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Intra-Ethnic Diversity in Ischemic Heart Disease and Stroke Mortality among Hispanics in the United States

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INTRA-ETHNIC DIVERSITY IN ISCHEMIC HEART DISEASE AND STROKE
MORTALITY AMONG HISPANICS IN THE UNITED STATES

By

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Abstract

Introduction: Hispanics are the largest racial/ethnic minority group in the United States (US), comprising 17% of the total US population in 2014, and projected to increase to 28.6% by 2060. Yet, the intra-ethnic heterogeneity for the second and fourth leading causes of death among Hispanic populations, heart disease and stroke, has never been comprehensively studied. We examined ischemic heart disease (IHD) and stroke mortality among distinct Hispanic subgroups: Caribbean Hispanics (including Puerto Ricans, Cubans, and Dominicans), Mexicans, Central Americans and South Americans, comparing their mortality with non-Hispanic whites (NHWs).

Methods: Five years (2008-2012) of death certificate data from Florida and California were used to calculate age-adjusted cause-specific mortality rates for ischemic heart disease and stroke. Mortality outcomes were compared with age-adjusted mortality rate ratios computed using negative binomial regression.

Results: Hispanics had stroke mortality rates equivalent to or higher than NHWs. The highest rate was seen in US-born Mexicans in California, 41.9 deaths per 100,000 (95% CI: 40.0- 44.0), compared to 36.3 (95% CI: 35.8-36.9) in NHWs. In Florida, Puerto Rican men had the greatest stroke mortality risk, 19% higher than NHWs. In aggregate, Hispanics had lower ischemic heart disease mortality rates than NHWs, 32% and 25% lower among females and males in Florida, respectively. South American men and women had the lowest IHD and stroke rates in both states.

Discussion: There was notable intra-ethnic variability in mortality, with the worst Hispanic outcomes seen among Cuban men and Puerto Rican women in Florida and US-born Mexicans and Caribbeans of both sexes in California. Our results for both IHD and stroke demonstrate that among Hispanics, US-born and/or those with a longer stay in the US were the most

disadvantaged, suggesting the importance of looking at acculturation patterns that negatively influence health, including diet and obesity.

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List of Acronyms

ACS	American Community Survey
AF	Atrial Fibrillation
AHA	American Heart Association
AVMs	Arteriovenous Malformations
CAC	Coronary Artery Calcification
CDC	Centers for Disease Control and Prevention
CIMT	Carotid Intimal-Medial Thickness
CVD	Cardiovascular Disease
HABLAS	Hispanic Americans Baseline Alcohol Survey
HIE	Healthy Immigrant Effect
IHD	Ischemic Heart Disease
NHW	Non-Hispanic White
NOS	Not Otherwise Specified
SES	Socioeconomic Status
TIA	Transient Ischemic Attacks
WHO	World Health Organization

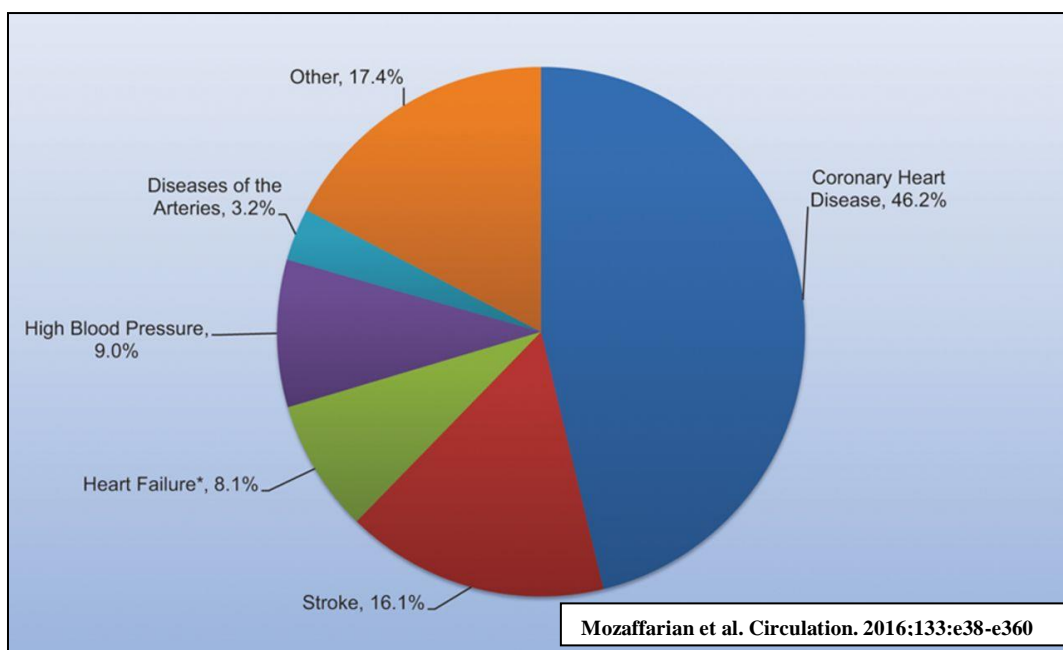
Chapter One: Background and Significance

Section One: Cardiovascular Disease - Ischemic Heart Disease and Stroke

Cardiovascular disease (CVD) is the leading cause of death worldwide, accounting for an estimated 31% of all deaths globally in 2012 (World Health Organization (WHO), 2016).

Atherosclerosis, a hardening and narrowing of the arteries due to the buildup of plaque, is the systemic disease process underlying most cardiovascular events. Of all the heart and blood vessel diseases, ischemic heart disease (IHD), sometimes called coronary heart disease, and cerebrovascular disease, often called stroke, are the two most deadly types. Figure 1 shows the percentage of deaths attributable to these two diseases, published in the American Heart Association's recent report entitled, Heart Disease and Stroke Statistics—2016 Update (Mozaffarian et al., 2016).

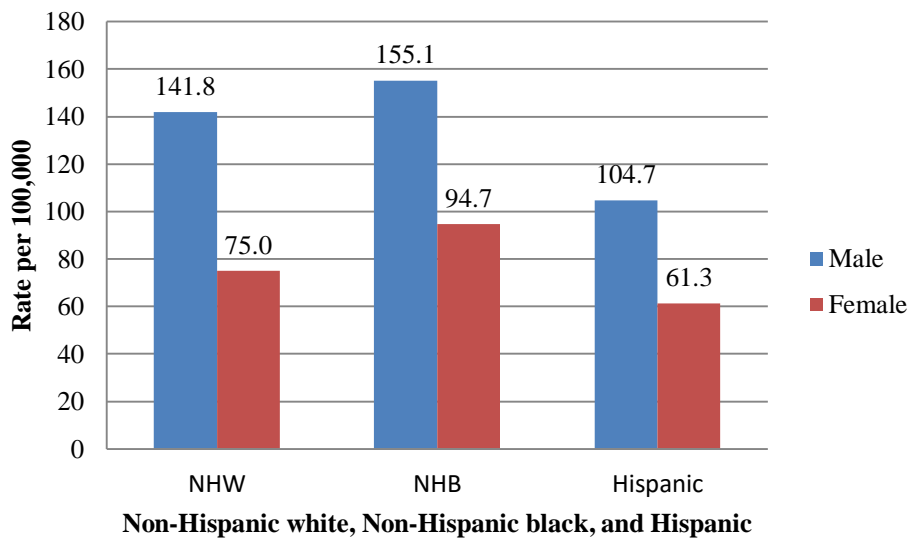
Figure 1. Breakdown of Deaths Attributable to Cardiovascular Disease in the US in 2013



Ischemic heart disease.

Ischemic heart disease occurs when the blood vessels supplying the heart become narrowed which limits the flow of oxygen and nutrients to the heart muscle. If the narrowing is severe and persistent, damage can occur to the heart muscle known as a myocardial infarction, or heart attack. Age is the greatest determinant of IHD. Based on 2013 mortality data, the average age of first myocardial infarction among men and women is 65.1 and 72.0 years old, respectively (Mozaffarian et al., 2016). Approximately 34% of people who experience a cardiac event will die of it within a year. Moreover, 76% of deaths from ischemic heart disease occur outside of the hospital. Mortality rates of ischemic heart disease differ by race/ethnicity as well as by gender, as seen in Figure 2. In 2013, across all racial/ethnic groups, men bore a larger mortality burden, but both male and female non-Hispanic blacks had higher rates than other race/ethnicities. Hispanics had the lowest rates (Mozaffarian et al., 2016).

Figure 2. 2013 Age-Adjusted Death Rates from Ischemic Heart Disease in the US by Race/Ethnicity

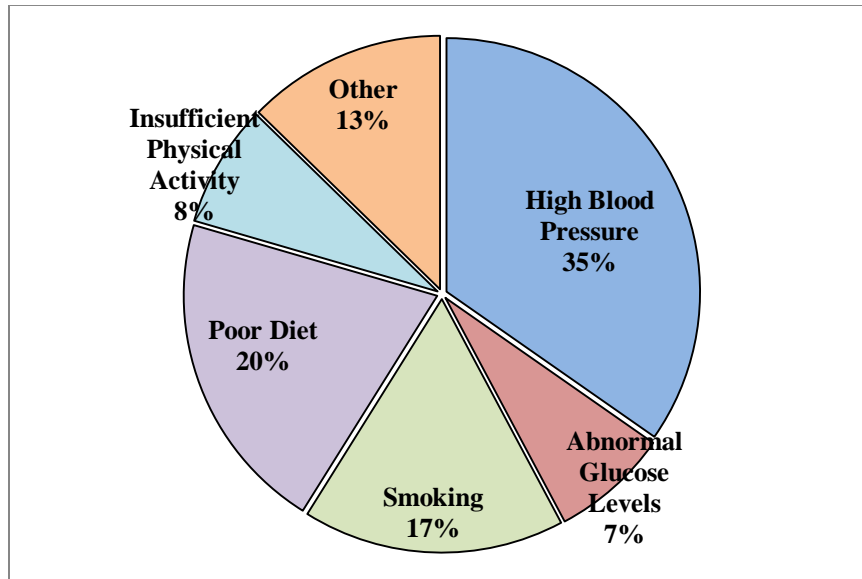


Although the death rate fell nearly 40% from 2001-2011, ischemic heart disease was still the underlying cause for 1 in 7 deaths in 2013. Decreases have been equally attributed to changes in risk factors resulting from lifestyle and behavioral changes, as well as improvements in medical and surgical treatments (Ford et al., 2007). Taking the most important of these into account, the American Heart Association (AHA) has defined ideal cardiovascular health in a population-based campaign to improve health and reduce CVD mortality called, “Life’s Simple 7”. The first four steps emphasize lifestyle factors: stop smoking; maintain a healthy weight; engage in physical activity; and eat a healthy diet. The final three may involve clinical intervention, including medication to maintain healthy blood pressure, cholesterol levels, and blood sugar, or glucose levels (Mozaffarian et al., 2016). Unfortunately, increases in obesity and diabetes may counteract the improvements seen in smoking reduction and control of hypertension and diabetes.

Additional determinants that influence mortality include family history of any cardiovascular disease; awareness of symptoms and time between symptom onset and arrival at hospital; secondary preventative therapies after myocardial infarction and/or revascularization; and access to quality health care including health insurance coverage and type of hospital. Other clinical risk factors for atherosclerosis include coronary artery calcium, carotid intimal-medial thickness and left ventricular hypertrophy (Rodriguez et al., 2014). Researchers are also examining the role of inflammatory biomarkers such as C-reactive protein and adipokines. (Gupta, Singh and Verma, 2006.) Geneticists are exploring the association of gene variants with IHD and/or its risk factors, with promising results at chromosome 9p21.3. However, to date, no markers have provided additional levels of predictability for IHD beyond that attained by family history, nor can they predict atherosclerosis better than traditional risk factors (Mozaffarian et al.,

2016). In their study, Yang et al., (2012) described the population-attributable fraction of five major risk factors to ischemic heart disease mortality, finding that only 12.3% is attributed to other factors (Figure 3).

Figure 3. Adjusted Population Attributable Fraction of Ischemic Heart Disease Mortality



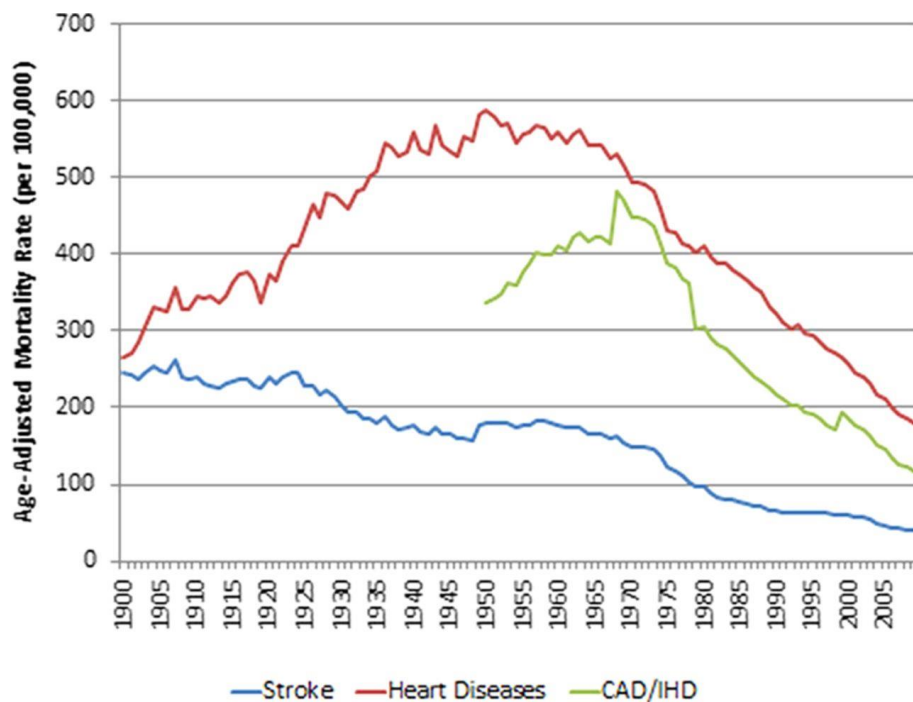
Cerebrovascular disease.

When the blood vessels supplying the brain are damaged, the result is cerebrovascular disease. Stroke may occur, often the first indication of underlying blood vessel disease (WHO, 2016). Eighty-seven percent of strokes are ischemic in which a thrombus, or blood clot, obstructs a blood vessel supplying blood to the brain. Like ischemic heart disease, the underlying cause of ischemic strokes is atherosclerosis. The other 13% of strokes are hemorrhagic, either subarachnoid hemorrhage (10%) or intracranial hemorrhage (3%). They are a result of weakened blood vessels, often either aneurysms or arteriovenous malformations (AVMs) that rupture and bleed into the brain, compressing brain tissue. Hemorrhagic strokes, although less frequent, are

more deadly, and have somewhat different risk factors (Mozaffarian et al., 2016). However, due to poor quality of stroke type reporting on death certificates (Lackland et al., 2014), especially given that 59% of stroke deaths occur outside a hospital (Mozaffarian et al., 2016), most mortality studies include both stroke types combined (Lackland et al., 2014). Transient ischemic attacks (TIA) are common but not deadly cerebrovascular events, but also risk factors for future stroke mortality (Mozaffarian et al., 2016).

In 2013, strokes were responsible for one out of every 20 deaths in the US, and ranked fifth as a leading cause of death (Mozaffarian et al., 2016). The mortality rate from stroke has been steadily declining, as has mortality from IHD, as seen in Figure 4 (Lackland et al., 2014).

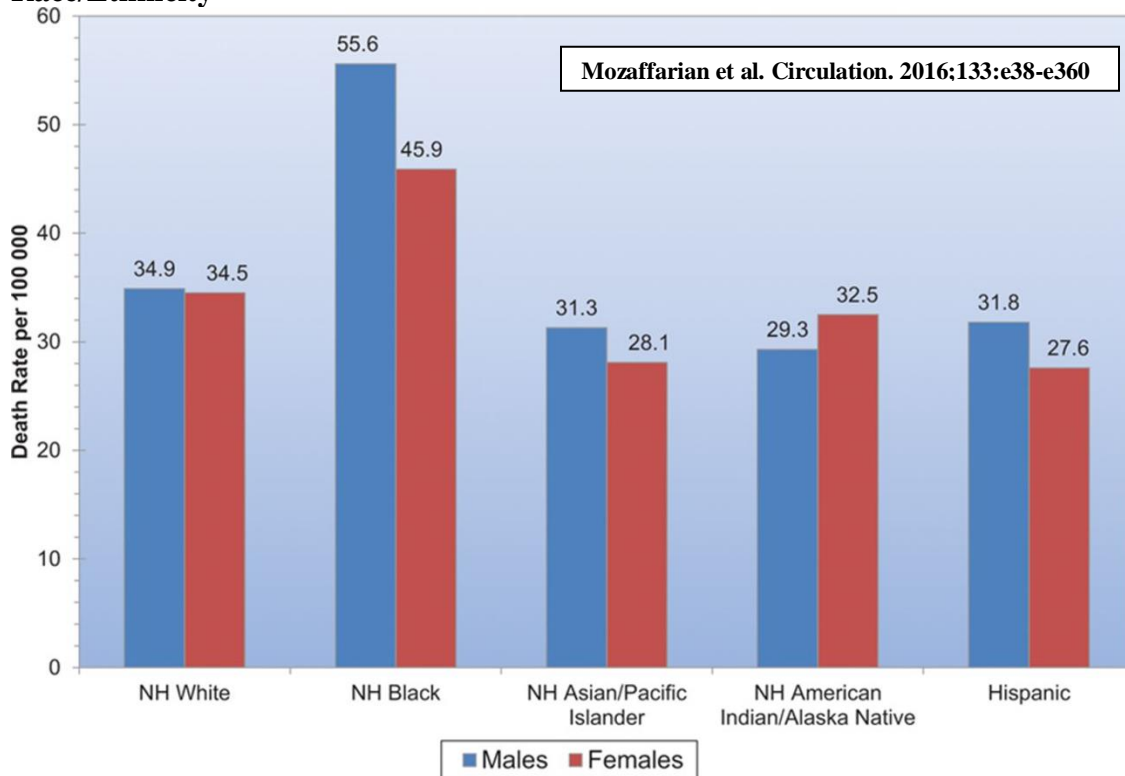
Figure 4. Stroke and Ischemic Heart Disease Mortality Rates in the US, 1900 to 2005



Lacklund et al. Stroke. 2014.

The decline has been steady among all age groups, both sexes, and all race/ethnicity groups. However, there are substantial differences in stroke mortality rates by sex and race/ethnicity. Unlike IHD, the mortality rate for stroke in women is roughly equal to that of men. In 2013, non-Hispanic black men had the highest stroke mortality rates, while Hispanic women had the lowest, as seen in Figure 5. Largely due to the higher actual number of elderly women, however, 58% of total stroke decedents in 2013 were women. Like IHD, age is a strong determinant of stroke mortality, with mortality rates increasing sharply in populations over 65 years of age (Mozaffarian et al., 2016).

Figure 5. Age-Adjusted Stroke Death Rates for Males and Females in 2013, by Race/Ethnicity



Many of the risk factors for stroke mortality are the same as for ischemic heart disease. The strongest identified modifiable risk factor for all stroke types is hypertension, especially

pronounced as a risk factor for hemorrhagic strokes. The association is linear, with increasing risk of stroke with increasing blood pressure. The decline in stroke mortality is partially attributed to the increase in antihypertensive medications, one of the most commonly prescribed medications in the US. Many of the other risk factors for stroke are in fact risk factors for hypertension including obesity, high alcohol intake, and excess sodium intake (Lackland et al., 2014).

Several comorbidities prevalent in the US are risk factors for stroke, including the already-mentioned obesity, as well as diabetes mellitus and atrial fibrillation (AF), an irregularity of heart rhythm. At all ages, AF confers a 5 times greater risk of stroke, and among 80-89 year old, AF is responsible for 23.5% of all strokes (Mozaffarian et al., 2016). The evidence supporting hyperlipidemia as a risk factor for stroke death is mixed, although this may be due to researchers grouping all stroke subtypes together. Likewise, although there is evidence that aspirin therapy after a first stroke event confers protection against a second, the evidence for preventing a first-event stroke is inconclusive. (Meschia et al., 2014).

Predictably, another strong risk factor for stroke is smoking, which increases risk of stroke 2-4 times. Moreover, exposure to second-hand smoke has been shown to increase risk in a dose-response relationship (Lackland et al., 2014). Other documented risk factors for stroke include physical inactivity, sleep apnea, aura migraines in women, particularly if they smoke and use oral contraceptives, unhealthy diet, and depression (Mozaffarian et al., 2016). Lackland et al., (2014) also attribute declining stroke rates to increased knowledge of stroke symptoms as well as improvements in stroke systems of care, including increases in primary stroke centers (Lackland et al., 2014).

The mortality burden of IHD and stroke is high in the US, and with an increasing aging population, public health professionals must understand the burden and prepare for it. The Centers for Disease Control and Prevention (CDC) launched the Million Hearts Initiative in 2011 to reduce the mortality burden of IHD and stroke (Valderrama, Loustalot, Gillespie, George and Schooley, 2011). Million Hearts focuses on the “ABCS” in the clinical realm: aspirin for high-risk patients, blood-pressure control, cholesterol management, and smoking cessation, as well as community-based prevention measures for healthy lifestyles. The American Heart Association also released a scientific statement on the importance of looking at the social determinants of CVD risk and outcomes, which includes suggestions to improve patient-provider communication and patient satisfaction/trust across racial/ethnic lines as well as to develop culturally and linguistically tailored interventions by ethnic group (Havranek et al., 2015).

Section Two: Hispanics in the United States

Hispanic subgroups.

Hispanics are the largest racial/ethnic minority group in the United States, comprising 17.4% of the total US population in 2014 and projected to increase to 28.6% by 2060 (Colby & Ortman, 2015). They are a young population, with a median age of 28, younger than the overall US median age of 37 (Stepler & Brown, 2016). Distinct collection of health data on Hispanics only began in 1976, with US Public Law 94-311 that mandated data collection on persons who self-identified as Hispanic, or of Spanish-speaking heritage. In the 1980 Census, ethnicity was added as separate question from race, and by the 2000 Census, the term Latino was added to the terms Hispanic and Spanish origin (Taylor, Lopez, Martinez, & Velasco, 2012).

Interestingly, the pan-ethnic terms “Hispanic” and “Latino” are embraced by only 21% of Hispanic adults; 51% prefer to identify with their family’s country of origin (Taylor, Lopez,

Martinez, & Velasco, 2012). Hispanics come from a wide variety of different backgrounds, whether immigrant or US-born. While they all share a common language background, there is considerable heterogeneity in culture, socioeconomic circumstances, immigration experiences, population age structures, and language use and dominance.

Mexicans.

According to the 2016 Pew Report, “Statistical Portrait of Hispanics in the United States”, Mexican Americans account for 64% of all US Hispanics (Stepler & Brown, 2016). Approximately two-thirds of Mexicans were born in the United States. Of the immigrants, 2% have been in the US more than 20 years, and 26% are US citizens. Mexicans overall are the youngest Hispanic population, with a median age of 26 years. More than half of all Mexicans live in the West: 35% in California alone; 26% in Texas. As of 2013, 26% of Mexicans in the US lived in poverty, 31% did not have health insurance, and median annual earnings were \$20,900, significantly less than the US median of \$30,000. Compared to all Hispanics combined and the US population overall, Mexicans have lower levels of education. About one fourth of all Mexicans are English-dominant, while 40% are Spanish dominant and the rest are bilingual (Stepler & Brown, 2016). Because of the longer history of Mexican-heritage populations in the US, most health research on cardiovascular disease to date has focused on this population (Rodriguez et al., 2014).

Hispanics from the Caribbean: Puerto Ricans, Cubans, and Dominicans.

Puerto Ricans are the second largest Hispanic subgroup representing 9.6% of the total Hispanic population, while Cubans make up 3.7% and Dominicans 3.2% (Lopez and Patten, 2015). There are currently more Puerto Ricans living in the continental US than on the island of Puerto Rico itself. Moreover, only 29% of Puerto Ricans living in the continental US were born

on the island of Puerto Rico. Because Puerto Rico is a US territory, Puerto Ricans are US citizens. However, many researchers refer to those born in Puerto Rico as foreign-born because their experiences more closely match life on other Hispanic Caribbean islands. While most Puerto Ricans are bilingual, 83% speak English very well, with only 16% Spanish dominant. Most mainland Puerto Ricans live on the East Coast: 21% live in New York, while 19% live in Florida. (Lopez and Patten, 2015)

Hispanics of Cuban descent are largely concentrated in the Southeast, with 68% in Florida, while Dominicans live in the Northeast, with 47% in New York. Over half, of these two populations, 57% and 55%, are immigrants from Cuba and the Dominican Republic, respectively. Cubans in the US have a significantly older median age, 40, than Dominicans, 28, and relatively lower rates of poverty, at 20%. In contrast, Dominicans have higher rates of poverty, 28%, than the overall Hispanic rate of 25%. All three Caribbean Hispanic populations have higher rates of educational attainment than Mexicans, but lower than the overall US population (Lopez and Patten, 2015). Because of significant populations in New York and Florida, some research on cardiovascular disease in these states has been conducted that includes these Caribbean Hispanic groups (Cortes-Bergoderi, et al., 2013).

Central Americans.

Hispanics with origins in Central America comprise almost 10% of the US Hispanic population (Lopez and Patten, 2015). The largest country of origin is El Salvador, followed by Guatemala, Honduras, and Nicaragua. Nicaraguans and Salvadorans have similar profiles, with 58% and 59% foreign-born, respectively. The median ages are 33 and 30, and only 17% and 20% live in poverty, lower than the Hispanic average. In 2013, 31% of Nicaraguans had no health insurance, compared to 37% of Salvadorans. 36% of Nicaraguans live in Florida, while

34% of Salvadorans live in California. In contrast, Honduran populations are much more dispersed throughout the US, while 31% of Guatemalans are in California. Both groups have very low education levels, high poverty, and almost 50% are without health insurance. The median age is 28, and 63% of both Guatemalan and Honduran people are foreign-born. Among all Central American populations, the vast majorities are Spanish-dominant, with very few English-dominant, and many bilingual (Lopez and Patten, 2015). Very little research on cardiovascular disease to date has looked at Central Americans as a distinct Hispanic subgroup, or if included, they are combined with South Americans into one category.

South Americans.

Over 60% of all South Americans in the US are foreign-born, and most are bilingual (Lopez and Patten, 2015). The largest population, comprising almost 2% of all Hispanics, is Colombian, followed by Ecuadorian, Peruvian, Venezuelan, and Argentinian. Together, South Americans comprise almost 6% of the Hispanic population, and their population is rapidly increasing (Lopez & Patten). Overall, they are more highly educated than other Hispanics and the US population as a whole. Similarly, poverty rates and rates of uninsured are lower than the other Hispanic groups. The median age for South Americans is high, ranging from 32 in Ecuadorians to 37 in Argentinians. Many Ecuadorians live in New York, while 20% of Argentinians live in California and 20% in Florida. Florida is also home to 33% of Colombian, 20% of Peruvian, and 42% of Venezuelan populations (Lopez and Patten, 2015). Although the populations are relatively small compared to Caribbean and Mexican Hispanic populations, our research uses two states, California and Florida, with relatively large numbers of South Americans. As such, to our knowledge, this is the first study of cardiovascular disease mortality that presents rates and mortality rate ratios for the distinct South American subgroup.

Examining health among Hispanics – The Hispanic Paradox.

In comparison to the most populous racial/ethnic group, non-Hispanic whites (NHWs), Hispanics in the US have relatively better health outcomes across multiple measures. In a comprehensive 2015 CDC report on Hispanic health, Dominguez et al., (2015) found that Hispanics had a 24% lower all-cause death rate, including a 25% lower rate for heart disease and an 11% lower rates for cerebrovascular disease. However, they also have higher prevalence of diabetes and obesity, lower rates of health insurance, and a higher proportion of reported delays or non-receipt of care for medical conditions due to cost concerns. Additionally, Hispanics were twice as likely as NHWs to live below the poverty line and four times as likely to not have completed high school. (Dominguez et al., 2015) In describing this epidemiological paradox, longer life expectancy and lower mortality despite lower socioeconomic status, lower health care access, and high prevalence of some risk factors, Markides and Coreil (1986) coined the term Hispanic Paradox, now widely used in health research.

Since the phrase was coined, there have been numerous attempts by health researchers to explain, verify, and/or repudiate the Hispanic Paradox, evidenced by over 2500 Google Scholar “hits” in a recent search using the term “Hispanic Paradox”. Several concepts are invoked in explaining observed Hispanic health advantages, including the Healthy Immigrant Effect, the Salmon Bias, cultural/social buffer theory, as well as health behaviors and acculturation hypotheses.

The Healthy Immigrant Effect (HIE) refers to the persistent observation that immigrants have a better health status than the native-born in the country to which they immigrate. Singh, Rodriguez-Lainz, and Kogan (2013) use multiple data sources to demonstrate that in the US, immigrants of all races have better infant, child, and adult health, higher life expectancy, and

lower disability and mortality rates than their US-born counterparts. The HIE also theorizes that immigrants may be healthier than the populations left behind in their native countries, suggesting that the process of immigration itself selects for better health. Given that in 2012, 50% of Hispanic adults were born in another country (Krogstad and Lopez, 2014), the HIE may partially explain the Hispanic Paradox. However, prior research documenting a continued health advantage of US-born Hispanics over whites suggests that the HIE alone does not suffice (Abraido-Lanza, Dohrenwend, Ng-Mak, and Turner, 1999).

Many researchers have found that Hispanics, especially immigrants, have lower levels of health-risk behaviors, including lower prevalence of smoking (Fenelon, 2013) and heavy drinking (Vaeth, Caetano, Rodriguez, 2012), combined with healthier diets (Singh et al., 2013). However, obesity and sedentary behaviors are higher in Hispanics (Daviglius, et al., 2014), suggesting that there are additional factors required to explain Hispanic health advantages. Nonetheless, examinations of increases in health-risk behaviors among longer-stay Hispanic immigrants as well as second and subsequent generations suggest that there is a negative health acculturation that takes place in the Hispanic community eroding the health advantages attributed to immigrants (Chang et al., 2015; Iribarren, Darbinian, Fireman and Burchard, 2009; Medina-Inojosa, Jean, Cortes-Bergoderi and Lopez-Jimenez, 2014; Morales, Leng, and Escarce, 2011; Van Wieren, Roberts, Arellano, Feller and Diaz, 2011). In response, and in recognition of the variety of factors that influence acculturation and assimilation, Yeh, Viladrich, Bruning, and Roye (2009) suggest the promotion of “selective acculturation”, a process that would involve maintaining the healthy habits of the culture of origin while adopting the more healthful aspects of the American lifestyle.

Yet another concept tied to migration selectivity is the Salmon Bias, which posits that some immigrants return to their country of origin when severely ill, and their deaths are therefore not taken into account in mortality data in the US (Abraido-Lanza et al., 1999; Palloni and Arias, 2004; Turra and Elo, 2008). According to this theory, any observed mortality advantage is partly artifactual, a result of these seeming “immortals” that never die in the US. However, researchers have found the impact of this bias to relatively be small (Abraido-Lanza et al., 1999; Turra and Elo, 2008).

Some researchers on Hispanic health advantages emphasize the role of cultural factors, or buffers on acculturation; including higher levels of familial and social support (Abraido-Lanza et al., 1999; Sorlie et al., 1993). Recent studies have also looked at the positive impact of living in homogenous residential enclaves (Kershaw and Albrecht, 2015; Correa, Greer and Sims, 2015). However, measurement of these “cultural effects” and linking them to specific health outcomes has proved challenging (Zsembik and Fennel, 2005).

Lastly, there is concern that methodological or technical issues surrounding data collection and measurement of Hispanic health outcomes has an impact on derived estimates, particularly for the foreign-born, and among groups who have substantial proportions of undocumented persons. The quality and accuracy race/ethnicity information on death certificates may lead to substantial misclassification (Arias, Schauman, Eschbach, Sorlie and Backlund, 2008; Rosenberg, et al., 1999). However, studies that attempted to correct for potential sources of misclassification found that the Hispanic mortality advantage still persisted (Palloni & Arias, 2004; Sorlie et al., 1993).

As the Hispanic population continues to grow and occupy a larger proportion of the elderly and ailing population, explanations for their health advantages will continue to be

explored. While none of the theories above are a perfect explanation, each contributes to an understanding of the issue, and provides a framework to discuss study results.

Section 3: Significance – Relevance to Public Health

Hispanics in the US are diverse, and this diversity manifests itself in distinct cultural practices, belief systems, economic circumstances, community connections, and access to health care, all of which play a role in determining health outcomes. Hispanics are also the youngest racial/ethnic group. The median age is 28, and over 60% of the Hispanic population is 33 years old or younger (Patten, 2016). Accurate estimates of IHD and stroke mortality in Hispanic subgroups in the US will highlight existing conditions and disparities within the Hispanic community, help to identify opportunities for prevention, and hopefully facilitate the development of targeted, culturally appropriate, patient-centered interventions to reduce mortality in the largest US minority population. Perhaps more importantly, this study can be used to encourage the identification and maintenance of protective factors to be promoted in younger Hispanics so as to minimize the future ischemic heart disease and stroke disease burden.

Section Four: Current Study

Review of the literature: Mortality from IHD and stroke among Hispanics.

Hispanics (aggregated) compared to non-Hispanic whites.

Numerous studies have been conducted that included, and sometimes even focused on Hispanic mortality from cardiovascular disease. From the earliest studies, findings have been mixed. Ellis (1962) found that Hispanic men in Texas, referred to as “Spanish” and identified by surname, had lower mortality from diseases of the heart than white men; however, Spanish women had higher mortality than white women. Similarly, Stern et al. (1987) found the same pattern in the 1970s for ischemic heart disease in Texas: higher mortality than whites for

Hispanic women; lower for men. However, for deaths recorded in the 1980s, both Hispanic men and women were lower than whites (Stern et al., 1987). In their study, Goff, Ramsey, Labarthe and Nichaman (1993) found equal IHD mortality rates for Hispanic and white women, but once again, rates for Hispanic men were lower. Other early studies found that mortality rates between Hispanics and whites were not significantly different in California (Frerichs, Chapman and Maes, 1984), Colorado (Rewers et al. 1993) and Texas (Wei, Mitchell, Haffner and Stern, 1996). However, there were also studies that showed Hispanics with significantly lower mortality than whites from cardiovascular diseases: two conducted in California (Friis, Nanjundappa, Prendergast and Welsh, 1981; Wild, Laws, Fortmann, Varady and Byrne, 1995) and one in New Mexico (Becker, Wiggins, Key and Samet, 1988). Notably, all of these studies were conducted in the Southwestern part of the US, where the primary origin of Hispanics is Mexican. Only one study (Sorlie, Backlund, Johnson and Rogot, 1993) from this time period looked at national data, finding lower mortality for Hispanics than whites across all types of cardiovascular disease.

Since 2000, there has been more consistency in the finding of a Hispanic advantage over NHWs in cardiovascular mortality. During this time, many studies were conducted including populations across the US, often utilizing national mortality data collected by the Centers for Disease Control and Prevention. Ayala et al. (2002), Keppel, Percy and Heron, (2010), and Gillespie, Wigington and Hong (2013) found that mortality from cerebrovascular disease was lower in Hispanics than in whites. Similar results were found for IHD, diseases of the heart, and cardiovascular disease (Keppel et al., 2010; Gillespie et al., 2013; Singh, Rodriguez-Lainz and Kogan, 2013, Singh and Azuine, 2015). Ni and Xu (2015) looked exclusively at heart failure, ICD-10 code I50, while a CDC report (2006) analyzed all hypertension-related deaths: both found Hispanic mortality lower than whites. To our knowledge, not a single study conducted

with national data has shown anything but a Hispanic advantage for all types of cardiovascular disease.

However, there are a few studies done at the local level since 2000 that call into question a Hispanic advantage, all of these in the same geographical region as the earlier mixed results studies. In particular, two different studies in Texas found Hispanics with greater mortality from IHD than whites (Pandey, Labarthe, Goff, Chan and Nichaman, 2001) or no difference between the groups (Hunt et al., 2003). Additionally, Swenson et al. (2002) found that in a cohort of men with Type II diabetes, Hispanics had greater mortality from heart disease. However, for men without diabetes, there was no difference in mortality between Hispanics and whites. Nonetheless, two other studies done with local data found a Hispanic advantage. Willey et al. (2012) looked at IHD and cerebrovascular disease among Hispanics in New York and found lower mortality than whites, and Palaniappan, Wang and Fortmann, (2004) found the same in California for ischemic heart disease.

Overall, the evidence suggests there is an advantage for Hispanics for cardiovascular disease mortality, although some uncertainty remains. A meta-analysis conducted by Cortes-Bergoderi et al.(2013) using eighteen of the studies mentioned above calculated a pooled Odds Ratio of 0.67; thus, research to date suggests that after adjusting for age, Hispanics have 33% lower odds of dying from cardiovascular disease than non-Hispanic whites.

Literature on Hispanic subgroups.

Significantly fewer studies have been done that look at cardiovascular disease mortality of Hispanic subgroups. In 1986, Shai and Rosenwaike published a study that looked at IHD and cerebrovascular disease mortality among Hispanics of Puerto Rican and Mexican descent in Chicago. They found that although Mexicans had significantly lower mortality than whites,

findings were mixed for Puerto Ricans. Puerto Rican women had much higher cerebrovascular mortality than whites, and slightly higher IHD. Puerto Rican males had similar cerebrovascular mortality to whites, but lower heart disease, although not nearly as low as Mexicans (Shai & Rosenwaike, 1986). Hummer, Rogers, Amir, Forbes and Frisbie, (2000) analyzed circulatory disease mortality using national data from 1986-1995, analyzing Puerto Ricans, Cubans, Mexicans, and Central/South American Hispanic subgroups. He found mortality rates for Mexicans and Central/South Americans were lower than non-Hispanic whites, but Puerto Rican and Cubans had similar rates to NHWs.

The CDC study (2006) on hypertension-related mortality looked at Mexican, Puerto Rican, Cuban, and Other Hispanic subgroups, and found that while overall Hispanics had significantly lower rates, by subgroup, only Cubans were lower, while Mexicans were similar to NHWs. Puerto Ricans had the highest mortality among the studied groups, followed by Other Hispanics (CDC 2006). In a 2005 study that looked only at diabetes-related mortality among Hispanics, Smith & Barnett (2005) found that Cubans had the lowest rates again, followed by Puerto Ricans. Mortality rates for diabetes-related deaths among Mexicans were over twice that of Cubans, for both men and women.

To our knowledge, these four studies are the only ones that have looked at Hispanic subgroup mortality for cardiovascular or related diseases, and the findings are very inconsistent. Therefore, there is a need to examine and characterize cardiovascular disease mortality rates within Hispanic subgroups.

Research questions and hypotheses.

The purpose of this study is to calculate and compare ischemic heart disease (IHD) and cerebrovascular disease (stroke) mortality rates for non-Hispanic whites (NHW) and Hispanics, in aggregate and by subgroup. The corresponding hypotheses are as follows:

H₀: There will be NO significant differences in IHD and stroke mortality rates between Hispanics and NHWs and between Hispanic subgroups.

H_A: There will be significant differences in IHD and stroke mortality rates between Hispanics and NHWs and between Hispanic subgroups.

Chapter 2: Methodology

Design, Data Procurement, and Approvals

This is a descriptive population-based cross-sectional study using death certificate data from Florida and California. Data were requested from the respective vital statistics division in each state. Approval under Data Use Agreement #2016006 was received from the Florida Bureau of Vital Statistics. In California, Protocol # 16-02-2412 was approved by the Committee for the Protection of Human Subjects, under the California Health and Human Services Agency. Approval to access vital statistics data was granted by the Vital Statistics Advisory Committee, after which the data request was approved by Center for Health Statistics and Informatics, both part of the California Department of Public Health. This project was granted Excluded Activity/Exempt status by the Institutional Review Board under Protocol # 866929-1 at the University of Nevada, Las Vegas. (Appendix A)

Mortality Data

Deaths.

Five years of complete de-identified records of death from all causes were obtained from Florida and California for 2008-2012. Deaths that listed ischemic heart disease (ICD-10 codes I20-25) and cerebrovascular disease (ICD-10 codes I20-25) as the underlying cause of death were included in this study. Non-resident cases from each state were excluded.

Variables.

From each state, the following variables were obtained for each decedent: underlying cause of death; year of event; age; sex; race, including all codes, text fields and multiracial codes, Hispanic ethnicity/origin code, including text fields, and place of birth.

Population Data

Population denominators for each state were obtained from the 2010 US Census and grouped by age, gender, race/ethnicity, and Hispanic subgroup. Because of its large size, the Mexican subgroup in California was further divided into two distinct groups, US-born and foreign-born Mexicans. As US Census data does not contain complete birthplace information, population denominators for these two groups were derived using the proportion of US-born/foreign born obtained from the 5-year 2008-2012 American Community Survey (ACS) using the University of Minnesota interface (Ruggles, Genadek, Goeken, Grover, & Sobek, 2016). The Census from 2010 falls exactly in the midpoint of our study years, and the ACS estimates serve the exact same five years. Hispanics who were Not Otherwise Specified (NOS) from the census data were bridged to each of the specific populations proportionately by age group and sex.

Data Preparation

The death records obtained required considerable organizing, cleaning, and recoding before rates and rate ratios could be calculated.

Race and ethnicity.

Cases of Hispanic ethnicity were extracted from each of the five standard racial categories, White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander, and combined into one aggregate Hispanic category. Remaining whites with no second race were labelled non-Hispanic whites, hereafter referred to as NHWs. Non-Hispanic cases from the other racial categories were excluded from this study.

Ethnicity, subgroups, and birthplace.

Extensive data cleaning based on specific ethnicity text codes as well as birthplace was conducted to maximize accurate classification into Hispanic subpopulations. Subgroups with sufficient number of deaths to calculate relatively stable rates were selected, although these differed by state. For Florida, the following mutually exclusive Hispanic subgroups were selected: Mexican, Central American, South American, Puerto Rican, Cuban, Dominican, and Spaniard, or persons from the European country of Spain. In California, cases were further separated according to birthplace among the large Mexican subgroup. The resulting subgroups selected were: US-born Mexican, foreign-born Mexican, Central American, South American, Spaniard, and Caribbean, which included Puerto Ricans, Cubans, and Dominicans.

Imputation.

For each state, there was a very small proportion of Hispanics, less than 3%, for whom we were unable to determine subgroup, called not-otherwise specified, or NOS. These NOS cases were reassigned to a subgroup using proportional imputation models, stratified by gender.

Mortality Rates

Mortality rates by sex for 2008-2012 for IHD and stroke for each analyzed population within each state were calculated. Rates were calculated per 100,000 persons, annualized and age-standardized to the 2000 US Standard Population. Corresponding 95% confidence intervals were calculated with gamma intervals modification (Tiwari, Clegg and Zou, 2006).

Mortality Rate Ratios

To compute adjusted mortality rate ratios with 95% corresponding confidence intervals between NHWs and Hispanics, as well as Hispanic subgroups, negative binomial regression was used. Negative binomial is a type of Generalized Linear Model that uses the negative binomial exponential probability distribution in the model building. Like Poisson, it is used for discrete

data that is measured in counts, such as number of deaths as seen in this study, which by nature cannot be negative, and adds an offset, the natural log of the population denominators, to the model (Kim & Kreible, 2009). However, when the Poisson assumption that the mean and variance of the data are equal is not met, negative binomial is preferred over Poisson (Kim & Kreible, 2009). Negative binomial also better addresses the problem of overdispersion, or greater variability than expected in the model, which is common in mortality data (Coxe, West, Aiken, 2009). The model was assembled to adjust for age and was stratified by sex. Age was grouped into 18 age group bands, each 5-year except the final, which includes ages 85 and older. Five year age groups are commonly used for mortality rates in order to be sufficiently detailed, yet not overly influenced by extreme variability. In final models, only ages 40 and over were included, as that is where the majority of cases are located, and exclusion of smaller counts makes the estimates more stable. All tests were two-sided, and p-values of <0.05 were considered statistically significant.

Software

SAS® version 9.3 and IBM® SPSS® Statistics software, version 22 were used for data management and analyses.

Chapter 3: Results

Stroke Deaths

There were 41,975 deaths from 2008-2012 in Florida from stroke, 42% among men and 58% among women. 73.5% of male decedents were NHWs and 11.3% were Hispanic. Among female stroke deaths, 75.1% were NHWs and 11.1% were Hispanic. (Table 1) In California, the total number of stroke deaths in this time period was 68,255, of which 42% were male and 58% female. Among males, the proportion of decedents who were NHWs and Hispanic was 59.8% and 18.1%, respectively. Whites comprised 65.3% of female stroke deaths, while 15.0% of all stroke deaths among women in California were Hispanic. (Table 2)

Ischemic Heart Disease Deaths

From 2008-2012 in Florida, there were 142,444 total deaths from IHD, 55% among men and 45% among women. Of those, 79.4 % of male IHD decedents were NHWs and 11.3% were Hispanic; female decedents were 77.1% NHWs and 12.5% Hispanic. (Table 1) During the same period in California, there were 203,433 deaths with IHD as the underlying cause, 56% and 44% among men and women, respectively. NHWs accounted for 68.5% of male IHD deaths and Hispanics accounted for 14.3%. In females, NHWs comprised 69.1% of IHD deaths and Hispanics were 13.6%. (Table 2)

Table 1. Florida: Final Number of Deaths from IHD and Stroke from 2008-2012

Populations	Ischemic Heart Disease				Stroke			
	Males		Females		Males		Females	
	n	%	n	%	n	%	n	%
Total*	79,193	100.0%	63,251	100.0%	17,749	100.0%	24,226	100.0%
Non-Hispanic whites	62,885	79.4%	48,753	77.1%	13,044	73.5%	18,195	75.1%
All Hispanics	8,958	11.3%	7,902	12.5%	2,013	11.3%	2,678	11.1%
Puerto Rican	1,646	2.1%	1,263	2.0%	433	2.4%	539	2.2%
Cuban	5,681	7.2%	5,245	8.3%	1,095	6.2%	1,455	6.0%
Dominican	183	0.2%	198	0.3%	47	0.3%	106	0.4%
Mexican	343	0.4%	542	0.9%	112	0.6%	265	1.1%
Central American	280	0.4%	177	0.3%	107	0.6%	111	0.5%
South American	635	0.8%	303	0.5%	176	1.0%	136	0.6%

* Includes decedents of all races/ethnicities

Table 2. California: Final Number of Deaths from IHD and Stroke from 2008-2012

Populations	Ischemic Heart Disease				Stroke			
	Males		Females		Males		Females	
	n	%	n	%	n	%	n	%
Total*	111,188	100.0%	92,255	100.0%	28,370	100.0%	39,885	100.0%
Non-Hispanic whites	76,175	68.5%	63,742	69.1%	16,961	59.8%	26,055	65.3%
All Hispanics	15,947	14.3%	12,544	13.6%	5,134	18.1%	5,986	15.0%
Caribbean*	777	0.7%	669	0.7%	198	0.7%	263	0.7%
All Mexican	13,180	11.9%	9,827	10.7%	4,328	15.3%	4,808	12.1%
US Born Mexican	6,553	5.9%	4,687	5.1%	1,923	6.8%	2,235	5.6%
Foreign-Born Mexican	6,627	6.0%	5,140	5.6%	2,405	8.5%	2,573	6.5%
Central American	1,045	0.9%	1,207	1.3%	348	1.2%	545	1.4%
South American	501	0.5%	429	0.5%	126	0.4%	220	0.6%

* Includes decedents of all races/ethnicities

* Includes Puerto Ricans, Cubans, and Dominicans

Imputation

Table 3 shows the number of Hispanic decedents in each state, by gender and cause of death, that were not otherwise specified (NOS) cases, for whom Hispanic subgroup status was unable to be determined from the death certificate data. The proportion of total Hispanics for whom imputation was required was very small, less than 3% in any category. In each state, these deaths were proportionally reassigned to all Hispanic subgroups according to the respective size of the subgroup population in that state.

Table 3. Total Hispanic Deaths and Imputed Not Otherwise Specified (NOS) Deaths for IHD and Stroke in Florida and California, 2008-2012

State	Males				Females			
	IHD		Stroke		IHD		Stroke	
	Total	NOS	Total	NOS	Total	NOS	Total	NOS
Florida	8,958	145 (1.62%)	2,013	29 (1.44%)	7,902	68 (0.86%)	2,678	22 (0.82%)
California	15,947	433 (2.72%)	5,134	112 (2.18%)	12,544	316 (2.52%)	5,986	154 (2.57%)

Deaths among Hispanic subgroups

The number of deaths from IHD and stroke in males and females in selected populations, after imputation, is shown for Florida in Table 1, and for California in Table 2. Deaths from IHD were more numerous than deaths from stroke in both states. There were more total ischemic deaths among males than females. This pattern held for all analyzed subgroups except among Dominicans and Mexicans in Florida and Central Americans in California; these populations had more female deaths from IHD than male. For stroke, more deaths were among females than

males for every analyzed population except South Americans in Florida, for whom males had more stroke deaths than females.

Population Data

For each state, the population denominators used to calculate the rates are show in Table 4. According to the 2010 Census, Hispanics were 22% of the total population in Florida and 38% in California. Cubans were the largest Hispanic population in Florida, comprising 31% of all Hispanics, followed by Puerto Ricans at 21% and South Americans at 18%. By contrast, Mexicans were by far the largest Hispanic population in California, almost 86% of all Hispanics, followed by South Americans at 8.5%. Of the Mexican population in California, approximately 37% were foreign-born.

Table 4. Populations in Florida and California, US 2010 Census

Populations	Males			Females		
	Number	% of Total	% of Hispanics	Number	% of Total	% of Hispanics
Florida						
Total	8,638,302	100.0%	-	9,082,753	100.0%	-
Non-Hispanic whites	5,083,586	58.8%	-	5,310,299	58.5%	-
All Hispanics	1,934,004	22.4%	100.0%	1,990,752	21.9%	100.0%
Puerto Rican	395,746	-	20.5%	421,574	-	21.2%
Cuban	592,496	-	30.6%	610,020	-	30.6%
Dominican	76,790	-	4.0%	91,855	-	4.6%
Mexican	215,865	-	11.2%	263,619	-	13.2%
Central American	301,303	-	15.6%	211,392	-	10.6%
South American	328,757	-	17.0%	367,288	-	18.4%
California						
Total	18,517,830	100.0%	-	18,736,126	100.0%	-
Non-Hispanic whites	7,445,722	40.2%	-	7,510,531	40.1%	-
All Hispanics	7,080,128	38.2%	100.0%	6,933,591	37.0%	100.0%
Caribbean	152,378	-	2.2%	153,524	-	2.2%
All Mexican	6,120,612	-	86.4%	5,934,478	-	85.6%
US Born Mexican*	3,822,760	-	54.0%	3,777,779	-	54.5%
Foreign-Born Mexican*	2,297,852	-	32.5%	2,156,699	-	31.1%
Central American	145,537	-	2.1%	164,031	-	2.4%
South American	590,565	-	8.3%	602,703	-	8.7%

* Numbers adjusted according to ACS proportions

Mortality Rates

Tables 5 and 6 show the resulting age-adjusted mortality rates per 100,000 by gender for each selected subpopulation within Florida and California, respectively. Among Hispanic men in both states, IHD rates were significantly lower than NHWs, with the exception of Cubans in Florida, and Caribbeans in California, whose rates were roughly equivalent to NHWs. In Florida, Dominican, Mexican, Central American and South American males had significantly lower IHD mortality rates than their Cuban and Puerto Rican counterparts. In California, foreign-born Mexican, Central American and South American males had significantly lower rates than US-born Mexicans and Caribbeans.

Although the rates for women were all much lower than the rates for men, the IHD mortality pattern across female populations was similar to males in California although somewhat worse in Florida, where Puerto Rican women were not significantly different from NHWs. Notably, Cuban women in Florida had significantly greater IHD mortality than NHW women.

For stroke, Hispanic male mortality rates in both Florida and California equivalent to or even worse than rates for NHW males. In Florida, Puerto Rican men had significantly higher stroke mortality than NHWs, and in California US-born Mexican men had significantly higher rates. In both states, South American males had a stroke mortality rate that was significantly lower than every other analyzed population except Central Americans.

Among Hispanic women in both states, stroke mortality rates for some subgroups were significantly lower than NHWs. The exceptions were Mexicans, Puerto Ricans and Dominicans in Florida and US-born Mexicans and Caribbeans in California; these groups had rates equivalent to NHWs.

Table 5. Age-Adjusted Mortality Rates for Ischemic Heart Disease and Stroke for Select Hispanic Populations in Florida, 2008-2012

Populations	Male				Female			
	IHD		Stroke		IHD		Stroke	
	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI
Non-Hispanic Whites	147.5	(146.3-148.7)	30.5	(29.9-31.0)	80.4	(79.7-81.2)	30.6	(30.1-31.0)
All Hispanics	131.4	(128.6-134.2)	29.3	(28.0-30.6)	77.0	(75.4-78.8)	26.1	(25.2-27.2)
Puerto Rican	136.1	(129.3-143.2)	36.9	(33.3-40.7)	77.5	(73.2-81.9)	33.0	(30.2-35.9)
Cuban	151.3	(147.4-155.3)	29.1	(27.4-30.9)	87.1	(84.7-89.5)	24.7	(23.4-26.1)
Dominican	98.7	(83.7-115.2)	24.9	(17.7-33.7)	61.6	(53.2-70.9)	31.9	(26.0-38.6)
Mexican	85.2	(75.0-96.1)	24.3	(19.1-30.3)	50.9	(43.4-59.2)	27.0	(21.7-33.0)
Central American	90.0	(77.8-103.2)	29.9	(23.2-37.6)	59.3	(52.6-66.6)	23.1	(19.1-27.5)
South American	79.0	(72.3-86.1)	23.1	(19.4-27.1)	46.1	(42.2-50.2)	21.6	(19.0-24.4)

CI: Confidence Interval

Table 6. Age-Adjusted Mortality Rates for Ischemic Heart Disease and Stroke for Select Hispanic Populations in California, 2008-2012

Populations	Male				Female			
	IHD		Stroke		IHD		Stroke	
	Rate	95% CI	Rate	95% CI	Rate	95% CI	Rate	95% CI
Non-Hispanic Whites	159.8	(158.6-160.9)	36.3	(35.8-36.9)	89.1	(88.4-89.8)	36.6	(36.1-37.0)
All Hispanics	119.1	(117.1-121.1)	37.7	(36.6-38.8)	74.1	(72.8-75.4)	34.0	(33.1-34.9)
Caribbean*	150.5	(139.9-161.6)	39.2	(33.8-45.1)	88.2	(81.6-95.2)	34.5	(30.5-39.0)
Mexican	118.6	(116.5-120.8)	38.2	(37.0-39.4)	74.5	(73.0-76.0)	34.9	(33.9-35.9)
USB-Mex	144.9	(141.2-148.6)	41.9	(40.0-44.0)	78.0	(75.8-80.3)	35.9	(34.4-37.5)
Mex-Born Mex	100.4	(97.7-103.1)	35.4	(33.9-37.1)	72.8	(70.8-74.9)	34.3	(32.9-35.7)
Central American	102.8	(95.5-110.4)	34.3	(30.1-38.8)	69.1	(65.2-73.1)	29.8	(27.3-32.5)
South American	109.1	(99.1-119.6)	26.9	(22.1-32.3)	57.7	(52.4-63.5)	28.8	(25.1-32.9)

CI: Confidence Interval

*Includes Puerto Ricans, Cubans, and Dominicans

Negative Binomial Models

Table 7 contains information about the negative binomial models used. Eight models were run for each state, four for females and four for males. Of the four within a given sex, two were for IHD and two were for stroke. Of the two within each disease, one model was run that

included two population groups, NHWs as the referent group and all Hispanics combined, which included Spaniards. Another model was run that included NHWs, again as referent, and each of the Hispanic subgroups included in this study. For each model, there was a vast difference between the mean and variance, as seen in Table 7, suggesting that the Poisson assumption of equality was violated and justifying the use of the negative binomial regression. In every case, the overall model was highly significant, with a p-value always less than .001. The model goodness of fit shows deviance values less than 2 for all of the models that included the subgroups. Ideally, this deviance value should be close to 1. In 3 of the 8 models that included only the NHW and Hispanic populations, the deviance is high, with the highest at 8.2. While not ideal, the overall significance of the models and relatively stable risk ratio estimates they provided justified keeping this as the model of best fit, and the rate ratios given by these models are much more accurate than crude rate ratios without any adjustments.

Table 7. Characteristics of Negative Binomial Regression Models

Models	Minimum Value	Maximum Value	Mean	Variance	Model Goodness of Fit Deviance (Value/df)	Overall Model Significance P-value
Florida						
IHD Males						
Model 1	115	21,315	3,572	25,445,295	2.6	<0.001
Model 2	3	21,315	1,018	9,562,777	1.3	<0.001
IHD Females						
Model 1	21	27,183	2,827	36,920,158	2.8	<0.001
Model 2	1	27,183	805	11,683,278	1.3	<0.001
Stroke Males						
Model 1	43	4,622	745	1,254,113	2.1	<0.001
Model 2	0	4,622	212	455,474	1.6	<0.001
Stroke Females						
Model 1	27	9,607	1,037	4,718,970	2.7	<0.001
Model 2	2	9,607	295	1,506,798	1.9	<0.001
California						
IHD Males						
Model 1	351	26,408	4,576	35,855,928	5.7	<0.001
Model 2	3	26,408	1,518	15,955,367	1.8	<0.001
IHD Females						
Model 1	57	36,817	3,806	66,553,192	7.9	<0.001
Model 2	0	36,817	1,262	24,288,525	1.5	<0.001
Stroke Males						
Model 1	105	6,867	1,084	2,388,706	2.5	<0.001
Model 2	3	6,867	359	1,003,910	1.0	<0.001
Stroke Females						
Model 1	98	14,974	1,588	11,107,583	8.2	<0.001
Model 2	0	14,974	527	4,071,041	1.3	<0.001

Note: Model 1 contains 2 populations groups: NHW and all Hispanics combined. Model 2 contains whites and the Hispanic subgroups selected for each state.

Mortality Rate Ratios

The mortality rate ratios computed from the negative binomial regression models are presented in Tables 8 and 9. When subgroups were combined altogether, Hispanic males and females in Florida were 25% and 32% less likely to die from ischemic heart disease than NHWs.

However, there was great variability: Puerto Rican males were only 17% less likely while South Americans were 58% less likely to die of IHD than NHWs, and Cuban males had no advantage. Puerto Rican women had no advantage over NHW women, while South American women had 63% less risk of dying of IHD than NHW women.

IHD rate ratios in California follow a similar pattern. Male Hispanics overall were 26% less likely to die from IHD than NHWs, but for foreign-born Mexicans, Central and South Americans, they were almost 40% less likely. Female Hispanics overall were 17% less at risk of IHD death than NHWs, but Caribbean and US-born Mexicans were actually equally at risk, while South American females were 51% less at risk.

For stroke, male Hispanics overall as well as most subgroups in Florida were equally as likely to die from stroke as their NHW counterparts. However, South Americans were 32% significantly less likely while Puerto Ricans were 19% more likely to die from stroke than NHWs. Female Hispanics in Florida were 14% less at risk as a whole, but by subgroup, the risk was equal to NHWs among Puerto Rican, Dominican, and Mexican women.

In California, Hispanic males overall had a significant 22% higher risk of stroke mortality than NHWs, largely driven by the US-born Mexican population, whose mortality risk was 35% higher than NHWs. Foreign-born Mexicans as well as Caribbean Hispanics also had elevated risk of stroke. Central Americans were generally equivalent in stroke mortality risk to NHWs, while South Americans were the only male Hispanic subgroup with a significantly lower risk, 23% lower than NHWs. Among females, Central and South Americans had significantly lower stroke risk than NHWs, 13% and 19% lower, respectively. All other female subgroups, as well as the combined Hispanic population, had stroke mortality risk that was not significantly different from NHWs.

Table 8. Mortality Rate Ratios for Ischemic Heart Disease and Stroke for Select Hispanic Populations in Florida, 2008-2012

Populations	Male				Female			
	IHD		Stroke		IHD		Stroke	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Non-Hispanic Whites	Referent		Referent		Referent		Referent	
All Hispanics	0.75	(0.66 - 0.85)	0.96	(0.91 - 1.00)	0.68	(0.57 - 0.82)	0.86	(0.82 - 0.89)
Puerto Rican	0.83	(0.72 - 0.96)	1.19	(1.08 - 1.32)	0.84	(0.70 - 1.00)	1.08	(0.97 - 1.20)
Cuban	0.89	(0.78 - 1.02)	0.96	(0.90 - 1.02)	0.79	(0.66 - 0.94)	0.80	(0.74 - 0.87)
Dominican	0.57	(0.46 - 0.69)	0.78	(0.58 - 1.05)	0.61	(0.48 - 0.78)	1.04	(0.85 - 1.27)
Mexican	0.55	(0.46 - 0.65)	0.86	(0.70 - 1.05)	0.56	(0.44 - 0.70)	0.95	(0.77 - 1.16)
Central American	0.49	(0.41 - 0.59)	1.00	(0.82 - 1.22)	0.53	(0.42 - 0.65)	0.74	(0.61 - 0.89)
South American	0.42	(0.36 - 0.49)	0.68	(0.59 - 0.79)	0.37	(0.30 - 0.45)	0.65	(0.56 - 0.74)

Note: CI=Confidence Interval

Table 9. Mortality Rate Ratios for Ischemic Heart Disease and Stroke for Select Hispanic Populations in California, 2008-2012

Populations	Male				Female			
	IHD		Stroke		IHD		Stroke	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Non-Hispanic Whites	Referent		Referent		Referent		Referent	
All Hispanics	0.74	(0.72-0.76)	1.22	(1.11-1.33)	0.83	(0.82-0.85)	0.97	(0.94-1.01)
Caribbean*	0.95	(0.87-1.03)	1.19	(1.01-1.42)	0.91	(0.77-1.09)	0.99	(0.84-1.16)
USB-Mex	0.93	(0.88-0.99)	1.35	(1.22-1.50)	0.95	(0.82-1.09)	1.17	(1.06-1.30)
Mex-Born Mex	0.62	(0.58-0.65)	1.16	(1.06-1.28)	0.68	(0.60-0.79)	1.06	(0.96-1.16)
Central American	0.64	(0.59-0.69)	1.05	(0.91-1.20)	0.69	(0.59-0.80)	0.87	(0.77-0.99)
South American	0.61	(0.55-0.67)	0.77	(0.63-0.94)	0.49	(0.41-0.60)	0.81	(0.69-0.96)

Note: CI=Confidence Interval

*Includes Puerto Ricans, Cubans, and Dominicans

Chapter Four: Discussion

Heart disease and stroke are the first and fifth leading causes of death in the United States. Among Hispanics, the largest US minority population, the burden of IHD was lower than the majority NHW population. However, this study finds that stroke mortality was high, with no advantage seen for Hispanics compared to NHWs. Moreover, there was noteworthy heterogeneity within the major US Hispanic subgroups for both diseases. Subgroups with greater proportions of foreign-born had better mortality outcomes, supporting the notion of a Healthy Immigrant Effect. Results of this study also reinforce the notion that increased acculturation has negative health impacts among Hispanics.

Comparing this Study with Past Research

Our finding that Hispanic stroke mortality rates are generally equivalent to and in some instances worse than those of non-Hispanic whites is, to the best of our knowledge, entirely novel. Past studies documented lower stroke mortality for Hispanics than for NHWs (Ayala et al., 2002; Keppel, Percy & Heron, 2010; Gillespie, Wong, & Hong, 2013; Willey et al., 2012). However, one early study in Chicago did show Puerto Rican women and men with higher and/or equivalent stroke mortality rates to NHWs, somewhat consistent with our findings in Florida (Shai & Rosenwaike, 1986). On the other hand, that same study showed Mexicans with significantly lower rates than NHWs and Puerto Ricans, which is not at all consistent with our finding of a high stroke mortality burden for Mexicans.

With regards to IHD, our study confirms what has been previously documented in most prior research and summarized in a recent meta-analysis: Hispanics have lower IHD mortality than NHW (Cortes-Bergoderi et al., 2013). The novelty of this study is the finding of important intra-ethnic differences in Hispanics, especially given that, to our knowledge, no prior study has

comprehensively examined ischemic heart disease mortality in Central Americans, South Americans, or Dominicans. We find lower mortality for these groups, and confirm low IHD mortality for Mexicans, as previously documented, although US-born Mexicans have rates approaching that of NHWs. Our findings are also consistent with a few studies documenting relatively higher heart disease rates among Cubans and Puerto Ricans than other Hispanic subgroups. (Hummer et al., 2000; Shai & Rosenwaike, 1986)

Stroke Mortality and Population-Based Risk Factors

Hypertension is the strongest modifiable risk factor for stroke; Mozzafarrian et al. (2016) reported that 77% of all stroke patients had high blood pressure. In the National Health and Nutrition Information Survey, the prevalence of hypertension was found to be equivalent between Hispanics and Whites (Yoon, Burt, Louis, and Carroll, 2012). However, hypertension was more prevalent among US-born than foreign-born populations (Gillespie, Hurvitz, and CDC, 2013), which may partially explain the significantly lower rates in South Americans of both sexes, who have the highest proportions of foreign-born (Lopez & Patten, 2015), as well as in Central American women. Puerto Ricans, who in our study have the worst stroke mortality outcomes except for US-born Mexicans in California, have been shown to have the highest prevalence of hypertension among all Hispanic subgroups (Sorlie et al., 2014; Daviglus et al., 2012). While Mexicans have lower hypertension prevalence overall, one study including only Mexicans showed higher prevalence in second generation than first generation Mexicans (Morales, L., Leng, M., & Escarce, J. (2011).

While prevalence of hypertension is an independent determinant of stroke risk (Graham, 2014), awareness, treatment, and control of the condition are also important. Among people with hypertension, Hispanics are significantly less aware of their condition and/or more likely to be

undiagnosed, less likely to be treated with hypertensive medications, and even if under treatment, less likely to have their hypertension controlled (Yoon, Burt, Louis & Carroll, 2012; Rodriguez et al., 2014; Cruz-Florez et al., 2011). Although insurance rates are higher in US-born than foreign-born Mexicans, a CDC report showed that foreign-born Mexicans actually had better control of their hypertension than their native born counterparts, which also may be a factor underlying the higher stroke mortality in US-born Mexicans in California (Rodriguez et al., 2015). Cubans have the highest rates of awareness and control of their hypertension, which may partially account for the relatively low stroke mortality seen in Cubans, despite high prevalence of other risk factors. (Schneiderman, Chirinos, Avilés-Santa and Heiss, 2014).

Excessive alcohol consumption and high salt intake are also independent predictors of hypertension. Alcohol consumption has been shown to increase with acculturation, especially among Hispanic women. Moreover, according to the Hispanic Americans Baseline Alcohol Survey (HABLAS), US-born Mexicans and Puerto Ricans are the heaviest drinkers, followed by other Caribbean populations (Vaeth, Caetano, and Rodriguez, 2012). Other national surveys also document higher alcohol consumption among Puerto Ricans than other Hispanic subgroups (Rodriguez et al., 2014). Unhealthy diets, which include high sodium intake, are also associated with US-born and more acculturated Hispanic populations, including Puerto Ricans; while South Americans were shown to have the healthiest diets among all Hispanic subgroups (Schneiderman et al., 2014; Van Wieren, Roberts, Arellano, Feller and Diaz, 2011).

There are several other comorbidities more prevalent in Hispanics than NHWs, including obesity, diabetes and depression that are risk factors for stroke, and may be explanatory in the patterns seen in Hispanic stroke mortality. Among all Hispanics, Puerto Rican men and women have the greatest prevalence of obesity, which is also an independent risk factor for diabetes

(Daviglius et al., 2012). However, when Mexicans are examined by nativity status, US-born Mexicans have even higher obesity rates than Puerto Ricans, significantly higher than all other Hispanics subgroups and NHWs (Singh et al., 2013). Hispanics also have higher rates of diabetes than NHWs (Mozaffarian et al., 2016). Among Hispanics, Mexicans and Puerto Ricans have the highest rates of diabetes, while Cubans and South Americans have the lowest (Daviglius et al., 2014; Schneiderman et al., 2014). Again, when analyzed by nativity status, US-born Mexicans have higher rates than foreign-born, supporting a negative impact of acculturation (Dominguez, et al., 2015). Additionally, as with hypertension, Hispanics are more likely to have undiagnosed diabetes and less likely to have control of their diabetes than NHWs (Cruz-Floes et al., 2011; Rodriguez et al., 2014). Hispanics also have a higher prevalence of self-reported depression than NHWs, yet are significantly less likely to have treatment (Pratt and Brody, 2014). Additionally, prevalence of depression is higher among US-born than foreign born Hispanics, and highest among Puerto Ricans (Wassertheil-Smoller et al., 2014).

While generally, the poor health risk profile of Hispanics appears to be explanatory for high stroke mortality, two risk factors stand in stark contrast: smoking and atrial fibrillation (AF). Although prevalence and incidence of AF is rising nationally, and increasing seen as an underlying factor causing stroke, Hispanics have lower burden of AF than NHWs (Rodriguez et al., 2015). Moreover, they also have lower rates of smoking, often credited for many observed health advantages (Blue and Fenelon, 2011). However, within the Hispanic population, Puerto Rican women and Mexican, Cuban, and Puerto Rican men have the highest smoking rates (Rodriguez et al., 2014; Daviglius et al. 2012; Kaplan et al. 2014) Multiple studies have shown that unlike for other risk factors, acculturation only impacts smoking prevalence among women, not men (Schneiderman et al., 2014), which may partially explain why in our study US-born

Mexican women in California are the only female subgroup with significantly higher stroke mortality than NHW women.

Ischemic Heart Disease Mortality and Population-Based Risk Factors

One might expect that the lower IHD mortality observed for Hispanics compared to NHWs in our study could be explained by a favorable risk profile for IHD. As discussed previously with stroke risk factors, however, that is certainly not the case for hypertension, obesity, and diabetes, for which Hispanics have higher prevalence and lower rates of treatment and control. Studies have shown, in fact, that Hispanics are significantly less likely than NHWs to have ideal cardiovascular health, as defined by the AHA's "Life's Simple 7" campaign (Gonzalez et al., 2012; Leigh, Alvarez, and Rodriguez, 2016). However, looking at five major risk factors, hypertension, diabetes, obesity, smoking and hyperlipidemia, Daviglus et al. (2012) found differences by Hispanic subgroup. While 25% of Puerto Rican men and women and 23% of Cuban men had three or more risk factors, the proportions were lower in other subgroups, with the lowest in South Americans, at only 13%, suggesting that a healthy risk profile may explain some of the observed mortality advantage seen in South Americans in our study.

Hyperlipidemia, a strong risk factor for atherosclerosis which underlies IHD, is more prevalent in Hispanic men than women. By race/ethnicity, sex mediates the relationship: among men, prevalence is higher in Hispanics than NHWs but among women, it has been found to be either lower or the same as NHWs (Mozaffarian et al., 2016; Daviglus et al., 2014). By subgroup, Puerto Rican women and Mexican men have the highest rates, followed by Cubans and Central Americans. Dominicans and South Americans had the lowest rates of hyperlipidemia (Daviglus et al., 2012). Lack of physical activity is also a risk factor for IHD. Some studies show that the more acculturated Hispanic populations report more leisure time physical activity

(Abraido, Choa and Florez, 2005), inconsistent with the greater IHD mortality burden seen in this study among the more acculturated and/or US-born Hispanics (Berrigan, Dodd, Troiano, Reeve and Ballard-Barbash, 2006). However, in response to questions raised as to the usefulness of measuring only leisure time activity, He and Baker (2005) showed that Hispanics have greater work-related physical activity than NHWs, and Evenson (2012) demonstrated that when measured objectively with accelerometers, Hispanics had greater levels of physical activity during normal daily functions than NHWs. Thus, higher levels of physical activity may play a protective role for all Hispanics against IHD mortality.

Smoking is one major risk factor that certainly helps explain the Hispanic advantage in IHD mortality, since smoking prevalence as well as intensity is lower in Hispanics (Blanco et al., 2014; Blue & Fenelon, 2011). Nonetheless, Hispanic men smoke much more than Hispanic women. Moreover, more acculturated and/or US-born Hispanic women smoke more than less acculturated women, aligning with the patterns seen in our study: greater mortality in men than women; and among Hispanics, great mortality in US-born Mexican and Puerto Rican women. Cuban men also have high IHD mortality rates, and are notably the heaviest smokers of all Hispanic subgroups, with lifetime pack years nearly twice that of other Hispanic smokers (Kaplan et al., 2014). Given Cubans' highest awareness and control of their hypertension (Schneiderman et al., 2014; Balfour et al., 2015), as well as their lowest hypertension-related deaths compared to other Hispanics (Graham, 2014), the weight of smoking as an IHD mortality risk factor for Cubans is likely high. In fact, in our study, they are the only Hispanic subgroup in Florida with IHD mortality rates that are not lower than NHWs.

Findings from studies that looked at clinical risk factors atherosclerosis in Hispanics, coronary artery calcification (CAC) and carotid intimal-medial thickness (CIMT) also support

the mortality patterns seen in this study; Hispanics had lower CAC and CIMT than NHWs, especially among women. By subgroup, Mexicans had the highest CAC, and US-born Hispanics had higher than foreign-born. Dominicans had the lowest CIMT compared to Puerto Ricans, Cubans, and Mexicans (Rodriguez et al., 2014). If these predictors of atherosclerosis are relatively low, then the vascular health of Hispanics would be relatively high; this could largely explain why in our study Hispanics had lower IHD mortality than NHWs.

Other Determinants of Health and the Hispanic Paradox Revisited

Common predictors of health include socioeconomic status (SES) measures such as education and income, with an expected gradient of better outcomes with higher education levels and income. Our study found that among all Hispanic subgroups, South Americans had the lowest IHD and stroke mortality. This population is also the only Hispanic subgroup with education levels higher than the US average, and poverty and uninsured rates lower than all other Hispanic groups (Lopez & Patten, 2015). Thus, this group does not really fit the Hispanic Paradox, as at a population level, their risk factors are low and their SES is relatively high. With this profile, the outcomes of our study are just as could be expected.

Puerto Ricans also do not fit the profile of a Hispanic Paradox, as there really is no observed health advantage between this group and NHWs. To a certain degree, their health profiles are similar to other non-immigrant low-income groups in the US, including US-born Mexicans. These groups do provide evidence of the negative impact of acculturation and adoption of native-like risk profiles among US-born and/or longer stay Hispanics, a phenomenon heavily documented (Abraido et al., 2005; Boldstad and Bungum, 2013; Chang et al., 2015; Singh et al., 2013; Van Weiren et al., 2011). Cubans, while mostly foreign-born, have longer average years lived in the US than Dominican, Central or South American immigrants at a

population level (Lopez & Patten, 2015), and thus may be more acculturated overall; yet they also have higher levels of income, education, and insurance status than the other immigrant groups (Lopez & Patten, 2015). Thus our study finds the Cuban mortality profile somewhat mixed: IHD and stroke mortality among men equal to NHWs, possibly due to their heavy smoking rates (Kaplan et al., 2014), but among Cuban women, mortality rates for both are lower than NHWs.

Most aligned with the Hispanic Paradox are the profiles of Mexicans, especially the foreign-born, Central Americans, and Dominicans. Undoubtedly, the better health outcomes we observed in these subgroups are evidence of the Healthy Immigrant Effect, especially in light of lower levels of education, higher poverty, and lower rates of health insurance (Lopez & Patten, 2015). There is, however, a possibility that the observed mortality advantage in these groups is partly artifactual, a result of under-reporting due to migration of the sick to their home countries of origin to die, the so-called Salmon Bias. As previously mentioned, however, the magnitude of this has been found to be very small (Abraido-Lanza et al., 1999; Turra and Elo, 2008). Additionally, there may also be cultural factors in the less acculturated Hispanic communities, including higher levels of familiar and community support, which positively impact health outcomes (Sorlie et al., 1993).

Implications for Public Health

Our study finds significant intra-ethnic heterogeneity in IHD and stroke mortality in Hispanics living in two large states with diverse and substantial Hispanic populations, Florida and California. This heterogeneity provides evidence of the limitations inherent in studies that aggregate Hispanics. Intra-ethnic differences reveal unique risk factors as well as protective factors: the pathways by which SES indicators, nativity, and culture influence health clearly vary

among subgroups of the Hispanic population. Cardiovascular surveillance systems in the US should be strengthened in general, given the magnitude of the CVD burden. Surveillance systems and future studies should attempt to be as specific as possible in collecting data on Hispanics, including birthplace and length of time in the US for the foreign-born, so that reporting of accurate results by subgroup is feasible. These results can then inform potential public health priorities for intervention and prevention campaigns.

Based on the findings of this study, stroke prevention strategies are warranted for all Hispanics, who are at equal or higher risk for stroke death than NHWs, with the exception of South Americans. Like all Americans, Hispanics should be made more aware of the symptoms of stroke and the importance of seeking timely care. Moreover, all groups should be screened and treated for hypertension, the strongest predictor of stroke. For populations with limited English proficiency, it will be critical to provide culturally appropriate support and interventions in Spanish. The use of community health workers, sometimes called *Promotores de Salud*, should be expanded in these populations. Of course, barriers to accessing health care should be removed, which include geographic, economic, linguistic, or other.

The relative burden of IHD is lower in most Hispanics than NHWs. Nonetheless, given the age structure of the Hispanic population, in the near future an increasing proportion of the elderly, those most at risk of all cardiovascular diseases, will be Hispanic. The public health community has a unique window of opportunity for intervening with this currently younger population to encourage ideal cardiovascular health, again through targeted programs. According to an AHA Policy Statement, if a given individual reaches middle age with optimal health, then their remaining lifetime risk of CVD is only 6-8% (Heidenreich et al., 2011). Preventing IHD and stroke mortality among Hispanics may involve promoting the recognition and maintenance

of traditional habits that are healthy, and providing support for resisting acculturation trends towards more unhealthy behaviors. Of course, population-level health change will also require societal interventions, including the examination of ways in which the built environment might be improved to promote healthy living for all Americans.

Limitations and Strengths

Our study is subject to the usual limitations of descriptive epidemiology. We lack individual level data on all of the risk factors for stroke and IHD, except for race/ethnicity, age, sex, and state of residence at death. Thus, our discussion is based on research from other studies to help identify which risk and protective factors likely account for our observed results. Additionally, it is not clear from our study the extent to which cost barriers prevent access to care, whether preventative, or secondary after first cardiac or stroke event, and how that might impact mortality. Research shows that Hispanics have lower rates of insurance, use fewer health care services, wait longer before seeking care, and cite cost as a barrier to seeking medical care more than NHWs (Leigh, Alvarez, & Rodriguez, 2016; Weinick, et al., 2004). It remains to be seen whether the full implementation of the Affordable Care Act will result in narrowing these disparities.

It is possible that the Hispanic populations in this study do not represent Hispanics in other states, and that the results may not be generalizable. However, almost 36% of all US Hispanics live in these two states alone (Colby & Ortman, 2015), so our coverage is broad. Moreover, these states are diverse, with large enough proportions from each of the major Hispanic subgroups to provide stable estimates. The aggregation of South American and Central American Hispanics into two distinct groups may also mask potential differences between countries of origin in these regions. Unfortunately, the number of deaths from individual

countries was not large enough to provide stable estimates if treated separately. However, this is the first study to our knowledge to provide mortality data for these two aggregated subgroups, often either excluded or combined into one, which is an improvement from previous studies. Similarly, in California, we were unable to provide separate rates for each major Caribbean subgroup, Puerto Rican, Cuban, and Dominican, due to relatively small death counts.

Death certificate data has several limitations including general inaccuracy in CVD cause of death coding (Lakkireddy, Gowda, Murray, Basarakodu, & Vacek, 2004) and specifically, an over attribution of CVD, especially ischemic heart disease, as the underlying cause of death, which leads to overestimation (Agarwal et al., 2010; Coady et al., 2001; Pagidipati & Gaziano, 2013). To our knowledge, no studies have shown a differential impact of this overestimation by race or ethnicity, and thus we don't expect that this non-differential misclassification, if existing, would significantly change our findings. As previously mentioned, the Salmon Bias might result in slight underascertainment of deaths among all subgroups except Cubans, who are restricted from returning home, and Puerto Ricans, whose deaths are captured even if they return to Puerto Rico as it is a US territory.

The major strength of our study is the very high proportion of completeness, over 99%, of birthplace information on the death data we received from Florida and California. This allowed for reliable classification of the selected Hispanic subgroups. We also used detailed denominators from the US Census adjusted for birthplace when necessary with data available from the American Community Survey. The rates we present here will serve as a baseline for monitoring the ischemic heart disease and stroke burden among Hispanics, the largest US minority population.

Chapter Five: Conclusions

Of all deaths in the US, 20% can be attributed to IHD; another 5% to stroke. Both diseases have hypertension, smoking, obesity, diabetes, and inadequate physical activity as major risk factors (Mozaffarian et al., 2016). These theoretically modifiable risk factors, recognized as critical for all Americans, are monitored as Leading Health Indicators in the Healthy People 2020 Initiative of the Office of Disease Prevention and Health Promotion of the US Department of Health and Human Services (2016). This initiative also aims to identify and reduce racial and ethnic disparities. Unfortunately, as discussed here, Hispanics, the largest racial/ethnic minority group in the US, have high prevalence of these risk factors, excluding smoking.

Despite this, Hispanics have previously been shown to have relatively low incidence and mortality from cardiovascular diseases (CVD) compared to other major racial/ethnic groups, a phenomenon often referred to as the Hispanic Paradox. However, this population of 55 million, usually studied in the aggregate, is very diverse. This diversity manifests itself in distinct cultural practices, belief systems, economic circumstances, community connections, and access to health care, all of which play a role in determining health outcomes. To maximize the impact of public health programs, it is critical to have accurate data on intra-ethnic variation in health outcomes.

Presented here is the most comprehensive characterization of IHD and stroke mortality for Hispanic subgroups to date, using two states whose combined Hispanic populations represent almost 36% of all Hispanics in the US. This study highlighted existing conditions and disparities within the Hispanic community, showing that Cubans and Puerto Ricans, as well as US-born Mexicans, are not true examples of the so-called Hispanic Paradox. Their mortality rates were equivalent to or even worse than NHWs for stroke and ischemic heart disease. However, foreign-born Mexicans, Dominicans, Central Americans, and especially South Americans had relatively

lower mortality. Thus, it is critical to study Hispanics not in the aggregate, but also by subgroup, as they have diverse cultural, socioeconomic, racial, and geographic backgrounds. Moreover, culturally appropriate and patient-centered prevention and intervention programs are warranted.

Future studies should attempt to elucidate selective acculturation mechanisms among Hispanics that could potentially counteract unfavorable trends towards worsening IHD and stroke outcomes. It is important to monitor these trends, especially in light of the fact that Hispanics will continue to represent an increasing proportion of those most at risk for ischemic heart disease and stroke deaths, our elderly population.

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Curriculum Vitae

Karen Elizabeth Callahan

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Education

University of Nevada, Las Vegas

Master of Public Health MPH - Expected Graduation Aug. 2016

Concentration - Epidemiology and Biostatistics

Research Interests: Descriptive Epidemiology, Cancer, Cardiovascular Disease, Health Disparities

GPA: 4.0

Rhode Island College

Master of Arts in Teaching MAT - May 1996

GPA: 4.0

University of District of Columbia

Bachelor of Arts BA May 1994

GPA: 4.0

Research Experience

Graduate Assistant - UNLV SCHS Fall 2015 – present

- *Conduct literature reviews. Gather and analyze data. Revise and edit research drafts. Create research posters. Prepare IRBs, grants, abstracts. Perform other administrative tasks as needed.*

Research Assistant - Nevada Institute for Children's Research and Policy, May - August 2015

- *Conducted and summarized focus groups for Youth at Risk of Homelessness project. Entered and cleaned data for Teen Pregnancy Prevention project. Completed phone surveys for Baby Safe Sleep project. Conducted research and assisted with report writing on other projects.*

Research Assistant - Health Impact Assessment Project October 2014 – August 2015

- *Assisted with Full Day Kindergarten Health Impact Assessment Grant. Conducted literature reviews. Gathered and organized data. Revised and edited final report. Drafted conference poster.*

Teaching Experience

Guest lecturer, UNLV PBH 202, Spring 2016

Topic: Epidemiology: Study Design – Experimental: Randomized Controlled Trials

Guest lecturer, UNLV PBH 202, Fall 2015

Topic: Sensitivity and Specificity in Diagnostic Screening Tests

Guest lecturer, UNLV, PBH 330, Fall 2015

Topic: The Global AIDS Crisis

Licensed Teacher, Clark County School District, 1996-2014

- Grades 4-8, Math, ESL
- Teacher Mentor
- Professional Development Instructor

Peer-Reviewed Publications

Accepted

1. Pinheiro PS, Callahan KE, Ragin C, Hage RW, Hylton T, Kobetz EN. Black heterogeneity in cancer mortality: US-Blacks, Haitians, and Jamaicans. Cancer Control. Accepted for July 2016 publication.
Impact Factor: 3.50

Under Review / Submitted

1. Ghimire S, Maheshwari S, Callahan KE, Wu, Q. The risk of incident asthma among overweight and obese children: A meta-analysis of prospective studies. PLoSOne. *Submitted*.
2. Callahan KE, Pinheiro PS, Ponce C, Kobetz E. Breast cancer survival disparities in Nevada. J Immigr Minor Health. *Under Review*.
3. Jin H, Pinheiro PS, Callahan KE. Examining Gastric Cancer Survival in Whites and Asian Subgroups in the United States. Gastric Cancer. *Under Review*.
4. Ghimire S, Baral BK, Callahan KE. Validation of the Mini Nutritional Assessment health screening tool among Older Adults in Nepal. PLoSOne. *Submitted*.

Professional Reports

Gakh M, Coughenour C, Pharr JR...**Callahan KE**. Full-Day Kindergarten in Nevada: A Health Impact Assessment (2015). Funded by the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and The Pew Charitable Trusts

Presentations

Oral Abstracts

1. Pinheiro PS, **Callahan KE**, Ragin C, Hage RW, Hylton T, Kobetz EN. “Black heterogeneity in Cancer Mortality: the US, Haiti, Jamaica and other West Indies” 61st Annual CARPHA Health Research Conference. Providenciales, Turks and Caicos Islands. June 2016.

Poster Sessions

1. **Callahan KE**, Pinheiro PS. “Are all Hispanics the same? Heart disease mortality among Mexican, Puerto Rican, Dominican, Cuban, South and Central American Hispanics”. Epidemiology Congress of the Americas 2016. Miami, FL June 2016
2. Pinheiro PS, **Callahan KE**, Jin H, Morris CR. “Rethinking the Hispanic advantage in cancer outcomes: Influence of birthplace” American Society for Clinical Oncology Annual Meeting. Chicago, IL June 2016
3. Ghimire S, Binaya KB, **Callahan KE**. *Nutritional Assessment of Older Adults in Nepal*. Poster Session: Graduate & Professional Student Research Forum. UNLV, March 12, 2016
AWARD: Honorable Mention
4. Ghimire S, Maheshwari S, **Callahan KE**, Wu, X. *The Risk of Incident Asthma among Overweight and Obese Children: A Meta-Analysis of Prospective Studies*. Poster Session: Nevada Institute of Personalized Medicine, 2016 Retreat, Las Vegas, NV, February 12, 2016
5. Gakh M, Pharr JR, **Callahan KE**. *Full-Day Kindergarten in Nevada: A Health Impact Assessment*. Poster Session: Nevada Public Health Association Annual Conference, Reno, NV. Sept. 24-25, 2015

