2015-01-01

The Association between Dietary Sodium, Salt, and Elevated Blood Pressure among Hispanic Adults in El Paso, Texas

Cynthia Chacon
University of Texas at El Paso, cchacon3@miners.utep.edu

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AND ELEVATED BLOOD PRESSURE AMONG

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CYNTHIA CHACON

Department of Public Health Sciences

APPROVED:

Maria Duarte-Gardea, Ph.D., RD, LD, Chair

Gabriel Ibarra-Mejia, MD, MSErg, Ph.D.

Guillermina Solis, Ph.D., APRN, FNP, GNP-C

Charles Ambler, Ph.D.
Dean of the Graduate School

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by

CYNTHIA CHACON, B.S.

THESIS

Presented to the Faculty of the Graduate School of

The University of Texas at El Paso

in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF PUBLIC HEALTH

Department of Public Health Sciences

THE UNIVERSITY OF TEXAS AT EL PASO

August 2015

ACKNOWLEDGEMENTS

I would like to express my most sincere gratitude to many people who have helped me throughout my journey in the MPH program. First I would like to thank my thesis mentor, Dr. Maria Duarte-Gardea, for all of her guidance, and for always providing endless amount of support, and unlimited belief in me. Dr. Gabriel Ibarra-Mejia, thank you for being a part of my thesis committee and for your invaluable reviews and feedback, and all of your guidance with the statistical analysis portion of my study. Dr. Guillermina Solis, thank you for also being a part of my thesis committee, and for providing feedback and suggestions to improve the quality of my study. Dr. Ximena-Burgos, thank you for your insightfulness and for always being so willing to help me. You are a wonderful teacher and I greatly value your support.

Finally, mom, dad, Alvaro, Jackie and Gilbert, thank you for your unconditional love, support, patience and encouragement. I offer this thanks for your understanding of lost evenings and odd working hours. You all are truly blessings in my life.

ABSTRACT

Introduction: High blood pressure (hypertension) is the leading cause of cardiovascular disease (CVD) which represents a worldwide public health concern, and continues to be the number one cause of death among both men and women affecting 1 out of 3 adults in the United States. Furthermore, there is evidence suggesting that high levels of dietary sodium and salt consumption intake can not only increase an individual's blood pressure level, but also their risk for CVD, heart attack, or stroke. **Objective:** To conduct a secondary data analysis to assess the association between sodium and salt intake and blood pressure among Hispanic adults participating in a culturally appropriate large-scale lifestyle intervention, a component of the community based participatory research, the H.E.A.R.T. (Health Education Awareness Research Team) project, conducted in El Paso, Texas from 2009 to 2014. **Specific Aims:** 1) To identify blood pressure levels of participants by age and gender; 2) to examine dietary sodium and salt intake by gender and age groups (<40, 40 – 60, and > 60 years), and; 3) to explore if there was an association between high dietary sodium and salt intake and elevated blood pressure. **Methods:** Secondary data analysis was performed using information collected at baseline from participants in the lifestyle intervention program of the H.E.A.R.T. project. Data collected included demographic, anthropometric and blood pressure measures. Dietary sodium and salt intake was self-reported using My Habits food eating pattern questionnaire which reported low and high sodium and salt intake. Sodium and salt intake were then categorized in two groups of either low or high intake scores. **Results:** There were a total of 741 project participants, ages 44.6 years (SD ± 13.3) with the majority being female (83.5%). The mean systolic and diastolic blood pressure among men was 132 mm Hg (SD ±10) and 80 mm Hg (SD ±10) respectively, which according to American Heart Association blood pressure categories, is consistent with prehypertension. The mean systolic blood pressure among women was 125 mm Hg (SD ±18) indicating prehypertension, however the diastolic blood pressure was within normal range (less than 80) at 76 mm Hg (SD ± 9). Odd's Ratio was conducted in order to explore any association between dietary sodium and salt intake and blood pressure among all participants. Results for the Odd's Ratio revealed no statistical difference between high and low sodium and salt intake groups: (OR=.8 [95%CI: 0.54-1.1]). Tests were then conducted among all participants using body mass index (BMI) as a covariate. The results for the Odd's Ratio among normal weight individuals (OR=.64 [95%CI: 0.27-1.5]), and overweight/obese individuals (OR=.88 [95%CI: 0.63-1.22]) did not yield a statistically significant difference between either of the groups. Additional tests were conducted by gender and by groups. A statistical difference between high and low sodium and salt intake groups was observed in overweight/obese males (OR=2.13 [95% CI: 0.81-5.56]) and within age groups; <40 (OR=3.14 [95% CI: 0.76-12.95]) and 40-60 (OR=3.1 [95% CI: 0.55-17.6]). No statistical difference was observed in low and high sodium and salt intake groups among females. **Discussion:** Elevated blood pressure was observed among men who reported high sodium and salt intake, but only when accounting for overweight and obesity. Contrary to what previous literature has reported, data from this study was not indicative of statistically significant associations between high dietary sodium and salt intake and elevated blood pressure for both genders. Limitations in the study that could potentially be a source of bias is that dietary sodium and salt intake was reported as a score, and was not quantified in milligrams of sodium and salt intake. Moreover, a more exact method such as urinary sodium excretion was not conducted for the purpose of this study. These results will, however, have implications for increasing awareness of the association of blood pressure and high sodium and salt intake among Hispanic populations, especially in overweight and obese males.

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INTRODUCTION

Cardiovascular disease (CVD) is a worldwide and long withstanding health condition that is multifaceted that affects the heart and blood vessels. CVD include coronary heart disease (CHD), cerebrovascular accident (stroke), rheumatic heart disease, congenital heart disease, peripheral arterial disease, deep vein thrombosis and pulmonary embolism (WHO, 2015). The effect of CVD is heightened when paired with an individual who has high blood pressure (hypertension), engages in smoking, has high levels of cholesterol, is pre-diabetic or diabetic, is overweight or obese, is physically inactive, follows an unhealthy diet, and/or is over the age of 55 (National Heart, Lung, and Blood Institute, 2015). Hypertension largely contributes to not only the onset of CVD, but kidney failure and premature disability and mortality as well. Recommendation and several initiatives such as the Dietary Approaches to Stop Hypertension (DASH) diet have outlined the importance of reducing dietary sodium and salt intake, as it is a major contributing factor in the progression of hypertension (WHO, 2013b).

The purpose of this secondary data analysis is to describe associations among elevated blood pressure (dependent variable) and dietary sodium and salt intake summative scores (independent variable) among adults who participated in a 16-week lifestyle intervention. The data analyzed was recorded at baseline, upon enrollment of the intervention. This study seeks to contribute to the limited research that exists regarding adult Hispanics, specifically Mexican-Americans, residing in El Paso County, and the development of hypertension with an emphasis on dietary sodium and salt intake, to reduce the risk of the development of CVD. These types of studies can provide insight on necessary preventative strategies that can be constructed and implemented to see a decline in the development of chronic illnesses, specifically hypertension and CVD in the U.S.-Mexico border region.

CHAPTER 1. BACKGROUND AND SIGNIFICANCE

1.1 Epidemiology of Cardiovascular Disease and Hypertension

Cardiovascular disease (CVD) is the leading cause of death among noncommunicable diseases (NCD) worldwide. Annually, 38 million people die due to NCD, and in 2012 alone CVD accounted for 17.5 million of these deaths, followed by cancer (8.2 million deaths), respiratory diseases (4 million), and diabetes (1.5 million) (WHO, 2015). Currently, the 5 top leading causes of death in the United States include: heart disease (611,105), cancer (584,881), chronic lower respiratory diseases (149,205), accidents/unintentional injuries (130,557), and stroke (128,978) (CDC, 2015). Nationally, CVD affects more than 1 out of 3 (83 million) adults, and is the number one killer of both men and women, accounting for roughly 25.4% of all deaths (CDC, 2013), and in 2009 it accounted for 32.3% (787,931) of the total number of deaths that year (2,437,163) (Go, et al., 2013). On any given day, it is estimated that 2,200 Americans die due to CVD, which amounts to 800,000 lives lost each year, of which 200,000 of these deaths could have been prevented (Million Hearts Initiative, 2014 & CDC, 2013). In 2009, 153,000 of lives lost due to CVD were among individuals under the age of 65, and 34% of the deaths attributed to CVD were among persons under the age of 75, a number below the average life expectancy for Americans, 78.5 years (Go, et al., 2013). Table 1 represents the prevalence of CVD by ethnicity in 2010.

Since 1935, heart disease and stroke have been among the top 5 leading cause of death in the United States, with high blood pressure (hypertension) being the number one risk factor for the development of both of these chronic diseases (Hoyert, 2012 & CDC, 2013). Hypertension is currently the leading cause of CVD worldwide and is one of the primary reasons for premature death and onset of diabetes complications in individuals (World Health Federation, 2013). It is also considered a primary risk factor for morbidity and mortality attributed to CVD, stroke, and heart failure, and it is believed to contribute to 49% of coronary heart diseases and 65% of strokes (CDC, 2012b). Inclusively, literature has outlined the relationship between elevated blood pressure and an increased risk of CVD (Appel, et al, 2011). This relationship has been consistent across countries, among different ethnicities and race, men and women, and various ages (Vasan, et al, 2001).

Hypertension is highly prevalent in the U.S., affecting one-third of the entire population (Doumas, et al., 2013), that is 77.9 million adults, and rates of prehypertension are not far behind either. It is estimated that an additional 1 out of every 3 Americans has prehypertension (Appel, 2009 & CDC, 2013), and males more often than females have higher rates of this condition, 40% and 33% respectively (Guo, et al., 2011). Elevated blood pressure has also been found to increase the risk of CVD. In a 10-year study, the Framingham Heart Study found that elevated blood pressure was associated with CVD (hazard ratio= 2.5 in women and 1.6 in men) (Vasan, et. al, 2001).

Risk factors for CVD include hypertension, smoking, diabetes, physical inactivity, unhealthy diet, high low-density lipoprotein (LDL) cholesterol, and overweight/obesity. Nearly half (49%) of all Americans present at least one of these risk factors (CDC, 2013). Similarly, risk factors associated with the development of hypertension are closely related to those of CVD, and include smoking, diabetes, overweight/obesity, consumption of high amounts of alcohol, high levels of stress, and/or consumption of a diet high in salt (U.S. National Library of Medicine, 2012).

Table 1. *CVD prevalence among U.S. adults 20 years and older by ethnicity and gender, 2010*

	Ethnic Group		
Gender	**Non-Hispanic White**	**Non-Hispanic Black**	**Mexican American**
Males	36.6%	44.4%	33.4%
Females	32.4%	48.9%	30.7%

Source: Go, et al., 2013

The leading cause of death in Texas in 2010 was CVD, with stroke reported in third place. That same year, CVD accounted for 30.5% of all deaths, of which 23.2% were among persons of 65 years and younger (TDSHS, 2012). El Paso County residents currently display a high prevalence of risk behaviors and comorbidities associated with increased risk for CVD. In 2013, 13.6% of El Paso adults had diabetes, only 11.4% reported consuming the USDA recommendation for fruits and vegetables, 68.6% reported engaging in some form of physical activity, 28.6% had hypertension, and 69.9% of all adults were either overweight or obese (Healthy Paso Del Norte, 2015b, c, d, & e). Factors contributing to the reduction of CVD include controlling blood pressure and cholesterol levels, diabetes, tobacco use, avoiding unhealthy dietary patterns, increasing physical activity levels, and reducing obesity (Healthy El Paso del Norte, 2013).

1.2 Hypertension

An individual's blood pressure reading refers to the force of blood pushing up against the wall of the heart's arteries and is based on two numbers: the systolic and diastolic blood pressure reading. Systolic blood pressure refers to the measurement of force the blood exerts on blood vessel walls when the heart beats (when the heart muscles contract), whereas diastolic blood pressure refers to the measurement of force the blood exerts on blood vessel walls between heart beats (when the heart muscles are resting and refilling with blood) (AHA, 2012). A normal blood pressure reading should consist of less than 120mm Hg for a systolic reading, and less than 80 mm Hg for a diastolic reading, more properly annotated: 120/80mm Hg (AHA, 2012). Table 2 illustrates the different blood pressure categories as outlined by the American Heart Association (AHA, 2014).

Table 2. *Blood pressure categories according to the American Heart Association*

Blood Pressure Category	**Systolic Reading (mm HG)**		**Diastolic Reading (mm Hg)**
Normal	Less than 120	AND	Less than 80
Prehypertensive	120-139	OR	80-89
High Blood Pressure (Hypertension Stage 1)	140-159	OR	90-99
High Blood Pressure (Hypertension Stage 2)	160 or higher	OR	100 or higher
Hypertensive Crisis (Emergency Care Needed)	Higher than 180	OR	110 or higher

Adapted from the American Heart Association recommendations for healthy blood pressure.

Source: (AHA, 2014)

The systolic blood pressure reading is of more concern among physicians because it is a major risk factor in the development of CVD in persons over the age of 50 (AHA, 2012). Because systolic blood pressure rises with age, it is the most common form of hypertension (He, et al., 2005) whereas diastolic blood pressure increases with age as well, but begins to decline around the age of 50 (Williams, et al., 2008). Noteworthy, according to the National Health and Nutrition Examination Surveys III and IV, isolated systolic blood pressure accounts for over 60% of diagnosed hypertension (e.g., isolated systolic hypertension, isolated diastolic hypertension, and combined hypertension) in persons aged 20-70 years (Townsend, et al., 2005).

According to the 2012 National Institutes of Health and the National Heart, Lung, and Blood Institute's report on Cardiovascular, Lung, and Blood diseases, in 2008 coronary heart disease accounted for 49.9% of all cardiovascular deaths, followed by 16.5% attributable to stroke, 15.6% to other CVD, and 7.5% due to hypertensive disease. Furthermore, the adjusted attributable fractions for CVD mortality consisted of 40.6% due to high blood pressure, 13.7% due to smoking, 13.2 % due to poor diet, and 8.8% due to abnormal glucose levels (Go, et al., 2013). Table 3 depicts CVD conditions among U.S. adults. Notably, hypertension is the highest condition found among all ethnicities.

Table 3. *CVD conditions in 2011 among U.S. adults 18 and older by ethnicity (NHIS and NCHS 2011)*

	CVD Condition			
Ethnic Group	**Coronary Heart Disease**	**Heart Disease**	**Hypertension**	**Stroke**
White	11.1%	6.3%	23.3%	2.3%
Black/African American	10.7%	6.9%	33.4%	4.5%
Hispanic/Latino	8.6%	5.9%	22.2%	2.8%
Asians	7.4%	4.3%	18.7%	2.7%
American Indians/Alaska Natives	12.7%	7.2%	25.8%	4.6%
Native Hawaiians/Other Pacific Islanders	---	---	21.8%	---

Source: Go, et. al, 2013

Noteworthy, hypertension control rates differences among men and women have also been observed. Among persons over the age of 20 in the U.S., 33.4% of non-Hispanic white males have hypertension, and 30.7% of non-Hispanic white women; 43.6% of non-Hispanic black males and 47% of non-Hispanic black women; and 30.1% of Mexican-American men, and 28.8% of Mexican American women (Go, et al., 2013). According to the Cardiovascular Research Network, a study consisting of more than 150,000 hypertensive patients showed higher blood pressure control among women than men, 45.7% and 41.2% respectively (Daugherty, et al., 2011). Moreover, blood pressure control differences were also observed within age groups. Higher control of blood pressure levels were observed in men ≥ 65 years of age (42.5%), and in women 18-49 years of age (49.4%) (Daugherty, et al., 2011). As observed in Figure 1, differences in prevalence can be observed by gender and age groups more clearly.

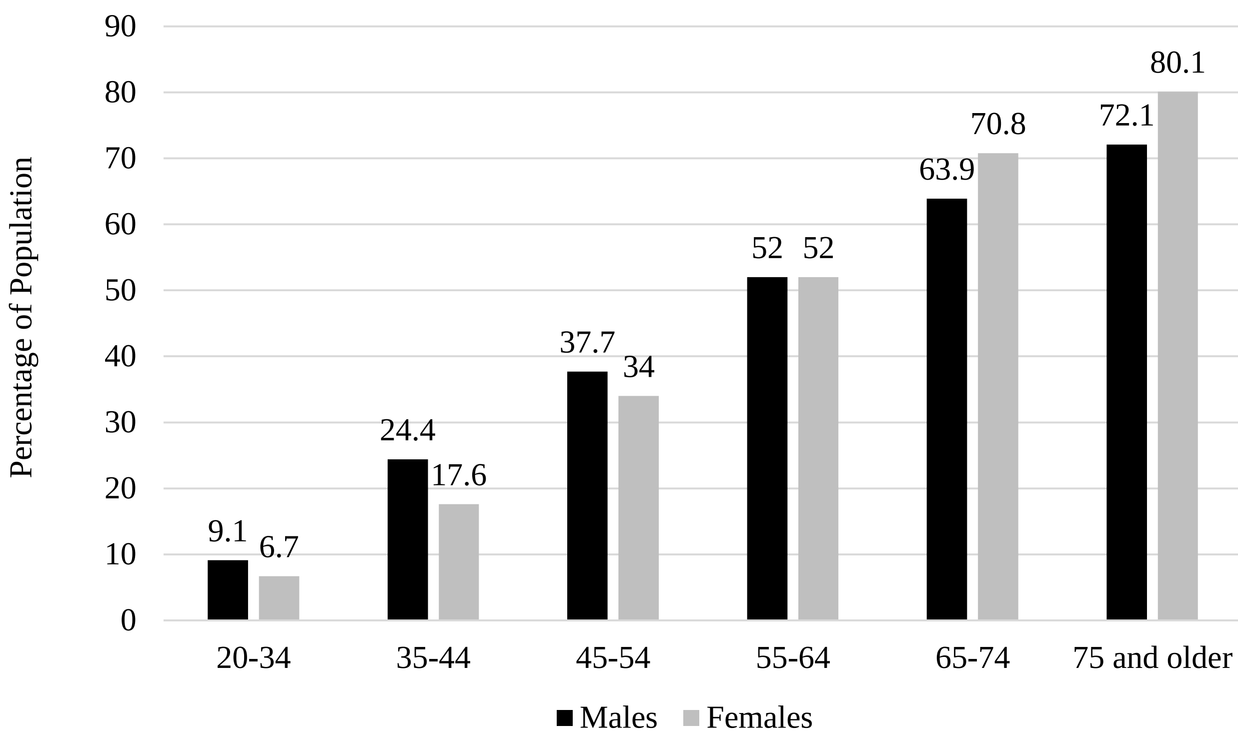

Figure 1. *Prevalence of hypertension among U.S. adults 20 and older by gender and age (National Health and Nutrition Examination Survey (NHANES): 2007-2010)*

Source: Go, et al., 2013

1.3 Overweight, Obesity, and Hypertension

Overweight is a term used to describe an excess amount of body weight resulting from increased muscle, bone, fat, or water, whereas obesity is defined as a chronic health condition in which an individual has an excess of adipose tissue (NIH, 2012). Being overweight or obese represents an increased the risk for developing numerous chronic illnesses such as hypertension, heart disease, type 2 diabetes, high cholesterol, asthma, and cancer (The Obesity Society, 2014). One method commonly used to assess an individual's weight category is by obtaining the body mass index (BMI). The BMI is obtained from height and weight and is calculated as follows: BMI=weight (kg)/height (m^2). When an individual's BMI is below 18.5, it is considered underweight, a normal weight BMI is represented by a range between 18.5 and 24.9, a BMI between 25 and 29.9 represents overweight, and a BMI over 30, indicates obesity (CDC, 2012).

Nationally, 2 out of 3 adults over the age of 20 are considered overweight or obese, that is 68.8% of the total adult population, of which 35.7% of these adults are considered obese. According to the National Health and Nutrition Examination Survey (NHANES) data from 2009-2010, 74% of adult men were either overweight or obese, while 68% of women fell into this category (NIH, 2012). In addition to gender differences with weight, weight differences among various ethnic groups have also been identified. For example, 78.8% of Hispanic adults are overweight or obese, followed by Blacks (76.7%) and Whites (66.7%). Figure 2 illustrates the differences in percentages among BMI across ethnicities.

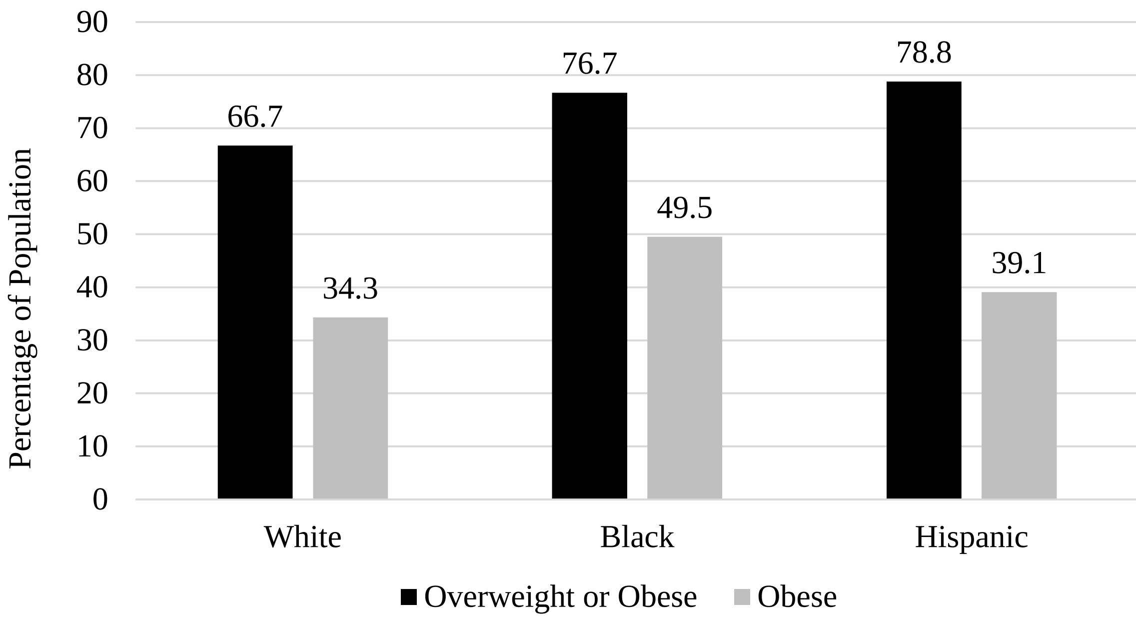

Figure 2. *Prevalence of overweight and obesity among U.S. adults 20 and older by ethnicity (National Health and Nutrition Examination Survey (NHANES): 2009-2010)*

Source: NIH, 2012

The relationship between increased BMI and the development of hypertension is substantial. In a prospective study consisting a cohort of 1,132 white men over the course of 46 years, obesity in young adulthood was strongly associated with the development of hypertension (HR=4.17; 95% CI, 2.34-7.42), as well as overweight status in young adulthood (HR=1.58; 95% CI, 1.28-1.96). Men with a normal weight status who became overweight/obese over time were also at increased risk for hypertension (HR=1.57; 95% CI; 1.2-2.07) (Shihab, et al., 2012). The Framingham Heart Study has also suggested that excess body weight accounts for 26% of hypertension cases in men and 28% for women, and that the relative risk for developing hypertension in women who gained between 10-22 pounds and those who gained over 55 pounds had a relative risk of 1.7 and 5.2, respectively (Delaney, 2015 & Julius, et al., 2000). The Tecumseh Study, a longitudinal epidemiological study conducted among persons residing in Tecumseh, Michigan, found that subjects who were at the average age of 31(n=123) and had hypertension, had also exhibited elevated blood pressure as children even though they were not overweight at that time. As they reached 20-24 years of age they began to see an increase in skinfold thickness, more so than normotensive patients, and by the age of 31, they had hypertension along with increased body weight, increased skinfold thickness, and a larger waist to hip ratio, more so than normotensive patients, suggesting that weight gain may precede hypertension (Julius, et al., 2000).

1.4 Hispanics and Hypertension

The Hispanic population is the fastest growing ethnic group in the U.S. Mexican-American is the largest Hispanic subgroup in the U.S. accounting for 67% of the entire nation's Hispanic population and 88% of the Hispanic population in Texas (Ayala, et al., 2012). They are disproportionately affected by chronic illnesses more than their population counterparts, whites and blacks. Foreign-born U.S. citizens are at an increased risk of having undiagnosed and uncontrolled hypertension. In the U.S. alone, hypertension treatment, awareness, and control were found to be lowest among Mexican-American individuals compared to whites and blacks; those individuals were found to have uncontrolled hypertension, and in addition, awareness and treatment was also lowest in Mexican-Americans compared to whites (59.4% and 44.0% respectively) and blacks (66.3% and 50.7% respectively) (Valderrama, et al., 2013). Hispanics and Mexican-Americans are disproportionately affected by CVD, a leading cause of mortality within this ethnic group (Allison, et al., 2008).

A predisposing factor such as diabetes is also noted to be higher among Mexican-Americans as opposed to non-Hispanic whites, and non-Hispanic blacks (Romero, et al., 2012). In the U.S., 7.6% of non-Hispanic whites have diabetes compared to 12.8% of Hispanics, and 13.2% of non-Hispanic blacks. Furthermore, the prevalence of diabetes among Hispanics, 13.9% are among Mexican-Americans, followed by 9.3% for Cubans, and 8.5% for South Central Americans (ADA, 2014).

Although a significant amount of efforts and progress have been made within the last decade to reduce the prevalence of CVD, an increased trend of mortality rates among person's ages 65 and younger still continues. In the U.S.-Mexico border region, specifically in El Paso, Texas, there were approximately 162.0 deaths per 100,000 persons from 2006 to 2010. Due to CVD, the age-adjusted death rate from 2004 to 2010 has decreased in El Paso, from 175.2 to 162 deaths per 100,000; however, it still remains a public health concern not only globally, but also locally (Healthy El Paso del Norte, 2013). Table 4 depicts the prevalence of high blood pressure among U.S. adults by gender and ethnicity in 2010.

Table 4. *High blood pressure prevalence among U.S. adults 20 years and older by ethnicity and gender, 2010*

Ethnic Group	Males	Females	Both Genders
Non-Hispanic White	33.4%	30.7%	---
Non-Hispanic Black	42.6%	47.0%	---
Mexican-American	30.1%	28.8%	---
Hispanic or Latino	---	---	22.2%
American Indian/Alaska Natives	---	---	25.8%
Asian	---	---	18.7%

Source: Go, et al., 2013

As indicated in Table 4, the prevalence of hypertension by gender in Hispanic or Latinos is 22.2%, a figure below the prevalence of hypertension reported in Mexican-American men and women, 30.1% and 28.8% respectively.

Having health insurance increases access to healthcare, preventative care, and treatment of illness. Health insurance has been found to decrease hypertension rates in foreign-born U.S. residents by up to 15% (Zallman, et al., 2013). The Hispanic Community Health Study/Study of Latinos found higher proportions of hypertensive persons who have health insurance being aware of their diagnoses, receiving treatment, and having their blood pressure under control, compared to hypertensive Hispanics who did not have any form of health insurance (Sorlie, 2013). However, an estimated 30.3% of Hispanics do not have access to health insurance, a number well below than their non-Hispanic white (10.6%) and non-Hispanic black (18.9%) counterparts (CDC, 2013b). Hispanics have lower levels of health insurance and annual health care visits compared to blacks in the U.S. (1.90 visits per year and .62 visits per year, respectively) (Egan, et al., 2013). Compared to blacks, Mexican-Americans were less aware of hypertension (75.5% and 57.7%), had lower treatment (62.3% and 39.7%) and lower hypertension control rates (62.3% and 17.6%) respectively (Hunte, et al., 2012). Of particular concern are the low levels of awareness of hypertension among Hispanic men under the age of 40 years; only 53% of men in this age group were aware of their diagnosis, 28.5% were receiving treatment, and only 18% had their blood pressure levels under control (Sorlie, 2013). An analysis of the National Health and Nutrition Examination Survey (NHANES) 1999-2000 found that Mexican-Americans, compared to whites, were less likely to receive antihypertensive medication, had lower blood pressure control rates despite being treated, and were less likely to have a regular health care provider or health insurance (Giles, et al., 2007). Self-reported data from the 2007 Texas Behavioral Risk Factor Surveillance System (BRFSS) showed that for the entire state of Texas, Hispanic adults were 40 times less likely to take any form of action (make a lifestyle modification or take hypertensive medication) to control their hypertension, than non-Hispanic persons. Persons less likely to take any form of action to control their blood pressure were Spanish-speaking Hispanics (83.2% ± 2.7% SE) compared with English speaking non-Hispanics (88.9% ±0.8% SE), and uninsured Hispanics had the lowest prevalence of taking action to control blood pressure when compared with uninsured non-Hispanics (63.8%±4.8% SE, 75.4% ±4.7% SE, respectively) (Ayala, et al., 2012).

1.5 Sodium, Salt, and Hypertension

Sodium is an essential mineral and an electrolyte that aids in the regulation of water balance within cells, and muscle and nerve functions within the body (Bellows and Moore, 2014). Salt is composed of approximately 40% sodium and 60% chloride and is often referred to as table salt. One-fourth teaspoon of salt contains 575 mg of sodium, and roughly 75% of the sodium we consume does not come from a salt shaker at all, but rather from the sodium that is added into processed and restaurant foods we consume (AHA, 2014a).

High sodium intake is a primary concern for health status of individuals since most of the sodium that is consumed derives from processed, packaged, and restaurant foods (NCCDPHP Division for Heart Disease and Stroke Prevention, 2011). Salt is a multi-purpose ingredient that is regularly used to cure meat, for baking purposes, to retain moisture in food, to enhance food's flavor, and/or to disguise it (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010). Alarmingly, over three-quarters of salt intake among developed countries is derived from salt added into processed foods (Burnier, 2008). Accumulated evidence has shown that high levels of sodium and salt intake can not only increase an individual's blood pressure level, but also their risk for CVD, heart attack, or stroke as well (CDC, 2013).

Statistics from the 2009-2010 National Health and Nutrition Examination Survey (NHANES) have reported the daily average intake of sodium among Americans over the age of 2 years old to be 3,655 milligrams/day, an amount above the recommended daily average intake of less than 2,300 milligrams/day (approximately a teaspoon of salt) for all healthy individuals over the age of 2 (U.S. Department of Human and Health Services, 2013). Even in humid and hot climates, and among persons engaging in physical activity for up to two hours per day, only minimal sodium and salt loss occurs so salt loading is not recommended and may actually be hazardous to individual's health (Konikoff, et al., 1986 & WHO, 2012). However, for high intensity activities of over 2 hours, supplementation of lost sodium through electrolyte replacement is suggested (Baker and Kenney, 2005; Konikoff, et al., 1986 & Sawka, 2007).

One meta-analysis consisting of 13 prospective studies with follow-ups ranging from 5-19 years has concluded that there is a direct relationship between increased sodium intake and increased risk of CVD and stroke (Strazzullo, et al., 2009). This particular meta-analysis consisted of 177, 025 participants, and higher sodium and salt intake (measured using a combination of 24-hour recall, food frequency questionnaires, and 24-hour urine collection) was associated with a greater risk of CVD (RR= 1.14, .99 to 1.32; p=0.07). In 5 of the cohorts that used food frequency questionnaires as a method of assessing high or low salt intake, the estimate for CVD reported a relative risk of 1.21, .92-1.31; p=0.32) (Strazzullo, et al., 2009).

INTERSALT is one of the largest cross-sectional epidemiological studies that looked at the relationship between an individual's level of salt intake and blood pressure. With over 10,000 participants and 52 centers around the world, 24-hour urinary sodium excretion was significantly associated with changes in systolic and diastolic blood pressure levels. Based on that particular study, it was estimated that persons who consumed 70 mmol/day of sodium (roughly 1,260 mg/day) compared to those who consumed 170 mmol/day of sodium (roughly 3,060 mg/day), had a drop of systolic blood pressure of 2.2 mm Hg. When accounting for normal weight BMI and low alcohol consumption, the systolic blood pressure number can drop up to 5 mm Hg. That study suggests that if a drop of 100 mmol/day of sodium is adhered by the population throughout their lifespan, systolic blood pressure could potentially decrease by 9 mm Hg (Burnier, 2008 & Stamler, 1989). In addition, CVD mortality rates were also observed to have an increase in cases of above normal blood pressure readings (prehypertension): above systolic blood pressure readings ≥ 130mm Hg and diastolic blood pressure readings ≥80mm (Burnier, 2008). A reduction of dietary sodium and salt intake can delay or prevent the incidence of antihypertensive therapy and has the capability of facilitating blood pressure reduction in hypertensive patients. Furthermore, an even greater decrease in blood pressure is also observed when combining a reduction of salt intake with a diet plan, such as the Dietary Approaches to Stop Hypertension (Frisoli, et. al., 2012).

1.6 The Dietary Approaches to Stop Hypertension (DASH) diet

The Dietary Approaches to Stop Hypertension (DASH) diet was developed by the U.S. National Institutes of Health, and has been shown to reduce blood pressure and cholesterol levels without the use of medication, and is especially recommended for persons with hypertension. This dietary guideline recommends increasing fruit and vegetable consumption, lowering salt intake, consuming products low in fat or nondairy products, whole grains, and incorporating lean meats (U.S. National Institutes of Health, 2013). One study consisting of 412 participants assessed the effectiveness of the DASH diet. Participants were randomly assigned to one of three groups based on sodium intake for 30 consecutive days: high (150mmol/day), intermediate (100mmol/day), or low (50mmol/day). Results from that study showed that there was a reduction in systolic pressure averages between high sodium and intermediate sodium intakes of 2.1 mmHg ($p<0.001$) and a reduction of 4.6mm Hg between the intermediate and low sodium consumption groups ($p<0.01$). Overall, participants who were on the low sodium intake group who had hypertension saw a 11.5 mm Hg systolic blood pressure drop, whereas participants without hypertension saw a 7.1 mmHg drop in systolic blood pressure (Sacks, et al., 2001).

In addition to lowering sodium and salt intake, increasing the intake of potassium, calcium and magnesium have been shown to have an antihypertensive effect on individuals

(Karppanen & Mervaala, 2006). Increasing potassium intake by approximately 1.8 to 1.9g/day in hypertensive persons can decrease systolic pressure by 4 mm Hg and diastolic pressure by 2.5 mm Hg. Increasing calcium intake to over 1,000mg/day can decrease a hypertensive systolic blood pressure reading by 1.4 mm Hg and diastolic pressure by 0.8 mm Hg. Magnesium consumption has also shown to reduce systolic blood pressure and diastolic blood pressure by 0.6 mm Hg and 0.8 mm Hg, respectively, and can further reduce systolic blood pressure by 4.3 mm Hg and 2.3 mm Hg for their diastolic blood pressure reading by simply increasing the consumption of magnesium by 10mmol/day (Karppanen & Mervaala, 2006).

The American Heart Association has estimated that when the average amount of sodium intake is cut by at least half, there would be a 26% decrease in high blood pressure cases in the US and a decrease of more than $26 billion in health care costs in one year (AHA, 2015). The Agency for Healthcare Research and Quality (AHRQ) attributed direct medical costs to treat hypertension in the US at $42.9 billion in 2010, with approximately half of that number pertaining to prescribed hypertension medication costs (Healthy El Paso del Norte, 2013).

1.7 Community-based Participatory Interventions

Community-based interventions and programs have been defined as a key to successfully implementing health initiatives, and for improving the health and wellness of all individuals (U.S. Department of Human Health Services, 2013). Community Health Workers (CHW) have been documented throughout the literature as successful components to community-based interventions by bridging the cultural and social gaps between the community and health and social providers and services (Browstein, et al, 2007). They have especially been noted to improve the health of African-American and Latino communities, often in underserved and socioeconomically disadvantaged communities (Harvey, et. al, 2009).

In a systematic review examining the effectiveness of CHW among minority persons with hypertension, a total of 14 studies were identified as meeting the criteria to be included in the systematic review. Out of the 10 studies that looked at the effects of CHW and blood pressure control, 9 reported as having positive results; 6 randomized controlled trials (RCTs), 1 time-series study, and 2 pre- and post-interventions. Among 8 studies that were identified as RCTs, 7 of them showed significant improvements in controlling blood pressure of which 2 of these studies showed additional health benefits, such as a reduction in CVD and heart mass (Browstein, et al, 2007). Overall, blood pressure control compared between CHW and control groups, the RCTs utilizing CHW found an improvement of blood pressure control of up to 46% compared to 4% for control groups over a 6 to 24-month span. In 1 of the pre- and post-intervention studies, CHW were associated with a significant decrease of 7 mm Hg in diastolic pressure, whereas in the other pre- and post-intervention, more than 90% of patients had their blood pressure under control after 12 months, and 79% to 90% had it under control at 18 months. Additionally, a time-series study looked at differences between patients' blood pressure control based on the assignment to a CHW or nurse practitioner. After a 24-month period, those patients assigned to CHW were more likely to be taking medication to control their blood pressure as opposed to those patients who were assigned to nurse practitioners (86% and 70%, respectively) (Browstein, et al., 2007).

In a CHW intervention aimed at improving hypertension in Latinos living along the U.S.-Mexico border, it was noted that following the 9-week Su Corazon, Su Vida curriculum (Sanchez, V., et al., 2014), out of 115 participants that were recruited and enrolled, 96 completed at least 1 out of 9 available health classes. That intervention utilized CHW to deliver the educational classes, and it was found that the more classes a person participated in, the better the self-reported outcome, decrease in sodium and salt intake, decrease in cholesterol and fat intake, and increase for readiness to diet and exercise ($p<.01$) (Sanchez, V., et al., 2014).

1.8 Healthy People 2020 Objectives

There are several topics and objectives outlined in Healthy People 2020 that are specifically addressed in this study. Under the heart disease and stroke topic, HDS Objective 1 is to increase the overall CVD health among the U.S. population. HSD Objective 2 is to reduce coronary heart disease deaths, from 129.2 to 103.4 deaths per 100,000 population. HSD Objective 3 is to reduce stroke deaths from 43.5 to 34.8 per 100,000 population. HSD Objective 5 and 5.1 are to reduce the proportion of persons over the age of 18 who have hypertension from 29.9% to 26.9%. HSD Objectives 9, 9.1, and 9.3 are to increase the proportion of adults with prehypertension who meet the recommended guidelines for BMI and sodium intake. And finally, HSD Objective 10, 10.1, and 10.3 are to increase the proportion of adults with hypertension who meet the recommended guidelines for BMI and sodium intake (U.S. Department of Human Health Services, 2013).

A second topic outlined in Healthy People 2020 is nutrition and weight status. NSW Objective 8 and 9 are to increase the proportion of adults who are at a healthy weight by reducing the proportion of adults over the age of 20 who are obese, from 33.9% to 30.5%. NSW Objective 19 is to reduce the daily average consumption of dietary sodium for all Americans over the age of 2, from 3,655 milligrams to 2,300 milligrams, but for persons over the age of 51, African-Americans, or persons who have been diagnosed with any level of hypertension, their sodium intake should be reduced to 1,500 milligrams of sodium per day (National Center for Chronic Disease and Health Promotion (NCCDPHP) Division for Heart Disease and Stroke Prevention, 2011 & U.S. Department of Human Health Services, 2013).

CHAPTER 2. RESEARCH OBJECTIVE AND SPECIFIC AIMS

The objective of this study was to conduct a secondary data analysis to assess the association between sodium and salt intake and blood pressure among Hispanic adults participating in a culturally appropriate large-scale lifestyle intervention, a component of the community based participatory research, the H.E.A.R.T. (Health Education Awareness Research Team) project, conducted in El Paso, Texas from 2009 to 2014. The specific aims of this study were to identify blood pressure levels of participants by age and gender, to examine dietary sodium and salt intake by gender and age groups (<40, 40 – 60, and > 60 years), and to explore if there was an association between high dietary sodium and salt intake and elevated blood pressure.

CHAPTER 3. RESEARCH QUESTIONS, AIMS, AND HYPOTHESIS

The purpose of this study was to identify dietary sodium and salt intake averages and their association with blood pressure among Hispanics of Mexican-American origin residing in the El Paso, Texas, border region. The social and environmental risk factors including low socioeconomic status, acculturative stress, and low family cohesion, (Balcazar, H. G., et. al., 2009) place Mexican-Americans at higher risk for CVD. Therefore, lack of hypertension control is a public health threat among Mexican-Americans that needs to be addressed. Additional research among Mexican-Americans living along the U.S.-Mexico border is needed to identify modifiable risk factors, such as consumption of sodium and salt, and its association with the development of hypertension. The proposed research questions, aims, and corresponding hypothesis for this thesis are found below.

3.1 Research Question 1

What is the average systolic and diastolic blood pressure reading among Hispanic adults participating in the H.E.A.R.T. project?

3.1.1 Specific Aim 1

Identify and describe levels of blood pressure in accordance with the American Heart Association blood pressure categories in Hispanic adults of the H.E.A.R.T. project by gender and by age groups <40,40-60, >60 years and older.

3.2 Research Question 2

What are the average dietary sodium and salt intake summative score averages among Hispanic participants of the H.E.A.R.T. project as reported by My Habits?

3.2.1 Specific Aim 2

Identify and describe dietary sodium and salt intake summative score averages as reported by My Habits among Hispanic participants of the H.E.A.R.T. project by gender and by age groups <40, 40-60, > 60 years and older.

3.3 Research Question 3

Is there an association between elevated blood pressure and high dietary sodium and salt intake among Hispanic adults participating in the H.E.A.R.T. project?

3.3.1 Specific Aim 3

Identify and characterize dietary sodium and salt intake summative score averages as low or high, and blood pressure categories in Hispanic adults participating in the H.E.A.R.T. project by gender and by age groups <40, 40-60, >60 years and older, using BMI as a covariate.

3.3.2 Hypothesis

Among adult Hispanics who participated in the H.E.A.R.T. project, high dietary sodium and salt intake and overweight/obesity is associated with elevated blood pressure.

3.3.3 Alternative Hypothesis

Among adult Hispanics who participated in the H.E.A.R.T. project, high dietary sodium and salt intake and overweight/obesity is not associated with elevated blood pressure.

CHAPTER 4. METHODS

4.1 Overview of the Study

The purpose of this study was to conduct a secondary data analysis to assess the association between self-reported sodium and salt intake and blood pressure among Hispanic adults from El Paso, Texas participating in a lifestyle culturally appropriate intervention called the My Heart My Community (Mi Corazon Mi Vida), MiCMiC program. The MiCMiC intervention was a component of the H.E.A.R.T. (Health Education Awareness Research Team) project, a community-based participatory research funded by the National Institutes of Health National, National Institute on Health and Health Disparities from 2009 – 2014. The H.E.A.R.T. project was conducted by a consortium of academic institutions, government (City of El Paso Parks and Recreation Department) and community based organizations including Paso del Norte Region YWCA and Centro San Vicente. The lifestyle intervention was led by CHW, members of the community who are trusted members of and/or have an unusually close understanding of the community they serve. This trusting relationship enables the worker to serve as a liaison between health services and the community to facilitate access to services and improve the quality and cultural competence of service delivered (APHA, 2015). The MiCMiC intervention aimed to reduce risk factors of CVD in low-income Hispanics residing El Paso County by promoting positive changes in individuals' self-reported behaviors related to weight management, sodium and salt intake, and cholesterol and fat intake (Balcazar, et al, 2012). The goals of the intervention were to 1) increase utilization and awareness of lifestyle programs of families living in El Paso, Texas, 2) increase healthy behaviors (self-efficacy and intentions) among this population, 3) decrease CVD risk factors among these families, and 4) encourage policy to integrate CHW in community-based organizations and public sector programs.

The 16-week CHW intervention was composed of culturally and family appropriate nutrition lifestyle and environmental friendly fitness programs. The intervention and lifestyle nutrition activities for the participants consisted of: Your Heart, Your Life (a user-friendly bilingual curriculum), healthy cooking demonstrations, coffee chats (charlas), Zumba classes, and indoor pool aerobics, all offered at the YWCA. Grocery store tours were conducted at an area supermarket, and environment fitness activities were conducted at parks, as well as Latin dance, aerobics, and walking groups. Because CHW prevention programs have been proven to be practicable and effective in promoting behavior changes in Hispanics, the H.E.A.R.T. project utilized CHWs to implement this socio-ecological approach (Ayala, et al., 2012; Balcazar, H. G., et. al., 2009).

4.2 Theoretical Framework

Various levels of influence determine the health status of individuals: personal, organizational, environmental, and policy. The theoretical framework utilized for the H.E.A.R.T. project was based on an ecological approach in which a combination of different levels of individuals' environment are essential in promoting change and community engagement in the nutrition and physical activity intervention, MiCMiC. This framework was chosen because of "…empirical evidence that supports using parks and recreation facilities to implement physical activity and nutrition programming" (Balcazar, et al., 2012). For this particular project, CHW were instrumental in addressing CVD risk factors and in implementing the lifestyle intervention, MiCMiC. The five levels outlined in the ecological framework include: individual level (e.g., participants), interpersonal level (e.g., CHW, family, friends, social networks), organizational level (e.g., YWCA, Parks and Recreation, Community Health Academy and Leadership Council, the University of Texas at El Paso, the University of Texas Houston School of Public Health, Centro San Vicente, El Paso Community College), Community (e.g., community members), and policy level (e.g., policy makers). In addition, the social cognitive theory was utilized for this intervention as it is a multicomponent conceptual model that illustrates the influence of social ecology over individual's behavior (Balcazar, et al., 2012).

4.3 Population

El Paso, Texas, is located on the U.S.-Mexico border and Texas-New Mexico border. According to the U.S. Census Bureau, the 2013 population estimate was 827,719, and approximately 81.2% of the population in 2012 was Hispanic or of Latino origin (U.S. Census Bureau, 2014). In 2012, 10.5% of the population was 65 years or older, 26.1% were foreign-born persons, 73.3% had at least obtained a high school degree, 20.3% had obtained a Bachelor's degree or higher, the median household income was $39,699, and 24.0% of the population lived below the poverty level (U.S. Census Bureau, 2014).

4.4 Sample Size

Participants consisted of adult Hispanic men and women residing in El Paso, Texas ZIP codes 79907 or 79915. For this study, a convenience sample size of 741 participants was recruited. Because of a sample size of this amount, there is an increased chance of finding statistically significant associations between the variables of interest. Table 5 shows sociodemographic characteristics of two low income ZIP codes in El Paso, Texas. Because this study was aimed towards reducing CVD risk among low-income Hispanics, these two ZIP codes were chosen as they met the criteria of a low income area with a high Hispanic population.

Table 5. *Sociodemographic characteristics of 79907 and 79915 ZIP codes in El Paso, Texas, 2010*

	El Paso, Texas	**79907**	**79915**
Total Population	800, 624	55,132	40,057
Hispanic or Latino	658, 134 (82.2%)	52,803 (95.8%)	38,024 (94.9%)
Median Age	31.3	32.8	35.8

Source: U.S. Census Bureau, 2010

4.5 Selection and Recruitment

Participants were recruited by CHW at community health fairs, recreational centers, after school programs, by newsletter distributions, radio and Spanish television announcements, mass mailings, and by door to door recruitment (Balcazar, et. al, 2012). Inclusion criteria to participate in the program included to be of Hispanic origin, at least 18 years old, reside in any of the two ZIP codes of El Paso County (79907 or 79915), not be a current member of the Paso del Norte Region YWCA, or have a preexisting heart condition that could potentially worsen during the intervention. Selection and recruitment of participants was conducted in cohorts. To achieve the population, a total of 5 cohorts of more than 100 participants in each, were conducted.

4.6 Ethics

Institutional Review Board approval was obtained to conduct the lifestyle intervention. Written consent from each participant was obtained by CHW and authorized research team members. Data collected by CHW included demographic information, acculturation information, anthropometric and clinical measurements, and self-reported behaviors.

4.7 Data Collection

The data collection that was used for the purpose of this thesis was obtained upon recruitment of participants who had agreed to take part in the MiCMiC intervention. In order to address culturally appropriateness, participants were given the option to complete the questionnaire in English or in Spanish.

4.7.1 Demographics

The following demographic information was obtained from participants: age, gender, birthplace, marital status, length of U.S. residency, years of education, place where education was obtained, employment status, annual household income, household size, health insurance status, and type of health insurance.

4.7.2 Acculturation

Acculturation was measured using multiple questions, presented in a Likert-Scale format, which addressed language preference and social support. Responses were summed to form a total summative score for each participant.

4.7.3 Anthropometric and Clinical Measures

The height of participants was obtained following standard clinical guidelines, utilizing a height scale, and it was reported in inches. Waist and hip circumferences were obtained using a measuring tape, and were reported in inches. Participants' weight was obtained in pounds using a digital scale while they wore light clothing, shoes and socks were removed prior to taking the weight of each participant. The percentage of body fat was calculated using a digital scale. BMI was calculated using the formula: BMI=(weight in pounds / (height in inches^2))x 703. Three blood pressure readings were obtained using standard clinical guidelines. The average of the three systolic and diastolic blood pressure readings was obtained.

4.7.4 Self-Reported Behaviors

The self-reported behaviors of participants related to dietary sodium and salt intake were based on the following questions illustrated in Table 6. All answers provided were then categorized as low or high dietary sodium and salt intake. Participants' responses were obtained using a Likert-Scale, in which answer options consisted of: never (0), once every two weeks (1), once a week (2), most days of the week (3), or every day (4).

Table 6. *Self-reported behaviors related to dietary sodium and salt intake*

Low Consumption	**High Consumption**
Eat fresh or frozen vegetables instead of canned vegetables?	Eat fruit with salt?
Eat fresh garlic or garlic powder instead of garlic salt?	Eat smoked, cured and processed beef, pork, and poultry like bologna, ham, and sausage?
Choose foods labeled low sodium, sodium free, or no salt added?	Use a saltshaker at the table?
Add little or no salt to the water when cooking beans, rice, pasta, and vegetables?	
Fill the saltshaker with a mixture of herbs and spices?	
Choose fruits and vegetables instead of salty snacks like chips, fries, and pork rinds?	

n=741

4.8 IRB Approval

This thesis project was conducted using data obtained from the previously described MiCMiC intervention. Institutional Review Board approved to conduct statistical analysis for the purpose of this secondary data analysis on June 4, 2015. IRB approval reference number is 86134-19.

4.9 Statistical Analysis Plan

SPSS version 22.0 was used to conduct the statistical analysis portion of this study. Statistical analysis was performed on quantitative data obtained from participants in the MiCMiC intervention upon enrollment. Descriptive statistics were conducted and include sample size (n), mean, standard deviation (SD), frequency, and percent (all where applicable). The continuous variables in this study included age, BMI, systolic blood pressure, and diastolic blood pressure. For further statistical analysis, systolic blood pressure, age, and BMI were recoded as categorical variables. The categorical variables in this study included: gender, age (<40, 40-60, and >60 years), systolic blood pressure (recoded as normal, and elevated/high blood pressure based on the American Heart Association blood pressure guidelines), sodium and salt summative score (low and high dietary sodium and salt intake based on the median of all scores), and BMI (normal and overweight/obese based on the guidelines of the Centers for Disease Control and Prevention).

For the first aim of this study, both mean systolic blood pressure and diastolic blood pressure readings were reported as continuous variables by gender and by age groups. A Univariate Analysis was conducted in order to calculate and report these Marginal Means.

For the second aim of this study, dietary sodium and salt intake summative score averages obtained from the Likert-Scale were reported by gender and age groups. A Univariate Analysis was also conducted to calculate and report these Marginal Means.

For the third aim of this study, BMI was used as a covariate. Participants were assigned to 1 of 2 groups according to normal or high BMI (overweight/obese), normal or elevated/high systolic blood pressure, and low or high dietary sodium and salt intake. An Odd's Ratio (OR) was conducted to assess the association between high levels of dietary sodium and salt intake, and elevated/high blood pressure by gender and age groups. A Chi-Square test was then performed to test the significance of the association.

CHAPTER 5. RESULTS

5.1 Descriptive Statistics of Participants

The MiCMiC intervention consisted of nutrition and physical activity programs, and was conducted at Paso del Norte Region YWCA, Centro San Vicente, and Parks and Recreation facilities located in the Lower Valley of El Paso, Texas. The intervention initially had an enrollment of 754 participants; however the data for 741 participants was available.

Table 7 illustrates the demographic characteristics of the participants. The mean age of participants was 44.6 (SD±13.3) years, and the large majority were females (83.5%). Over half of participants earned less than $15,000 annually, 55.4% were well below the national median household income of $53,046 (U.S. Census Bureau, 2015). The majority of participants were born in Mexico (62.5%), Spanish was the language preference among most participants (82.6%), and nearly half of all participants had no form of health insurance (47.8%). Furthermore, the mean number of years of education was 12 (SD±3.6).

Table 7. *Demographic characteristics participants in the MiCMiC intervention*

Variable	**n=741**
Age, years, $\bar{x}\pm$SD	44.6 ±13.3
Gender, n (%)	
Male	122 (16.5)
Female	619 (83.5)
Annual Income, n (%)	
<$15,000	408 (55.4)
$15,000-$25,000	166 (22.6)
>$25,000	162 (22.0)
Language Preference, n (%)	
English	129 (17.4)
Spanish	612 (82.6)
Birthplace, n (%)	
U.S.	273 (36.8)
Mexico	463 (62.5)
No Health Insurance, n (%)	353 (47.8)
Years of Education, $\bar{x}\pm$SD	12 ± 3.6

Demographic characteristics of participants by gender and age groups are illustrated in Table 8. As previously mentioned, the majority of participants fall within the 40-60 of years age group, while the minority of participants fell into the >60 years age group. The larger majority of participants also had an annual income below $15,000, and years of education was the lowest among the >60 years age groups for both males and females.

Table 8. *Descriptive characteristics by gender and age group of MiCMiC participants*

Variable	Males			Females		
Age, years	<40	40-60	>60	<40	40-60	>60
Gender, n (%)						
Male	54 (44.3)	58 (47.5)	10 (8.2)			
Female				240 (38.8)	294 (47.5)	85 (13.7)
Annual Income, n (%)						
<$15,000	31 (25.6)	22 (18.1)	3 (2.5)	148 (24.1)	112 (24.7)	52 (8.4)
$15,000-$25,000	7 (5.8)	15 (12.4)	5 (4.2)	45 (7.3)	77 (12.6)	17 (2.8)
>$25,000	16 (13.2)	20 (16.5)	2 (1.6)	45 (7.3)	63 (10.3)	16 (2.6)
Language Preference, n (%)						
English	42 (34.4)	47 (38.5)	9 (7.4)	44 (7.1)	43 (6.9)	18 (2.9)
Spanish	12 (9.8)	11 (9.0)	1 (0.8)	196 (31.7)	251 (40.5)	67 (10.8)
No Health Insurance, n (%)	34 (28.1)	20 (16.5)	3 (2.5)	136 (22.0)	142 (23.0)	18 (2.9)
Years of Education, $\bar{x}$±SD	12.7 ± 3.0	12.9 ± 3.6	11.3 ± 5.0	12.7 ± 2.7	11.8 ± 3.9	9.9 ± 4.2

5.2 Specific Aim 1

Specific aim 1 described the average systolic and diastolic blood pressure averages among Hispanic adults participating in the MiCMiC intervention by gender and by age groups. In order to obtain these averages, a Univariate Analysis was calculated to obtain the Marginal Means for the variables of interest.

5.2.1 Blood Pressure

The mean systolic blood pressure among all adult participants who consented to participated in the intervention had a reading level of 126 mm Hg (SD±18) at baseline. Among males, the mean systolic blood pressure was 132 mm Hg (SD±18) and among females, the mean systolic blood pressure was 125 mm Hg (SD±18). By age groups alone, the mean systolic blood pressure for age group <40 years was 118 mm Hg (SD±12), for age group 40-60years it was 130 mm Hg (SD±19), and for age group >60 years, it was 138 (SD±19). Figures 3 and 4 provide a visual representation of the differences in systolic blood pressure among males and females. Mean systolic blood pressure by age group is depicted in Figure 4.

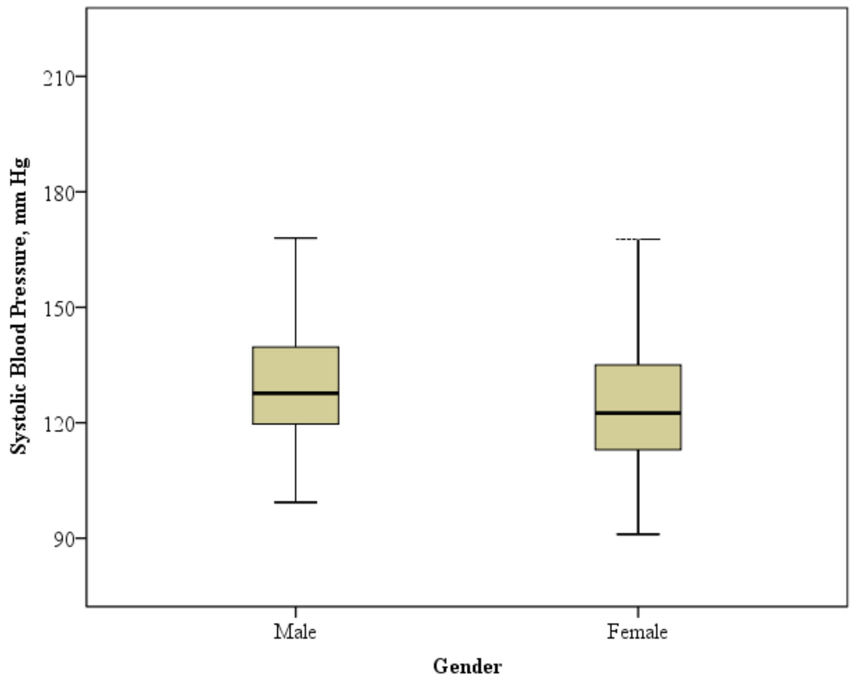

Figure 3. *Mean systolic blood pressure by gender of participants in the MiCMiC intervention at baseline*

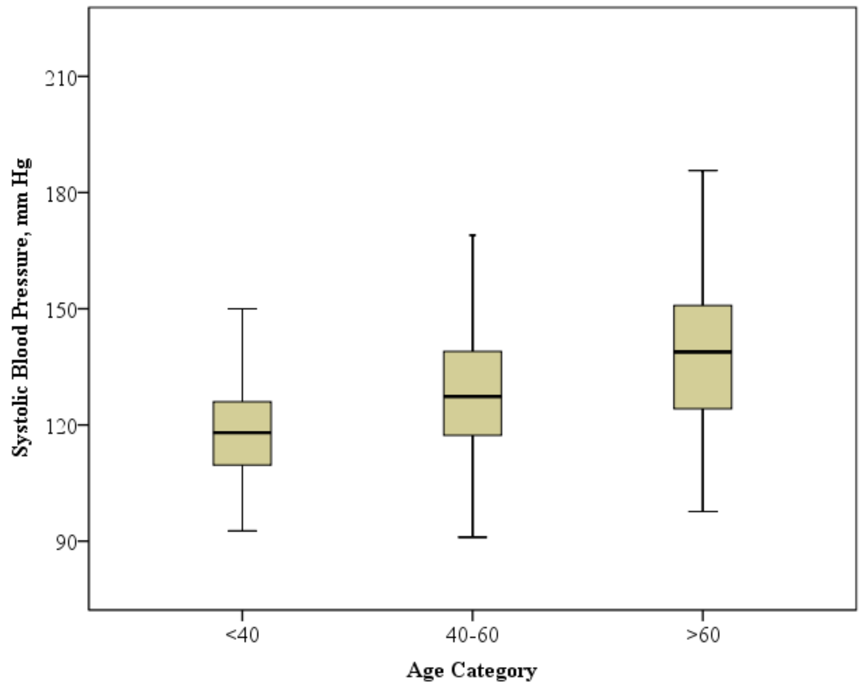

Figure 4. *Mean systolic blood pressure by age groups among participants in the MiCMiC intervention at baseline*

Overall, the mean diastolic blood pressure among all adult participants in the MiCMiC intervention at baseline was 77 mm Hg, (SD±10), 80 mm Hg (SD±10) for males and 76 mm Hg (SD±9) for females. By age groups alone, the mean diastolic blood pressure for age group <40 years was 75 mm Hg (SD±10), 79 mm Hg (SD±10) for the 40-60 age group, and 73 mm Hg (SD±9) for the >60 age group. Figure 5 and 6 show the differences in diastolic blood pressure for both males and females.

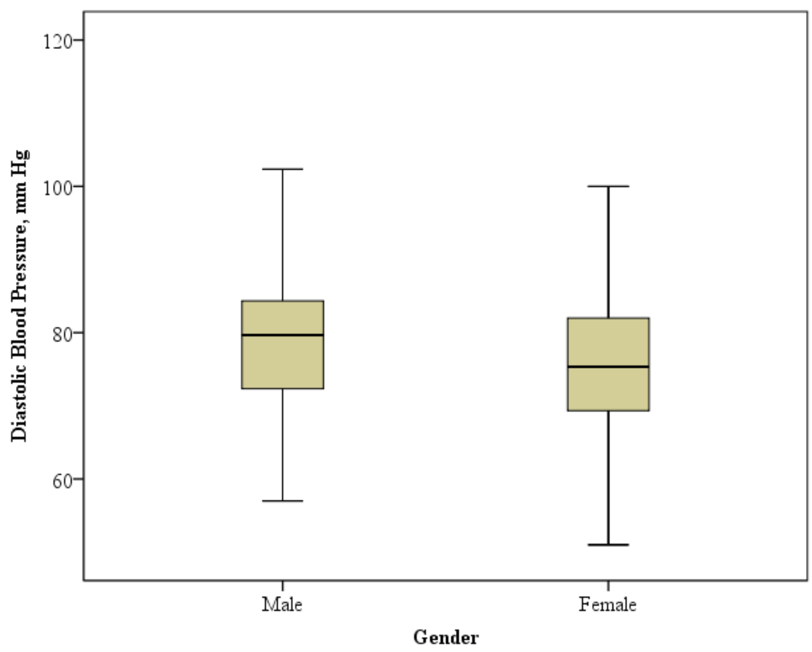

Figure 5. *Mean diastolic blood pressure by gender among participants in the MiCMiC intervention at baseline*

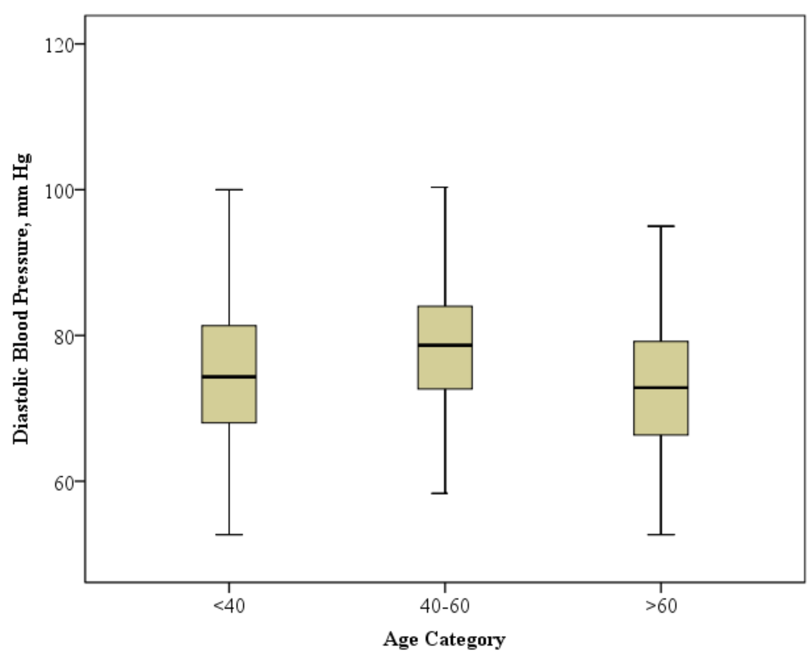

Figure 6. *Mean diastolic blood pressure by age groups among participants in the MiCMiC intervention at baseline*

A further breakdown of mean systolic and diastolic blood pressure averages by gender and age groups can be seen in Table 9. Systolic blood pressure steadily increased with age among both genders and was highest within the >60 years age group, while diastolic blood pressure increased in both the <40 and 40-60 years age groups, but then dropped in the >60 years age group.

Table 9. *Mean systolic and diastolic blood pressure by gender and age among participants in the MiCMiC intervention*

Variable	**Males**			**Females**		
Age, years	<40	40-60	>60	<40	40-60	>60
Gender, n (%)						
Male	54 (44.3)	58 (47.5)	10 (8.2)			
Female				241 (38.8)	292 (47.5)	86 (13.7)
Mean Systolic BP, mm HG, x̄±SD	124 ±13	137±20	141 ±18	117±12	128±19	138±19
Mean Diastolic BP, mm Hg, x̄±SD	76 ±10	84 ±10	76 ±9	75 ±10	78 ±9	73 ±9
Blood Pressure, mm Hg, n (%)						
Normal						
Systolic <120	23 (18.9)	9 (7.4)	1 (0.8)	124 (23.8)	105 (17.1)	15 (2.4)
Diastolic <80	37 (30.3)	23 (18.9)	7 (5.7)	170 (27.7)	188 (30.6)	71 (11.6)
Elevated/High						
Systolic >120	31 (25.4)	49 (40.2)	9 (7.4)	90 (14.7)	188 (30.6)	70 (11.4)
Diastolic >80	17 (14)	35 (28.7)	3 (2.4)	66 (10.8)	105 (17.1)	14 (2.3)

5.3 Specific Aim 2

Specific aim 2 described self-reported dietary sodium and salt intake among participants in the MiCMiC intervention. A summative score average obtained from My Habits questionnaire by gender and by age groups was calculated. In order to obtain the averages of sodium and salt intake, a Univariate Analysis was conducted to obtain the Marginal Means. Because some of the questions to document dietary sodium and salt intake were not on the same 0-4 scale (where the lower end of the scale, 0, delineated a positive behavior/low dietary sodium and salt intake, and the higher end of the scale, 4, delineated a negative behavior/high dietary sodium and salt intake), some questions corresponding answer choices were first recoded to reflect this 0-4 scale before running any tests. The total dietary sodium and salt intake summative score average of participants was then categorized as either low or high dietary sodium and salt intake based on the median summative sodium and salt intake score average among all participants (1.7778). Summative score averages <1.7778 were categorized as low, and summative score averages>1.7778 were categorized as high sodium and salt intake.

5.3.1 Sodium and Salt

On a scale from 0-4 of all possible dietary sodium and salt intake summative score averages, the average range was from .33-3.67. Overall, the average dietary sodium and salt intake summative score among all participants was 1.83 (SD±.59). Among age groups, <40 years had an average score of 1.94 (SD±.55), among the 40-60 years, the average was 1.80 (SD±.59), and among the >60 age group, the average was 1.57 (SD±.59). Males had a higher dietary sodium and salt intake summative score averages than females, 1.96 (SD±.61) and 1.80 (SD±.58) respectively. Table 10 further illustrates these averages by age group and gender. Data gathered from My Habits questionnaire used a scale from 0 (low sodium and salt intake) to 4 (high sodium and salt intake).

Table 10. *Descriptive characteristics by gender and age of participants in the MiCMiC intervention at baseline*

Variable	**Males**			**Females**		
Age, years	<40	40-60	>60	<40	40-60	>60
Gender, n (%)						
Male	53 (44.3)	58 (47.5)	10 (8.2)			
Female				238 (38.8)	292 (47.5)	86 (13.7)
Mean Sodium and Salt Summative Score, x̄±SD	2.08 ±.54	1.91 ±.65	1.61±.54	1.91 ±.55	1.79 ±.57	1.56 ±.61

5.4 Specific Aim 3

Specific aim 3 seeks to investigate an association between elevated/high blood pressure and the intake of high dietary sodium and salt among Hispanic adults participating in the MiCMiC intervention by gender and by age groups, using BMI as a covariate. Table 11 shows a breakdown of participants and their corresponding BMI classification.

Participants' dietary sodium and salt intake summative score averages were first characterized as low or high. The placement of participants was based on a cutoff point of all scores, the median (1.7778). Participants were then placed in one of two groups for systolic blood pressure: normal or elevated/high blood pressure based on the American Heart Association guidelines. Finally, participants were placed in one of two groups for BMI: normal or overweight/obese, based on the guidelines from Centers for Disease Control and Prevention.

5.4.1 Sodium, Salt, and Blood Pressure

In order to explore any association between high dietary sodium and salt intake and elevated blood pressure, an Odd's Ratio was conducted. Subsequently a Chi-Square analysis was performed to detect any association between the variables of interests. Results for the Odd's Ratio and Chi-Square analysis did not reveal a statistical difference between high and low sodium and salt intake groups [(OR=.8 [95%CI: 0.54-1.1]) and (X^2 (1)=2.26, p=.13)].

A further analysis was performed among all participants using BMI as a covariate. The results for the Odd's Ratio and Chi-Square analysis among normal weight individuals [(OR=.64 [95%CI: 0.27-1.5]) and (X^2(1)=1.09, p=.3)], and overweight/obese individuals [(OR=.88 [95%CI: 0.63-1.22]) and (X^2(1)=.62, p=.43)] did not yield a statistical significant difference between either of the two sodium and salt intake groups. Tests were then conducted among age groups. As can be seen in Table 12 there was not a statistical significant difference within any of the age groups.

Table 11. *BMI categories by gender and age groups among participants in the MiCMiC intervention at baseline*

Variable	**Males**			**Females**		
Age, years	<40	40-60	>60	<40	40-60	>60
BMI, n (%)						
Normal	13 (10.7)	4 (3.3)	1 (.08)	53 (8.6)	32 (5.2)	6 (1)
Overweight/Obese	41 (33.9)	53 (43.8)	9 (7.5)	182 (29.7)	261 (42.6)	79 (12.9)

Table 12. *Odd's Ratio and Chi-Square results by age among participants in the MiCMiC intervention at baseline*

Age	BMI	Odd's Ratio	95% CI	Chi Square	Significance
<40	Normal	.69	.2-2.33	.37	.55
	Overweight/Obese	1.33	.79-2.25	1.14	.29
	Total	1.13	.71-1.8	.26	.61
40-60	Normal	.71	.17-2.96	.23	.63
	Overweight/Obese	.8	.49-1.3	.82	.36
	Total	.79	.5-1.23	1.12	.29
>60	Normal	1.67	.82-3.41	.6	.44
	Overweight/Obese	1.42	.36-5.64	.25	.62
	Total	1.61	.41-6.27	.48	.49
Total	Normal	.64	.27-1.5	1.09	.3
	Overweight/Obese	.88	.63-1.22	.62	.43
	Total	.8	.6-.1.1	2.26	.13

*Significance level at p<0.5

Furthermore, tests were then conducted by gender and age group. Differences between high and low sodium and salt intake groups were observed among all overweight/obese males [(OR=2.13 [95%CI: 0.81-5.6]), however these findings were not statistically significant ($X^2(1)$=2.37, p=.12)]. Similarly, differences for overweight/obese males <40 years [(OR=3.14 [95% CI: .76-12.95) and ($X^2(1)$=2.26, p=.11)] and overweight/obese males 40-60 years [(OR=3.1[CI: .55-17.6]). ($X^2(1)$=1.75, p=.19)] were observed, but neither were statistically significant associations. Table 13 displays additional results among males within age groups by BMI classification.

Table 13. *Odd's Ratio and Chi-Square results by age group among male participants in the MiCMiC intervention at baseline*

Gender	Age	BMI	Odd's Ratio	95% CI	Chi-Square	Significance
Male	<40	Normal	.21	.014-3.37	1.31	.25
		Overweight/Obese	3.14	.76-12.95	2.26	.11
		Total	1.56	.47-5.22	.53	.47
	40-60	Normal	1	.20-50.397	0	1
		Overweight/Obese	3.1	.55-17.6	1.75	.19
		Total	2.46	.56-10.96	1.44	.23
	>60	Normal	---	---	---	---
		Overweight/Obese	1.6	2.74	.56	.45
		Total	1.8	1-3.22	.74	.39
	Total	Normal	.47	.05-3.44	.68	.41
		Overweight/Obese	2.13	.81-5.6	2.37	.12
		Total	1.32	.58-3	.43	.51

*Significance level at p<0.5

Odd's Ratio and Chi-Square tests were then conducted for low and high sodium and salt intake among female participants by age group. Tests did not yield a significant difference between normal weight females [(OR=0.58 [95%CI: 0.22-1.55]) and ($X^2(1)=1.21$, p=.27)] and overweight/obese [(OR=0.74[95% CI: 0.52-1.1]) and ($X^2(1)=2.85$, p=.09)] classification. In addition, no statistical significant difference was observed within any of the age groups or within BMI categories. Table 14 summarizes the previously described results.

Table 14. *Odd's Ratio and Chi-Square results by age group among female participants in the MiCMiC intervention at baseline*

Gender	Age	BMI	Odd's Ratio	95% CI	Chi-Square	Significance
Female	<40	Normal	.7	.16-3.17	.21	.65
		Overweight/Obese	1.05	.59-1.87	.03	.87
		Total	.95	.57-1.6	.30	.86
	40-60	Normal	.67	.14-3.17	.26	.61
		Overweight/Obese	.57	.4-1.14	2.2	.14
		Total	.67	.42-1.1	2.6	.11
	>60	Normal	1.33	.76-2.35	.31	.58
		Overweight/Obese	1.22	.3-5	.08	.78
		Total	1.35	.34-5.39	.18	.67
	Total	Normal	.58	.22-1.55	1.21	.27
		Overweight/Obese	.74	.52-1.1	2.85	.09
		Total	.7	.5-.96	4.9	.03

*Significance level at $p<0.5$

CHAPTER 6. DISCUSSION

Hypertension is a prevalent and serious health condition in the U.S. and globally and a predisposing factor for CVD. It has been reported that obesity in combination with a higher than recommended dietary sodium and salt intake can result in elevated blood pressure. It is suggested for hypertensive patients to follow a diet such as the Dietary Approaches to Stop Hypertension (DASH diet) in which sodium and salt are reduce and combined with a variety of foods that provide micro minerals such as magnesium and potassium, so blood pressure levels can be reduced.

According to the American Heart Association, normal blood pressure is consistent with a systolic blood pressure reading of less than 120 mm Hg and a diastolic blood pressure reading less than 80 mm Hg. A prehypertensive stage is consistent with a systolic blood pressure reading of 120-139 mm Hg or a diastolic blood pressure reading between 80-89 mm Hg, whereas hypertension is defined as having a systolic blood pressure reading above 140 mm Hg or a diastolic blood pressure reading above 90 mm Hg (AHA, 2014). According to the study by Go, et al., 2013, blood pressure differences are observed among gender and among age groups as males exhibited higher systolic blood pressure averages compared to females, 132 mmHg (SD±18) and 125mm Hg (SD±18) respectively, and higher diastolic blood pressure averages, 80 mm Hg (SD±10) and 76 mm Hg (SD±10), respectively. These numbers indicate that based on the mean systolic blood pressure among both males and females, both genders fall into the prehypertension category, whereas when only taking into account diastolic blood pressure, only males fall into the prehypertension category.

Among males <40 and 40-60 years systolic blood pressure levels were consistent with prehypertension with averages of 124 mm Hg (SD±13) and 137 mm Hg (SD±20) respectively, whereas males >60 years exhibited levels of hypertension with an average of 141 mm Hg (SD±18). Females <40 years displayed normal levels of hypertension with an average of 117 mm Hg (SD±12), however within 40-60 and >60 years, levels of prehypertension were observed with averages of 128 mm Hg (SD±19) and 138 (SD±19) respectively. These systolic blood pressure readings are cause for concern since high systolic blood pressure is regarded as a major risk factor for the development of CVD in persons over the age of 50 (AHA, 2012), and high systolic blood pressure is the most common form of hypertension accounting for over 60% of all diagnosed hypertension in persons ages 20-70 (He, et al., 2005 & Townsend, et al., 2005).

Among males <40 and >60 years diastolic blood pressure, displayed normal levels with averages of 76 mm Hg (SD±10) and 76 mm Hg (SD±9) respectively, whereas males 40-60 years exhibited levels of prehypertension with an average of 84 mm Hg (SD±10). Among all females age groups, the diastolic blood pressure averages fell within normal range for females <40, 40-60, and > 60 years, 75 mm Hg (SD±10), 78 mm Hg (SD±78), and 73 mm Hg (SD±9) respectively.

Consistent with previous findings, the systolic blood pressure average among participants increased consistently among both males and females with age (He, et al., 2005) however diastolic blood pressure increased with age among both genders, but only before dropping again after reaching 60 years (Go, et al, 2013 & Williams, et al., 2008). Also, prehypertension was more prevalent among males and females (Guo, et al., 2011), especially when taking into account mean systolic blood pressure. Because prehypertension currently affects 1 out of 3 Americans (Appel, 2009 & CDC, 2013), and is a predisposing factor for hypertension and subsequently a factor for CVD, the results from this study reveal the need for higher levels of blood pressure control, especially among the male population (Vasan, et al, 2001).

Highest dietary sodium and salt intake was observed among both male and female <40, and 40-60 years, while the lowest sodium and salt intake was observed among the males and females >60 years with scores of 1.61 and 1.56 respectively. Recommendations for lower sodium and salt intake among persons of 51 years or older have been defined, and could potentially be the reasoning for the observed lower sodium and salt intake seen in the older age group in this study (NCCDPHP Division for Heart Disease and Stroke Prevention, 2011 & U.S. Department of Human Health Services, 2013).

Nationally, the prevalence of overweight and obesity among adults is 68.8% (74% for men, and 68% among women) while among Hispanics that number jumps to 78.8% (NIH, 2012). In this study, 86% of the participants were either overweight or obese (86% of the male population and 85% of the female population), a number well above the national level, and that of El Paso County, 69.9% (Healthy Paso Del Norte, 201e). Because food insecurity, low income, and the prevalence of obesity have been documented, it is important to note that participants of the intervention had a lower annual income average that of El Paso County's, and the U.S. The higher prevalence of overweight and obesity at baseline among participants is consistent with the literature, when accounting for low income levels.

Overall, five studies that utilized food frequency questionnaires to categorize high and low dietary sodium and salt intake found statistically significant associations between higher dietary sodium and salt intake and high blood pressure (Strazzullo, et al., 2009), inconsistent with this study's findings. The discrepancy might be due to self-reported low and high sodium and salt intake score derived from a Likert-Scale.

Nevertheless, differences in elevated blood pressure among overweight/obese males and healthy weight males is consistent with literature, where obesity in young adulthood for males was strongly associated with high blood pressure as well as those who were overweight (Shihab, et al., 2012).

Although the null hypothesis was rejected and the alternative hypothesis accepted for this study, which stated: high dietary sodium and salt intake is not significantly associated with elevated blood pressure, there are public health implications that need to be addressed among pre-hypertensive and hypertensive overweight/obese individuals, especially males.

There is a need for the implementation of effective evidence based practice recommendations aimed at reducing the prevalence of overweight and obesity, as well as increasing the awareness and control of blood pressure in order to overcome the rising prevalence of overweight, obesity, hypertension, and CVD. There also exists a need for the adoption of modifiable risk factors, such as a healthy diet and exercise, as diets high in sodium and salt contribute to both the development of hypertension and overweight and obesity across all age groups and among both genders. Because Hispanic and Mexican-American males are disproportionately affected by the prevalence of hypertension and CVD, interventions aimed at targeting them is critical in order to better understand the lack of blood pressure control, the higher prevalence of overweight and obesity, and the higher intake of dietary sodium and salt. This study will have future implications for increasing awareness of high blood pressure, a risk factor for developing CVD, and the effect of high dietary sodium and salt intake and overweight and obesity among Hispanic populations, specifically among overweight and obese Hispanic males.

6.1 Strengths

One of the main strengths of this study was the large sample size collected at baseline of the intervention. A sample size consisting of 741 participants, could allow for the detection of statistically significant differences and associations.

Another strength was the large sample included Hispanics which could be useful in generalizing findings among this ethnic group.

6.2 Limitations

Limitations of this study include potential recall bias in the intake dietary sodium and salt as part of My Habits food eating pattern questionnaire, or lack of understanding of questions and answer choices. Because some of the questions were on the reverse 0 (low) - 4 (high) scale for dietary sodium and salt intake, it could have conflicted with participants understanding of the questions and/or answer choices. Limitations to this questionnaire also exist, since dietary sodium and salt scores were self-reported using a Likert-Scale that is based on a score, and was not quantified in actual milligrams of sodium and salt. Moreover, a more exact method such as urinary sodium excretion was not conducted for the purpose of this study.

Another limitation of this study could also be solely utilizing systolic blood pressure as opposed to combined systolic and diastolic blood pressure, since differences have been observed in isolated systolic blood pressure versus combined blood pressure. Because systolic blood pressure is more of a concern among persons over the age of 50 and this number steadily rises with age (American Heart Association, 2012; He, et al., 2005; & Williams, et. al., 2008), it was only used for this study. However, the mean age of participants was 44.6 (SD±13.3).

The large majority of females (83.5%) in the sample also pose a limitation since they were on average younger, consumed lower levels of sodium and salt, and had lower systolic and diastolic blood pressure readings. Low participation from males could be attributed to the fact that in the Hispanic culture, males are seen as the head of the household and providers and may not have had the same opportunity to participate in the project due to limited time. Recruiting males from worksites may have resulted in a better representation among this gender.

CHAPTER 7. CONCLUSION

Despite of the lack of statistical significant findings, this study that assessed the associations between high dietary sodium and salt intake and elevated blood pressure, found observational differences between gender and age groups regarding blood pressure levels, BMI, and higher and lower dietary sodium and salt intake. In addition, implementing a lifestyle intervention led by CHW to create awareness among overweight and obese Hispanic males with respect to the association of high sodium and salt intake and elevated blood pressure, a risk factor leading to the development of CVD, could result in a reduction of sodium and salt intake, blood pressure, and body weight. Recreating this study in a larger male population using clinical measures of dietary sodium and salt intake and targeting the male population could further explore and find positive associations between high dietary sodium and salt intake and blood pressure among low-income Hispanic populations residing along the U.S.-Mexico border.

CHAPTER 8. MPH CORE COMPETENCIES

The University of Texas at El Paso (UTEP) Master of Public Health (MPH) program has several core competencies that guide the MPH program in practical research, training, and student learning. The core competencies that were addressed throughout this study include: epidemiology, biostatistics, health policy and management, and Hispanic and border health. The epidemiology core competency was addressed by identifying and utilizing reliable and key sources of data; addressing current public health issues that are prevalent; describing public health problems in terms of persons, magnitude, time, and place; and by communicating epidemiologic information to lay and professional audiences.

The biostatics core competency was addressed by the selection of particular statistical methods used for the aims of this study; through the interpretation of results of statistical analysis; and through the development of written and oral presentations for public health professionals and lay audiences.

The health policy and management core competency was addressed by discussing policy process for improving the health status of populations.

The social and behavioral science core competency was addressed by identifying basic theories, concepts and models used in public health research and practice, and by describing the role of social and community factors in the onset and solutions of public health issues.

The Hispanic and border health concentration core competency was addressed through the sample population of this study by describing the historical, cultural, social and economic similarities among Hispanic and border groups; through the identification of major chronic public health illnesses that affect Hispanics and border communities; and by the identification and access of major sources of public health data relevant to Hispanic and border populations.

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CURRICULUM VITAE

Cynthia Chacon was born in El Paso, Texas, and raised in Clint, Texas. She is the daughter of Alvaro and Benita Chacon. In 2007, she became a Gates Millennium Scholarship recipient, and has been a scholar since then. Cynthia graduated from The University of Texas at El Paso (UTEP) with a BS in Health Promotion and a minor in Community Health in the spring of 2012. In the fall of 2012, Cynthia was accepted in the Master of Public Health program at UTEP's Department of Public Health Sciences. While attending graduate school, Cynthia worked as a graduate teaching assistant for the Department of Public Health Sciences. In 2014, Cynthia was chosen to attend the Institute on Teaching and Mentoring Conference, the largest gathering of minority graduate students in the country, on behalf of the Compact for Faculty Diversity, in which she currently remains as a scholar. In 2015, on behalf of the Bill and Melinda Gates Foundation, she was chosen to attend a Public Health conference in conjunction with the American Cancer Society in Portland, Oregon. Cynthia's thesis explored possible associations between dietary sodium and salt and elevated blood pressure of the H.E.A.R.T. project's intervention, MiCMiC, among Hispanic adults in El Paso, Texas.