermudez & Tucker (2003) investigated dietary patterns in Hispanic elders living in Massachusetts and their association with total and central obesity. The authors identified five different patterns using cluster analysis: fruit and breakfast cereal, starchy vegetables, rice, whole milk, and sweets patterns. Results showed that when compared to non-Hispanic whites, Hispanics were more likely to follow the starchy vegetable or milk patterns and

less likely to follow the fruit and cereals or sweets patterns. In addition, Hispanics were the only group following the rice pattern which was the only pattern positively associated with total and central obesity (Lin, Bermudez & Tucker, 2003). Different results were found by Carrera, Gao, & Tucker (2007) who obtained data from the National Health and Nutrition Examination Survey 2001-2002 to define dietary patterns and identify their association with total and central obesity. The authors derived four dietary patterns using cluster analysis. The patterns were named after the most predominant food group relative to the other clusters; dietary patterns were labeled poultry and alcohol, milk and baked products, traditional Mexican, and meat. None of the patterns was identified as a healthy pattern. Although the traditional Mexican had higher intakes of legumes and dietary fiber, it was also high in dietary cholesterol. Results did not show any significant association between dietary patterns and obesity; but obesity was prevalent in all groups (Carrera, Gao, & Tucker, 2007).

In summary, dietary patterns studies have identified important relationships between specific patterns and health outcomes. Many authors have identified similar dietary patterns, Western and Prudent, using factors analysis. The Western pattern has been associated with higher risk of cardiovascular diseases risk factors, whereas the Healthy or Prudent patterns have been associated with better health outcomes. Summarized information about the previously mentioned studies is presented in Table 3.

Table 3
Summary of Studies investigating dietary pattern

Study	Study population	Method	Mayor dietary patterns
Slattery, 1998	Northern California, Utah, and Minnesota	Factor Analysis	Male and Females - Western, Prudent, high fat/Sugar dairy, drinker, substituter Male only: fruits juice Female only: coffee and roll
Hu, 1999	Health Professional follow-up study-Men	Factor Analysis	Western Prudent
Fung, 2001	Nurses' Health Study	Factor Analysis	Western Prudent
Kerver, 2003	National Health and Nutrition Examination Survey, dietary patterns of healthy US adults	Factor Analysis	Major: Western and American-Healthy Minor: California, breakfast, Southwestern, and Convenience
Lin, 2003	Massachusetts Hispanic Elderly Study (MAHES)	Cluster analysis	Fruit and breakfast cereal Starchy vegetables Rice Whole milk Sweets
Iqbal, 2008	INTERHEART is a standardized case-control study involving participants from 52 countries	Factor Analysis	Oriental Western Prudent
Murtaugh, 2007	Population-based control participants from the Southwestern U.S.	Factor Analysis	Western Prudent
Carrera, 2007	National Health and Nutrition Examination Survey 2001-2002 Mexican-American	Cluster analysis	Poultry and Alcohol Milk and baked products Traditional Mexican Meat
Nettleton, 2009	Multi-Ethnic Study of Atherosclerosis (MESA). White, black, Hispanic, and Chinese adults	PCA	Fats and processed meats Vegetable and Fish Beans, tomatoes, and refined grains Whole grains and fruits
Denova-Gutierrez, 2010	Health Workers Cohort Study Mexican adults	Factor Analysis	Prudent Western High protein/fat
Sofianou, 2011	National Health and Nutrition Examination Survey years 2003-2006	PCA	Western Healthy Tomato/tortilla Coffee/Sugar
Eilat-Adar, 2012	Strong Heart Study	Factor Analysis	Western Traditional AI/Mexican Healthy Unhealthy

Dietary Patterns and cardiovascular disease risk factors by demographic and socioeconomic characteristics

As mentioned before, diet is a very complex behavior influenced by multiple factors. Many researchers have examined associations between diet and various demographic and socioeconomic characteristics. For example, previous reports have identified differences between males and females related to variation of socioeconomic status and BMI (Borodulin, 2012). In addition, others have found dietary differences according to type of employment (Ball, Mishra, Crawford, 2002), level of education (Kerver, Yang, Bianchi, & Song, 2003; Robinson et al., 2004) income (Lallukka, Laaksonen, Rahkonen, Roos, & Lahelma, 2007), and place of birth (Montez & Eschbach, 2008; Dixon, Sundquist, Winkleby, 2000; Guendelman & Abrams, 1995). The following section is a brief description of the available literature addressing the association between diet and various demographic and socioeconomic characteristics. This section is focused on providing information about how diet is influenced by several demographic and socioeconomic factors.

For example, Sofianou, Fung, & Tucker (2011) examined dietary patterns among participants of the National Health and Nutrition Examination Survey 2003-2006 to explore if time living in the United States was associated with a specific dietary pattern. Participants included only those of Mexican descent. The authors derived dietary patterns with principal component analysis and identified four patterns: the Western, characterized by consumption of red meat, processed meats, desserts, pasta, and fried potatoes; the healthy, characterized by higher consumption of green and yellow vegetables and fresh fruit; the tomato and tortilla, characterized by consumption of tomato-based products; and the coffee/sugar pattern, characterized by consumption of coffee, added sugars, butter/margarine, and tea. After

comparing adjusted means for length of residency, results did not show significantly different results for participants of Mexican descent who lived in the U.S. for more than 15 years compared to those who lived in the U.S. for less than 15 years. However, comparisons of adjusted means for place of birth showed significant differences. Mexico-born participants had lower consumption of the Western pattern and higher consumption of the tomato/tortilla pattern compared to U.S.-born. In addition, those born in the U.S. had higher scores of the Western and Coffee/Sugar dietary patterns, suggesting preferences for an unhealthier dietary pattern (Sofianou, Fung, & Tucker, 2011). Similar results were identified by different authors who found that Hispanics that were born in Mexico had a higher intake of a healthier pattern, that includes nutrients and food items such as fruits, legumes, fiber and whole grains; and lower intake of total fat than people of Mexican descent that were born in the US (Duffey, Gordon-Larsen, Ayala, & Popkin, 2008; Montez & Eschbach, 2008; Dixon, Sundquist, Winkleby, 2000; Guendelman & Abrams, 1995).

Other studies have looked at the influence of education and type of employments and its association to type of diet. For example, Kerver and associates (2003) replicated similar patterns to those previously mentioned in this report, the Western and the American-Healthy pattern, similar to the prudent pattern, using factor analysis. The authors found that the Western pattern was associated with lower educational attainment and lower income (Kerver et al., 2003). Likewise, similar results were identified by Mullie, Clarys, Hulens, & Vansant (2010) who identified three dietary patterns, the Meat, the Healthy, and the Sweet dietary pattern. The authors identified that higher educational levels and higher income was associated with the healthiest of the three patterns (Mullie, Clarys, Hulens, & Vansant, 2010).

The influence that diet has on health outcomes is well established. Additionally, lower socioeconomic status and educational attainment is associated with poorer-unhealthier dietary patterns. Many studies have shown that different demographic and socioeconomic factors can also influence the presence of several cardiovascular disease risk factors. A growing interest to study the mediating effect of diet on the association between demographic and socioeconomic characteristics and health outcomes has arisen. To the author's knowledge, only a few studies have looked at the mediating role of diet in the association between demographic and socioeconomic characteristics and cardiovascular disease risk factors, specifically among the Hispanic population. The following section describes the few studies that look at the mediating role of diet on overall health outcomes with a clear emphasis on cardiovascular disease risk factors.

Dietary patterns as mediators of health outcomes

The study of dietary patterns is relatively novel as is mediation analysis. Mediation refers to a set of statistical methods used to explain the process or mechanisms of how a third variable affects the relationship between two variables (Baron & Kenny, 1986; MacKinnon, Fairchild, and Fritz, 2007). In nutrition research, for example, mediation analysis can provide information about the mediating role of dietary patterns between demographic and socioeconomic characteristics and cardiovascular disease risk factors. The mediation model is a causal model where the mediator (M), also known as the intervening variable, is a third variable that transmits the effect of an antecedent variable or independent variable (IV) to an outcome variable or dependent variable (DV), providing information about the IV-DV relation (e.g., X and Y relationship) and presuming that the IV causes a mediator which then causes the DV. For example, socioeconomic status (X) may be associated with elevated consumption of high-fat

diets (M), which in turn is associated with the development of a CVD risk factor (Y), specifically high cholesterol. Therefore, it is said that high-fat diet consumption may mediate the relation between SES and CVD risk factors. Moreover, overweight and obesity, as measured by indicators such as BMI, or central adiposity, are common mediators in dietary health research.

This section is intended to review specific literature using mediation analysis to investigate the intervening role of dietary behaviors on associations between demographic and socioeconomic characteristics and cardiovascular disease risk factors, including overweight/obesity and blood pressure. Only a few studies have explored diet as mediating pathways between demographic and socioeconomic characteristics with cardiovascular disease risk factors, including obesity. Unfortunately, none of the studies described below have analyzed the diet using dietary patterns derived by factor analysis.

The first study was conducted in Australia. In this study, the authors assessed the mediating influence of diet on the association between socioeconomic status and adiposity in children. Diet was assessed using a 24-hour diet recall and path analysis was used to assess direct and indirect association between socioeconomic status, dietary behaviors, and adiposity. Diet was operationalized as energy and fat intake from a three 24h diet recall, and adiposity was assessed using five skinfold measurements. Analyses were conducted separately for girls and boys. Results from this study showed adverse anthropometric profiles among lower socioeconomic participants. Although SES was related to adiposity in girls and boys, for girls, the type of diet, as measured by energy and fat intake, did not mediate the association between socioeconomic status and adiposity. In boys, however, there was weak evidence that suggests that fat intake mediated the negative association between socioeconomic status and waist circumference (Dollman, Ridley, Magarey, Martin, & Hemphill, 2007).

A second study was conducted in Canada. The purpose of this investigation was to examine the association between income and education with obesity and to characterize indirect associations that might occur through fruit and vegetable consumption. This study did not investigate dietary patterns either, but it assessed fruit and vegetable consumption using the Behavioral Risk Factor and Surveillance System questionnaire. Results by gender showed that for men obesity decreased with higher education levels and increased with lower income levels. For women, the prevalence of obesity was higher among those with less education, but lower among the highest income levels. Results from the indirect association with overweight and obesity provided stronger evidence that education and income were inversely associated with high risk of adiposity and indirect paths were seen from income and education to risk of adiposity with fruit and vegetable consumption mediating this association in women (Ward, Tarasuk, & Mendelson, 2007). A similar study examining associations between income and obesity found that fruit and vegetable consumption was a significant mediator only among women.

Ward, Tarasuk, Mendelson & McKeown-Eyssen (2007) questioned whether health behaviors, including diet, mediated the association between socioeconomic status and obesity, using data from the Canadian Community Health Survey lifestyle factors. Similar to the studies described previously, the authors did not use dietary patterns in the analysis, using instead a latent variable measured by fruit and vegetable consumption and adiposity risk-assessed using a BMI > 30. Results from the structural equation modeling analysis showed that education and income were inversely associated with higher adiposity risk in women but not in men. In addition, among women, fruit and vegetable consumption significantly mediated the association

between education and adiposity risk, but not between income and adiposity risk (Ward, Tarasuk, Mendelson, & McKeown-Eyssen, 2007).

Lastly, another recent study conducted in Finland by Borodulin and colleagues (2012) explored the existence of a mediating pathway between socioeconomic position and BMI in men and women who participated in a population-based FINSRISK 2002 study. In this study, the authors did not analyzed dietary patterns; instead, dietary behavior was analyzed as a latent variable called diet and measured by three variables: consumption of fruits, consumption of vegetables, and perception of diet quality. Results from this study showed that the latent variable diet mediated the association between socioeconomic position and BMI, in both men and women. In addition, the authors identified that other health-behaviors, including leisure time physical activity, smoking, and alcohol consumption also mediated the association between education, income, and BMI. Although this study did not analyze dietary patterns per se, the results suggest that a latent variable reflecting lower consumption of fruits and vegetables and poor self-rated diet quality contributed to higher BMI in participants with lower education and income levels. Overall, results suggest that higher socioeconomic status predicted lower BMI and most health behaviors mediated this association in both genders (Borodulin et al., 2012).

As described above, the analysis of dietary patterns has become an important and widely used approach in nutritional epidemiology to investigate the association between diet and health outcomes (Hu, 2002; Newby, 2004). Unfortunately, studies using mediation analyses have not examined diet using dietary pattern as derived by factor analysis. Moreover, the analyses that have used mediation analysis to identify the mediating role of diet have not been conducted among Hispanics. Previous research suggests a mediating role of diet in the association between demographic and socioeconomic characteristics and obesity, a cardiovascular disease risk factor.

In addition, it is well known that people with lower socioeconomic status are affected greatly with overweight and obesity. This affection could be mediated by unhealthier dietary habits, nonetheless little is known about the characteristics of the diet among Hispanics living in the U.S. Mexico border. Therefore, understanding characteristics of dietary practices among Hispanics living in the U.S.-Mexico border and identifying demographic and socioeconomic variations in cardiovascular disease risk factors and dietary patterns will provide guidance for future nutrition and education interventions, in a disproportionally affected population, to prevent cardiovascular disease risk factors by targeting specific mediators.

Purpose of Study 1

The primary aim of Study 1 was to characterize the dietary patterns of Hispanic adults participating in the H.E.A.R.T. study using factor analysis. The secondary aim was to examine associations among the derived dietary patterns, demographic characteristics, and cardiovascular disease risk factors in the same sample. A third aim of this study was to explore dietary patterns as mediating pathways between demographic and socioeconomic characteristics and cardiovascular disease risk factors. It was hypothesized that factor analysis would reveal at least two different dietary patterns; one reflecting a healthier diet, or as others have called a Prudent pattern-characterized by higher consumption of fruits and vegetables, poultry and fish; and the other reflecting an unhealthier diet: the Western pattern, characterized by higher consumption of high-fat and high-energy foods. Specifically, this study proposed the following research questions and hypothesis.

Research Questions and Hypothesis Study 1

1. What dietary patterns characterize Hispanic adults participating in the H.E.A.R.T. study?

Hypothesis 1: Using factor analysis, we identify at least two different dietary patterns in Hispanics adults participating in the H.E.A.R.T. study.

2. Do these dietary patterns differ as a function of demographic and socioeconomic characteristics?

Hypothesis 2: Dietary patterns among Hispanic adults vary according to demographic and socioeconomic characteristics. Unhealthier dietary patterns will be associated with lower educational attainment, lower socioeconomic status, younger adults, the male gender, and being born in the U.S. (Kerver, 2003; Nettleton, 2009).

3. Do dietary behaviors mediate associations between demographic and socioeconomic characteristics and cardiovascular disease risk factors including overweight-obesity and blood pressure?

Hypothesis 3: The healthy dietary pattern, as derived by factor analysis, will be negatively associated with CVD risk factors, whereas the unhealthy dietary pattern will be positively associated with CVD risk factors. In addition, at least one dietary pattern mediates the association between demographic and socioeconomic characteristics with cardiovascular disease risk factors.

Methods

The current section describes specific methods for study 1. General methods were described in previous sections.

Data analysis

Data Screening, diagnosis, and editing

As described above, H.E.A.R.T. study baseline data from N=605 participants was screened for incongruities including outliers, missing data, and strange patterns in the distribution. For all variables in this study, values of skewness and kurtosis were between -1 and +1, suggesting no major deviations from normal. In addition, four univariate outliers and three multivariate outliers were identified and examined. After evaluating the outliers, three extreme values from the cases were manually changed to be equal to the highest value + 1. Finally, it was decided to retain outliers in the analyses because their inclusion did not change the interpretation of further analysis (Tabachnick & Fidell, 2007).

Measures

Food Frequency Questionnaire

The Food Frequency Questionnaire (FFQ) is the most frequently used method to assess dietary intake of populations in epidemiological studies. It provides an average of the long-term diet of a population at a low cost for researchers and low burden for participants. In addition, all the participants receive the same set of questions and in the same format. The current study analyzed a 65-item FFQ divided into 7 different groups including grains, dairy products, meats and beans, fruits, vegetables, desserts, and beverages. Food items were analyzed using factor analysis to identify dietary patterns. The use of factor analysis helped reduce the multiple items from the food frequency questionnaire into fewer, more manageable and informative variables

that reflect variation in diet. Specifically, the 65 items of the FFQ were subjected to Principal Component Factor Analysis with Oblimin rotation to simple structure to determine the number of specific dietary factors in the food frequency Q/sample data. The number of specific factors extracted was determined by examining factor eigenvalues, scree plots, and rotated factor solutions. Only those items that significantly contributed to the pattern with factor loadings ≥0.32 were retained. Five dietary components with eigenvalues > 1.5 were derived from the factor analysis. Labels for the factors reflected the specific combinations of foods as well as highest factor loadings. Items loading on each factor were used to create composite variables (i.e., dietary components) that reflected scores for individuals on the dietary variables.

Demographic and socioeconomic characteristics

Measures in Study 1 include age, gender, level of education, household income, and place of Birth. Intermediate outcomes include the dietary patterns derived by factors analysis, and the outcome variables include clinical measures, BMI, blood pressure, waist and hip circumference, waist to height ratio. Additional measures include the cardiovascular disease risk index. Definition and methods for variables are described in the overall methodology (Pg. 26).

Results

Descriptive statistics

Table 4 describes the demographic characteristics of the participants. The sample consisted of 605 participants with an average age of 44 ± 12.9 years. As shown, the vast majority of the sample was female and almost two-thirds were born in Mexico. On average, participants completed 12 years of education and only one-third of the participants reported a household income above $20,000 dollars per year. Half of the sample reported being married or living with a partner; in addition, half of the participants reported owning or in the process of owning their own home. Clinical measure results showed that only one fifth of the participants had a normal BMI (18-25), one third were overweight (25-29.9) and a little more than half of the participants were obese according to the World Health Organization criteria for overweight and obesity. Table 5 shows intercorrelations among the demographic, socioeconomic characteristics, and clinical measures of the participants.

Study Aim 1: Exploratory Factor Analysis of FFQ

The specific aim 1 was to characterize the dietary patterns in Mexican-American adults participating in the H.E.A.R.T. study using factor analysis of food frequency questionnaire items. Table 6 shows the pattern of rotated factor loadings. As shown, Factor 1 was characterized by high-energy, high-fat foods such as hamburgers, French fries, pizza, hot dogs, macaroni and cheese, spaghetti and pasta sauce, nachos with cheese, potato chips, meats (e.g., beef, pork, lamb), pancakes, cheese, and diet soda; this factor was labeled Western, as previously found and labeled by Slattery et al., (1998). Factor 2 consisted of raw and cooked vegetables, raw and dried fruit, fish, tuna, chicken or turkey, yogurt, and dressing; this factor was labeled Prudent, as previously found and labeled by Slattery et al., (1998). Factor 3 was characterized by the

consumption of rice, corn and flour tortillas, refried beans, peas and lentils, eggs, and salsa; this factor was labeled Mexican. Factor 4 consisted of items such as fruit juices, canned fruit, breakfast cereals, and pudding; this factor was labeled Juice. The last factor was characterized by the consumption of high-energy foods including cakes, cookies, pastries, doughnuts and sweet rolls, ice cream, chocolate, popsicles, hard candies and regular soda; this factor was labeled Sweets.

Items loading on each factor were used to create composite variables (i.e., dietary components) that reflected scores for individuals on the dietary variables. Alpha reliability scores of the components were calculated and are displayed in Table 7. The Western composite was measured by 17 items (α=.80), the Prudent pattern by 11 items (α=.78), the Mexican pattern by 6 items (α=.53), the Juice pattern by 5 items (α=.49), and the Sweets pattern by 7 items (α=.66). Table 7 also presents the intercorrelations among dietary components. The Prudent dietary component significantly correlated with the Mexican and Juice dietary components but not with the Western or the Sweets dietary component. Moreover, the Western dietary component, characterized by the consumption of high-energy and high-fat foods, was statistically and positively associated with the Mexican, the Juice, and the Sweet dietary component.

Table 4.
Demographic characteristics of study participants

	Mean ± SD or *f* (%) (*N*=605)
Age	44.0 ± 12.93
Gender (female)	511 (84.50%)
Birth place	
Mexico	386 (63.81%)
USA	216 (35.70%)
Other	3 (0.50%)
Years of Education	12.1 ± 3.69
Household Income	
< $10,000	209 (34.50%)
$10,000-$20,000	211 (34.91%)
>$20,000	185 (30.59%)
Employed	236 (38.91%)
Marital Status	
Never Married	105 (17.39%)
Married/living w/ partner	341 (56.39%)
Separated/Divorced	126 (20.78%)
Widow	33 (5.51%)
Home Ownership	318 (53.19%)
Clinical Measures	
Body Mass Index (BMI)	31.17± 6.37
< 24.9	92 (15.21%)
25.00-29.99	192 (31.69%)
30.00-39.99	256 (42.32%)
>40.00	65 (10.78%)
Waist circumference	38.57± 5.55
Waist to Height ratio	0.61 ± 0.08
Blood pressure	
Systolic blood pressure	126.39 ± 18.58
Diastolic blood pressure	77.11± 9.85
CVD risk index	5.49 ± 1.65

Table 5.
Intercorrelations among demographic, socioeconomic characteristics, and clinical measures

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	-												
2. Gender	.04	-											
3. Birth	-.10**	-.03	-										
4. Education	-.17**	-.09*	.24**	-									
5. Income	.11**	-.11**	.11**	.25**	-								
6. Home	-.28**	-.05	-.09*	-.08	-.38**	-							
7. Employment	-.02	-.07	.06	.14**	.11**	-.06	-						
8. Marital	.36**	.09*	-.07	-.08	-.10*	-.02	-.01	-					
9. BMI	.15**	.02	.08*	.00	-.03	.02	-.04	.06	-				
10. WC	.19**	-.16**	.12**	.01	.01	.03	-.05	.08*	.87**	-			
11. WtoH	.25**	.06	.08	-.05	-.04	.01	-.08	.11**	.89**	.93**	-		
12. DBP	.10**	-.19**	.08*	.05	.05	.00	.03	.04	.21**	.24**	.20**	-	
13. SBP	.44**	-.15**	.01	-.08*	.03	-.08	-.02	.18**	.29**	.33**	.31**	.65**	-
14. CVD Index	.16**	-.04	.11**	.00	.05	-.02	-.01	.05	.44**	.48**	.45**	.35**	.34**

** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).
3. Place of birth; 6. Home Ownership; 8. Marital Status; 9. Body Mass Index; 10. Waist Circumference; 11. Waist to Height ratio; 12. Diastolic Blood Pressure; 13. Systolic Blood Pressure; 14. CVD Risk Index

Table 6.
Factor-loading matrix for major dietary components

	Dietary patterns				
Food Groups	Western	Prudent	Mexican	Juice	Sweet
Hamburger or cheeseburger	.60	--	--	--	--
French fries	.60	--	--	--	--
Pizza or pizza bread	.59	--	--	--	--
Fried Chicken nuggets	.52	--	--	--	--
Hotdogs, franks, sausage	.50	--	--	--	--
Macaroni and cheese	.49	--	--	--	--
Spaghetti, noodles	.47	--	--	--	--
Pasta Sauce	.43	--	--	--	--
Nachos w/ cheese	.42	--	--	--	--
Potato chips, corn chips	.41	--	--	--	.40
Sandwich meat	.41	--	--	--	--
Pancakes, waffles, French toast	.39	--	--	.33	--
Diet soda	.38	--	--	--	--
Cheese	.38	--	--	--	--
Potato stuffing	.37	--	--	--	--
Popcorn	.36	--	--	--	--
Beef, pork, lamb	.34	--	--	--	--
Raw vegetables	--	.67	--	--	--
Cooked vegetables	--	.66	--	--	--
Lettuce	--	.66	--	--	--
Vegetable main dishes	--	.60	--	--	--
Tomatoes (raw or tomato juice)	--	.60	--	--	--
Fish, tuna in water	--	.57	--	--	--
Chicken or turkey	--	.52	--	--	--
Fresh Fruit	--	.47	--	--	--
Yogurt, frozen yogurt	--	.46	--	--	--
Raisins, dried fruit	--	.33	--	--	--
Dressing	--	.33	--	--	--
Rice	--	--	.58	--	--
Corn Tortillas	--	--	.54	--	--
Refried beans, black beans, peas and lentils	--	--	.48	--	--
Eggs	--	--	.46	--	--
Flour tortillas	--	--	.44	--	--
Salsa	--	--	.32	--	--
Apple, grape, fruit juice	--	--	--	.56	--
Orange juice	--	--	--	.50	--
Canned fruit	--	--	--	.44	--
Breakfast Cereal	--	--	--	.42	--
Pudding	--	--	--	.37	--
Cake, Cookies, pastries	--	--	--	--	.60
Doughnuts, sweet rolls	--	--	--	--	.57
Ice cream	--	--	--	--	.54
Chocolate, chocolate candy	--	--	--	--	.52
Popsicles	--	--	--	--	.48
Hard Candy	--	--	--	--	.46
Regular soda	--	--	.37	--	.37

Table 7
Intercorrelations among dietary components

	Western	Prudent	Mexican	Juice	Sweet
Western	(.80)				
Prudent	-.04	(.78)			
Mexican	.26**	.14**	(.53)		
Juice	.25**	.10*	.04	(.49)	
Sweet	.48**	-.03	.23**	.25**	(.66)

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
Numbers in the diagonal are Cronbach's alpha

Study Aim 2: Dietary Patterns by Demographic and SES Characteristics

The aim 2 was to investigate how dietary patterns among Hispanics varied as a function of demographic and socioeconomic characteristics. Table 8 summarizes the effect for demographic and socioeconomic characteristics on the five identified dietary patterns.

In order to identify differences in dietary patterns by demographic and socioeconomic characteristics a series of one-way MANOVA analyses were conducted. Table 8 present a summary of effects for demographics and sociodemographic characteristics on dietary patterns. For these analyses, the demographic or socioeconomic variable served as the between subjects factor and the five dietary composite variables served as the dependent measures. The dietary composite variables were standardized prior to allow comparability across the factors. The demographic and socioeconomic variables were transformed into a tripartite (e.g. income and years of education) or quartile (e.g., age) variables, while place of birth and gender remained with two categories. Tukey's PostHoc tests were conducted on those variables that showed to have statistically significant differences. Figures 1-5 displays the graphs for each demographic or socioeconomic characteristic separately.

Table 8
Dietary patterns by demographic and socioeconomic characteristics

	Western	Prudent	Mexican	Juice	Sweets
Age					
18-35	.25[a]	-.25[a]	-.01[a]	.16[a]	.12[a]
35-45	.09[a]	.08[b]	.02[a]	.08[a]	.08[a]
45-55	-.10[a]	.07[b]	.13[a]	-.06[a,c]	-.01[a,c]
≥ 55	-.39[b]	.12[b]	-.13[a]	-.21[b,c]	-.22[b,c]
F	11.61**	4.63**	1.78	4.17**	3.63*
Gender					
Male	.27	-.24	.16	.21	.11
Female	-.05	.04	-.03	-.04	-.02
F	8.63*	6.89*	2.89	5.22*	1.51
Education					
≤ 11	-.08[a]	-.07[a]	.03[a]	-.00[a]	.06[a]
12-14	.02[a]	-.03[a]	.00[a]	.04[a]	.00[a]
≥ 15	.06[a]	.17[a]	-.05[a]	-.08[a]	-.09[a]
F	1.05	2.96	.38	.81	.94
Income					
≤ $10,000	.04[a]	-.01[a]	.03[a]	.11[a]	.03[a]
$10,000-20,000	-.08[a]	-.06[a]	.04[a]	.00[a]	.05[a]
≥ $20,000	.04[a]	.09[a]	-.09[a]	-.13[b]	-.10[a]
F	1.14	1.32	1.19	3.21*	1.48
Place of Birth					
Mexico	-.09	.09	.11	.01	-.03
United States	.18	-.15	-.18	-.02	.06
F	10.67**	8.76**	12.60**	.19	1.40

* $p<0.05$
* * $p<0.01$
[a,b,c] Means not sharing common superscripts differ at p<0.05 using Tukey's post hoc procedure

Age. The age variable was divided into quartiles: Group 1 included people aged 18-35 years, group 2 people aged 35-45 years, group 3 people aged 45-55, and group 4 people older than 55 years. Results of the one-way MANOVA for age revealed a statistically significant effect for dietary component by age, $\Lambda = .91$, F (15,1648.45) = 3.85, $p < .001$. Univariate ANOVAs were significant for the Western $F(3)= 11.61$, p<.001, Prudent $F(3)=4.64$, p<.01, Juice $F(3)=4.17$, $p<.01$, and Sweets dietary pattern $F=(3)=3.63$, $p<.05$. The Tukey's HSD PostHoc

tests showed that mean scores for the Western dietary pattern were different by age group; the Western dietary pattern was higher in younger people when compared to older people. Figure 1 displays the graph for age. The younger age groups had a higher consumption of the Western dietary pattern than people older than 55 years did. Results for the Prudent Dietary pattern showed an inverse tendency, where younger people (e.g.18-35 years old) had lower intake of the Prudent dietary pattern when compared to older people. There were no univariate significant differences for the Mexican dietary pattern by age.

For the Juice dietary pattern, univariate ANOVAs were statistically significant and similar to those of the Western dietary pattern, where younger people had higher consumption of the Juice dietary pattern than older people did. For example, people between 18-35 years old ($p<0.01$) and between 35-45 years ($p<0.05$) had higher consumption of the Juice pattern than those > 55 years old, but there were no differences in the consumption of the Juice dietary pattern between those ages 45-55 and >55 years groups. Moreover, a similar trend was seen for the Sweet dietary pattern. Results indicated that people older than 55 years had a lower consumption of the Sweets dietary patterns compared to people between 18-35 years ($p< 0.05$) and people between 35-45 years ($p<0.05$) but not different from those 45-55 years old. Figure 1 displays differences for each dietary component by group of age.

Gender. Results of the one-way MANOVA for gender revealed a statistically significant effect for dietary component by gender, $\Lambda = .96$, F (5,599) =4.30, $p < .01$. Univariate ANOVAs were significant for the Western F (1) = 8.63, Prudent F (1)=6.89, $p<.05$, and the Juice dietary pattern F (1)= 5.21, $p<.05$. Results showed that males scored higher on the Western and Juice dietary pattern than females did. In addition, an inverse association was identified for the Prudent

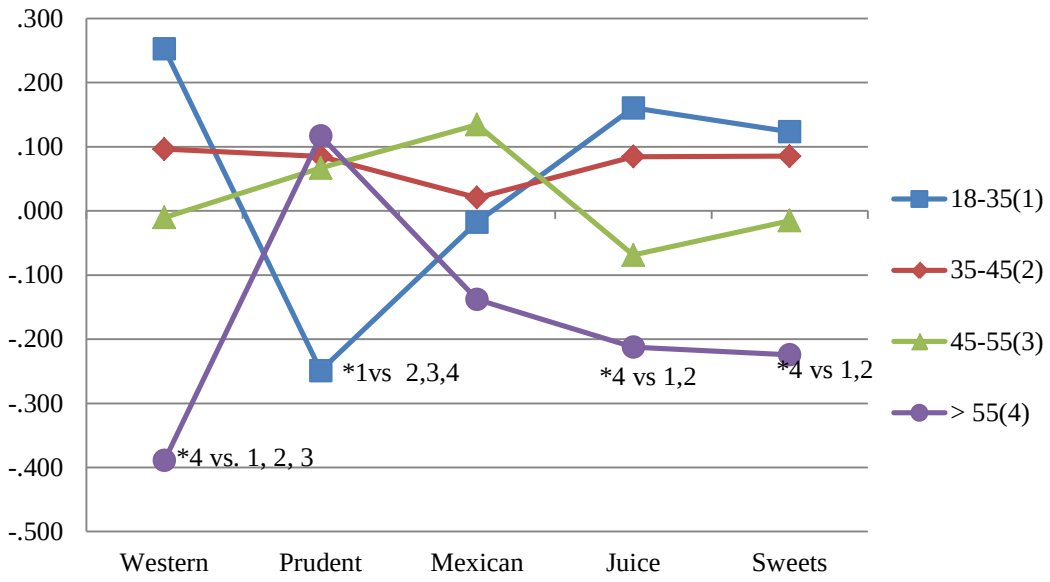

Figure 1. Dietary patterns by age group.

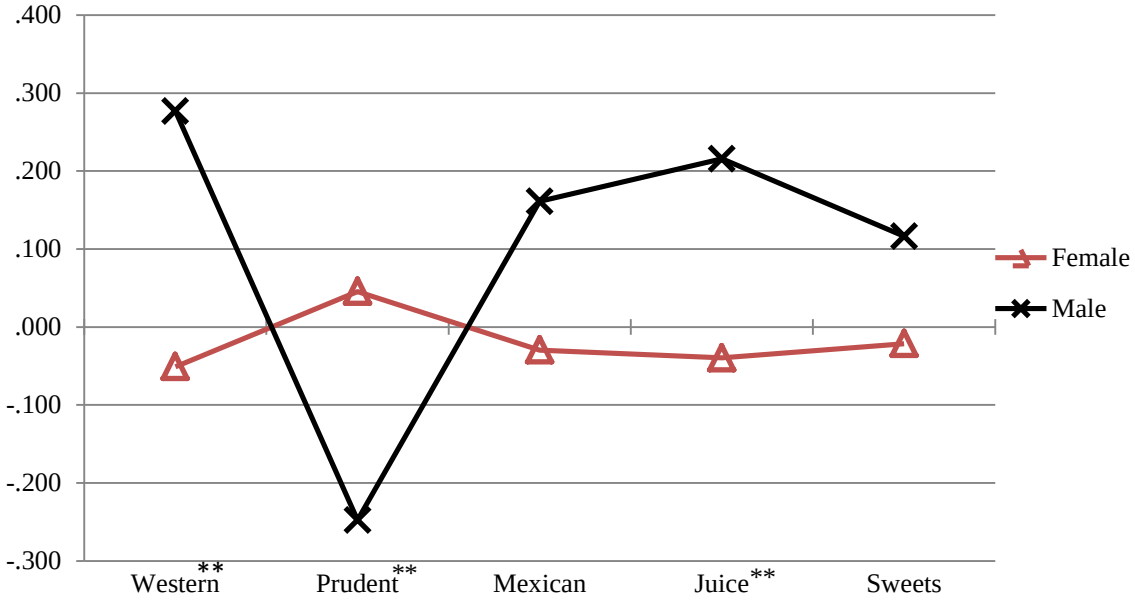

Figure 2. Dietary patterns by gender

dietary pattern, where males scored lower on the Prudent pattern than females did. No differences were found on the Mexican or the Sweets dietary pattern between males and females. Figure 2 shows the graph for the different dietary patterns and differences by gender.

Income. The variable for household income was divided into tripartite; where group one had a household income < $10,000, group two a household income between $10,000 and $20,000, and group three a household income > $20,000. Results from the one-way MANOVA for income revealed a statistically significant effect for dietary component by income, Λ = .96, F (10, 1169) =2.24, p < .05. Univariate ANOVAs were significant for the Juice dietary pattern F (2)= 3.21, p<.05 only. The Tukey's HSD post-hoc tests showed that mean scores for only the Juice dietary pattern differ between the lower and the upper income category where people on the lower category of household income had a higher consumption of the Juice dietary pattern when compared to the group of people in the ≥ $20,000 group. Figure 3 describes in detail the different consumption of the Juice pattern related to household income.

Years of Education. Figure 4 shows the results from the one-way MANOVA where there were no statistically significance differences in the dietary pattern consumption by years of education Λ = .97, F (10, 1196) =1.77, p > .06.

Place of Birth. For this analysis, three cases were excluded because participants indicated being born in other place but Mexico or United States; for the purpose of this analysis the n=602. Results of the one-way MANOVA for gender revealed a statistically significant effect for dietary component by place of birth, Λ = .94, F (5,596) =7.70, p < .001. Univariate ANOVAs were significant for the Western F (2) = 10.67, p<.001, Prudent F (2) = 8.76, p<.01, and Mexican dietary pattern F (2) = 12.60, p < .001. Results showed that dietary patterns differed by place of birth. People born in the United States had a higher score on the Western dietary pattern than people that were born in Mexico (p<0.001). An inverse result was identified for the Prudent dietary pattern. People born in the United Stated had lower scores on the Prudent dietary pattern than people that were born in Mexico (p<0.01).

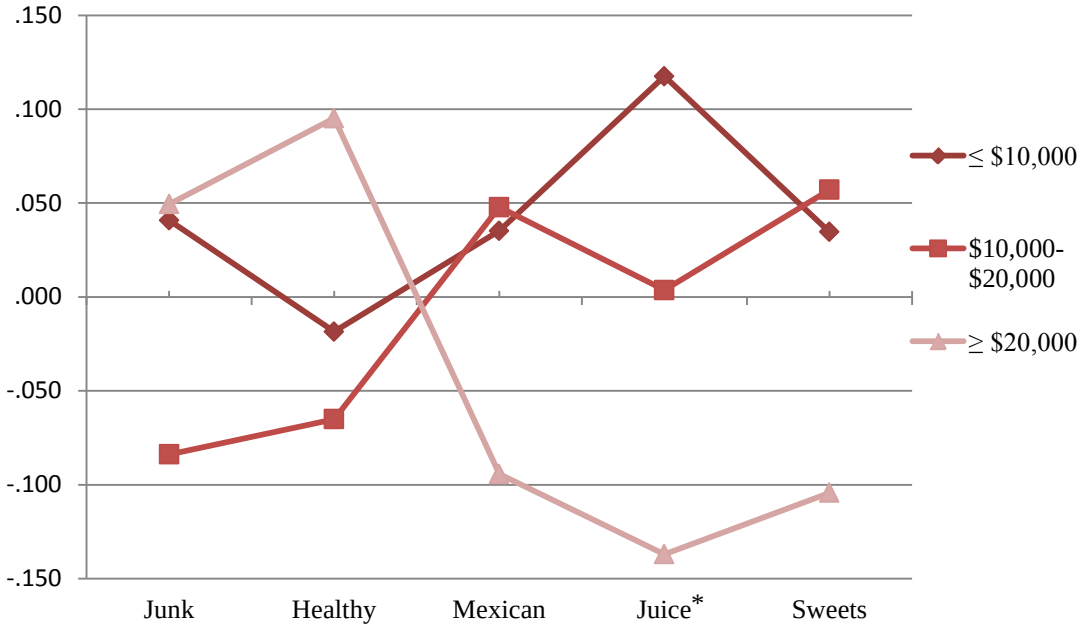

Figure 3. Dietary pattern by household income

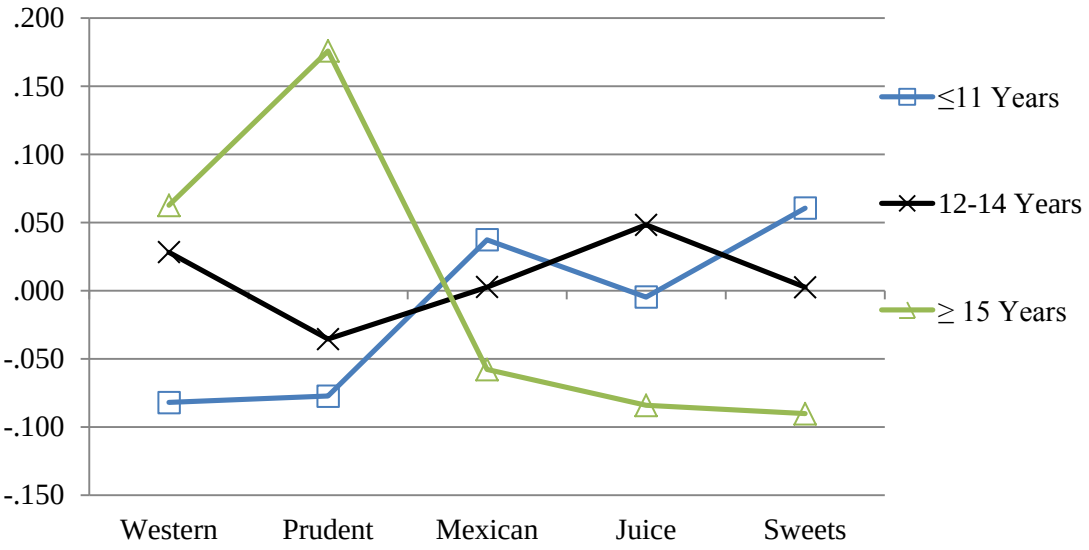

Figure 4. Dietary patterns by years of education

Results were similar for the Mexican dietary pattern where people that were born in the United states scored lower on this dietary pattern compared to those born in Mexico ($p<0.001$). Figure 5 illustrates the dietary patterns by place of birth.

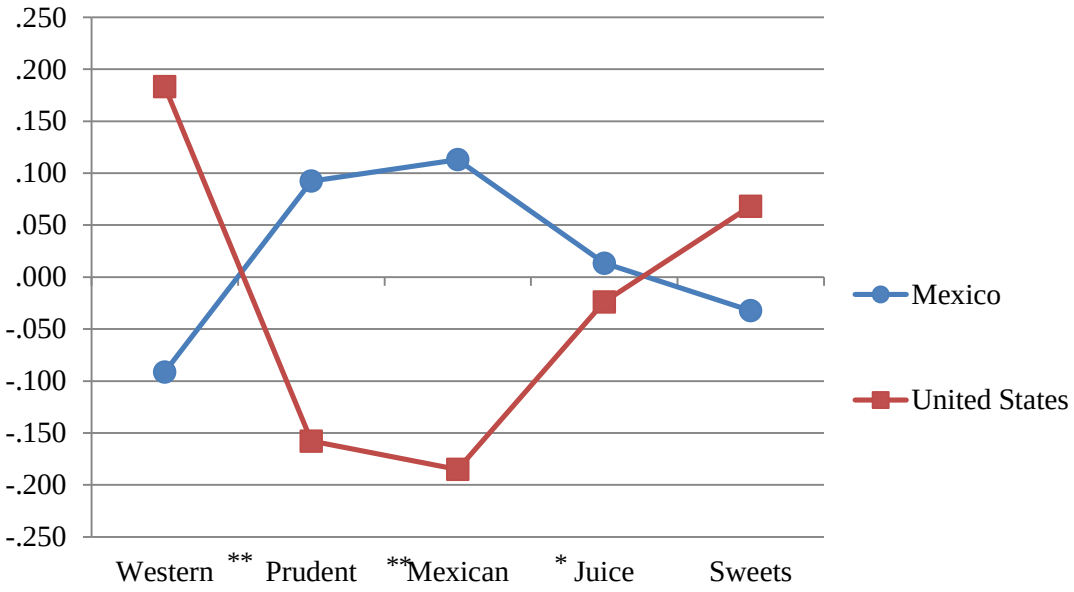

Figure 5. Dietary Patterns by place of Birth

In summary, individuals that scored higher on the Western dietary pattern were males, younger adults, and were born in the United States. In addition, the Western pattern was significantly correlated to the Mexican, Juice, and Sweets dietary pattern, but not the Prudent dietary pattern. Individuals with higher scores on the Mexican, Juice, and Sweets dietary pattern tended to be males, younger adults, had a lower household income, and were born in the United States as well. Finally, individuals that scored higher on the Prudent pattern were females, older adults, with higher education and income, and were born in Mexico.

Study Aim 3: Associations between dietary patterns and cardiovascular disease factors

The aim 3 for Study 1 was to explore associations among dietary patterns and cardiovascular disease risk factors and to identify the direct and indirect effects of dietary behaviors as mediators of the association between demographic and socioeconomic characteristics and cardiovascular disease risk factors, including a latent variable called obesity measure by BMI, waist circumference, and waist to height ratio; and a latent variable called

blood pressure. Table 9 summarizes the intercorrelations among the five identified dietary components and cardiovascular disease risk factors.

For the purpose of this aim, correlations were conducted to identify associations between the five dietary components, derived by factor analysis, and the measured cardiovascular disease risk factors including calculated BMI, waist circumference, systolic and diastolic blood pressure, and CVD risk index. As, shown in Table 9, the Western factor was positively correlated with waist circumference. The Juice factor was negatively associated with body mass index, waist circumference, systolic blood pressure, and CVD risk index. The Prudent dietary pattern was negatively associated with CVD risk index.

Table 9
Intercorrelations between dietary components and cardiovascular disease risk factors

	Western	Prudent	Mexican	Juice	Sweet
BMI	.02	-.02	.00	-.14**	-.01
WC	.08*	-.06	.02	-.11**	.05
WtoH Ratio	.02	-.03	.02	-.15**	.01
SBP	-.06	-.03	.00	-.09*	-.07
DBP	.01	-.07	-.02	.01	-.01
CVD Risk	.06	-.15**	-.01	-.10*	.03

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
BMI, Body Mass Index; WC, Waist Circumference; WtoH Ratio, Waist to Height Ratio; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure

Mediation analysis

Mediation analyses were conducted using SPSS AMOS 20.0 to understand the relationship between demographic and socioeconomic characteristics with cardiovascular disease risk factors, including BMI, CVD Risk Index, and one latent variable called blood pressure measured by systolic and diastolic blood pressure. Dietary patterns were analyzed as mediator variables in this relationship. For the purpose of this analysis, the measurement model for the latent variable blood pressure was tested to assess how well different observed indicators (e.g.,

systolic and diastolic blood pressure) capture the underlying latent construct. For just identified models, the goodness-of-fit evaluation does not apply; therefore, the model will be evaluated by the strength and magnitude of its parameter estimates (e.g., factor loadings). Factor loadings for systolic was 1.00 and for diastolic blood pressure was .99.

The statistical significance of the indirect effects, which suggest mediation (Morera & Castro, 2013), was tested using the bootstrapping technique which provides average estimates of indirect effects and the 95% CI surrounding them. The hypothesized mediation model is depicted in Figure 6. The general model examined different demographic and socioeconomic factors including gender, age, income, years of education, and place of birth as exogenous variables, dietary pattern as an endogenous observed variables (and mediators), and three cardiovascular risk factors as the dependent variables. Parallel analyses were conducted for all five dietary patterns, the Western, Prudent, Mexican, Juice, and Sweet, and all three cardiovascular disease risk factors, obesity-measured by BMI, blood pressure, and CVD risk index. In total, results for 15 models were estimated. This included testing of models where the initial association between the IV and the DV was not statistically significant--a practice recommended in modern treatments of mediational analyses (Hayes, 2009; Morera & Castro, 2013; Rucker, Preacher, Tormala, & Petty, 2011).

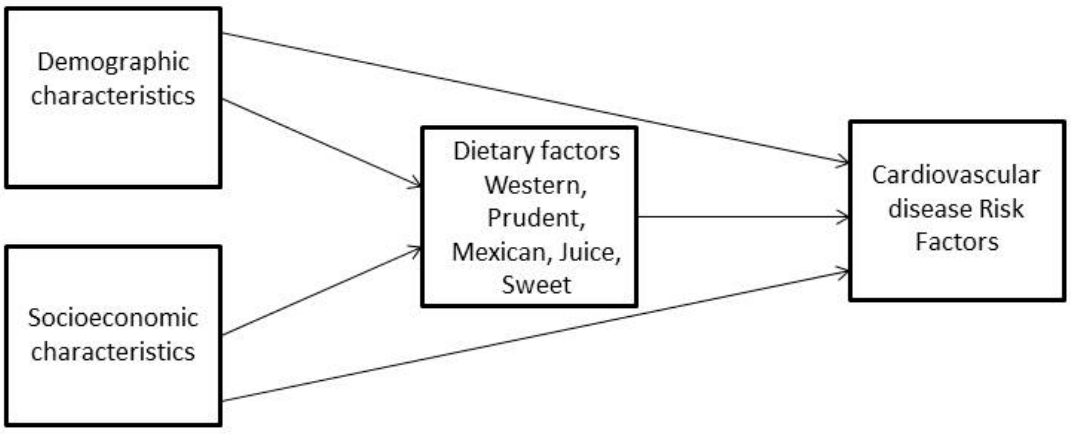

Figure 6. Hypothetical Model of the mediating role of dietary patterns.

Results from the mediational analysis indicated that only the Prudent and the Juice dietary pattern mediated the association between demographic and socioeconomic characteristics with cardiovascular disease risk factors.

Prudent dietary pattern: Standardized regression coefficients are shown in Figure 7, which illustrates the model displaying the mediating role of the Prudent pattern between gender, age, years of education, and place of birth with CVD risk index. The paths from gender, age, and years of education to Prudent pattern were all positive and significant. The path from place of birth to prudent was negative and significant. Female gender, older adults, higher education levels, and being born in Mexico were associated with higher consumption of the Prudent pattern. The Prudent pattern was negatively and significantly associated with the CVD Risk Index. Higher consumption of the Prudent pattern was associated with lower CVD Risk Index. There were significant direct effect of age (b=.20, p <.01) and place of birth (b=.*11*, p <.05) to CVD Risk Index (not shown in the picture).

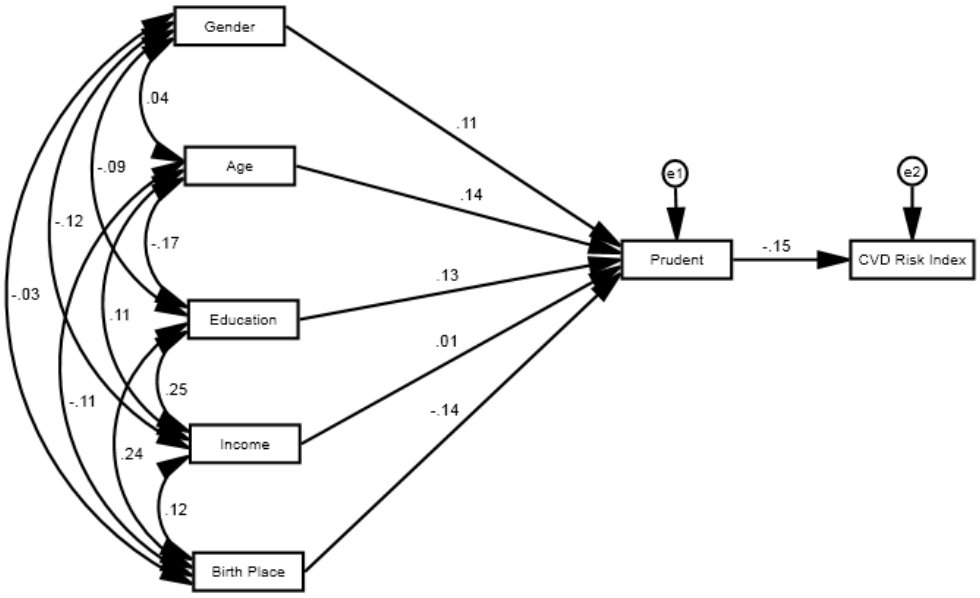

Figure 7. Mediating role of the Prudent dietary pattern between demographic and socioeconomic characteristics with CVD Risk Index. Mean indirect effects for gender *b*= -.08 (95%BootCI= -.19; -.02), age *b*= -.003 (95%BootCI= -.006; -.001), years of education *b*= - .01 (95%BootCI= -.02; -.003), and place of birth *b*= .08 (95%BootCI= .03; .15) to CVD risk Index.

Indirect effects were significant from demographic and socioeconomic characteristics to CVD risk Index through the Prudent dietary pattern. The mean indirect effects (calculated from 5000 bootstrap samples) were significant for gender *b*= -.08 (95%BootCI= -.19; -.02), age *b*= -.003 (95%BootCI= -.006; -.001), years of education *b*= -.01 (95%BootCI= -.02; -.003), and place of birth *b*= .08 (95%BootCI= .03; .15). Significant indirect effects suggest the mediating role of the Prudent pattern between different demographic and socioeconomic characteristics and CVD Risk Index. Females, older adults, and having greater education levels were all associated with greater consumption of the Prudent pattern and lower CVD Risk Index. In contrast, being born in the U.S. was associated with lower consumption of the Prudent pattern and higher CVD Risk index.

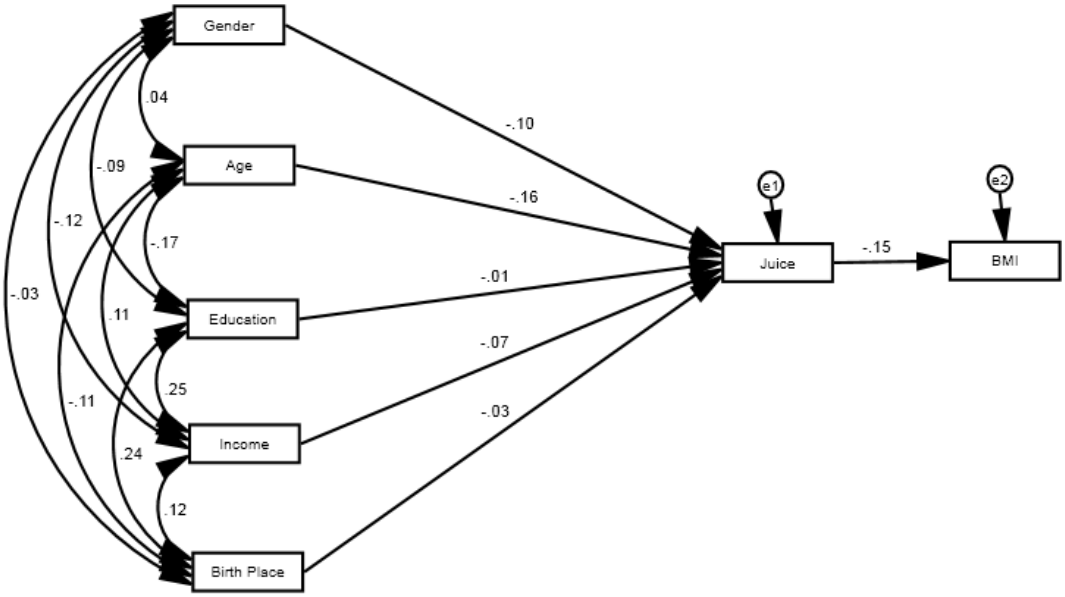

Figure 8. Mediating role of the Juice dietary pattern between demographic and socioeconomic characteristics with BMI. Mean indirect effects for gender *b*= .20 (95%BootCI= .021; .448), age *b*= .010 (95%BootCI= .003; .020), and income *b*= .026 (95%BootCI= .001; .068) to BMI.

Juice dietary pattern and BMI: Results from the mediational analysis showed that the Juice dietary pattern mediated the associations between demographic and socioeconomic characteristics and two cardiovascular disease risk factors, BMI (Figure 8) and CVD risk Index (Figure 9). Standardized regression coefficients are shown in Figure 8, which illustrates the model displaying the mediating role of the Juice pattern between gender, age, years of education, income, and place of birth with BMI. The paths from gender and age to Juice dietary pattern were negative and significant. Male gender and younger age were associated with higher consumption of the Juice dietary pattern. The Juice pattern was negatively and statistically significant associated to BMI. Higher consumption of the Juice dietary pattern was associated with lower BMI. There were a significant direct effect from age (*b*=.14, *p* <.001) and place of birth (*b*=.10 *p* <.05) to BMI (not shown in the picture). Indirect effects were significant for demographic and socioeconomic characteristics to BMI through the Juice dietary pattern. The mean indirect effects for gender *b*= .20 (95%BootCI= .021; .448), age *b*= .010 (95%BootCI=

.003; .020), and income *b*= .026 (95%BootCI= .001; .068) were all significant. Significant indirect effects suggest the mediating role of the Juice dietary pattern between different demographic and socioeconomic characteristics and BMI. Males, younger adults, and having lower income are associated with greater consumption of the Juice dietary pattern and lower BMI.

Juice dietary pattern and CVD Risk Index: Standardized regression coefficients are shown in Figure 9, which illustrates the model displaying the mediating role of the Juice pattern between genders, age, years of education, income, and place of birth with CVD Risk Index. The paths from gender and age to Juice dietary pattern were negative and significant. Male gender and younger adults were associated with higher consumption of the Juice dietary pattern. The Juice pattern was not statistically significant associated with CVD Risk Index. There were a significant direct effect from age (*b*=.17, *p* <.001) and place of birth (*b*=.13 *p* <.01) to CVD Risk Index (not shown in the picture). Indirect effects were significant for demographic and socioeconomic characteristics to BMI through the Juice dietary pattern. The mean indirect effects for gender *b*= .044 (95%BootCI= .005; .102), age *b*= .002 (95%BootCI= .000; .005), and income *b*= .006 (95%BootCI= .000; .015) were all significant. Significant indirect effects suggest the mediating role of the Juice dietary pattern between different demographic and socioeconomic characteristics and CVD Risk Index.

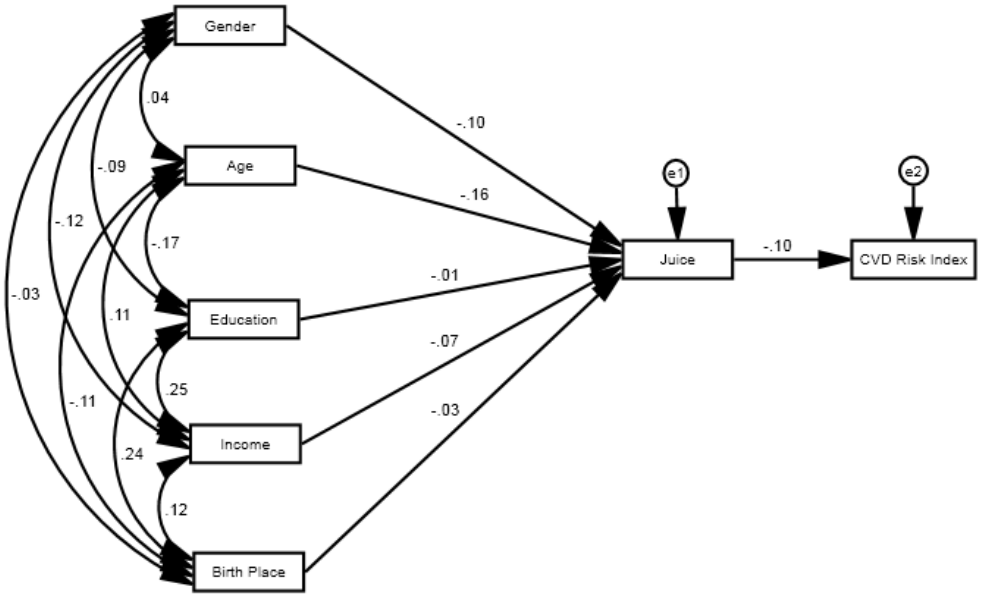

Figure 9. Mediating role of the Juice dietary pattern between demographic and socioeconomic characteristics with CVD Risk Index. Mean indirect effects for gender *b*= .044 (95%BootCI= .005; .102), age *b*= .002 (95%BootCI= .000; .005), and income *b*= .006 (95%BootCI= .000; .015) to CVD Risk Index

Discussion

The overall aim of Study 1 was to characterize dietary patterns using factor analysis and to examine its association with demographic characteristics and cardiovascular disease risk factors in Hispanic adults participating in the H.E.A.R.T. study. In addition, Study 1 aimed to explore dietary patterns as mediating pathways between demographic and socioeconomic characteristics and cardiovascular disease risk factors. The population of this study was a targeted community participating in the H.E.A.R.T. project. Demographic characteristics showed that the majority were female and a little more than two thirds reported to have an income below $20,000 dollars per year. In addition, results indicated that more than half of the participants were obese.

Factor analysis identified five dietary patterns confirming the hypothesis that at least two dietary pattern would be derived by factor analysis. The first dietary pattern was labeled the Western pattern and was characterized by higher consumption of fast food, French fries, processed meats, refined grains, dairy, and diet soda. The second pattern was labeled the Prudent pattern and was characterized by higher consumption of fruit and vegetables, chicken, fish, yogurt, and dressing. The third pattern was label Mexican and was characterized by higher consumption of traditional Mexican foods including rice, corn and flour tortillas, beans, peas, lentils, eggs, and salsa. The fourth pattern was labeled Juice and was characterized by higher consumption of fruits juice, canned fruits, breakfast cereals, and pudding. The last and fifth pattern was labeled Sweet and was characterized by higher consumption of sweet deserts, ice cream, candy, and regular soda.

The first and second dietary patterns, the Western and the Prudent, were labeled according to previously identified patterns by Slattery et al (1998) who were the first authors to

identify these patterns using factor analysis. The present study confirmed the presence of these factors in a predominantly Hispanic sample very different from the original studies.

Study 1 also looked at the variation of dietary patterns in relation to demographic and socioeconomic status. It was hypothesized that the unhealthier dietary patterns, as labeled Western, would be associated with lower educational attainment, lower socioeconomic status, younger adults, the male gender, and being born in the U.S. Results from this study shows that the Western pattern related to male gender, younger age, and birth in the U.S., but not related to education attainment or socioeconomic status, as measured by income. In addition, our healthy dietary pattern, labeled the Prudent pattern, was associated with female gender, older adults, and Mexico-born participants, but not related to education attainment income either.

The Mexican pattern was only related to place of birth, where those born in the U.S. had lower consumption of this pattern, suggesting that foreign-born first generation Mexican immigrant tend to retain their traditional diet more than their U.S. born counterpart. Interestingly, the Mexican pattern did not differ by age, suggesting that younger generations continue to consume traditional Mexican foods. The Juice pattern was the only dietary pattern that was related to gender, income, and age, where male, younger participants with lower income consumed more of this pattern. The Sweet dietary pattern was also consumed significantly more by younger adults.

The second and third aims of Study 1 related to the associations between dietary patterns with CVD risk factors, as well as the mediating role of diet in the relation between demographic and socioeconomic factor with CVD risk factors. Confirming the hypothesis, the Western dietary pattern was related to at least one CVD risk factor, waist circumference, but was unrelated with BMI, waist to height ratio, systolic and diastolic blood pressure, and CVD risk

Index. Moreover, the Prudent pattern was negatively related to CVD risk index, but not associated with BMI, waist circumference, waist to height ratio, systolic or diastolic blood pressure. Overall, these associations, even when statistically significant, were modest in size.

Unexpectedly, the Juice pattern was significantly and negatively associated with most of the CVD risk factors except diastolic blood pressure. This result was surprising since the Juice pattern included higher consumption of fruits juice, canned fruits, breakfast cereals, and pudding, food items that can be considered unhealthy; but it was also consumed significantly more by younger adults, a characteristic that can be associated with lower risk, since age is a predictor for many risk factors.

Results from the mediation analysis indicated that only the Prudent and the Juice dietary pattern mediated the association between demographic and socioeconomic characteristics with cardiovascular disease risk factors. Specifically, the Prudent pattern mediated the association between age and education levels with the CVD risk index. In addition, the Prudent pattern mediated the association between place of birth and CVD risk index. It is important to remember that the majority of the sample were female (84%) and the Prudent pattern was predominantly consumed by females. The Juice pattern mediated the association between gender, age, income with BMI and CVD Risk Index, in separate models. These results are interesting and unexpected, since the Juice pattern was negatively associated with CVD risk factors. As previously stated, the Juice pattern was predominantly consumed by males, younger adults, and low income participants; it is possible that these characteristics influenced the ability to detect this association. It is also possible, that the Juice pattern was related to lower consumption of total energy intake or that this pattern was consumed as a way to maintain o restrict weight gain affecting the results.

The Western pattern did not mediate any association, nor was it related to any of the CVD risk factors, this result was unexpected. It is possible that the ability to detect an effect of the Western pattern on any of the CVD risk factors was affected by the low male participation, about one fifth, and age because the Western pattern was predominantly consumed by males and younger adults. Moreover, it could be possible that the results were affected because the specific population in this study was part of a big intervention that was targeted specifically because of its demographic and socioeconomic characteristics.

Our results are similar to those found by many authors (Sofianou, Fung, & Tucker, 2011; Duffey, Gordon-Larsen, Ayala, & Popkin, 2008; Montez & Eschbach, 2008; Dixon, Sundquist, Winkleby, 2000; Guendelman & Abrams, 1995). For example, Sofianou et al., (2011) found that Mexico-born participants had lower consumption of the Western pattern and higher consumption of the tomato/tortilla pattern compared to U.S.-born. In addition, those born in the U.S. had higher scores of the Western and Coffee/Sugar dietary patterns, suggesting preferences for an unhealthier dietary pattern. Overall, evidence suggests that foreign-born or first generation Mexican immigrants have healthier behaviors and outcomes than the second generation Mexican descent counterpart (Viruell-Fuentes, 2007).

In addition, in our study, income and years of education did not relate to any of the dietary patterns, except for income that was negatively related the Juice dietary pattern, lower income, was associated with higher intake of the Juice pattern. Contrasting results have been found by others, regarding income and education. For example Kerver et al., (2003) found that the Western pattern was associated with lower educational attainment and lower income. Likewise, Mullie, Clarys, Hulens, & Vansant (2010) identified that higher educational levels and higher income was associated with the healthiest pattern (Mullie et al., 2010). As noted above,

this study was conducted among an already recognized low-socioeconomic community, specifically targeted at the H.E.A.R.T. study. Therefore, the possibility that we did not have enough variability in income and education to detect differences in dietary pattern consumption exists.

In this study, the Mexican dietary pattern was similar to the American Indian/Mexican pattern found by Eilar-Adar et al., (2012), but contrarily to the present results, the American Indian/Mexican pattern, which included traditional foods, was related to being male, higher BMI, and higher waist circumference. In our study, the Mexican pattern was not related to any of the demographic, socioeconomic characteristic, or CVD risk factor, other than place of birth.

In the present study, the Juice dietary pattern was consumed significantly more by males, younger adults, and people in the lower income category. Similarly, a Juice dietary pattern has been previously found by Slattery et al (1998), the authors identified this pattern among men but not women, and higher among younger adults, similar to our findings. Moreover, we identified the Sweets dietary pattern which is comparable to the one identified by (Lin, Bermudez, & Tucker, 2003) in elder Hispanics. Interestingly, findings in this study show that the Sweets pattern was predominantly consumed by younger adults, whereas in the Lin and associated (2003) study was identified to be consumed by elder adults. These contrasting results are interesting because age is an important determinant of the type of diet, generally as people grow older they tend to adopt a healthier pattern, it is possible that after a particular age people return to an unhealthier dietary pattern, similar to that at younger age. Similarly to our results, the Sweet pattern found predominantly consumed by elder adults was not significantly associated with BMI or waist circumference.

Although, to the author knowledge, there are not studies investigating the mediating role of dietary patterns, derived by factor analysis, between demographic and socioeconomic characteristics with CVD risk factors among Hispanics, some studies have looked at the mediating role of diet, as measure by different variables such as fruit and vegetable consumption or quality of diet, between socioeconomic characteristics and adiposity. For example, Ward, Tarasuk, & Mendelson (2007) found strong evidence that education and income were inversely associated with high risk of adiposity and that indirect paths were seen from income and education to risk of adiposity with fruit and vegetable consumption mediating this association in women (Ward et al., 2007). Our result indicates, that the Prudent pattern, high in fruit and vegetable consumption, mediated the association between gender, age, education, and place of birth with CVD risk index. Interestingly, the Juice dietary pattern also mediated the association between gender, age, and income with BMI and CVD risk (separate models). In contrast, the Western pattern was surprisingly not related to these outcomes, although sample characteristics may have limited our ability to find such effects.

Study 2

Dietary patterns, acculturation, and psychosocial factors as mediators of cardiovascular disease risk factors in Mexican-American adults participating in the H.E.A.R.T. Study

Introduction

Studying diet and its predictors has become a priority among nutrition researchers because of the importance that diet plays as a determinant of obesity and other chronic diseases. For many years, researchers have focused on identifying the link between diet and health outcomes, and results from these reports have provided strong evidence that current dietary changes are partially responsible for the increasing epidemic of chronic diseases and obesity worldwide. In addition, it is well established that the consumption of a healthy dietary pattern and specific nutrients, such as dietary fiber, and specific foods such as fruits and vegetables can help prevent and control morbidity and mortality (WHO, 2002).

Globalization and industrialization have occurred rapidly in the last decades and have brought with them major changes in lifestyle behaviors, including dietary changes. Although they brought with them economic development and market globalization improving food availability, they also brought unfortunate dietary changes. For example, there has been an increased consumption of energy-dense foods leading to higher intake of saturated fats and refined carbohydrates. Overall, there has been an increase in the consumption of an unhealthier dietary pattern with more industrialization happening around the globe. Unfortunately, these changes have not only occurred among developed countries but also among developing countries, where it is occurring at a faster rate (WHO, 2002).

As mentioned before, lifestyle modifications have occurred in the last decades, bringing along changes in the way people eat. Nowadays, an increased number of factors affect dietary

choices. For example, the frequency of eating outside the home has increased in the last decades. And it is well known that foods and meals prepared and eaten outside home are significantly higher in calories from fat, specifically saturated fats; are higher in cholesterol and sodium; and include higher consumption of sugar-sweetened beverages. It is also established that eating out is associated with having a higher BMI (Jeffery & French, 1998). Recently, the study of diet has taken a new approach and it is being studied not only by looking at specific nutrients or foods, but also by looking at dietary patterns, as a whole. A diet with higher consumption of energy-dense, nutrient-poor, such as fast foods with high levels of saturated fats, sugary beverages, and low in dietary fiber and nutrients has been labeled as the Western dietary pattern.

The Western dietary pattern was first characterized and labeled by (Slattery, Boucher, Caan, Potter, & Ma, 1998) using factor analysis. The method for deriving dietary patterns using factor analysis has been previously explained in this paper. The Western dietary pattern is characterized by higher consumption of refined grains, processed meat, butter, French fries, eggs, and high-fat dairy products. Other authors—and Study 1—have replicated this type of dietary pattern among different populations. The consumption of this pattern, and overall energy-dense, nutrient-poor foods, has increased worldwide because of lifestyle modifications which have made them affordable and convenient for the population (Lopez et al., 2009). Unfortunately, evidence suggest that exposure to a Western lifestyle increases the risk for chronic disease, including cancer, obesity, and cardiovascular disease risk factors (Satia-Abouta, Patterson, Neuhouser, & Elder, 2002)

The dietary pattern follow by people is affected by many factors and in a world where globalization is part of the everyday, migration and multicultural environments are part of those factors changing our dietary behaviors. In the United States, it is calculated that 12.9% of the

total population was born in a foreign country (U.S. Census, 2010). Migration to a new Country brings new opportunities to the people who migrate, but it also represents significant changes in the way people behave and conduct themselves. One of the most dramatic changes that can occur is a change in diet. As described above, the Western dietary pattern has popularized in the United States, therefore, people who migrate to the U.S. tend to adopt a Western type of dietary pattern, which is higher in fat content and low in consumption of fruits and vegetables. As a matter of fact, strong evidence indicates that people who are exposed and adopt a western lifestyle are at increased risk for major chronic disease (Satia-Abouta et al., 2002).

The term acculturation has been defined as "the process by which immigrants adopt the attitudes, values, customs, beliefs, and behaviors of a new culture" (Abraido-Lanza, White & Vazquez, 2004; p. 533). For many years, acculturation has been studied among different minority groups to explore the influence it may have on different health behaviors and outcomes, including diet. Research suggests that Hispanics that have migrated to the United States have an unhealthier dietary pattern than other ethnic groups living in the U.S. It has been suggested that the acculturation process could be linked to a more unhealthy dietary behaviors and poorer health outcomes (G. X. Ayala, Baquero, & Klinger, 2008).

Acculturation has been described as a multidimensional and dynamic process. People who are exposed to a new culture will have different levels of acculturation depending on the degree to which they have been exposed and have adapt to the new culture, age at the time of migration, and place of birth (Sanou et al., 2013). For example, some studies indicate that greater time living in the U.S. and being exposed to a western lifestyle for longer period of time is associated with more unhealthy dietary patterns (Benavides-Vaello, 2005; Satia-Abouta et al., 2002). In addition, foreign-born immigrants tend to retain a more healthful dietary pattern than

first and second generation of immigrants (Sofianou et al., 2011). Study 2 will investigate how acculturation relates to adoption of the Western dietary pattern, among others, and cardiovascular disease risk factors.

Psychosocial factors, Diet, and cardiovascular disease risk factors

The term psychosocial factors refers to a wide range of concepts that reflect personal knowledge, beliefs, and attitudes that affect an individual's willingness and ability to participate in a wide variety of health behaviors. Common psychosocial factors include attitudes, self-efficacy, perceived barriers and benefits for performing a specific behavior, and social support. These factors are frequently contained in health behaviors theories such as the Health Belief Model (Hochbaum, 1958), Social Cognitive Theory (Bandura, 1977), and the Theory of Planned Behavior (Ajzen, 2001), to name only a few. Recent evidence indicates that dietary behaviors are affected by many of these psychosocial factors.

Specific theory-based studies have looked at different psychosocial constructs in relation to consumption of specific nutrients or foods. For example, the Social Cognitive Theory and the PRECEDE framework have been used to explore factors associated with fat intake (Baranowski, Cullen & Baranowski, 2005; Watters & Satia, 2009). Watters & Satia (2009) identified that beliefs about healthy eating and self-efficacy to eat healthy were strongly inversely associated with total and saturated fat intake among African-American adults (Watters & Satia, 2009). Similarly, the Theory of Planned Behavior concepts have been used to identify determinants of snack consumption and intentions to consume a healthful diet among adolescents. For example, Backman and associates (2002) identified that intentions to eat a healthy dietary pattern is a strong predictor of a healthful dietary behavior as measure by total calories and servings of fruit and vegetables (Backman, Haddad, Lee, Johnston & Hodkin, 2002).

Another psychosocial factor that has been studied in relation to healthy behaviors is social support. Harley & Eskenazi (2006) reported that high social support among pregnant women is related to better quality of the diet (Harley & Eskenazi, 2006). Finally, concepts from the Health Belief Model have been used to predict low-fat diets and understand the consumption of a healthy diet (Kristal et al., 1995; Kristal, Glanz, Tilley, & Li, 2000). For example, two different sets of psychosocial factors, predisposing factors such as beliefs, perceived benefits, and motivation, and enabling factors such as barriers, norms, and social support were studied in the Working Well Trial. Results from this trial showed that predisposing factors strongly predicted type of diet, intentions to change the diet, and self-efficacy (Kristal et al., 1995). Similarly, another study identified that perceived barriers, a Health Belief Model construct, was the strongest predictor of fruit and vegetable consumption (Dittus, Hillers, & Beerman, 1995b).

Although many studies have used concepts from only a particular theory, recommendations in the field of nutrition research suggest the use of a combination of variables derived from different theories; this may be needed in order to understand the complex dietary behavior (Baranowski, Cullen, & Baranowski, 1999). Furthermore, the design of effective nutrition education programs requires the assessment of key variables that influence the dietary behavior regardless of the specific theory from which they come (Bartholomew, Parcel, & Kok, 1998). These multi-theoretical approaches have been used to examine how several psychosocial factors relate to nutrient intake, intentions, and self-efficacy for consuming a healthful diet (Kristal, Patterson, Glanz, Heimendinger, Hebert, Feng & Probart, 1995). For example, the Soul Effectiveness Trial evaluated if different psychosocial constructs were related to fruit and vegetable consumption. The authors of this Trial found that social support and self-efficacy had direct effects on the consumption of fruit and vegetables, suggesting the use of this construct

when planning and implementing dietary intervention programs targeted at increasing fruits and vegetables consumption (Fuemmeler et al., 2006). Similarly, Bruening and associates (2010)examined if perceived barriers to healthy eating mediated the association between self-efficacy to eat healthy foods and fruit and vegetable consumption. Results indicated that perceived barriers mediated this association between self-efficacy and fruit and vegetable intake, suggesting that self-efficacy should be considered when planning interventions to increase fruits and vegetable consumption, and specially to consider the influence that perceived barrier to eating healthy can have on such interventions (Bruening et al., 2010). Another construct that has been studied in relation to eating a healthy diet is social support; this construct has been studied among pregnant women. Results from this study indicated that having high social support was related with better quality of diet among Mexican decent pregnant women (Harley & Eskenazi, 2006).

Finally, (Guillaumie, Godin, & Vezina-Im) (2010) conducted a systematic review to identify main psychosocial determinant of fruit and vegetable consumption by reviewing social cognitive theory-based studies, specifically the Theory of Planned Behavior (TPB), the Social Cognitive Theory (SCT), and the Health Belief Model (HBM). Studies reviewed included those investigating determinants of fruit and vegetable consumption and determinant of intentions of fruit and vegetable consumption. Results from this review suggest that constructs from the TPB and SCT were effective in predicting behavior and intention to consume fruit and vegetables; however, construct of the HBM were less appropriate in predicting this type of behavior. Overall, the most consistent determinant of fruit and vegetable consumption were motivation and goals and beliefs about capabilities; the most consistent determinant of intentions was beliefs about consequences, beliefs about capabilities, and social influences (Guillaumie et al., 2010).

Although many studies have investigated the predictors of fruits and vegetables intake, to the author's knowledge, no studies have examined relationships between psychosocial factors and specific dietary patterns derived via factor analysis. Accordingly, the study described below used a multicomponent framework to examine the effects of psychosocial factors on the dietary factors identified in Study 1. In addition, with the exception of one (Fuemmeler et al., 2006), none of the psychosocial studies described previously have used structural equation modeling (SEM) as part of the analysis. SEM includes a series of statistical methods that allows the researcher to model relationships between several independent and dependent variables. Moreover, SEM allows the researcher to control for measurement error and to avoid problems of over- and under-estimation of effects; estimate models with multiple mediators; and isolate direct effects when including mediating or third variables in the model (Byrne, 2010).

Purpose of Study 2

The overall goal of Study 2 was to examine the associations between acculturation, various psychosocial factors, and their relationship to dietary patterns and cardiovascular disease risk factors among Hispanic adults participating in the H.E.A.R.T. project. Within this larger goal, the first aim was to examine the direct effects of acculturation on dietary patterns and cardiovascular disease risk factors. It also examined indirect effect of acculturation on cardiovascular disease risk factors as mediated through dietary patterns. A second aim was to identify the direct and indirect effect of psychosocial factors on dietary patterns and cardiovascular disease risk factors among this same sample of Hispanic adults. This study utilized SEM to identify psychosocial determinants of dietary behavior, which can help develop and improve nutrition education interventions targeted at modifying dietary behaviors as a way to reduce cardiovascular disease risk factors.

Specifically, this study proposed the following research questions and hypothesis.

Research Questions and Hypothesis- Study 2

1. What are the direct and indirect effects of acculturation on cardiovascular disease risk factors?

Hypothesis 1: There will be positive direct effects between acculturation and cardiovascular disease risk factors such that greater acculturation to United States customs will be associated with greater cardiovascular disease risk.

Hypothesis 2: There will be a positive indirect effect between acculturation and cardiovascular disease risk factors with at least one dietary pattern mediating these associations. For example, being more acculturated will be associated with higher cardiovascular disease risk factors and this association will be mediated by the Western dietary pattern.

2. What are the direct and indirect effect of psychosocial factors and intentions to eat healthy on two dietary pattern, the Western and Prudent, and cardiovascular disease risk factors?

Hypothesis 3: Psychosocial factors will predict dietary patterns among participants of the H.E.A.R.T. project in ways consistent with past studies.

Hypothesis 4: There will be a significant direct effect of psychosocial factors and intentions to eat healthy on at least one dietary pattern, specifically, having social support, higher levels of perceived benefits of healthy eating and higher self-efficacy to eat healthy will be positively and significantly related to the Prudent dietary pattern. In addition, higher levels of perceived barriers to eating healthy will be positively and significantly related to the Western dietary pattern.

Hypothesis 5: There will be a significant indirect effect of psychosocial factors and intentions to eat healthy on cardiovascular disease risk factors with the Prudent and Western dietary patterns mediating these associations.

Theoretical Framework

Study 2 incorporated a multicomponent framework to examine the effects of psychosocial factors on dietary patterns and cardiovascular disease risk factors among Hispanics participating in the H.E.A.R.T. study. As noted, previous research has suggested the integration of significant determinants and constructs from multiple theoretical perspectives when examining complex behaviors, such as diet (Guillaumie et al., 2010; Kristal et al., 1995). The following section presents and briefly describes the different constructs that were investigated in relation to dietary behavior and cardiovascular disease risk factors.

Social Support was measured by the Social Provision Scale developed by Cutrona & Russell (1987) to assess the provisions of social relationships reflecting those things people receive from other people. The social provision scale has six provisions including guidance (i.e., advice or information), reliable alliance (i.e., assurance that others can be counted on in times of stress), reassurance of worth (i.e., recognition of one's competence), attachment (i.e., emotional closeness) social integration (i.e., a sense of belonging to a group of friends), and opportunity for nurturance (providing assistance to others). The global score measures social support (Cutrona & Russell, 1987).

The Health Belief Model (HBM) underlying concept is that healthy behaviors are determined by individual beliefs about disease and strategies available to reduce its occurrence (Hochbaum, 1958). *Perceived benefits* are defined as: "a person's opinion of the value or usefulness of a new behavior in decreasing the risk of developing a disease" (Glanz, 2002). This construct indicates that people will be more likely to perform a new behavior if they believe it will decrease the risk of developing a disease. They have the belief that adopting the new behavior is beneficial.

Another construct from the HBM are *Perceived Barriers* that are defined as: "individual's own evaluation of the obstacles in the way of him or her adopting a new behavior" (Glanz, 2002). Janz & Becker (1984) described perceived barriers as the most significant construct in determining a change in behaviors.

Self-efficacy refers to the personal belief about one's own ability to perform an action (Bandura, 1977). This concepts underlies that people will generally do not start a new behavior unless they believe they can perform it.

Intention is a construct from the Theory of Planned Behavior and is an indicator of a person's readiness to perform a behavior. Intentions are the immediate antecedent of a behavior (Ajzen, 1991; Ajzen & Fishbein, 1975).

Table 10
Definitions of Key Constructs

Construct	Definition
Perceived Benefits	One's belief in the efficacy of the advised action to reduce risk or seriousness of impact
Perceived Barriers	One's opinion of the tangible and psychological cost of the advised action
Self-Efficacy	Confidence on one's ability to take action
Intentions	Person's readiness to perform a behavior
Social Support	Assess the provisions of social relationships reflecting those things people receive from other people.

Source: Glanz, K., Rimer, B.K. & Lewis, F.M. (2002). *Health Behavior and Health Education. Theory, Research and Practice.* San Fransisco: Wiley & Sons.

Methods

Data Analysis

A description of the process for data screening, diagnosis, and editing is provided in the general methodology of the dissertation. For the purpose of Study 2, SPSS Analysis of Moment Structures (AMOS; Arbuckle, 2006; Byrne, 2010) was used to examine the theorized models regarding associations among acculturation, psychosocial variables, dietary patterns, and cardiovascular disease risk factors. These models are displayed in Figures 10 through 18. Structural Equation Modeling (SEM) was used to test hypothetical associations between different variables analyzed in this study. SEM includes a series of statistical methods that allows the researcher to model relationships between several independent and dependent variables by examining the goodness of fit of the proposed model. Moreover, SEM has been considered an efficient and the least problematic method for testing mediation because it allows for confirmatory and exploratory modeling with the present investigation relying on the latter. The advantages of using SEM to assess mediation include the ability to estimate multiple equations simultaneously and the option to include latent variables in the model, which are variables that are not measured directly. Another advantage is that SEM allows the researcher to control for measurement error and to avoid problems of over- and under-estimation of effects; estimate models with multiple mediators; and isolate direct effects when including third variables in the model (Byrne, 2010).

Measures

Dietary patterns were defined previously in Study 1. Participants were asked to respond to a survey by the time enrolled to participate in the study. This questionnaire included specific measures on acculturation (Marin, Sabogal, Marin, Otero-Sabogal, & Perez-Stable, 1987), social

support (Cutrona & Russell, 1987), perceived barriers and benefits of healthy eating (Glanz, Rimer, & Lewis, 2002), self-efficacy (Glanz et al., 2002) and intentions to eat healthy (Ajzen, I.,1991).

Acculturation has been defined as "the process by which immigrants adopt the attitudes, values, customs, beliefs, and behaviors of a new culture" (Abraido-Lanza, White & Vazquez, 2004; p. 533). Acculturation was measured by a 12-item Short Acculturation Scale for Hispanics, SASH (Marin et al, 1987). The scale assesses acculturation through measures of language and media use and social relationship preferences. The overall level of acculturation was obtained by calculating the mean score for the 12 items and higher scores indicate higher levels of acculturation.

Social Support was measured by the Social Provisions Scale, a 24-item to examine the degree to which respondent's social relationships provide several dimensions of social support (Cutrona & Russell, 1987). After reversal of negatively worded items, a total score was computed by summing all items. In addition, subscale scores were computed by summing items related to each specific subscale: attachment, social integration, reassurance of worth, reliable alliance, guidance, and opportunity for nurturance (Cutrona & Russell, 1987).

Perceived barriers to eat healthy refer to "one's opinion of the tangible and psychological cost of the advised action" (Glanz, Rimer & National Cancer Institute, 1997). A construct from the Health Belief Model, perceived barriers to eat healthy was measured by a 1 to 10 scale, where 1 indicates strongly disagree and 10 indicates strongly agree, Perceived barriers was measured by 6 items: "I do not buy healthy foods because they are expensive", "I do not buy healthy foods because they are not always available", "I do not eat healthy foods because they are not tasty", "I do not eat healthy food because I do not know how to prepare them", "I do not

eat healthy food because it takes a long time to prepare them", "I do not eat healthy foods because my family does not like this type of food". A total score was calculated and higher scores indicated higher perceived barriers to eat healthy.

Perceived benefits of healthy eating refer to "one's belief in the efficacy of the advised action to reduce risk or seriousness of impact" (Glanz, Rimer & National Cancer Institute, 1997). A construct of the Health Belief Model, perceived benefits of healthy eating was measured by a 1 to 10 scale where 1 indicates strongly disagree and 10 indicates strongly agree. Perceived benefits of healthy eating was measured by 3 item: "I believe that eating at least 5 servings of fruit and vegetables per day will help lower the risk of developing cardiovascular disease", "I believe that reducing the amount of fatty-food in my diet will help me lower the risk of developing cardiovascular disease", "I believe that reducing the amount of salt in my diet will help lower the risk of developing cardiovascular disease". A total score was calculated by summing all items score; higher scores indicated higher perceived benefits of healthy eating.

Self-Efficacy, a construct from the Health Belief Model, was measured by 6 items: "How confident are you that you can buy and prepare healthy foods for your family?", "How confident are you that you can eat at least 5 serving of fruits and vegetables per day?", "How confident are you that you can cook using less fat?", "How confident are you that you can avoid eating fast food more than once a week?", "How confident are you that you can cook using less salt?", "How confident are you that you can avoid eating foods rich in sodium, such as canned foods, ham, and chips?". Responses were scored on a ten point likert scale from 1, indicating not at all confident, to 10, indicating absolutely confident. Scores were summed and the mean was calculated; higher scores on the scale indicated higher levels of self-efficacy to eat healthy.

Cardiovascular disease risk factors analyzed in Study 2 include three variables, obesity, blood pressure, and CVD Risk Index. Two of the variables were created as latent variables. *Obesity* as measured by BMI, WC, and WtoH ratio and *Blood Pressure* as measured by systolic blood pressure and diastolic blood pressure. The third variable was the CVD risk index that was calculated from information from a CVD risk assessment data, presented in Table 11 and described more in detailed in the general methodology. This paper focuses specifically on data from the H.E.A.R.T. baseline survey, therefore this section focuses on data collection during this session. Readers are referred to Balcázar, Wise, Rosenthal, Ochoa, Rodriguez, Hastings, Flores, Hernandez & Duarte-Gardea (2012) for details regarding follow-up assessments (Balcazar et al., 2012).

Table 11
H.E.A.R.T. Cardiovascular Disease Risk assessment questionnaire

Have you ever had your blood cholesterol checked?
Have you ever been told by a doctor, nurse, or other heath professional that your blood cholesterol is high?
Have you ever been screen for diabetes?
Have you ever been told by a doctor, nurse, or other heath professional that you have diabetes?
If women, was this only when you were pregnant?
Have you taken part in a class to improve your health in the last 3-6 months?
Do you exercise for at least 30 minutes 3 times per week?
Do you eat at least five fruits and vegetables a day?
Is your mean blood pressure, out of 3 reading taken today, above normal range?
Is your waist circumference measurement taken today above normal range?
Is your BMI base on today's weight and height, above normal range?
Do you currently smoke cigarettes?

Results

Overview

The overall aim for Study 2 was to examine direct and indirect associations between acculturation, psychosocial factors, dietary patterns and cardiovascular disease risk factors using baseline data from the H.E.A.R.T. Study. In addition, Study 2 aimed to identify the mediating role of diet between acculturation, psychosocial factors and cardiovascular disease risk factors.

Univariate and Bivariate Analysis

Overall demographic characteristics of the participants are presented in Table 4 in Study 1. Descriptive characteristics related to variables investigated in Study 2 are presented in Table 12. Based on the possible range of the scale and the conceptual midpoints, the overall means indicate that participants had low levels of acculturation and high scores for social support. Participants indicated high perceived benefits for eating a healthy diet and low scores of perceived barriers for eating a healthy diet. Moreover, participant showed strong self-efficacy levels and high scores for intentions to eat a healthy diet within the next six months.

Intercorrelations between acculturation, psychosocial variables, and dietary patterns are presented in Table 13. Results from the correlation analysis showed that higher levels of acculturation to U.S. were associated with higher consumption of the Western dietary pattern and lower consumption of the Mexican dietary pattern—a finding that was consistent with the hypotheses. In addition, social support for healthier eating was negatively related to consumption of the Prudent diet. Regarding constructs from the Health Belief Model, higher scores on perceived benefits of eating a healthier diet were associated with higher consumption of the Prudent and the Mexican dietary patterns and lower consumption of the Juice pattern.

Table 12
Descriptive Statistics of Acculturation and Psychosocial Factors

Variable	Mean (N=605)	SD	Cronbach's Alpha	Conceptual Scale range
Acculturation	2.3	.86	.91	1-5
Social Support-total score	3.5	.49	.88	1-4
Attachment	3.5	.49	.50	1-4
Social Integration	3.5	.48	.60	1-4
Reassurance of Worth	3.3	.50	.49	1-4
Reliable alliance	3.6	.46	.62	1-4
Guidance	3.6	.47	.60	1-4
Opportunity for Nurturance	3.5	.51	.65	1-4
Benefits	9.4	1.2	.83	1-10
Barriers	3.1	2.2	.84	1-10
Self-Efficacy	8.2	1.7	.86	1-10
Intentions	9.2	1.1	.88	1-10

Table 13 contains the associations between acculturation, psychosocial factors, and dietary patterns. Result shows that higher scores on perceived barriers to eating a healthy diet were associated with lower consumption of the Prudent pattern and higher consumption of the Western and the Sweet pattern. Self-efficacy was positively and significantly associated with consumption of the Prudent pattern and negatively and significantly associated with consumption of the Western, Juice, and Sweet patterns. Lastly, intentions to eat healthier was positively associated with the Prudent and Mexican pattern and negatively associated with the Western and the Sweets pattern.

Table 14 contains the associations between acculturation, psychosocial factors and CVD risk factors. In regards to associations with CVD risk factors, acculturation was associated with higher levels of diastolic blood pressure and higher scores on the CVD risk index. Perceived benefit scores were positively associated with BMI, WC, and Waist to Height Ratio, but not blood pressure or CVD risk Index. Similarly, perceived benefit scores were positively associated with diastolic blood pressure and CVD risk index besides BMI, WC, and waist to height Ratio.

Table 13
Intercorrelations among acculturation and psychosocial factors and dietary patterns

	Western	Prudent	Mexican	Juice	Sweet
Acculturation	.14**	-.08	-.12**	.01	-.01
SS	0.04	-.16**	-.03	.03	-.01
Benefits	-.03	.14**	.12**	-.13**	.04
Barriers	.28**	-.30**	-.01	-.02	.17**
Self-Efficacy	-.35**	.24**	.03	-.09*	-.21**
Intentions	-.18**	.20**	.09*	.02	-.14**

** p< 0.01 level; * p< 0.05 level; SS=Social Support

In addition, Self-efficacy was weakly but significantly associated with BMI only. Associations between Social support and intentions to eat healthy and CVD risk factors were small and not significant.

Table 14
Intercorrelations among acculturation and psychosocial factors and CVD risk factors

	BMI	WC	WtoH	SBP	DBP	CVDIndex
Acculturation	.02	.07	.01	.05	.12**	.10*
Social Support	.04	.08	.06	.02	-.03	.07
Benefits	.13**	.11**	.14**	.01	.00	.02
Barriers	.11**	.15**	.12**	.05	.09*	.18**
Self-Efficacy	.08*	.02	.07	.03	-.06	-.06
Intentions	.07	.02	.05	.01	-.05	-.07

** p< 0.01 level; * p< 0.05 level
BMI= Body Mass Index; WC= Waist Circumference; WtoH= Waist to Height Ratio;
SBP= Systolic Blood Pressure; DBP= Diastolic Blood Pressure; CVDIndex= Cardiovascular disease Risk Index

Specific aim 1- Mediation analysis of acculturation's effect on cardiovascular disease risk factors.

Structural equation modeling examined multivariate relationships between acculturation and CVD risk factors and the potential mediating role of dietary patterns. Specifically, the dietary patterns derived using factor analysis and described in Study 1 were tested separately in the association between acculturation and three different cardiovascular disease risk factors; 1) obesity, a latent variable as measured by BMI, WC, and WtoH ratio; 2) blood pressure, a latent variable as measured by systolic blood pressure and diastolic blood pressure; and 3) CVD risk Index, an observed variable calculated using the CVR assessment questionnaire (see Table 11). The statistical significance of the indirect effects, which suggest mediation (Morera & Castro, 2013), was tested using the bootstrapping technique which provides average estimates of indirect effects and the 95% CI surrounding them.

The general model treated acculturation as an exogenous latent variable, dietary pattern as an endogenous observed variable (and mediator), and cardiovascular risk factor as the dependent variable. Parallel analyses were conducted for all five dietary patterns, the Western, Prudent, Mexican, Juice, and Sweet, and all three cardiovascular disease risk factors, obesity, blood pressure, and CVD risk index. In total, results for 15 models were estimated. This included testing of models where the initial association between the independent and dependent variables was not statistically significant—a practice recommended in modern treatments of mediational analyses (Hayes, 2009; Morera & Castro, 2013).

Of the 15 acculturation models tested, the only one to show a significant indirect effect was the Prudent dietary pattern in relation to CVD risk index. The mediational model showing the mediating role of the Prudent dietary pattern between acculturation and CVD risk index is

illustrated in Figure 10. This model shows that the path from acculturation to CVD risk index was positive and significant (b = .09, p >.05). The path from acculturation to the Prudent pattern was negative and significant (b = -.11, p >.05) as was the path from the Prudent pattern to CVD risk index was significant (b = -.14, p >.01). Bootstrap results indicated that the indirect effect of acculturation on CVD index was significant (Indirect effect= .082; 95% CI (.016; .190), p<.05). Results suggest that the Prudent dietary pattern mediates the association between acculturation and one cardiovascular disease risk factors, the CVD risk Index, such that greater acculturation leads to lower consumption of foods comprising the prudent pattern, a pattern that in turn is associated less CVD risk. This mediated effect is in addition to the residual significant direct effect of acculturation on CVD risk Index. There were no significant direct or indirect effect of acculturation on the rest of cardiovascular disease risk factors, obesity and blood pressure, through any of the five dietary patterns. Although not shown, the models continued to show significant associations between acculturation and the Western and Mexican dietary patterns, and acculturation and CVD outcomes, as suggested by the bivariate correlational analyses.

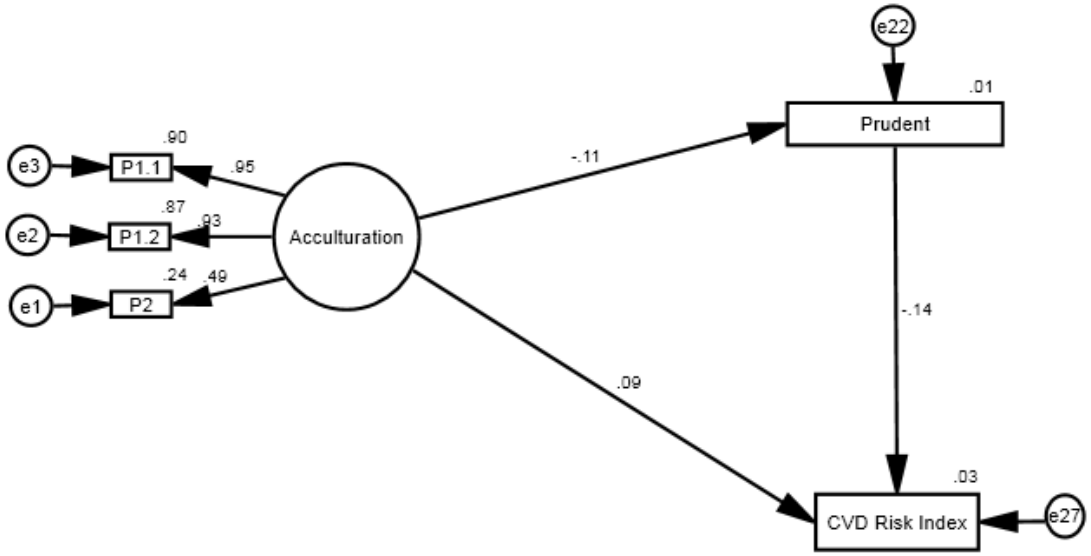

Figure 10. Prudent dietary pattern mediating the association between acculturation and CVD risk Index. Indirect effect= .082; Bootstrapping 95% CI (.016;.19), p<.05

Specific aim 2- Effect of psychosocial factors on dietary patterns and CVD risk factors

Measurement model

Given the multiple psychosocial factors, models for Specific Aim 2 were significantly more complicated than the models for Aim 1. Specifically, these estimates required preliminary evaluation of a measurement model prior to the assessment of structural relationships among constructs (Byrne, 2010). In SEM, measurement models help researchers to understand how observed variables relate to the latent variables they are intended to measure (Byrne, 2010). They also use confirmatory factor analysis methods to assess the adequacy of the measurement models simplification of the relationships among multiple specific observed variables. As such a confirmatory Factor Analysis was conducted before the full structural model was estimated.

The general model tested, including the measurement and structural analyses is shown in Figure 11. The confirmatory model is contained within the dashed circle and reflects the how

observed variables (represented as rectangles) relate to their corresponding latent constructs (represented as circles). The structural model (i.e., the entire diagram) adds the structural associations among the other constructs (observed and latent). In all analyses, the goodness of model fit was assessed using different indices defined in Table 15. It is recommended to use several indices of fit in SEM because χ^2 is sensitive to sample size, therefore CMIN/DF is recommended to accompany chi-square results.

Several scales were proposed as latent variables for the final SEM model. Perceived benefits for healthy eating latent variable was measured by a three item scale (α = .83). Acculturation latent variable was measures by three subscales including language use (α = .90), media use (α = .88), and social relations (α= .76) as proposed by Marin et al (1987). Social support latent variable was measured by 6 subscales as proposed by Cutrona & Russell (1987) and include: attachment (α = .50), social integration (α = .60), reassurance of worth (α = .50), reliable alliance (α = .62), guidance (α = .60), and opportunity for nurturance (α = .65). For the rest of the psychosocial factors, perceived benefits, perceived barriers, self-efficacy, and intentions to eat healthy, parcel disaggregation was conducted. Parceling is when several items become one "parcel" and this parcels then can be used as indicator of latent variable (Coffman & MacCallum, 2005). Parcels were constructed following a *random assignment* technique proposed by Little, Cunningham, Shahar, & Widaman (2002), where each item in the scale is assigned, randomly, to one parcel group allowing to assume that each parcel contains equal factor variance (Little et al, 2002).

The latent variable perceived barriers to healthy eating was measured by three constructed parcels: parcel 1(α = .56), parcel 2 (α = .64), and parcel (α = .67). Self-efficacy to eat healthy was measure by three constructed parcels: parcel 1(α = .57), parcel 2 (α = .63), and

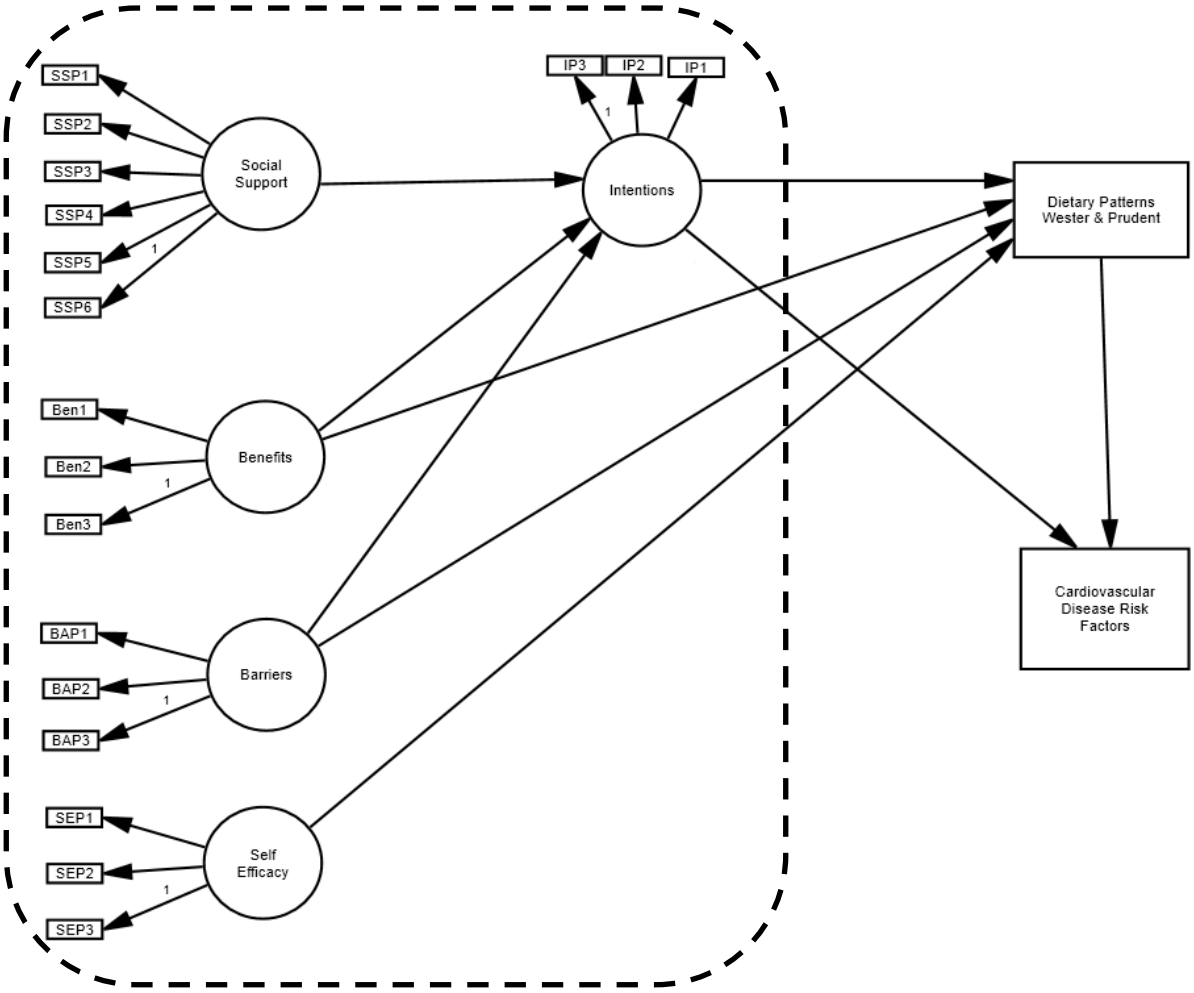

Figure 11. General model tested. Including the measurement (dashed line) and structural analyses. Error terms and correlations among exogenous variables not shown for simplicity

parcel (α = .70). Finally, intention to eat healthy was measured by three parcels: parcel 1(α = .64), parcel 2 (α = .77), and parcel (α = .69).

Table 15
Indices to assess fit of the model

Index	Recommended Values
Chi-Square	Non-significant *P* value
CMIN/DF	> 2
Comparative Fit Index (CFI)	≥ .95 good fit
Root Mean Square Error (RMSEA)	≤ .05 close fit .05 - .08 reasonable fit ≥ .10 bad fit

Confirmatory Factor Analysis

Figure 12 shows the results testing the adequacy of the proposed measurement model. The model includes six latent variables. Acculturation which was measure by three subscales, social support measured by six subscales, perceived benefits measured by three items, perceived barriers to healthy eating measured by three parcels, self-efficacy measured by three parcels, and intentions to healthy eating measured by three parcels. Descriptive statistics for the psychosocial factor responses are presented in Table 12. After an initial CFA was run, modification indices were examined to improve model fit. These indices suggested that allowing errors for items 2, 5, and 6 for social support to correlate significantly improve the model fit. Results from the final model indicated an acceptable fit of the data, where χ^2 (172, N=605)=480.2, p<.001; CMIN/DF= 2.80; CFI= .95; RMSEA= .05 (90% CI: .049; .060).

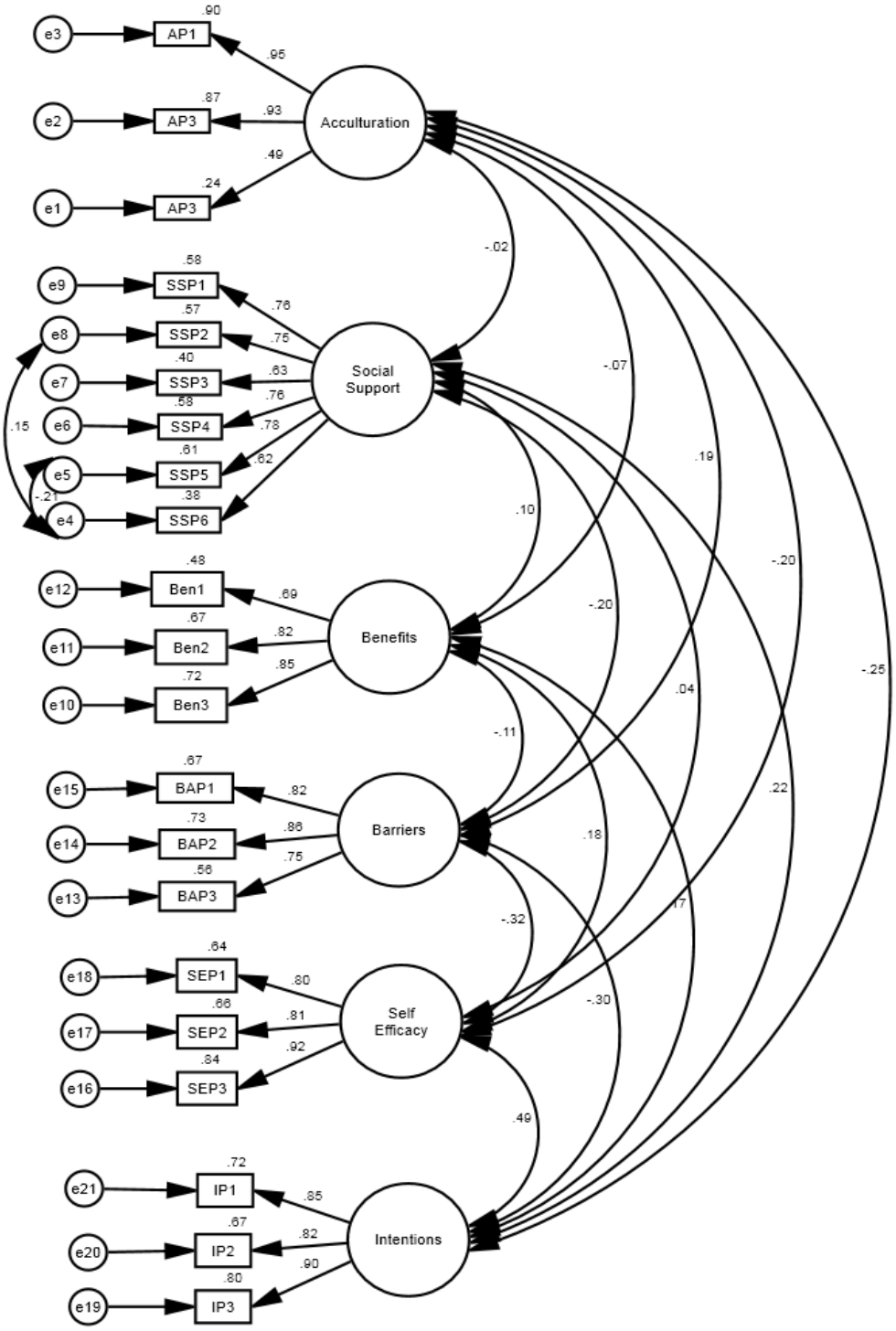

Figure 12. Confirmatory Factor Analysis model 1
Fit indices: χ^2 (172, N=605) = 480.2 p<.000, comparative fit index=.95, CMIM/DF = 2.80; root-mean-square approximation=.05 (90% confidence interval: .049, .060)

Structural model

In SEM, the structural model is the part of the model that relates latent variables to one another and any outcome variables in structure that represents presumed causal relationships (Kline, 2005). The goodness-of-fit and the path standardized coefficients for the models are illustrated in Figure 13 through Figure 16. For the purpose of the specific aim 2 four different models were tested and investigated two cardiovascular disease risk factors, obesity and CVD Index. Two dietary patterns, the Western and the Prudent, were also included in the model along with several psychosocial factors, social support, benefits of healthy eating, barriers to eat healthy, Self-Efficacy to eat healthy, and intentions to eat healthy.

Model 1

Figure 13 depicts the structural model for the Prudent dietary pattern and Obesity variables. The indices of fit including the χ^2 (192, N=605) = 506.5 p<.000, comparative fit index=.96, CMIM/DF = 2.64; root-mean-square approximation=.05 (90% confidence interval: .047, .058) suggest that the model had a reasonable fit. Results showed that social support only predicted intentions to eat healthier but did not relate, neither direct nor indirectly, to obesity. Benefits to healthy eating did not relate to any of the mediators, but had a significant direct effect on obesity. Perceived barriers to healthy eating were negatively related to, mediators, intentions to eat healthy and the Prudent dietary pattern and positively related to obesity. Self-efficacy also related positively to intentions to eat healthier, the Prudent dietary pattern, and obesity. Regarding mediation, neither the path from intentions to the Prudent pattern and from the Prudent pattern to obesity was significant. Moreover, all indirect paths through these variables were not significant (p > .311), suggesting the Prudent pattern does not mediate the association between different psychosocial factors and Obesity. The model showed that social support (β=

.18, p <.001), perceived barriers (β=-.12, p <.01), and self-efficacy (β= .44, p <.001) all predicted intentions. In addition, perceived benefits, barriers, and self-efficacy were the only psychosocial factors that had a significant direct effect on obesity. Finally, the model showed that perceived barriers is the strongest psychosocial factor with an effect on the Prudent pattern (β=-.25, p <.001) followed by self-efficacy (β=.13, p <.01) and Benefits of Healthy Eating (β=.09, p <.05) (last path not shown in the picture). Overall, the model accounted for only 6% of the variance in obesity.

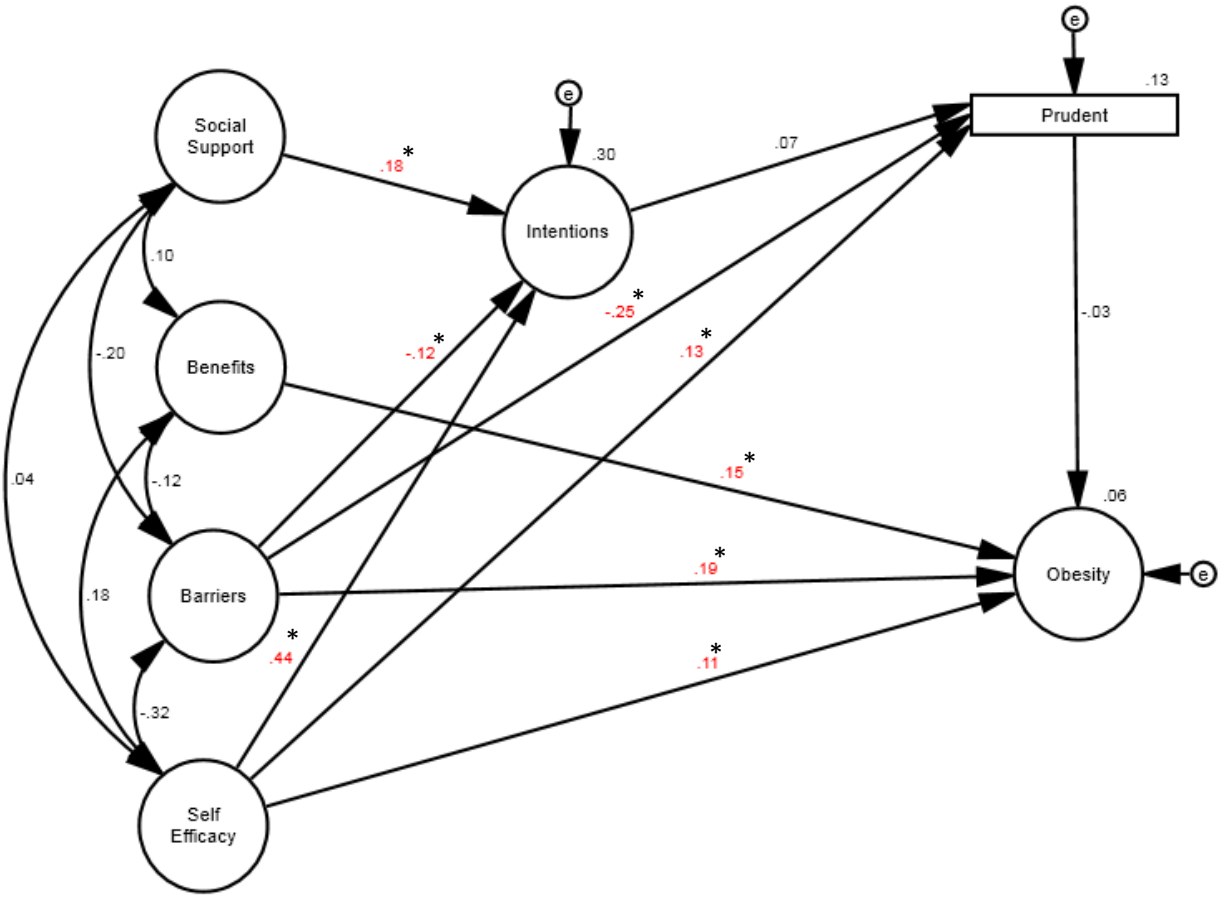

Figure 13. Structural model 1 for Psychosocial factors, Prudent pattern and Obesity.
Fit indices: χ^2 (192, N=605) = 506.5 p<.000, comparative fit index=.96, CMIM/DF = 2.64; root-mean-square approximation=.05 (90% confidence interval: .047, .058). *p<.05

Model 2

Figure 14 depicts the structural model for the Prudent dietary pattern and the CVD Risk index variables. The indices of fit including the χ^2 (155, N=605) = 434.2 p<.000, comparative fit index=.95, CMIM/DF = 2.80; root-mean-square approximation=.055 (90% confidence interval: .049, .061) suggest that the model had a reasonable fit. Results showed that social support only predicted intentions to eat healthier but did not relate, neither direct nor indirectly, to the CVD Risk Index. Benefits to healthy eating related significantly to the Prudent dietary pattern, but did not relate to the other mediator, intention to eat healthy, or CVD Risk Index. Perceived barriers to healthy eating were negatively related to both mediators, intentions to eat healthy and the Prudent dietary pattern, and positively related to CVD Risk Index. Self-efficacy also related positively to intentions to eat healthier and the Prudent dietary pattern but did not relate significantly to the CVD risk Index.

Regarding mediation, bootstrapping results showed a mediating role of the Prudent pattern between three different psychosocial factors and CVD Risk Index. The first significant indirect effect was seen from perceived barriers to CVD risk Index through the Prudent dietary pattern *b*= .02 (95%BootCI= .006; .045). This result suggests a mediating role of the Prudent pattern between perceived barriers to eat healthy and CVD risk index. Standardized coefficients indicate that CVD risk index is expected to increase by about .02 standard deviation for every increase in perceived barriers to eat healthy of one full standard deviation via it prior effect on the Prudent pattern. The second significant indirect effect was seen from perceived benefits to CVD risk Index through the Prudent dietary pattern *b*= -.013 (95%BootCI= -.039; -.002). Standardized coefficients indicate that CVD risk index is expected to decrease by about .013 standard deviation for every increase in perceived benefits to eat healthy of one full standard

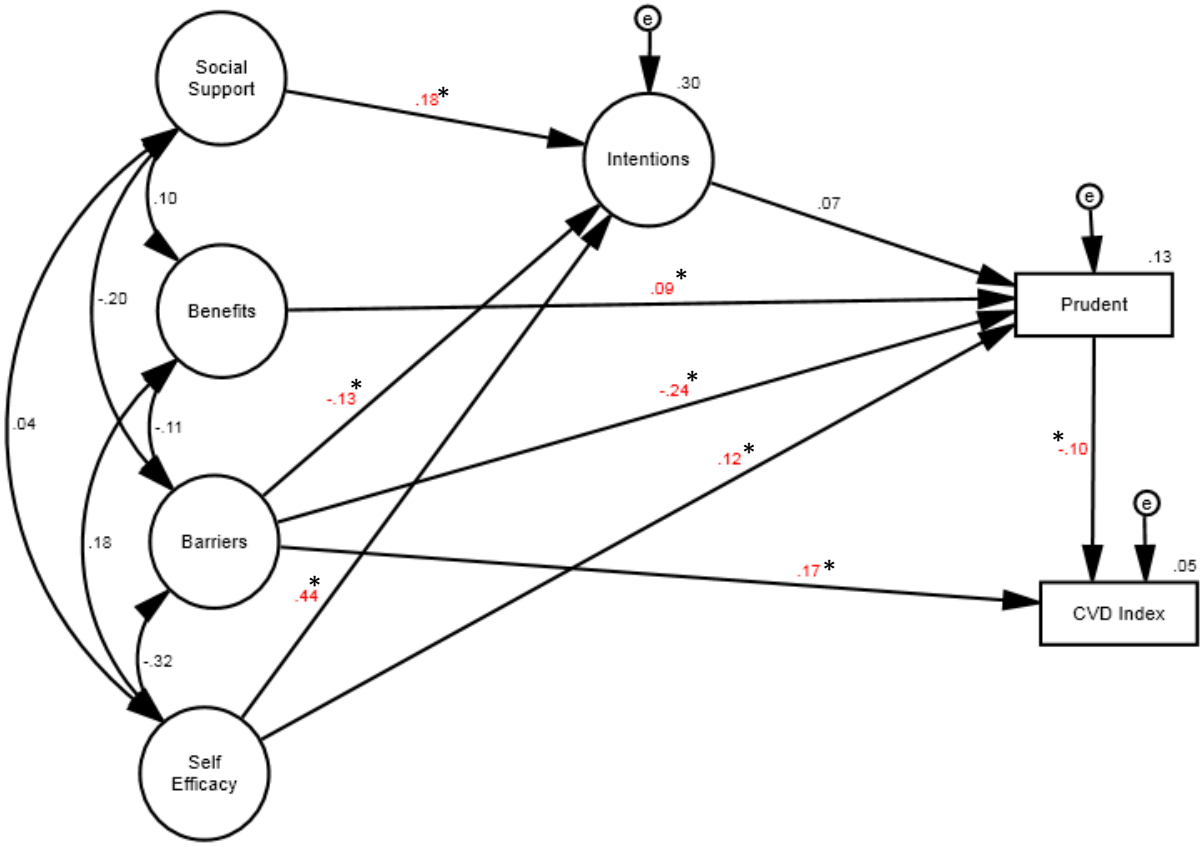

Figure 14 . Structural model 2 for Psychosocial factors, Prudent pattern and CVD Risk Index. Fit indices: χ^2 (155, N=605) = 434.2 p<.000, comparative fit index=.95, CMIM/DF = 2.80; root-mean-square approximation=.055 (90% confidence interval: .049, .061). *p<.05

deviation via it prior effect on the Prudent pattern. The third and last significant indirect effect was seen from self-efficacy to CVD risk Index *b*= -.012 (95%BootCI= -.032; -.002). Standardized coefficients indicate that CVD risk index is expected to decrease by about .012 standard deviation for every increase in Self-efficacy to eat healthy of one full standard deviation via it prior effect on the Prudent pattern.

In this model, intentions to eat healthy was predicted by self-efficacy, social support, and perceived barriers. Perceived barriers were the only psychosocial factor to have a significant direct and indirect effect on CVD Risk Index. Overall, the model accounted for only 5 % of the variance in CVD Risk Index.

Model 3

Figure 15 depicts the structural model for the Western dietary pattern and obesity. The indices of fit including the χ^2 (192, N=605) = 520.3 p<.000, comparative fit index=.96, CMIM/DF = 2.7; root-mean-square approximation=.05 (90% confidence interval: .048, .059) suggest that the model had a reasonable fit. Results showed that social support only predicted intentions to eat healthier but did not relate, neither direct nor indirectly, to obesity. Perceived benefits to eat healthy was not related to any of the mediators, intentions or Western dietary pattern, but it was related significantly to obesity. Perceived barriers were negatively related to intentions and positively related to the Western dietary pattern and obesity. Self-efficacy related positively to intentions to eat healthy and negatively to the Western dietary pattern. There is a significant direct effect from Self-efficacy to obesity. Regarding mediation, neither the path from intentions to the Western dietary pattern and from the Western dietary pattern to Obesity was significant. Moreover, all indirect paths through these variables were not significant (p > .394), suggesting the Western dietary pattern does not mediate the association between different psychosocial factors and Obesity. Overall, the model accounted for only 6% of the variance in Obesity.

Model 4

Figure 16 depicts the structural model for the Western dietary pattern and the CVD Risk Index. The indices of fit including the χ^2 (106, N=605) = 378.1 p<.000, comparative fit index=.945, CMIM/DF = 3.6; root-mean-square approximation=.065 (90% confidence interval: .058, .072) suggest that the model had a reasonable fit. Results showed that social support only predicted intentions to eat healthier but did

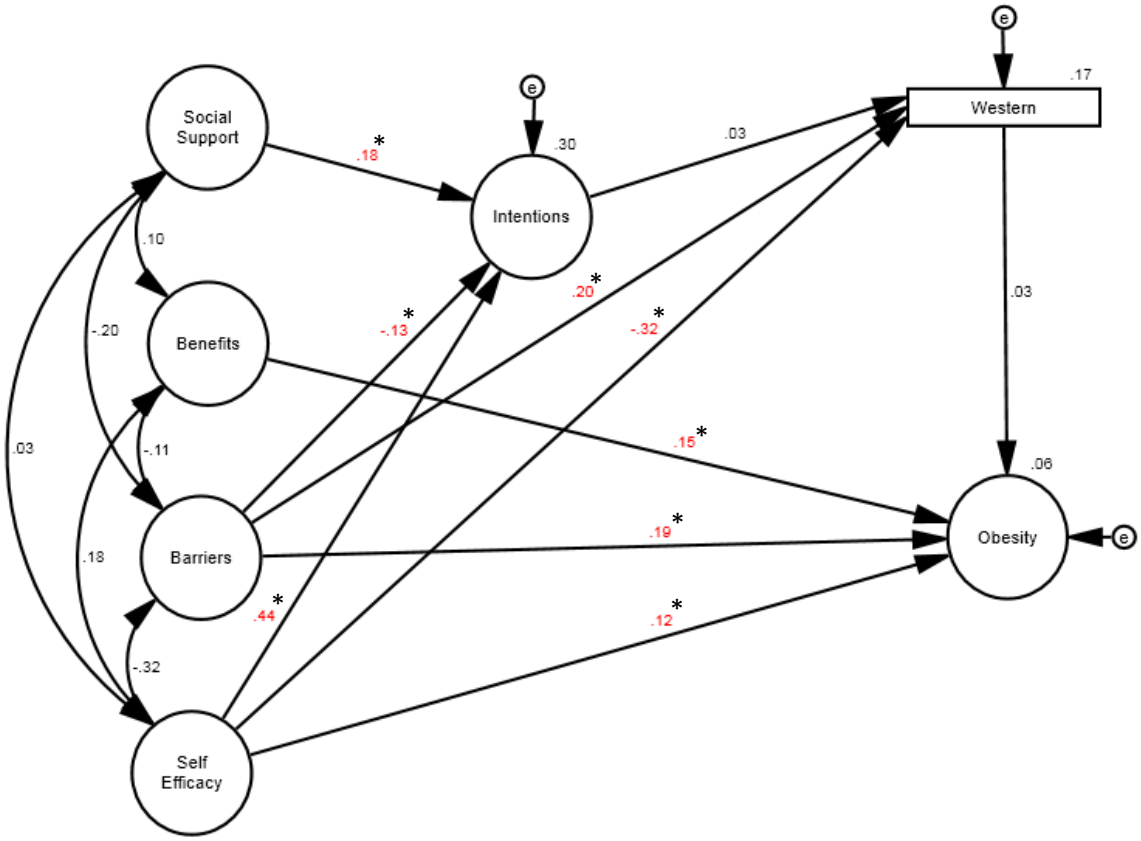

Figure 15 . Structural model 3 for Psychosocial factors, Western pattern and Obesity
Fit indices: χ^2 (192, N=605) = 520.3 p<.000, comparative fit index=.96, CMIM/DF = 2.71; root-mean-square approximation=.05 (90% confidence interval: .048, .059). *p<.05

not relate, neither direct or indirectly, to CVD Risk Index. Perceived benefits to eat healthy was not related to any of the mediator, intentions or western dietary pattern, or the CVD Risk Index, therefore is not shown in this model. Perceived barriers to healthy eating were negatively related to intentions to eat healthy and positively related to the Western dietary pattern and CVD risk Index. Self-efficacy also related positively to intentions to eat healthier and negatively to the Western dietary pattern, but it did not relate to CVD risk index.

Regarding mediation, neither the path from intentions to the Western dietary pattern and from the Western dietary pattern to CVD Risk Index was significant. Moreover, all indirect paths through these variables were not significant (p > .633), suggesting the Western dietary

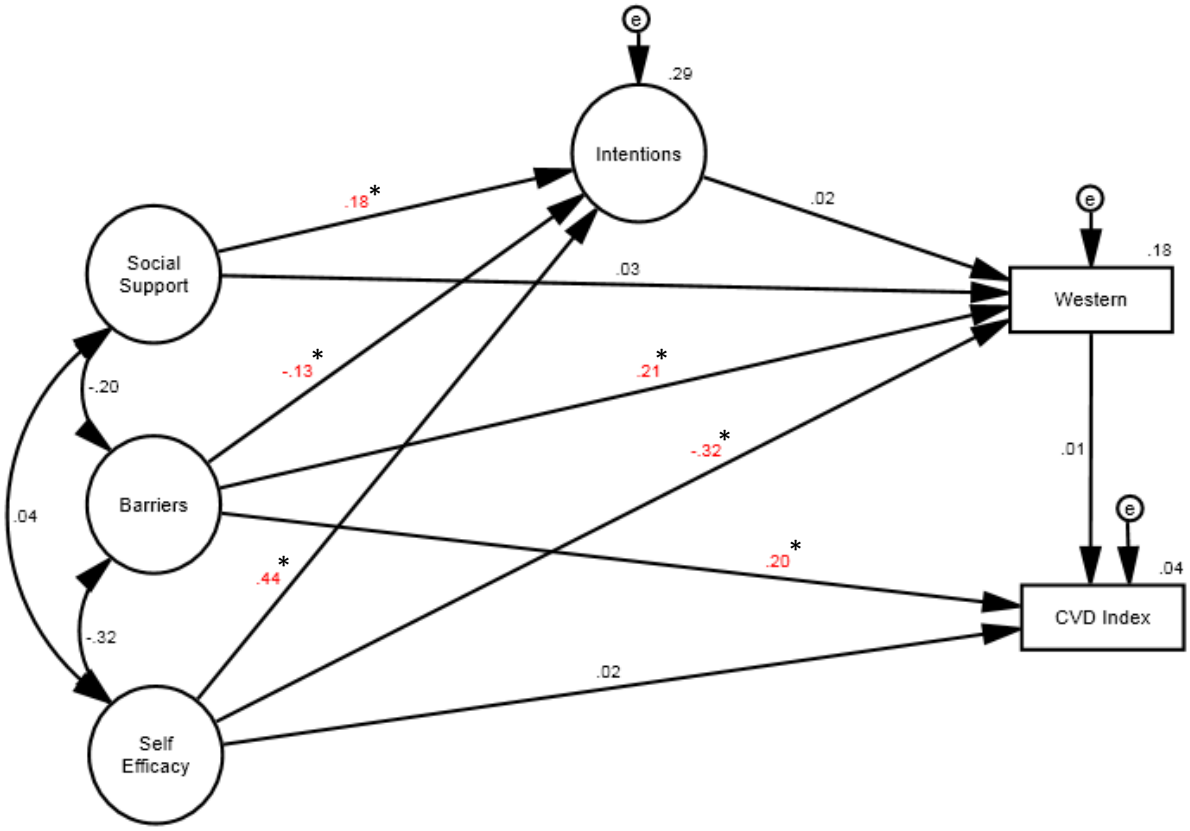

Figure 16. Structural model 4 for Psychosocial factors, Western pattern and CVD Risk Index. Fit indices: χ^2 (106, N=605) = 378.1 p<.000, comparative fit index=.945, CMIM/DF = 3.6; root-mean-square approximation=.065 (90% confidence interval: .058, .072). Items and loadings not displayed for model simplicity. *p<.05

pattern does not mediate the association between different psychosocial factors and CVD Risk Index. The model showed that self-efficacy is the strongest predictor of the Western dietary pattern (β= -.32, p <.001) followed by perceived barriers (β= .21, p <.001). This model also shows that perceived barriers (β= .20, p <.001) were the strongest predictor of CVC Risk Index. Overall, the model accounted for only 4% of the variance in CVD Risk Index.

Mediation analysis

Additional parallel mediation analyses were conducted for specific psychosocial mediators and three dietary patterns, the Mexican, the Juice, and the Sweets pattern and three cardiovascular disease risk factors, BMI, Blood pressure, and CVD Risk index. These models were conducted guided by the significant association shown in the correlations. As above, this also included testing of models where the initial association between the independent and dependent variable was not statistically significant--a practice recommended in modern treatments of mediational analyses (Hayes, 2009; Morera & Castro, 2013; Rucker et al., 2011). Results from the mediational analysis indicated that only the Juice dietary pattern mediated the association between a psychosocial factor and a CVD risk factor. Figures 17 and 18 display the models that revealed significant indirect effects.

Perceived benefits and Juice dietary pattern: Standardized regression coefficients are shown in Figure 17 and Figure 18, which illustrates the models displaying the mediating role of the Juice dietary pattern between two psychosocial factors, perceived benefits and self-efficacy to eat healthy with BMI. The direct effect perceived benefits to BMI was positive and significant (b=.12 p <.01). The path from perceived benefits to the Juice pattern was negative and significant (b=-.14 p <.001). Similarly, the path from the Juice pattern to BMI was negative and significant (b=.13 p <.01). Bootstrapping results indicate a positive and significant indirect effect from perceived benefits to BMI through the Juice dietary pattern b= .10 (95%BootCI= .022; .244)A significant indirect effect suggests the mediating role of the Juice pattern between perceived benefits of healthy eating and BMI. This net positive indirect effect suggests that those with low beliefs about benefits of eating healthy consumed more juice, and that such consumption was in turn associated with lower BMI.

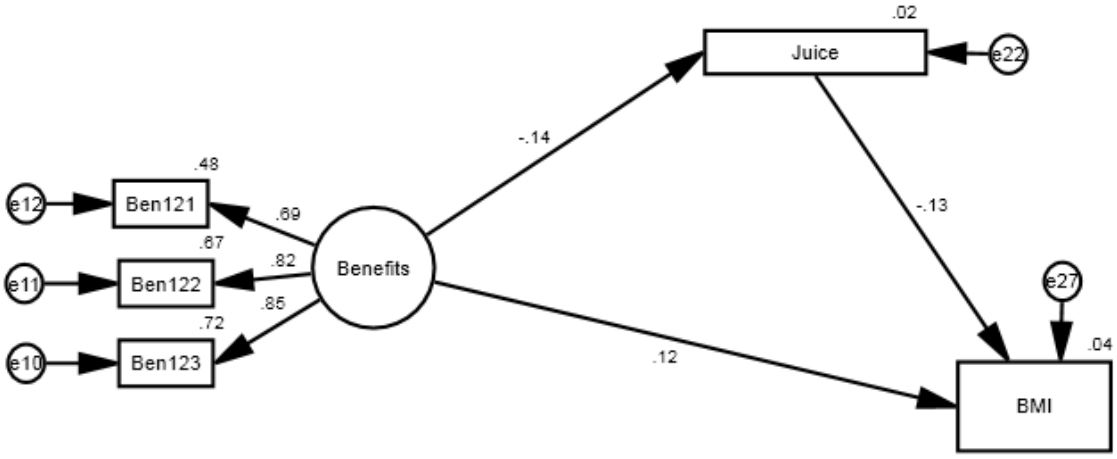

Figure 17. Mediating role of the Juice dietary pattern between perceived benefits with BMI.

Self-efficacy and Juice dietary pattern: Standardized regression coefficients are shown in Figure 18. The direct effect of self-efficacy on BMI was not significant. The path from self-efficacy to the Juice pattern was negative and significant (b=-.11 p <.01). Similarly, the path from the Juice pattern to BMI was negative and significant (b=.14 p <.001). Bootstrapping results indicate a positive and significant indirect effect from self-efficacy to BMI through the Juice dietary pattern b= .06 (95%BootCI= .015; .134). A significant indirect effect suggests the mediating role of the Juice pattern in the association between self-efficacy to eat healthy and BMI, even though there was not direct effect . This net positive indirect effect suggests that those with high self-efficacy consumed less Juice, however, that consumption was in turn associated with lower BMI.

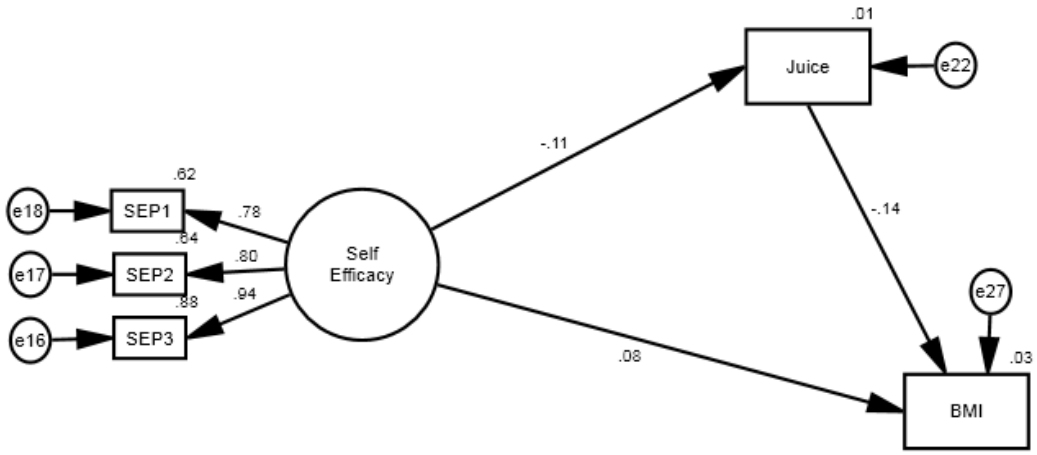

Figure 18. Mediating role of the Juice dietary pattern between Self-efficacy to eat healthy with BMI.

Discussion

The overall aim of Study 2 was to examine associations between acculturation, various psychosocial factors, and their association to dietary patterns and cardiovascular disease risk factors among Hispanic adults participating in the H.E.A.R.T. project. Results from this study shows that higher levels of acculturation to U.S. customs was significantly related to higher consumption of the Western pattern and lower consumption of the Mexican pattern. Moreover, acculturation levels were associated with two CVD risk factors; higher diastolic blood pressure and higher CVD risk Index. Mediational analysis indicated that the Prudent pattern, but not the Western pattern, significantly mediated in the association between acculturation and CVD risk Index. A significant indirect effect indicates that there will be an increase in the CVD risk index when acculturation levels increases via the Prudent pattern.

Intercorrelations between different psychosocial factors and dietary patterns and CVD risk factors indicate that social support was significantly and negatively related to the Prudent pattern. This results is unexpected, since it was hypothesized that higher social support would be related to healthier eating patterns. It is possible that because most of the participant reported to have higher social support, the homogeneity of the sample and limited range could have affected these results. Significant negative association were seen between perceived benefits and the Juice pattern, suggesting that people who had higher perceived benefits of eating healthy had lower consumption of this pattern, paradoxically, this pattern was associated with better health outcomes. Self-efficacy was significantly and positively related to the prudent and negatively related to the Western, Juice, and Sweet. Intentions to eat healthy were positively related to the Prudent and Mexican, and negatively related to the Western and Sweet.

Using Structural Equation Modeling, Study 2 also examined at the associations between various psychosocial factors on two dietary patterns and two cardiovascular disease risk factors. The models in Study 2 suggested that perceived barriers were the strongest predictor of the Prudent pattern, followed by self-efficacy, and perceived benefits. Self-efficacy was the strongest predictor of the Western pattern followed by perceived barriers. With regards to CVD risk factors, results for obesity show that even though neither the Prudent nor the Western pattern showed an effect on obesity, several psychosocial factors did. The strongest predictor of obesity was perceived barriers to eat healthy, followed by perceived benefits, and self-efficacy. These results are interesting as they are unexpected in relation to the direction of these associations, with the exception of perceived barriers, where lower perceived barriers predicted lower obesity. Perceived benefits and higher self-efficacy predicted higher obesity, as measured by a latent variable. It is possible that there was a study selection bias and results might confound with larger H.E.A.R.T. study. For example, people participating in the project were overweight or obese, but were also motivated to eat healthier—reason to enroll in the intervention.

Parallel models looking at CVD risk index as the outcome showed that the Western patterns had no effect on it, but the Prudent pattern did. Among the different psychosocial factors, only perceived barriers predicted CVD risk index. Finally, the analysis provided information about the indirect effect of the Prudent pattern, suggesting a mediation role of a healthy diet in the association between perceived barriers, perceived benefits, and self-efficacy to eat healthy with CVD risk Index.

Despite these results, many of which were consistent with the hypothesis, many hypothesis for the mediating role of diet were not supported or did not received strong support. For example, the Western pattern was not associated to any of the CVD risk factors, therefore,

indirect effect were not significant. There are several reasons why the data may have failed to support these hypotheses for the role of diet in cardiovascular risk, and the subsequent failure of dietary patterns to mediate the effects of predisposing factors such as acculturation and psychosocial variables. For example there is the possibility that diet does not relate to these outcomes in this population. For example, evidence suggest that foreign-born or first generation Mexican immigrants have healthier behaviors and outcomes than the second generation Mexican descent counterpart; almost 85% of participants were born in Mexico.

More likely, however, there is the possibility that the homogeneous composition of the sample restricted the ability to find strong associations. The H.E.A.R.T. study targeted a specific community to implement the intervention to reduce CVD risk factors. This population was selected because of its demographic and socioeconomic characteristics, in addition to their disproportionally higher risk for CVD risk factors. This selection bias could have created a restricted range of predictors and outcome. Having a restricted range can limit the ability to find significant associations. It is possible that a more diverse sample would have provided stronger finding. Many studies have investigated the effect of acculturation on diet. Unfortunately, because the type of design (e.g., cross-sectional vs. longitudinal) and different methods used to measure acculturation, inconsistent results have been found to the extent that some authors do not support the use of acculturation as a variable to understand health outcomes (Viruell-Fuentes, 2007). However, some consistent results indicate that more acculturated people tend to have higher consumption of fast foods, snacks, and added fats and lower consumption of fruit, rice, and beans. In addition, people less acculturated drink less sugar-sweetened beverages than those more acculturated (G. X. Ayala et al., 2008).

Overall, the results of the present dissertation support the notion that acculturation leads to unhealthy outcomes and that diet plays a role in this association. The results about the effect of acculturation and dietary patterns indicated a positive association between acculturation and diet. The Prudent pattern, but not the Western pattern, significantly mediated the association between acculturation and CVD risk Index.

In addition, previously on Study 1 we identified that place of birth was significantly associated with type of diet, where U.S. born Mexican descent participants had a higher consumption of the Western pattern, whereas Mexico-born participant had a higher consumption of the Prudent and Mexican pattern. These results were also found by others. Sofianou, Fung, & Tucker (2011) found that Mexico-born participants had lower consumption of the Western pattern and higher consumption of the tomato/tortilla pattern compared to U.S.-born. In addition, those born in the U.S. had higher scores of the Western and Coffee/Sugar dietary patterns, suggesting preferences for an unhealthier dietary pattern. This result suggests that place of birth could be included when measuring acculturation.

Unlike previous studies, the present study did not find strong associations between intentions and dietary patterns. For example, Backman, Haddad, Lee, Johnston, & Hodgkin, (2002) found that intentions to eat a healthy diet are a strong predictor of a healthful dietary behavior as measure by total calories and servings of fruit and vegetables. In contrast, the present study showed only very weak associations between intentions and dietary factors. There are several possible reasons for the diverging results. For example, Backman and associated (2002) did not measure diet using dietary patterns, but using total calories and fruits and vegetable consumption only. In addition, the study by Backman et al, (2002) was conducted among adolescents, not adults like in the present study. Indeed, results from Study 1, showed significant

differences in dietary pattern by age, suggesting that adolescents might have looked at intentions to eat healthy different than adults. As mentioned above, however, the homogeneous nature of the sample examined in this dissertation may have also contributed to the inability to find strong associations between intentions and dietary patterns and health outcomes.

Perceived barriers to eating healthy was the strongest predictor of a dietary pattern and CVD risk factors including obesity and CVD risk index. Similarly, Dittus, Hillers, & Beerman (1995a) identified that perceived barriers to fruit and vegetable intake were the strongest predictor in actual fruits and vegetable consumption, suggesting special emphasis on reducing barriers to eat healthy as a strategy to improve quality of diet. Similar results regarding the strong effect of perceived barriers on diet is the one by Bruening et al., (2010). This study is one of the few mediation analyses that investigated the association between psychosocial factors and diet. Bruening and associates (2010) found that perceived barriers to eat healthy mediated the association between self-efficacy to eat healthy foods and fruit and vegetable consumption. Suggesting that self-efficacy should be considered when planning interventions to increase fruits and vegetable consumption, and specially to consider the influence that perceived barrier to eating healthy can have on such interventions (Bruening et al., 2010). Consumption of Juice foods was also a notable and unique finding in the present study. As mention above, this pattern was found among men in a previous study conducted by Slattery, (1987).

To the authors' knowledge, SEM has not been used to analyze the effect of psychosocial factors on dietary patterns, derived via factor analysis, and CVD risk factors. The majority have focused on diet as measured by other variables, such as fruit and vegetable consumption or fat intake. For example, in our SEM model we did not found intentions to eat healthy to be associated with any of the two dietary patterns, Western or Prudent. Finally, self-efficacy has

been one of the most commonly measured construct to be studied in relation to consumption of fruits and vegetables.

General Discussion

The present dissertation generated four primary results. *First*, five dietary patterns were identified by factor analysis; the Western, Prudent, Mexican, Juice, and Sweets. *Second*, dietary patterns varied by gender, age, and place of birth, but education and income had not effect on most of the dietary patterns. *Third*, acculturation to the U.S. lifestyle was positively associated with the Western dietary pattern and negatively associated with the Mexican dietary pattern, and was related to CVD risk variables. *Lastly*, structural equation models described associations between psychosocial variables associated with dietary pattern and CVD risk factors among Hispanics in El Paso, TX.

In general, however, the overall hypothesis of this study that dietary patterns would relate to CVD risk factors and that such dietary patterns would mediate associations between acculturation, psychosocial factors with CVD outcomes received only very limited support. It is well documented that diet has an effect on a variety of chronic diseases and that current dietary behaviors are associated with higher risk for CVD. Therefore, non-significant associations between dietary pattern and CVD risk index were unexpected.

Future Directions

The current study was conducted using secondary data from the H.E.A.R.T. study. Future actions include presenting results to the community and creating practical recommendations for Community Health Workers/Promotoras de Salud to continue providing evidence based practices to the community. Results from the study indicate the need to provide knowledge and skills for healthy dietary choices in the El Paso community. Because data for this dissertation was only baseline data from a large scale intervention study, it is important to analyze the effect the nutrition education intervention had on dietary patterns in this community.

In addition, dietary patterns can be evaluated in different areas of El Paso, Texas to identify if other areas of El Paso have a similar diet to the one identified in the current study.

Message to Community Health Workers/Promotoras de Salud

Results from this study confirmed the great public health concern that obesity contributes to poor health in Hispanic adults. It is important that Community Health Workers continue to promote overall heart-healthy behaviors among the El Paso community. Specifically, it would be beneficial to continue providing nutrition education and teaching about heart-healthy dietary choices, not forgetting to include information about traditional Mexican foods that are healthy and information about the effect of processed foods, and how to overcome barriers to eat healthy. In addition, Community Health Workers can continue to promote the use of existing physical activity facilities to help reduce sedentary lifestyles.

Study Limitations

This is a cross-sectional study design; therefore, it was not possible to establish causal effects. A limitation of studying dietary patterns is that pattern of diet change constantly and that patterns are likely to vary according to sex, socioeconomic status, ethnic groups, or even over period of time.

This study was conducted among a specific targeted population to participate in the H.E.A.R.T study because of their low socioeconomic status and higher risk for cardiovascular diseases. The homogenous nature of the study and likely limited ranges in the different demographic and socioeconomic characteristics could have affected the results by limiting ranges on dietary patterns which inhibited the ability to find strong effect for diet and CVD risk index.

Strengths

It is important to note that one of the strengths of the present study was its large sample size. This allowed for more complex analysis such Structural Equation Modeling, which includes a series of statistical methods that allows the researcher to model relationships between several independent and dependent variables while controlling for measurement error and avoiding problems of over- and under-estimation of effects. In addition, this study analyzed data from a very unique population of Hispanics living in the U.S.-Mexico border where dietary pattern information is limited or does not exist. Although this population was very unique, because of their role in participating in the H.E.A.R.T. project, this study provides evidence for generalizability of dietary patterns to a unique group.

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Curriculum Vita

Ximena Burgos-Monzon earned her Bachelor in Nutritional Sciences from the Universidad Autonoma de Ciudad Juarez in 2004. She received her Master of Sciences in Health Promotion in 2008 from the University of Texas at El Paso. In 2008, she joined the doctoral program in Interdisciplinary Health Sciences at the University of Texas at El Paso.

Dr. Burgos-Monzon has been the recipient of numerous honors and awards including the Interdisciplinary Health Sciences Ph.D. Program, Doctoral Student Award, the Allien & Paul C. Davidson award, and the Jimmy & Yolanda Janecek Scholarship award.

While pursuing her degree, Dr. Burgos-Monzon worked as a research associate for the Interdisciplinary Health Sciences Ph.D. program and the H.E.A.R.T. study. Dr. Burgos-Monzon has presented her research at international conference meetings and workshops including the Obesity Society Annual Scientific Meeting.

Her dissertation title is: “The mediating role of dietary patterns on the relation between acculturation, psychosocial factors, and cardiovascular disease risk factors in the U.S. - Mexico border” and was supervised by Dr. Joe Tomaka.

Dr. Burgos-Monzon will begin her postdoctoral work at the University of Texas at El Paso with the H.E.A.R.T. Study.

Ximena Burgos-Monzon

Interdisciplinary Health Sciences

University of Texas at El Paso

500 West University Ave. PMB 268

xburgos@miners.utep.edu

EDUCATION

2008 – 2013	Interdisciplinary Health Sciences PhD Program University of Texas at El Paso, El Paso, TX 79968 Dissertation title: The Mediating Role of Dietary Patterns on the Relation Between Acculturation, Psychosocial Factors, and Cardiovascular Disease Risk Factors in The U.S. - Mexico Border
2005-2008	Master of Science, University of Texas at El Paso, Health Promotion 500 West University Ave Thesis: "Association of overweight/obesity with inflammation and cardiovascular health in Mexican public elementary school children"
1999-2004	B.S., Universidad Autonoma de Ciudad Juárez, Nutritional Sciences/ICB Ciudad Juarez, Chihuahua Mexico. Thesis: Malnutrition in the hospitalized patient"

RESEARCH EXPERIENCE

2012- Present	Doctoral Research Associate H.E.A.R.T Project (Health Education Assessment Research Team)

2008-2011 Graduate Research Associate, College of Health Sciences,

Interdisciplinary Health Sciences Program, University of Texas at El Paso,

2008 – 2010 College of Health Sciences and Graduate School

Role: PI
Title: *Metabolic Syndrome and Carotid-Intima Media Thickness in Young, Hispanic Women*
Total funding: $3,200
Date: February to August 2010

2007-2008 Graduate Teacher Assistant, College of Health Sciences,

Department of Health Promotion, University of Texas at El Paso,

2005-2007 Graduate Research Assistant, College of Health Sciences, Human Immunology and Nutrition Research Lab, Department of Health Promotion, University of Texas at El Paso, August 2005-July 2007

TEACHING EXPERIENCE

2013 Co-teaching- Fundamentals of Nutrition (Online)

University of Texas at El Paso

2012 Courses Developed Nutrition Online Course.

Role: Student collaborator
Objective: To provide basic nutrition information to childcare personnel, parents, children and the general public.

El Paso, Texas

GRANTS / AWARDS / FELLOWSHIPS

2011-2012 Interdisciplinary Health Sciences Ph.D. Program, Doctoral Student award

2010-2011	Allien & Paul C. Davidson Scholarship, 2010-2011
	Research Award, University of Texas at El Paso, College of Health Sciences, UTEP
2010	Research Award, University of Texas at El Paso, Graduate School, 2010
2005-2007	Jimmy and Yolanda Janecek Scholarship award, College of Health Sciences, UTEP
2006	Research Award, University of Texas at El Paso, College of Health Sciences, 2006
2000-2004	Academic Achievement- Honor student scholarship, Instituto de Ciencias Biomédicas, Universidad Autonoma de Ciudad Juárez, 2000-2004
2002-2004	Research Sumer, Mexican Academy of Sciences, 2002-2004

PUBLICATIONS AND MANUSCRIPTS UNDER PREPARATION

Vella, C. A., **Burgos, X.**, Ellis, C. J., Zubia, R. Y., Ontiveros, D., Reyes, H., & Lozano, C. (2013). Associations of insulin resistance with cardiovascular risk factors and inflammatory cytokines in normal-weight Hispanic women. *Diabetes Care*, *36*(5), 1377-1383. doi:10.2337/dc12-1550

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Third Annual Texas Tech University Health Sciences Center Paul L. Foster School of Medicine Research Colloquium, El Paso, TX, May 2009. "Association between body fatness and cardiovascular disease risk factors in normal-weight Hispanic Women"

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