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# Addressing Cardiovascular Disease Among Populations Disproportionately Impacted in the United States

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Abstract

Addressing Cardiovascular Disease among Populations Disproportionately Impacted in the United States

by

Michael L. Sells

MS, University of Texas, 2000

BS, University of Houston, 1993

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

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## Abstract

Cardiovascular disease (CVD) causes the most deaths in the United States and is disproportionately impacting certain groups more than others. A gap in the research exists when focusing on national data for those who bear the highest burden of CVD amongst people with hypertension when cardiovascular morbidity and mortality are examined. There is also a need to investigate the relationships between key indicators for CVD health disparities in people with hypertension. The purpose of this quantitative study is to investigate the cumulative effect of key health disparities indicators such as race, age, gender, education, and income using national-level surveillance data to determine if there are significant differences in CVD morbidity and mortality outcomes among people with hypertension. Systems theory is the theoretical foundation for this research study. Two major research questions seek to determine if there are significant differences in the selected CVD morbidity and CVD mortality outcomes in hypertensive subpopulations who are ages 30 years and older who experience health disparities, and the best group in the United States for hypertension when 3 or more of the health disparities indicators intersect. Data were provided by NHANES between 1999–2010. The results of multivariate analysis show that there are significant differences among people with hypertension in morbidity and mortality CVD outcomes when three or more health disparity indicators intersect. Positive social change can result when the findings of this study are used to address health disparities in CVD and hypertension.

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# Chapter 1: Introduction to the Study

## Introduction

Cardiovascular disease (CVD) is the leading cause of death in the United States (Guide to Community Preventive Services, 2014). It is estimated that a person in the United States suffers from a heart attack every 43 seconds (CDC, 2016). There are known risk factors for CVD (i.e., high cholesterol, smoking, and hypertension). Hypertension or high blood pressure is a major risk factor for CVD that is often uncontrolled and undetectable (Valderama, Gillespie, Coleman King, et al., 2012). There are certain subpopulations in the United States who are disproportionately impacted by both CVD and hypertension resulting in major health disparities (CDC, 2013).

Education, race and/or ethnicity, income, gender, and geographic location are used to determine subpopulations in the United States who often bear the highest burden of disease (Kreiger & Sydney, 1996; Liao, et al., 2011; and Opara, et al., 2013). These subpopulations are experiencing health disparities that often lead to health inequities. For example, Gupta (2011) conducted a study in Delaware and examined the prevalence of multiple risk factors for CVD and found that a higher proportion of those from population subgroups identified by socioeconomic status had multiple risk factors for heart disease and stroke. The researcher found that prevalence of multiple risk factors was higher for those who were older, less educated, and unemployed (Gupta, 2011). In another study by Zimmerman and Anderson (2019), the researchers utilized the Behavioral Risk Factor Surveillance System to determine if health equity has improved over the past 25 years from 1993 to 2017 among adults in the United States. The researchers found a decline in

health equity and health justice over time, as well as worse income disparities (Zimmerman & Anderson, 2019). There are also examples of health disparities that are linked to geographic location. O'Connor and Wellenius (2012) utilized data from the Centers for Disease Control and Prevention (CDC) 2008 Behavioral Risk Factor Surveillance System (BRFSS) to link health disparities to geographic location and they found that the crude prevalence rate of coronary heart disease was higher among those living in rural areas versus urban areas.

The purpose of my research study is to investigate the cumulative effect of key health disparities indicators such as race, age, gender, education, and income using national-level surveillance data to determine if there are significant differences in CVD morbidity and mortality outcomes among people with hypertension . Systems theory is the theoretical foundation. There are two research questions related to morbidity and mortality of CVD among people with hypertension. They seek to determine if there are significant differences in the selected CVD morbidity and CVD mortality outcomes in persons who are ages 30 years and older who experience health disparities, and the best group in the United States for hypertension, when 3 or more of the health disparities indicators intersect.

This research study has the following potential positive social change implications. First, I found few studies in the literature review that applied a health equity lens to national-level hypertension and CVD surveillance data to highlight health disparities. Next, the findings from this study will fill a gap in the research as it relates to the impact of multiple risk factors for health disparities on the CVD health outcomes

among persons with hypertension. According to Agurs-Collins, et al. (2019), who examined the impact of multilevel interventions to reduce health disparities, interventions that focus on only single or individual-level factors are limited in their impact. The current study will contribute to the knowledge base in public health and clinical practice by highlighting the need to consider the cumulative effect of multiple health disparities indicators on those with hypertension when planning and implementing interventions.

The major sections that will be covered in this chapter are the introduction, statement of the problem, purpose of the study, research questions and hypotheses, definitions of theoretical constructs, definition of terms, significance, assumptions and limitations, and summary.

## Background

Numerous state- and local-level research studies have been conducted to examine the prevalence of cardiovascular diseases, as well as hypertension, and the associated risk factors on the state and local levels (Andersen & Jensen, 2013; Liao, et al., 2011). However, there is a gap in the research related to the impact of three or more demographic characteristics associated with health disparities on the CVD health outcomes among persons with hypertension. Race, gender, education, age and income are the key demographic characteristics which are risk factors that are associated with CVD-related health disparities.

### Hypertension

During my review of the hypertension literature, I found few studies that applied a health equity lens to national level hypertension data, compared it with cardiovascular

morbidity and mortality data, and examined the cumulative effect of multiple health disparities indicators on individuals with hypertension. Hypertension has been found to disproportionately affect certain subpopulations. In one example publication, the researchers examined racial/ethnic disparities in awareness, treatment, and control of high blood pressure by hypertension stages using the National Health and Nutrition Examination Survey (NHANES) during the period of 2003-2010 (Valderama, et al., 2012). The researchers found that the proportion of Mexican-Americans and Blacks with Stage 1 and Stage 2 hypertension was greater than for Whites. Stage 1 hypertension is 140–159 systolic or 90–99 diastolic and Stage 2 hypertension is 160 or higher systolic or 100 or higher diastolic (National Heart, Lung and Blood Institute, 2012). However, the researchers made no efforts to further examine the health inequities that were identified in the study. A similar study is needed for the impact of hypertension on CVD health outcomes.

Loustalot, et al. (2014) also conducted a study in which they examined race. They found that mortality rates for hypertensive heart disease among Blacks were significantly higher than Whites in 2010 (50.9 per 100,000) when they examined the trends in mortality by subtypes of heart disease in the United States. The Framingham study was the first major observational study that included substantial numbers of women. It has also been central to the development of the notion of absolute risk and the importance of blood pressure alongside other risk factors (Turnbull, 2010).

Hypertension is a major cause of disparities in mortality between Blacks and Whites in the United States because of the differences in prevalence and in hypertension

control (Opara, et al., 2013; Satcher, 2008;). Hypertension disproportionately impacts some groups' burden of cardiovascular disease more than others by beginning earlier in life and being more difficult to control. For example, a 2018 study found that the cumulative incidence of hypertension by the age 55 years was 75.5% in Black men, 75.7% in Black women compared to 54.5% White men, and 40.0% in White women (Thomas, et al., 2018). In addition to race, gender was found to be linked to disparities in hypertension in the literature. For example, using a cohort study, Ford (2011) sought to examine the change in the all-cause mortality rate among people with and without hypertension in the United States and whether any such changes differed by gender or race. The researcher found that the mortality rate was higher among hypertensive adults than non-hypertensive adults, among hypertensive men than hypertensive women, and among hypertensive Blacks than hypertensive Whites (Ford, 2011).

**CVD.** All heart disease, coronary heart disease, acute myocardial infarction, and cardiac dysrhythmia are the CVD morbidity and mortality health outcomes for the research study. Race has been found to have a negative impact on CVD outcomes and risk factors among certain subpopulations in the United States. For example, Liu, et al., (2011) found that Hispanics and non-Hispanic Blacks were more likely to have uncontrolled blood pressure (BP; Hispanics odds ratio [OR]: 1.58, 95% confidence interval [CI]: 1.21-2.07; Blacks OR: 1.42, 95% CI: 0.21-1.67) and elevated glycosylated hemoglobin (Hispanics OR: 2.70, 95% CI: 1.89-3.87; Blacks OR: 2.17, 95% CI: 1.70-2.77). The literature was reviewed to investigate the impact of age as a risk factor for CVD and hypertension. A recent study by Gupta (2014) analyzed multiple risk factors as

well as self-reported CVD prevalence overall and discussed the differences in prevalence by age. The prevalence of multiple risk factors was higher for the aged, less educated, and unemployed (Gupta, 2014).

A review of the literature associated with the impact of education on hypertension and CVD was conducted. There has been a long-standing inverse relationship between education and mortality that has strengthened substantially at the end of the 20th century (Cutler, et al., 2011). A cross sectional study using the 2006 BRFSS to investigate education was conducted (Kelly & Weitzen, 2010). After adjusting for confounders, respondents with less than a high school education had 1.61 (95% CI: 1.41-1.83) times the odds of having had an MI compared to college graduates. According to the researchers' findings, participants with a high school education and those who completed some college or technical school were 1.22 times more likely to have had a myocardial infarction in comparison to college graduates (Kelly & Weitzen, 2010).

The relationships between income and hypertension, as well as CVD, were reviewed in the literature. The ability to obtain health insurance in the United States is more commonly linked to the ability to have a source of employment that provides health care coverage. One major research study found that: (a) the prevalence of hypertension and elevated LDL cholesterol was similar for the insured and uninsured, (b) the proportion of those who obtained treatment and achieved control of these risk factors was lower among the uninsured, and (c) uninsured men and women were less likely to be treated for hypertension (Brooks, et al., 2010).

There were specific subpopulations (i.e., non-Hispanic Blacks, low income, and low education) who were the most impacted when I examined the indicators (Ritchey, et al., 2014; Ford, 2011). Additionally, I found that there were few research studies that examined CVD and hypertension on the national level. In these studies, the researchers examined some of the indicators also (Liao, et al., 2012; Ritchey et al., 2014). However, I did not find any recent studies that examined the cumulative effect of the health disparities indicators for CVD among people with hypertension on a national level.

## Problem Statement

According to the CDC (2013), hypertension is a leading cause of CVD. Both CVD and hypertension are disproportionately impacting certain subpopulations in the United States, resulting in major health disparities (CDC, 2013). I found very few studies that applied a health equity lens to national level data amongst people with hypertension, compared it with cardiovascular morbidity and mortality, and investigated the relations between numerous indicators for health disparities. The application of a health equity lens (or focusing first on those who bear the highest burden of the disease) is a new concept. The health equity lens has not been widely written about and no formal definition currently exists for it.

A gap exists in the literature as it relates to the analysis of national CVD event data for populations who are bearing the highest burden of the CVD by culture, socioeconomic status, and geographic region (Schieb, et al., 2013). Sentinel observational studies such as the Framingham Study, as well as other landmark observational studies, have played key roles in establishing the link between hypertension and many

cardiovascular diseases (Turnbull, et al., 2010). The link between hypertension and CVD is created by demonstrating that the association between high blood pressure readings and cardiovascular risk was continuous, linear, and consistent across different age groups and for a range of major cardiovascular events (Lalonde, et al., 2012). The Framingham study was integral in the development of the concept of absolute risk and the importance of blood pressure alongside other risk factors (Turnbull, et al. 2010). There were other important studies such as Ritchey, et al.'s (2014) investigation of the mortality trends in heart disease that established the foundation for much of this research. I was able to find numerous examples of recent CVD morbidity and mortality literature, such as the study by Yang, et al. (2015) in which the researchers examined the racial, sociodemographic, and state-level disparities in heart age among U.S. adults who are 30 years and older. Schieb, et al. (2013) described the disproportionate number of death rates from heart disease, stroke, and hypertensive disease related to race and geographic location in the United States.

In this study, I have expanded the literature by investigating numerous health disparities indicators for CVD among people with hypertension and examining the cumulative effect of three or more health disparities indicators. There were previous studies that had similar foci. For example, data from the Multiple Cause of Death Files during 1999-2013 were compiled from 57 vital statistics jurisdictions (CDC, 2015). When gender and age were examined, the researchers reported that the average annual rate of first CVD events rises from three per 1,000 men at 35-44 years-old to 74 per 1,000

men at 85-94 years-old with comparable rates found to occur 10 years later in life among women (CDC, 2015).

## Purpose of the Study

In this quantitative cross-sectional study, I utilized national surveillance data to explore the cumulative effect of demographic characteristics such as race, gender, age, education, and income to determine if there are significant differences in CVD morbidity and mortality outcomes among hypertensive subpopulations that are linked to CVD and hypertension health disparities. A hypertensive subpopulation is defined in the following three ways: (a) an average systolic blood pressure (SBP) ≥140 mmHg;, (b) an average diastolic blood pressure (DBP) ≥90 mmHg, or (c) currently using blood pressure lowering medication (Valderama, et al., 2010). The independent variables for the research study were education level, age, household income, race/ethnicity, body mass index (BMI), and gender. The dependent variables were CVD morbidity – hospitalizations for pain or discomfort in the chest and coronary heart disease, acute myocardial infarction, heart failure and cardiac dysrhythmia diagnoses. CVD mortality – death as a result of coronary heart disease, acute myocardial infarction, heart failure and cardiac dysrhythmia diagnoses. Covariate variables that were also considered are smoking, cholesterol levels, and hemoglobin A1-C levels.

## Research Questions and Hypotheses

I examined the following research questions and hypotheses in this research study.

Research Question 1 (RQ1): Are there significant differences in the selected CVD morbidity outcomes between hypertensive subpopulations, adults who are 30 years and older, experiencing health disparities and the best group (i.e., the subpopulation with the best CVD morbidity outcomes) in the United States for hypertension and when three or more indicators (race, gender, education, age and income) intersect? The following variables that are relevant include: CVD morbidity as a dependent variable; education level, household income, race/ethnicity, body mass index (BMI), and gender are the independent variables. Other covariates are hypertension medications, taking cardiovascular medications, smoking, and cardiovascular fitness.

Null Hypothesis ($H_0$1): There are no significant differences in the selected CVD morbidity outcomes between hypertensive subpopulations experiencing health disparities and the best group with hypertension in the United States when three or more indicators intersect.

Alternative Hypothesis ($H_a$1): There are significant differences in the selected CVD morbidity outcomes between hypertensive subpopulations experiencing health disparities and the best group with hypertension in the United States when three or more indicators intersect.

Research Question 2 (RQ2): What are the significant differences in CVD mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group (i.e., the subpopulation with the best CVD mortality outcomes) with hypertension in the United States when three or more indicators (race, gender, education, age and income) intersect? The following variables that are relevant to this question

include: CVD mortality as a dependent variable; education level, household income, race/ethnicity, BMI, and gender are the independent variables. Other covariates are hypertension medications, taking cardiovascular medications, smoking, and cardiovascular fitness.

Null Hypothesis ($H_0$2): There are no significant differences in CVD mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group with hypertension in the United States when three or more indicators intersect.

Alternative Hypothesis ($H_a$2): There are significant differences in CVD mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group with hypertension in the United States when three or more indicators intersect.

## Theoretical and Conceptual Framework for the Study

I used systems theory as the theoretical framework for this cross-sectional observational study. Systems theory originated from the notion that the interrelations of multiple perspectives from complex systems should be taken into consideration in public health (Leischow & Milstein, 2006). The ability to simultaneously explore these connections among different components and among different subareas on the macro-level is a major focus of systems theory.

My emphasis in this study on the cumulative effect of indicators for health disparities is in alignment with systems theory's focus on the inter-relations of multiple components. I used systems theory in this study's macro-level focus on CVD outcomes among people with hypertension across the United States by examining the impact of numerous health disparities indicators on CVD morbidity and mortality. The reliance on

simulation (or modeling in order to examine relationships) and numerous variables are key components of this theory that align with the approach and research questions of this study. A more detailed explanation of Systems theory and its relation to the research study will follow in Chapter 2.

In this research study, I sought to determine if relationships exists between numerous selected components or indicators using the principles contained in systems theory for a large study population to determine if there are significant differences in CVD morbidity and mortality outcomes among hypertensive subpopulations experiencing health disparities in comparison to people with hypertension who do not experience health disparities. The intersectionality of multiple health disparities indicators (i.e., race, gender, age, education, and income) amongst hypertensive subpopulations can also be examined using this method. In systems theory, Leischow and Milstein (2005) described the emphasis on relationships and the desire to obtain a larger, more connected understanding are critical to this study.

Traditionally, cardiovascular and hypertension morbidity and mortality data are examined based on each of the indicators individually. According to the Guide for Community Preventive Services (2015), nearly half of Americans show at least one of three key CVD risk factors which are hypertension, uncontrolled high levels of low-density lipoprotein cholesterol (LDL), and smoking. LDL and smoking are covariates while hypertension is the major focus for this study. Uncontrolled hypertension is a major concern for many of the persons with hypertension. One national study of 36 million U.S. adults found that approximately 39% were unaware of the fact that they are

hypertensive, 16% knew about their hypertensive status but were not on medication, and 45% were taking medicine but did not have their blood pressure under control (Valderama, Gillespie, et al., 2012). There are demographic factors that must be considered in order to explain why certain subpopulations are struggling to control their hypertension, and thus prevent morbidity and mortality associated with CVD. By preemptively considering the demographic and epidemiologic findings to prioritize those who were identified as being disproportionately impacted by hypertension, I applied a health equity lens to this research study. In this quantitative study, I incorporated a health equity lens and systems theory into its approach in order to address these issues. The connections among these key elements will be examined in more detail in Chapter 2.

## Nature of the Study

The nature of this research study was quantitative and I used a cross-sectional design. I used quantitative data that has been previously collected over a period of 4 years from a large sample of study participants to rigorously analyze data in a timely manner from a national surveillance study. I used CVD event surveillance data and secondary data analysis to respond to the research questions. The key study variables included: dependent variables such as CVD morbidity and mortality variables. Independent variables were: education level, household income, race/ethnicity, body mass index (BMI), and gender. Having hypertension was an inclusion criterion for this study. Other covariates were: hypertension medications, taking cardiovascular medications, smoking, and cardiovascular fitness.

I analyzed secondary data from previously collected data that was derived from a sample of the National Health and Nutrition Survey (NHANES) 1999-2010 participants to explore potential differences in health outcomes among subpopulations with hypertension. These participants may have had varying indicators for health disparities. I analyzed the data using SAS to perform the following analyses: descriptive statistics, bivariate analysis, multivariate analysis, and regression modeling.

## Definitions

*Covariates*: Are "any of two or more random variables exhibiting correlated variation" (Merriam-Webster, 2016). Smoking, elevated cholesterol and obesity are examples of covariates.

*Dependent Variables*: "A mathematical variable whose value is determined by that of one or more other variables in a function" (Merriam-Webster, 2016). Dependent variables in the research study may include coronary heart disease, acute myocardial infarction, and cardiac dysrhythmia.

*Health Disparity*: "a particular type of difference in health (or in the determinants of health that could be shaped by policies) in which disadvantaged social groups systematically experience worse health or more health risks than do more advantaged social groups" (Braverman, 2009).

*Health Equity*: "the absence of avoidable or remediable differences among groups of people, whether those groups are defined socially, economically, demographically, or geographically" (World Health Organization, 2015).

*Health Equity Lens:* The application of a health equity lens is a new concept that has not been widely written about and no formal definition currently exists. A health equity lens is applied when the researcher or practitioner proactively analyzes the epidemiological findings to implement interventions and/or conduct research that prioritizes those who were identified as being disproportionately impacted by a disease.

*Hypertension:* A person is considered to have hypertension in one of the following three ways: 1) an average systolic blood pressure (SBP) ≥140 mmHg; or 2) an average diastolic blood pressure (DBP) ≥90 mmHg; or 3) currently using blood pressure lowering medication (Valderama, et al., 2010).

*Independent Variables:* "A mathematical variable that is independent of the other variables in an expression or function and whose value determines one or more of the values of the other variables" (Merriam-Webster, 2016). Examples of independent variables are the demographics in the research study.

*Systems Theory*: "an interdisciplinary theory that requires merging of multiple perspectives and sources of information and deals with complex systems in technology, society, and science" (Best, et al., 2003).

## Assumptions

I made the aassumptions by and about subpopulations with hypertension. The following misconceptions among hypertensive populations are discussed below. Contracting high blood pressure is assumed to be inevitable amongst some people with hypertension. There is a belief that a hypertension diagnosis can only be treated and controlled by medication. Because hypertension often has no symptoms, then treatment

is not a priority. Some persons with hypertension believe that there is no cure for hypertension. Some medical providers believe that the non-compliance to medication of certain subpopulations related to hypertension and CVDs cannot be helped. This is a major misconception that exists among some providers.

These assumptions are important to keep in mind because many of them are held by the subpopulations who are disproportionately impacted. The finding from the research study can raise the awareness of the populations by addressing these misconceptions. These assumptions may assist in building the case for applying a health equity lens to interventions and addressing the social determinants of health by providers and public health practitioners that are associated with hypertension and CVDs. According to the Office of Disease Prevention and Health Promotion (2020), "social determinants of health reflect the social factors and physical conditions structural conditions in which people are born, live, learn, work, worship, play, and age" (Paragraph 6). These are recognized as critical determinants of health and health disparities.

## Scope and Delimitations

There is a drastic need to address the multiple risk factors related to CVD health outcomes that disproportionately impact certain hypertensive subpopulations in the United States. The specific aspects of this research problem will be addressed in this research study. They include: demographic indicators such as race, gender, age, education, and income; CVD health outcomes (i.e., morbidity and mortality);

hypertension as a major risk factor; and the cumulative effect of the indicators of CVD among people with hypertension on a national level.

The populations who are included in the research study are large samples from the United States population that were extracted from the NHANES survey. Adult respondents from all races and ethnicities that are 30 years and older who were diagnosed with hypertension were sampled. Individuals who were not diagnosed with hypertension and were younger than 30 years-old were excluded. In addition to age, the sample will be further categorized by education, gender, race or ethnicity, and income.

There were theories and concepts such as the Social Ecological Model and empowerment that are relevant to this study but were excluded because a broader approach was needed. The Social-Ecological model is a multi-level approach that considers the different domains of influence and provides an overarching framework for understanding the interrelations among diverse personal and environmental factors (Fleury & Lee, 2006). This model spans across the following categories: intrapersonal resources, interpersonal resources, and community and environmental resources (Fleury & Lee, 2006). Empowerment is defined as "a social action process for people to gain mastery over their lives and the lives of their communities" (Batholomew, et al., 2011, p.1). It is important to ensure that the needs of all sub-groups are met when the populations are diverse. Empowerment provides a means for those sub-groups who have been marginalized to regain a sense of control and awareness of their health outcomes in health promotion. Additionally, the findings from this study can be generalized to persons in the general United States population who are either hypertensive, or at-risk for

hypertension and CVD. The sample size is large enough to be applicable on the micro, meso, and macro levels. It also allows practitioners to translation the research findings to practice.

## Limitations

This correlational study focused on the relationships between the demographic variables related to health disparities, hypertension and CVD. Causation cannot be assessed for studies of this type. Internal validity is weaker for correlational than for experimental designs. The health interview portion of the data collection relies on the participant to remember specific events. Difficulty with memory among the participants is a limitation with cross sectional studies of this type. This may result in inaccurate or biased recall.

The ability to recall the sequence of events can pose a problem. There are also confounder variables, such as smoking, that may influence CVD outcomes which were not examined in this research study. This did not significantly impact the results of this study because many of the confounders such as smoking are not as closely linked to hypertension, which is an inclusion criterion for this study. According to the American Heart Association (2016), the connection between smoking and hypertension is still being determined. This study employed multivariate analysis and regression analysis to determine the direction of the relationship between variables. For the purposes of this study, a correlational design was appropriate despite its limitations because the intention of this study is to determine if a relationship exists between numerous variables.

## Significance

This research study can potentially contribute to the scientific evidence-base by identifying and describing national cardiovascular and hypertension health disparities using specified indicators (i.e., race and/or ethnicity, education, income, gender, and age) among individuals within certain subpopulations in the United States. The following CVD evidence gaps that were identified by the Community Preventive Services Task Force were explored in this study: large scale studies; more diverse populations; information on socioeconomic status (SES); and reporting of morbidity and mortality outcomes (Guide to Community Preventive Services, 2012). This study helps to fill the large scale studies gap by including a much larger sample from a national-level data source. The need for more diverse populations and SES information was met in this study because of its emphasis on examining CVD and hypertension data from subpopulations who are from diverse races and/or ethnicities, education levels, and incomes. This study examined the socioeconomic and demographic information from national data of subpopulations who are the most at-risk for CVD. By focusing on the cumulative effect of the major risk factors, this study expands the knowledge base by identifying those variables that converge to place certain persons with hypertension at an increased risk for morbidity and mortality related to CVD. The findings from this study informed efforts such as policies, interventions, and resources allocated to reduce cardiovascular events and hypertension health disparities by clinical and public health practitioners.

This study has the potential to contribute to positive social change by highlighting the CVD and hypertension-related health disparities that are faced by those who are commonly under-resourced, under-represented, and marginalized. The inclusion of systems theory promotes the "big picture perspective" and results in a more diverse approach to collaboration and data collection. Organizations from academia, medicine, and public health could form better collaborations. It would also lead to gathering and analyzing different types of data (i.e., behavioral and environmental) and integrating that data and interpreting it. It will also assist researchers and practitioners in their efforts to understand those subpopulations who bear the highest burden of CVD events and hypertension in the United States by applying a health equity lens, as well as implementing tailored approaches.

## Summary

Chapter 1 discussed the need to analyze national CVD event data for hypertensive subpopulations in the United States who are bearing the highest burden of CVD morbidity and mortality. The cumulative effect of those risk factors that are linked to health disparities among those people with hypertension who are most at risk for CVD morbidity and mortality is an important component of this research study that was described. The purpose of the study, research questions, hypotheses, definitions, significance, scope, limitations, and significance were also examined. For the indicators in certain subpopulations, I found that morbidity and mortality health disparities existed for CVD and hypertension.

Chapter 2 provides a detailed review of the existing literature associated with CVD outcomes among people with hypertension in the United States who are at increased risk. The chapter will begin with literature associated with the theoretical basis for the research study. Systems theory is the theoretical basis for this study. Cardiovascular diseases, hypertension, health disparities, health equity, geographic location, race, age, gender, education, and income, will be further examined in the literature review. The sections of this literature review include: the Introduction, Literature Search Strategy, Theoretical Foundation, Literature Review Related to Key Variables and/or Concepts, Implications of Past Research on Present Research, and the Summary. The chapter will end with implications of past research and its influence on this research.

# Chapter 2: Literature Review

## Introduction

In this literature review, I discuss the need for continued research concerning the cumulative effect of indicators (i.e., race, gender, education, income, and geographic location) within certain subpopulations that lead to CVD morbidity and mortality associated with hypertension in the United States. In this quantitative study, subpopulations refer to the persons from the national samples or demographic groups when the population data of the United States is disaggregated. CVD health disparities have been among the most serious public health problems in the United States (Mensah, 2005). According to the American Heart Association (2011), CVD morbidity can include numerous heart problems such as strokes, heart failure, arrhythmia, and heart attacks. Cardiovascular mortality is defined as deaths among people with an underlying cause of ischemic heart disease from the following *International Classification of Diseases, 10th Revision* (ICD-10) codes: cerebrovascular disease (stroke) (I60–I69), hypertensive disease (I10–I15), or chronic rheumatic heart disease (I05–I09; Macinko & Elo, 2009). In this study, I focused on cerebrovascular disease (stroke), hypertension, and chronic rheumatic heart failure among adults who are 30 years and older.

The purpose of this quantitative study was to investigate the cumulative effect of indicators (i.e., age, race, gender, education, and income) using surveillance data from across the United States to determine if there are significant differences in CVD morbidity and mortality outcomes among hypertensive subpopulations that are linked to CVD and hypertension health disparities. A health disparity is defined as "a particular

type of difference in health (or in the determinants of health that could be shaped by policies) in which disadvantaged social groups systematically experience worse health or more health risks than do more advantaged social groups" (Braverman, 2009, p. A91). There are widening CVD health disparities detected across the United States over the past 30 years in population subgroups identified by race, ethnicity, gender, socioeconomic status, educational level, and geography (Mensah, 2005).

There is a link between hypertension and the risk of many cardiovascular diseases. Sentinel observational studies such as the Framingham Study, as well as other landmark observational studies, have been instrumental in examining this relationship by demonstrating that the association between blood pressure and cardiovascular risk was continuous, linear, and consistent across different age groups and for a range of major cardiovascular events (Lalonde, et al., 2012). The Framingham study has played an important role in the development of the notion of absolute risk and the importance of blood pressure alongside other risk factors (Turnbull, et al. 2010). In addition to the Framingham Study, there were other seminal studies such as Ritchey, et al.'s (2014) examination of the mortality trends in heart disease that established the foundation for much of this research. Numerous examples of recent literature were also found, such as the study by Yang, et al. (2015), in which the researchers examined the racial, sociodemographic, and state-level disparities in heart age among U.S. adults who are 30 years and older. In another study by Schieb, et al. (2013), the researchers described the disproportionate number of death rates from heart disease, stroke, and hypertensive disease linked to race and geographic location in the United States.

In this review, I examined literature associated with systems theory, which is the theoretical basis for this study, as well as cardiovascular diseases, hypertension, health disparities, health equity, geographic location, race, age, gender, education, and income. The major sections of this chapter include: the Introduction, Literature Search Strategy, Theoretical Foundation, Literature Review Related to Key Variables and/or Concepts, Implications of Past Research on Present Research, and the Summary.

## Literature Search Strategy

To search the literature, I used three databases and search engines as the primary resources of information. The scope of the literature review spanned from 2005 to 2019. I searched peer-reviewed journal articles, literature reviews, book chapters, and commentaries. Medline was a major source of biomedicine and life sciences journals. PubMed is a larger database with biomedical literature from MEDLINE, life science journals, and online books. I also used CINAHL to search for journals from the fields of nursing and allied health. The citations for all literature used was stored in the EndNoteX7 reference library.

To perform the literature review, the independent variables (race, gender, education, income, and geographic regions of the United States) and dependent variables (cardiovascular disease morbidity, cardiovascular disease mortality, hypertension morbidity, and hypertension mortality) formed the basis of the key word search. I utilized a specific search strategy using *cardiovascular disease, hypertension, mortality, morbidity, United States, trends, surveillance, epidemiology, health disparities, ethnic disparities, racial disparities race, gender, education, income, geographic region,* and

*health inequities* as key search terms to retrieve the relevant literature. I used a variety of combinations when searching for the key words.

## Theoretical Foundation

### Systems Theory

I used systems theory as the theoretical framework for this cross-sectional observational study. The origin of systems theory in public health is derived from the systems approach which is a paradigm that focuses on the interactions among different components versus a single element (Leischow & Milstein, 2006). The Institute of Medicine made key recommendations regarding systems approaches in a 2010 report from *(For the Public's Health: The Role of Measurement in Action and Accountability)* to improve health data analysis and reporting (Yang, et al., 2015). According to Leischow and Milstein (2006), being aware of the wider context and transdisciplinary thinking are also important in the systems approach (Leischow and Milstein, 2006). In addition to transdisciplinary thinking, the ability to take multiple perspectives from complex systems is also needed. Systems theory is defined as "an interdisciplinary theory that requires merging of multiple perspectives and sources of information and deals with complex systems in technology, society, and science" (Best, et al., 2003. p. S207).

This study's emphasis on the cumulative effect of indicators for health disparities is in alignment with Systems theory's focus on multiple components. For example, Systems theory's particular emphasis on multiple variables can be transferred to the indicators for health disparities in this study. The states, as well as regions of the United

States, and the hypertensive subpopulations that are impacted by the indicators for health disparities make up the system in this study. According to Lehrer and Eddie (2013), a system is defined as a variety of elements that interact with one another to form a whole entity. The unique parts or elements are not separated from each other and the characteristics of the whole entity cannot generally be inferred from characteristics of its components (Lehrer and Eddie, 2013). There are two major theoretical propositions that are appropriate to the application of Systems theory in this study. Its reliance on simulation and numerous variables are the two propositions. According to Green (2006), systems theory relies on simulation rather than the controlled trial as the major source of evidence. Additionally, it treats numerous variables as a resource to be used for further evaluation than as adversaries to be controlled. The intent of this study is to analyze multiple indicators and to generalize from large samples to the U.S. population. Green (2006) stated that systems science can "help us unravel the complexity of causal forces in our varied populations and the ecologically layered community and societal circumstances of public health practice" (p. 406).

It is important to ensure that Systems theory is related to the study's research questions. The research questions for this research study will test the cumulative effect of several indicators that lead to CVD morbidity and mortality associated with hypertension in the United States. Systems theory provides the organizing theoretical framework through which the indicators at different levels and of different domains can be explicitly integrated dynamically in understanding health disparities (Diez Roux, 2011). Additionally, Systems theory allows the synthesis of meaning from a broad

evidence base by simultaneously exploring relationships among different subareas (i.e., health disparities indicators, hypertension and cardiovascular disease) of the field being considered (Mabry, 2010). Systems theory was utilizes for this study's macro level focus on hypertension and cardiovascular disease across the United States by providing national level health disparities data and addressing the social determinants of health.

## Literature Review Related to Key Variables and Concepts

### Morbidity and Mortality of Cardiovascular Diseases and Hypertension

There are numerous studies that highlight the impact of hypertension on certain subpopulations. I utilized the research questions to examine whether significant differences exist in the selected CVD morbidity and mortality outcomes between hypertensive subpopulations who are experiencing health disparities among people with hypertension when three or more indicators (race, gender, education, income) intersect. I reviewed the literature related to the research questions. For example, in a research study by Loustalot, et al. (2014), the researchers examined the trends in mortality by subtypes of heart disease in the United States. Loustalot, et al. (2014) found that mortality rates for hypertensive heart disease among Blacks were significantly higher than Whites in 2010 (50.9 per 100,000). The Framingham Study is a sentinel study in this literature review. It was the first major observational study that included substantial numbers of women and it has been central to the development of the notion of absolute risk and the importance of hypertension alongside other risk factors (Turnbull, 2010). Much of our current understanding of the role blood pressure in cardiovascular disease can be attributed to the research from Framingham.

**Hypertension**

I reviewed the literature for hypertension and its relationship to CVD morbidity and mortality. Hypertension impacts approximately 1 in 3 adults (an estimated 75 million) in the United States (Fryar, et al., 2017). I also reviewed hhypertension health disparities. In a study by CDC (2005), the researchers analyzed self-reported data from the 2003 BRFSS survey. The CDC (2005) researchers examined six risk factors for heart disease and stroke: high blood pressure, high cholesterol, diabetes, current smoking, physical inactivity, and obesity. In this study, 37.2% of respondents reported having two or more of the six heart disease and stroke risk factors examined (CDC, 2005). The CDC study is similar to this research study in its examination of multiple risk factors for CVD. However, to expand on the prior study, I analyzed the potential relationship between health disparity indicators and CVD.

I reviewed the literature that specifically identified racial disparities in hypertension. Hypertension is a major cause of disparities in mortality between Blacks and Whites in America because of the differences in prevalence and in hypertension control (Satcher, 2008; Opara, et al., 2013). In another study, racial disparities in systolic blood pressure (SBP) measurements were analyzed among 1,545 Black adults and 1,335 White adults (Fiscella & Holt, 2008). The results of the study showed that the mean SBP among Blacks with hypertension was approximately 6 mm Hg higher than that for the total adult Black population and 7 mm Hg higher than that for Whites with hypertension.

In addition to race, I identified other indicators (i.e., gender, education, income, and geographic location) that are linked to disparities in hypertension and evaluated in

the literature. For example, in one cohort study, the researchers sought to examine the change in the all-cause mortality rate among people with and without hypertension in the United States and whether any such changes differed by sex or race (Ford, 2011). The researcher found that the mortality rate was higher among hypertensive adults than non-hypertensive adults, among hypertensive men than hypertensive women, and among hypertensive Blacks than hypertensive Whites (Ford, 2011). I determined the prevalence of healthy diets in overweight U.S. adults by race or ethnicity by using dietary recalls from the National Health and Nutrition Examination Survey of 1999 to 2000. After controlling for dietary factors, Black ethnicity was associated with a greater risk of high SBP compared to Whites (Diaz, et al., 2005). This is an example of a national study that focuses on racial health disparities in hypertension. However, in this study I go further by examining the cumulative effect of multiple health disparity indicators among people with hypertension.

**Impact of Geographic Location on CVD and Hypertension**

I reviewed the morbidity and mortality outcomes for CVD and hypertension by geographic location in the scientific literature. A critical review of the literature revealed that there are certain areas in the United States that are more heavily impacted by health disparities than others. Cosby and Bowser (2008) described the disparities associated with excess mortality in the Delta region of the United States The Delta region refers to the 252 economically distressed counties in the following eight states: Alabama, Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee (National Park Service, 2001). Cosby and Bowser (2008) found that mortality disparities in the

Delta had doubled to about 187 excess deaths per 100,000, or approximately 18,000 excess deaths in 2004. Cosby and Bowser (2008) concluded that these deaths would not have occurred had the region achieved the average rate of mortality experienced by the remainder of the nation.

Geographic location has been shown to play a factor in health outcomes related to heart disease and hypertension. Schieb, et al. (2013) examined National Vital Statistics mortality data from 2001-2010 by race and gender in geographic regions of the United States The emphasis of the researchers was primarily on geographic regions, race and gender. Schieb, et al. (2013) found that CVD mortality was disproportionately impacting Blacks and is located in the southern region of the United States. Regarding gender, Black men experienced the most CVD deaths. However, they did not include education and income as focus areas.

In a study that relied on data from the BRFSS and the American Community Survey, Jones (2013) examined the impact of segregation and socioeconomic status (SES) on hypertension for a sample of 200,102 individuals (Jones, 2013). Jones (2013) analyses and findings revealed that both segregation and hypersegregation (i.e., areas where there is very little interaction with non-Black residents) were associated with hypertension. However, highly educated and high-earning individuals were protected against hypertension in both segregated and hypersegregated environments (Jones, 2013).

I compared rural and urban incidence of coronary heart disease. O'Connor and Wellenius (2012) examined the rural-urban differences in the prevalence of diabetes and coronary heart disease, and the extent to which they are explained by the presence of

established risk factors including poverty. The crude prevalence rates of coronary heart disease was 38.8% ($P < 0.001$) higher among respondents living in rural areas compared with urban areas (O'Connor & Wellenius, 2012). After controlling for poverty, obesity, tobacco, and other risk factors, the prevalence of coronary heart disease was higher among respondents living in rural areas (O'Connor & Wellenius, 2012). This research study expanded this area of research by using national data to analyze health disparity indicators in people with hypertension across regions and states of the U.S.

## Impact of Race on CVD and Hypertension

**CVD and race**. Race has also been found to play a major role as a CVD risk factor among certain subpopulations. For example, Liu, et al., (2011) investigated racial disparities and trends in glycosylated hemoglobin, high-density lipoprotein (HDL), C-reactive protein, plasma homocysteine, albuminuria, and other risk factors among 4,758 diagnosed hypertensive subjects age 18 years or older from the NHANES, 1999-2006. They found that Hispanics, and non-Hispanic Blacks were more likely to have uncontrolled blood pressure (BP) (Hispanics odds ratio [OR]: 1.58, 95% confidence interval [CI]: 1.21-2.07; Blacks OR: 1.42, 95% CI: 0.21-1.67), elevated glycosylated hemoglobin (Hispanics OR: 2.70, 95% CI: 1.89-3.87; Blacks OR: 2.17, 95% CI: 1.70-2.77), albuminuria (Hispanics OR: 2.36, 95% CI: 1.71-3.27; Blacks OR: 1.80, 95% CI: 1.47-2.20), and less likely to have central obesity (Hispanics OR: 0.68, 95% CI: 0.51-0.91; Blacks OR: 0.70, 95% CI: 0.58-0.84). Blacks had lower risks of elevated serum cholesterol (OR: 0.81, 95% CI: 0.67-0.98) and low HDL (OR: 0.76, 95% CI: 0.61-0.94) than Whites. The risk of high serum homocysteine was lower in Hispanics and higher in

Blacks compared with Whites (Hispanics OR: 0.64, 95% CI: 0.46-0.90; Blacks OR: 1.36, 95% CI: 1.14-1.63). These findings are in alignment with other studies of this type that were reviewed.

A study by Holm, et al., (2010) measured health disparities by comparing the American Indian sample data with a northern plains statewide (North Dakota) sample and a United States national sample. Holm, et al., (2010) compared outcomes with BRFSS statewide (North Dakota) and U.S. national data from telephone-based interviews. The American Indian participants showed a significantly greater coronary heart disease than either the regional or national samples (Holm, et al., 2010). They also reported being less likely to engage in leisure-time physical activity and to have had age-appropriate preventive screenings for several diseases including colorectal cancer, prostate cancer, breast cancer, and cardiovascular disease.

**Hypertension and race**. Race is a known population parameter and health indicator that is commonly associated with health disparities that has been studied in numerous creative ways. A sentinel study of racial discrimination examined the relationships between blood pressure and self-reported experiences of racial discrimination and responses to unfair treatment (Kreiger & Sidney, 1996). The researchers found that Black-White differences in blood pressure were substantially reduced by taking into account reported experiences of racial discrimination and responses to unfair treatment (Krieger & Sidney, 1996).

Race can also play a factor in patient satisfaction. The researchers in this study compared the determinants of satisfaction with medical care among 1,784 (781 Black and

1,003 Caucasian) cardiac patients (LaVeist, et al., 2000). They found that the perception of racism and mistrust of the medical care system led to less satisfaction with care among Blacks (LaVeist, et al., 2000). In a study that analyzed temporal trends in population attributable risk for CVD, the researchers studied 13,541 participants (56% women, 26% Black) in the Atherosclerosis Risk in Communities Study, aged 52 to 66 years and free of CVD at exams in 1987 through 1989, 1990 through 1992, 1993 through 1995, or 1996 through 1998 (Cheng, et al., 2014). It was determined from this study that the contribution to CVD of all traditional risk factors combined is greater in Blacks than Whites, and the contributions of hypertension remain especially high, in women as well as Blacks (Cheng, et al., 2014).

This research study seeks to examine race by taking a national perspective and examining the cumulative effect of risk factors that are associated with CVD and hypertension health disparities. Similar studies have been done which have analyzed national data and found health disparities. An example of a study that spanned across 17 states and 28 communities reinforces the need to further examine health disparities data from a national perspective. In this study, Liao, et al. (2011) utilized data from the REACH U.S. Risk Factor Survey to demonstrate that residents in most of the minority communities continue to have lower socioeconomic status, greater barriers to health-care access, and greater risks for and burden of disease compared with the general populations living in the same MMSA, county, or state. However, there are fewer studies that have analyzed the cumulative effect of racial health disparities indicators among people with hypertension and CVD.

In addition to Blacks and Hispanics, American Indian/Alaska Natives were also found to experience disparities in blood pressure when compared to Whites. Amparo, et al., (2011) examined the prevalence of high cholesterol, high blood pressure, diabetes, body mass index data for 2,821 American Indian/Alaska Native women and 105,664 non-Hispanic White women aged 18 to 44 years from the 2005 and 2007 Behavioral Risk Factor Surveillance System. American Indian/Alaska Native women were found to have significantly higher rates of high blood pressure (Amparo, et al., 2011).

There were studies identified that examined the intersection of race with other indicators of hypertension and CVD. In one such study, the researchers evaluated the disparate association of BMI and risk of hypertension and diabetes in Asians in a retrospective study of 150,753 adults from the 1985-2011 California Behavioral Risk Factor Survey (Wong, et al., 2014). Asians had the lowest BMI among all groups. However, the impact of increasing BMI on risk of hypertension and diabetes was significantly greater in Asians (Wong, et al., 2014). To examine racial/ethnic disparities in awareness, treatment, and control of high blood pressure by hypertension stages, the Centers for Disease Control and Prevention (2013) analyzed data from the National Health and Nutrition Examination Survey (NHANES) for the period 2003-2010. The researchers found that the proportion of Mexican-Americans and Blacks with stage 1 and stage 2 hypertension was greater than for Whites (Centers for Disease Control and Prevention, 2013).

A study by Zhang and Rodriguez (2012) investigated racial/ethnic disparities in the prevalence of obesity and its related diseases in Massachusetts and assess disparities

in the risk of developing diseases related to overweight and obesity. Hypertension and CVD are obesity-related diseases that were included in the outcome measures. Blacks had higher odds of high blood pressure (OR = 1.88), heart attack (OR = 1.40) and stroke (OR = 2.14) than Whites. Hispanics were more likely to have high blood pressure (OR = 1.34), high cholesterol (OR = 1.56), stroke (OR = 1.71), and heart attack (OR = 1.54) than Whites (Zhang & Rodriguez, 2012). Health behaviors and disparities in blood pressure control were examined by race in a study using data from the NHANES in another study. Data from NHANES were analyzed to conduct cross-sectional analyses among 21,489 U.S. adults aged >20 years participating in NHANES from 2001 to 2006 (Redmond, et al., 2011). Non-Hispanic Blacks were found to have 90% higher odds of poorly controlled blood pressure compared with non-Hispanic Whites after adjustment for sociodemographic and clinical characteristics ($P<0.001$) in primary analyses. In secondary analyses among hypertensive subjects, non-Hispanic Blacks and Mexican Americans had 40% higher odds of uncontrolled blood pressure compared with non-Hispanic Whites after adjustment for sociodemographic and clinical characteristics ($P<0.001$). Additionally, for both analyses, the racial/ethnic differences in blood pressure control persisted even after further adjustment for modifiable health behaviors, which included medication adherence in secondary analyses ($P<0.001$ for both analyses) (Redmond, et al., 2011). A cross-sectional study was conducted to determine whether being Black and having poor BP control interact to adversely affect patient-physician communication more than either condition alone. This situation is referred to as "double jeopardy" by Cene, et al., (2009). After controlling for patient and physician

characteristics, the researchers found that Blacks with uncontrolled BP have shorter visits with less biomedical, psychosocial, and rapport-building statements than Whites with controlled BP (Cene, et al., 2009). A large amount of research has been done that demonstrates the impact of race on hypertension and CVD. This research study goes further by linking race to other health disparity indicators to analyze their effect on CVD and hypertension.

**Impact of Age on CVD and Hypertension**

The literature was reviewed to investigate the impact of age as a risk factor for CVD and hypertension. A study by Gupta (2014) analyzed multiple risk factors as well as self-reported CVD prevalence overall and discuss differences in prevalence by age. Analysis was conducted using Delaware data for 4,777 respondents from the 2011 BRFSS. Overall, 22.51% of persons reported having no risk factors, 32.30% reported one risk factor, and 45.20% reported multiple risk factors and prevalence of multiple risk factors was higher for the aged, less educated, and unemployed (Gupta, 2014).

Age was found to be related to pre-hypertension in a study by Glasser, et al., (2011). They conducted a cross-sectional analysis of 5,553 pre-hypertensives, 20,351 people with hypertension, and 4,246 non-hypertensive participants (age >45 years) from the REasons for Geographic And Racial Differences in Stroke Study (REGARDS) data to determine racial, clinical, and demographic differences in the prevalence of pre-hypertension and its cross-sectional association with vascular risk factors. The prevalence of pre-hypertension increased by age and African-American race (Glasser et al., 2011).

The notion that in persons of older age, SBP is no longer associated with mortality was examined in the Rotterdam Study. The Rotterdam Study is a population-based prospective cohort study among 4,612 participants aged >55 years without previous cardiovascular disease and with a median follow-up of 14.9 (interquartile range, 11.1-15.8) years (Blom, et al., 2013). Analyses in the 5-year age groups revealed an increased risk with higher SBPs up to age 75 years, and after 75 years, a trend towards systolic blood pressure no longer being associated with an increased mortality risk was seen in the study (Blom, et al., 2013).

**Role of Gender in CVD and Hypertension Health Outcomes**

CVD are the main cause of death in women and men worldwide (Hochleitner, 2013). According to Hochleitner (2013) Gender Medicine research has shown gender differences in cardiology to the detriment of women, for example it takes longer for them to receive and they are less likely to have access to high-tech medicine, such as the ICU, heart catheters, bypass surgery, and they have poorer outcomes (Hochleitner, 2013). Many research studies were found that examined gender in relation to hypertension and CVD health outcomes. A specific focus was placed on the comparison of women by race and/or ethnicity in many of the articles that were reviewed. For example, a review of the recent literature on the subject of CVD in women over the past several years was conducted with an emphasis on CVD in Black women and Caucasian women (Williams, 2009). According to Williams (2009), the mortality rate from coronary artery disease is 69% higher in Black women than in Caucasian women. Mortality for Black females was also found to be much higher (352%) from hypertension than for White females.

Hypertension and the specified cardiovascular events in this study that was conducted, compared male and female genders with each other, as well as with the other indicators.

Gender was linked to other risk factors in the literature that was reviewed. Andersen and Jensen (2013) conducted a longitudinal study (i.e., the Copenhagen City Heart Study) of the association between income factors and trends in population blood pressure and hypertension. This Copenhagen City Heart Study is a prospective longitudinal epidemiological study on almost 20,000 individuals through four surveys from 1976 to 2003. After adjusting for cardiovascular risk factors, there were no significant differences in systolic blood pressure trends associated with income among men. Among women, however, there was a reverse relationship between SBP and income. In addition, there was a trend towards a lowering of risk-factor adjusted SBP in the high income women with time (Andersen & Jensen, 2013).

Community-based CVD programs that are tailored to reach women are needed. Altman et al., (2014) utilized a systems approach to develop, assess, and pilot a community-based education program for improving outcomes for knowledge/awareness of CVD, cardiometabolic risk, and health behaviors in Latinas. It was determined that a bilingual culturally appropriate community-based CVD-prevention program based on health education, medical screenings, and empowerment is a successful, effective, adaptable, and replicable model to significantly improve cardiometabolic risk in Latinas (Altman et al., 2014).

CVD mortality was analyzed by gender in three different regions (27 countries) in a time series study of the Americas by Gawryszewski and Souza (2014). During the

study period, the age-adjusted mortality rates for men were higher than those of females in all regions and North America showed lower rates than Latin America countries and the Non-Latin Caribbean (Gawryszewski & Souza, 2014). A similar investigation in the U.S of gender along with other risk factors for CVD is much needed.

Andersen and Jensen (2013) investigated the association between income factors and trends in population BP and hypertension in the prospective longitudinal Copenhagen City Heart Study among women. They found that women in higher income groups have lower systolic blood pressure than women in low-income groups and the gap between SBP in high-income women and low-income women increased with time. There were no significant differences in SBP-trend associated to income among men (Andersen & Jensen, 2013).

When gender is associated with race, Blacks continue to be the most disproportionately impacted. Black women were compared to Caucasian women in regards to 4 categories of CVD: coronary artery disease (CAD), hypertension, stroke, and congestive heart failure (CHF) in a literature review (Williams, 2009). The statistical findings from Williams' (2009) review of the research over the past several years indicate that Black women have greater mortality than Caucasian women from CAD, hypertension, stroke, and CHF. Incidence, prevalence, and morbidity figures for CAD, hypertension, stroke, and CHF are all higher for Black females than for Caucasian females (Williams, 2009).

**Role of Education in CVD and Hypertension Health Outcomes**

There has been a long-standing inverse relationship between education and mortality that has strengthened substantially at the end of the 20th century (Cutler, et al., 2011). For example, during 1986 to 2002, the growing gradient for all-cause mortality reflected increasing mortality among low-educated women and declining mortality among college-educated women; during 2003 to 2006 it mainly reflected declining mortality among college-educated women (Montez & Zajacova, 2013).

The need to understand the relationship of educational achievement with hypertension and CVD morbidity and mortality outcomes is important. This is important because educational achievement has been negatively linked to numerous other health conditions and health outcomes (Cutler, 2011). An example of a publication that used national data to study education was identified. A cross sectional study using the 2006 Behavioral Risk Factor Surveillance System (BRFSS) was conducted (Kelly & Weitzen, 2010). Among respondents aged 40 years and older to the 2006 BRFSS survey those with less than a high school education had 3.09 (95% CI: 2.79-3.43) times the odds of having had a myocardial infarction (MI) compared to college graduates. After adjusting for confounders, respondents with less than a high school education had 1.61 (95% CI: 1.41-1.83) times the odds of having had an MI compared to college graduates. According to the researchers' findings, participants with a high school education and those who completed some college or technical school were 1.22 times more likely to have had a myocardial infarction in comparison to college graduates (Kelly & Weitzen, 2010).

Education was often studied in conjunction with other indicators. For example, Gupta (2014) examined the disparities associated with the risk factors for CVD in Delaware. In the manuscript, the researcher stated that prevalence of multiple risk factors was higher for the aged, less educated, and unemployed. This study, as well as many others that were reviewed, focused on state-level data.

**Impact of Income on CVD and Hypertension Health Outcomes**

Income levels can be linked to the health outcomes of many diseases and conditions. The relationships between income and hypertension, as well as CVD, were reviewed in the literature. A good example is found in a study that was done to assess whether community affluence modifies the association between individual SES and six CVD risk factors: diabetes, hypertension, physical inactivity, obesity, smoking, and poor nutrition (Abeyta, et al., 2012). Data were stratified from the Colorado Behavioral Risk Factor Surveillance System for 2007 and 2008 based on individual socioeconomic status and three categories of community affluence (median household income of county). People who had a low SES seemed to benefit from residing in high-affluence communities. Living in high-affluence communities may counteract the effect of poverty on CVD risk factors. Findings such as these support the value of interventions that address the social determinants of health (Abeyta, et al., 2012).

Income studies have been done in other countries. One such study examined hypertension screening campaigns in middle-income countries. The researchers sought to identify socio-demographic predictors of hypertension prevalence, diagnosis, treatment, and control among 6 middle-income countries (China, Ghana, India, Mexico,

Russia, and South Africa) (Basu & Millet, 2013). Insurance status and income were found to be significant correlates to diagnosis and treatment probability (Basu & Millet, 2013).

The ability to obtain health insurance in the United Stares is more commonly linked to one's ability to have a source of employment that provides health care coverage. Brooks, et al., (2010) investigated the relations of health insurance status to the prevalence, treatment, and control of major cardiovascular disease risk factors-hypertension and elevated low-density lipoprotein (LDL) cholesterol-among Framingham Heart Study (FHS) participants in gender-specific, age-adjusted analyses among 6098 participants. At the time of the FHS clinic examination, 3.8% were uninsured and ages ranged from 19 to 64 years. The researchers concluded that treatment and control of hypertension and hypercholesterolemia were lower among uninsured adults (Brooks, et al., 2010). Specifically, they found that: 1) the prevalence of hypertension and elevated LDL cholesterol was similar for the insured and uninsured; 2) the proportion of those who obtained treatment and achieved control of these risk factors was lower among the uninsured; and 3) uninsured men and women were less likely to be treated for hypertension (Brooks, et al., 2010).

Hajat, et al., (2010) examined the relationship between wealth and three CVD risk factors (smoking, obesity and hypertension) in a U.S. population from the Panel Study of Income Dynamics (PSID) collected between 1999 and 2005. They defined wealth as inflation-adjusted net worth and specified as a six category variable: one category for those with less than or equal to zero wealth and quintiles of positive wealth. A weak

inverse association between wealth and hypertension incidence was found after controlling for income and other time-varying confounders (Hajat, et al., 2010).

Research has been done on an aggregate basis across multiple countries on various income levels. One study sought to identify sociodemographic predictors of hypertension prevalence, diagnosis, treatment, and control among middle-income countries. The researchers analyzed data from 47,443 adults in 6 middle-income countries (China, Ghana, India, Mexico, Russia, and South Africa) sampled in nationally representative household assessments from 2007 to 2010 as part of the World Health Organization Study on Global Aging and Adult Health (Basu & Millett, 2013). Hypertension prevalence varied from 23% (India) to 52% (Russia), with between 30% (Russia) and 83% (Ghana) of people with hypertension undiagnosed before the survey and between 35% (Russia) and 87% (Ghana) untreated (Basu & Millett, 2013). Additionally, Basu and Millett (2013) found that insurance status and income emerged as significant correlates to hypertension diagnosis and treatment probability.

## Implications of Past Research on Present Research

The literature was reviewed and the findings indicate that much research has been conducted on CVD and hypertension morbidity and mortality in general. Sentinel studies such as the Framingham Study (Lalonde, 2012; Turnbull, 2010) and the CDC article titled: *Trends in Mortality Rates by Subtypes of Heart Disease in the United States, 2000-2010* by Ritchey, et al., (2014) have established the foundation for this literature review. Subpopulations who are disproportionately impacted by morbidity and mortality indicators that are linked to CVD and hypertension were identified and analyzed in the

literature. The findings from this literature and research will contribute to achieving health equity by addressing the health disparities in CVD and hypertension among those subpopulations who are disproportionately impacted. According to the World Health Organization, health equity is "the absence of unfair, avoidable or preventable differences in health among populations or groups defined socially, economically, demographically or geographically" (World Health Organization, 2015, Paragraph 27).

The CVD of focus include stroke, hypertensive disease, and chronic rheumatic heart disease. The impact of CVD on hypertensive populations was established based on the past research. There were specific subpopulations who were the most impacted when the indicators were also examined (Ritchey, et al., 2014; Satcher, 2008; Ford, 2011). These subpopulations included Blacks, low income groups and people with low educational attainment. Additionally, there were few research studies found that examined CVD and hypertension on the national level. These studies examined some of the indicators also (Liao, et al., 2012; Ritchey et al., 2014). However, there were no recent studies that examined the cumulative effect of three or more health disparities indicators of CVD in hypertension on a national level.

## Summary

Each of the indicators (i.e., race, gender, education, income, age, and geographic location) was examined in relation to CVD and hypertension in this literature review. The availability of literature varied from a very large amount for race to a very small number of relevant articles for geographic location. Morbidity and mortality health disparities were found to exist for CVD and hypertension for the indicators in certain

subpopulations. In many instances, indicators were found to overlap in some subpopulations. For example, race: Black, gender: female, and low income were linked to CVD (Williams, 2009; and O'Connor & Wellenius, 2012). The cumulative effect of the indicators for CVD among hypertensive persons across the United States is of particular concern in this literature review. Very few studies of this type were found. Although some preliminary research on states and communities explore the cumulative effect of the indicators for CVD among hypertensive persons, what has yet to be established in the literature are the impact of numerous indicators for CVD morbidity and mortality intersecting among people with hypertension in a national representative sample.

The design for this study was chosen based upon a careful review of existing public health literature in the areas of surveillance research associated with CVD, hypertension, health disparities in CVD and hypertension, and the indicators for morbidity and mortality. Numerous state- and local-level research studies were found that examined the prevalence of cardiovascular diseases, as well as hypertension, and the associated risk factors on the state and local levels. On the other hand, few studies were found that applied a health equity lens to national hypertension data and compared it with cardiovascular morbidity and mortality data across the geographic regions of the United States. This study utilized national level data to analyze the cumulative effect of health disparity indicators on CVD morbidity and mortality among people with hypertension.

The gaps in the literature that were described are addressed in the methods described in Chapter 3 of this study. In Chapter 3, the cumulative effect of indicators

(i.e., race, gender, education, income, and geographic location) among individuals within certain subpopulations will be examined to determine whether or not there are significant differences in CVD morbidity and mortality outcomes among hypertensive subpopulations experiencing health disparities.

# Chapter 3: Research Method

## Purpose of the Study

The purpose of this study was to examine the cumulative effect of demographic characteristics (i.e., race, gender, education, and income) on CVD health outcomes (i.e., coronary heart disease) among hypertensive subpopulations. Surveillance data from across the United States between 1999 to 2010 was used to determine if there are significant differences in CVD morbidity and mortality outcomes among hypertensive subpopulations that are linked to CVD and hypertension health disparities. I selected the years of 1999 to 2010 because they were the most recent data available that included the variables of interest. Numerous studies have been conducted that link one or two (i.e., race and/or gender) indicators for health disparities to CVD morbidity and/or mortality (Loustalot, et al., 2014; Turnbull, 2010). However, more research is needed to examine whether there are differences in health outcomes among subpopulations with hypertension who have numerous indicators for health disparities in comparison to subpopulations with hypertension who have one or fewer health disparities indicators. In this study I explored this potential association between numerous demographic characteristics among persons with hypertension and/or CVD outcomes.

This chapter contains a description of the study's design, sample, instrumentation, data analysis, and ethical considerations. An overview of the study's design includes a rationale for why I selected this specific research design. I presented the sample characteristics and size as well as a description of the instrumentation. I also discussed the data collection process and analysis.

## Research Design and Rationale

I utilized the quantitative cross-sectional observational study design for this study.

### Study Variables

**Dependent variable.** The dependent variables were blood pressure readings, being told that you had high blood pressure as well as CVD morbidity and mortality variables from the National Health and Nutrition Examination Survey (NHANES). I extracted other variables related to CVD morbidity and CVD mortality data variables (i.e., coronary heart disease, acute myocardial infarction, and cardiac dysrhythmia from International Classification of Diseases, 9th and 10th Revision (ICD-9 and 10 Codes) codes of the National Death Index (NDI) survey.

**Independent variable.** Independent variables were hypertension, education level, household income, race/ethnicity, body mass index (BMI), and gender. I obtained each of the independent variables from NHANES. Hypertension is defined as 140 mmHg or higher systolic, and/or 90 mmHg or higher diastolic (U.S. Preventive Services Task Force, 2007).

### Research Design

In this cross-sectional observational study, I analyzed multiple demographic characteristics (i.e., indicators for health disparities) and generalized from large samples to the United States population. The cross-sectional observational study was appropriate because it provides a numeric description of the relevant trends of certain subpopulations in the United States (Creswell, 2009). The cross-sectional observation study is less expensive and time consuming than a longitudinal study. Specifically, I utilized secondary data analysis on previously collected data to explore potential differences in health outcomes among subpopulations with hypertension who have varying indicators for health disparities, as well as address the research questions by studying a sample of that population. The population and sample data from the cross-sectional study is collected at one specific point in time versus a period of time. This has assisted me in completing the study within a reasonable period of time. I utilized this research design to address the research questions and the purpose by allowing multivariate analyses, absolute, and relative risks to be calculated from the prevalence of CVD morbidity and mortality between hypertensive subpopulations.

## Methodology

### Study Population

The population of this study consists of the participants who were screened, interviewed, and examined between 1999 to 2010 in alignment with the data that are available from the National Death Index. The information gathered by NHANES provides a glimpse of the health and nutrition for a broad range of age groups as well as

racial/ethnic characteristics of the United States population (Centers for Disease Control and Prevention, 2015). The study participants are found in 15 randomly selected counties across the United States.

## Study Sample

**Inclusion criteria**. For this research study, the sample consists of persons identified in NHANES data between the years of 1999-2010. I calculated the rates of hypertension for various subgroups. In addition, I conducted analyses on the persons with hypertension who are 30 years and older. I selected this age range because it represents the majority of the adult population who are most vulnerable to hypertension and CVD (Centers for Disease Control & Prevention, 2015). The sample with hypertension was defined by persons who answered yes to at least one of the following: ever told that they had high blood pressure (blood pressure readings which are at least 140 millimeters of Mercury (mmHg) systolic and/or at least 90 mmHg diastolic); told had high blood pressure two or more times; or taking prescriptions for hypertension.

**Exclusion criteria**. I excluded persons who are under the age of 30 years old from the study. Additionally, I excluded persons with blood pressure readings of less than 140 mmHg systolic and less than 90 mmHg diastolic that were taken during the physical examination and who are not taking prescriptions for hypertension from the study.

## Power Analysis

This is a cross-sectional study in which I utilized secondary data from a large publicly available and nationally representative data set. For this study, I computed a priori power analysis to establish the required sample size, given Alpha (α), power, and effect size. I assumed a small effect size of 0.25, along with a power of 0.80 (1-β error probability) and alpha of error probability of 0.05. The resulting sample size was 95 total participants for both research questions using multiple regression statistical tests of four variables. The large sample size (at least 1,000 participants) in this study exceeds the power needed. A statistical program such as G*Power can be used to determine the appropriate study sample size. G*Power is designed to be a stand-alone power analysis program for statistical testing (Kraemer & Thiemann, 1987).

## Procedures for Recruitment, Participation, and Data Collection

The NHANES survey conducted by the CDC is the original study and it served as the data source for this study (CDC, 2015). Population data were collected on the prevalence of chronic conditions such as hypertension and diabetes. Personal interviews, physical examinations, laboratory tests, nutritional assessments, and a DNA repository are the primary data sources and methods of NHANES. The home interview and the physical examination were the two main sources of data for this study.

**NHANES home interview.** The NHANES home interview consisted of demographic, socioeconomic, dietary, and health-related questions. The interviewer only interviewed those individuals who were at least 18 years-old. During the home interview, participants were asked questions about their health, disease history, and diet.

There were questions that were relevant to my research study. The questionnaire was retrospective, and I placed a particular interest on the questions that focus on hypertension and CVD. I extracted the participants' responses to these questions.

**Physical examination.** The physical examination consisted of a number of measurements and tests that are contingent upon the age, gender and self-reported medical conditions of the participants. Medical, dental, and physiological measurements, and laboratory tests make up the physical examination portion of NHANES (CDC, 2015). I analyzed the participants' blood pressure readings from the physical examination.

**Procedures for Recruitment**. The following procedures for recruitment were used in the original NHANES study. The communities and participants within those communities were selected using a complex, multistage probability sampling design (CDC, 2013). The researchers divided the United States into communities that were subdivided into randomly selected neighborhoods. From each neighborhood, housing units were selected at random. Selected households were approached by the NHANES interviewers who asked residents a few short questions to determine if individuals in the household were eligible. A computer algorithm randomly selects all, some, or none of the members of the household. According to the CDC (2015), approximately 5,000 persons are selected each year in 15 counties representing around 50,000 other U.S. residents. Persons 60 years-old and up, Blacks, and Hispanics are oversampled to increase the reliability and precision of estimates of health status indicators for these population subgroups (CDC, 2015). The identities of the participants are held strictly confidential. NHANES is a publicly accessible database and access and necessary

permission to restricted data items in the data set are gained by submitting a proposal to the Research Data Centers at the NCHS. The information needed for this research study can be obtained from the publicly available data sets.

**Instrumentation**

The United States Department of Health and Human Services created the National Center for Health Statistics (NCHS) in 1959. The NCHS is an agency at the who manages NHANES and the Behavioral Risk Factor Surveillance System (BRFSS). In addition, NCHS extracts mortality data files from the National Death Index (NDI) survey and links that data to NHANES. NHANES has undergone revisions and updates throughout the years. The current version of NHANES began in 1999 (CDC, 2013). Health interviews were used to collect the data at the participants' homes and from mobile examination centers. These are highly equipped medical vans that are driven by the NHANES examiners. The health interviews consisted of home interviews and the physical examinations of the selected participants followed by laboratory testing. According to the CDC (2013), the oversampling of the participants that was previously mentioned helps to increase the reliability and precision of the health status indicators for the selected population subgroups.

The information, such as the blood pressure and cardiovascular disease questions, which is collected from the health interviews are closely related to the variables of interest in the current study. The demographic, hypertension, and CVD variables from the current study can be identified in the home interviews and physical examinations.

Demographic variables that were collected from NHANES participants during the home interviews include: race, gender, age, education and income. The demographic characteristics were used as composite variables and compared based on the relevant CVD and hypertension variables from NHANES. Variable scores for the demographic characteristics were developed based on the level of risk for CVD mortality and morbidity. For example, the variable scores for race were determined for Blacks, Whites, Asians, Hispanics and others. The subpopulation with the highest risk for CVD mortality received a score of 5 followed in descending order by the other racial groups. Frequency distributions of scores from high to low risks were developed. The following CVD and hypertension variables with their descriptions were retrieved from NHANES. They were helpful in answering the research questions.

## Operationalization of the Variables

The operational definitions of education level, household income, race/ethnicity, and gender can be found in the variable tables below. Control variables are taking hypertension medications, taking cardiovascular medications, smoking, and cardiovascular fitness.

### NHANES Variables

The following tables contain descriptions of the demographic, dependent, and outcome variables for education level, gender, age, race/ethnicity, household income, hypertension, Body Mass Income, Hypertension and CVD treatments and conditions/symptoms.

**Demographic Variables:**

Table 1

*Highest Education Level Achieved by Adults*

| Code or Value | Value Description (Ordinal level of measurement) |
|---|---|
| **1** | Less Than 9th Grade |
| **2** | 9-11th Grade (Includes 12th grade with no diploma) |
| **3** | High School Grad/GED or Equivalent |
| **4** | Some College or AA degree |
| **5** | College Graduate or above |
| **7** | Refused |
| **9** | Don't Know |
| **.** | Missing |

Table 2

*Gender of Participants*

| Code or Value | Value Description (Nominal level of meas.) |
|---|---|
| 1 | Male |
| 2 | Female |

Table 3

*Age of Participants at Screening*

| Code or Value | Value Description (Ordinal level of meas.) |
|---|---|
| **0 to 84** | Range of Values |
| **85** | >= 85 years of age |

Table 4

*Race/Ethnicity of Participants*

| Code or Value | Value Description (Nominal level of meas.) |
|---|---|
| **1** | Non-Hispanic White |
| **2** | Non-Hispanic Black |
| **3** | Mexican American |
| **4** | Other Race - Including Multi-Racial |
| **5** | Other Hispanic |

Table 5

*Annual Household Income of Participants*

| Code or Value | Value Description (Nominal level of meas.) |
|---|---|
| **1** | $ 0 to $ 4,999 |
| **2** | $ 5,000 to $ 9,999 |
| **3** | $10,000 to $14,999 |
| **4** | $15,000 to $19,999 |
| **5** | $20,000 to $24,999 |
| **6** | $25,000 to $34,999 |
| **7** | $35,000 to $44,999 |
| **8** | $45,000 to $54,999 |
| **9** | $55,000 to $64,999 |
| **10** | $65,000 to $74,999 |
| **11** | $75,000 and Over |
| **12** | Over $20,000 |
| **13** | Under $20,000 |

Table 6

*Body Mass Index (BMI) of Participants*
Both males and females 2yrs. – 150 yrs.

| Code or Value | Value Description |
|---|---|
| **12.1 to 82.9** | **Body Mass Index (kg/m**2)** |

**Dependent and Outcome Variables:**

Table 7

*Hypertension Variables*

| Variable Name | SAS Label | Variable Description |
|---|---|---|
| BPQ020 | Ever told you had high blood pressure | {Have you/Has} ever been told by a doctor or other health professional that {you/s/he} had hypertension, also called high blood pressure? |
| BPQ030 | Told had high blood pressure - 2+ times | {Were you/Was} told on 2 or more different visits that {you/s/he} had hypertension, also called high blood pressure? |
| BPQ040A | Taking prescription for hypertension | Because of (high blood pressure/hypertension), {have you/has s/he} ever been told to . . . take prescribed medicine? |
| BPXSY1 | Systolic: Blood pressure (first reading) mm Hg | BPX_H |
| BPXDI1 | Diastolic: Blood pressure (first reading) mm Hg | BPX_H |
| BPXSY2 | Systolic: Blood pressure (second reading) mm Hg | BPX_H |
| BPXDI2 | Diastolic: Blood pressure (second reading) mm Hg | |

| | | |
|---|---|---|
| BPXSY3 | Systolic: Blood pressure (third reading) mm Hg | BPX_H |
| BPXDI3 | Diastolic: Blood pressure (third reading) mm Hg | |
| BPXSY4 | Systolic: Blood pressure (fourth reading) mm Hg | BPX_H |
| BPXDI4 | Diastolic: Blood pressure (fourth reading) mm Hg | |

**CVD Morbidity Variables**
Table 8

*Ever had pain or discomfort in chest*
Both males and females 40 YEARS - 150 YEARS

| Code or Value | Value Description |
|---|---|
| 1 | Yes |
| 2 | No |
| 7 | Refused |
| 9 | Don't know |
| . | Missing |

Table 9

*Severe pain in chest more than half hour*
Both males and females 40 YEARS - 150 YEARS

| Code or Value | Value Description |
|---|---|
| 1 | Yes |
| 2 | No |
| 7 | Refused |
| 9 | Don't know |
| . | Missing |

**ICD Codes from the NDI**

Tables 8 and 9, as well the ICD 9 Morbidity (Hospitalization) codes below, contain the symptoms and conditions that indicate CVD morbidity in the sample. ICD 10 Mortality Codes below that are found in the NDI survey form the morbidity variable. These codes are extracted by the NCHS from the NDI survey and linked to NHANES data. The following list contain the ICD 9 and 10 codes that indicate CVD mortality and/or morbidity outcomes in this research study.

**Morbidity (Hospitalizations) from the NDI Survey: ICD-9 Codes**

- All Heart Disease: 390-398, 402, 404, 410-429; principle (i.e., first-listed) diagnosis.
- Coronary Heart Disease: 410-414, 429.2; principle (i.e., first-listed) diagnosis.
- Acute Myocardial Infarction: 410; principle (i.e., first-listed) diagnosis.

- Cardiac Dysrhythmia: 427; principle (i.e., first-listed) diagnosis.
- Heart Failure: 428; principle (i.e., first-listed) diagnosis.
- Hypertension: 401-405; principle (i.e., first-listed) diagnosis.

**Mortality from the NDI Survey**: **ICD-10 Codes**

- All Heart Disease: I00-I09, I11, I13, I20-I51; underlying cause of death.
- Coronary Heart Disease: I20-I25; underlying cause of death.
- Acute Myocardial Infarction: I21-I22; underlying cause of death.
- Cardiac Dysrhythmia: I47-I49; underlying cause of death.
- Heart Failure: I50; deaths with heart failure mentioned in any of the 20 listed causes of death on the death certificate.
- Hypertension: I10-I15; deaths with hypertension mentioned in any of the 20 listed causes of death on the death certificate.

## Data Analysis

SAS software was used to analyze the data. Descriptive statistics was used first to describe the basic features of the data and provide summaries about the sample and the measures. The best and worst groups will be identified according to the CVD morbidity and mortality outcomes. Descriptive statistics were used to point out variables that should be further examined. The CVD morbidity variables for chest pain and hospitalization codes from ICD-9, as well as the ICD-10 Mortality Codes, were counted to determine the number of CVD related morbidity and mortality diagnoses.

## Multivariate Analyses

Multivariate analyses were performed to assess associations between CVD outcomes and multiple risk factors for CVD morbidity and mortality amongst those with hypertension who may have numerous health disparities risk factors. The absolute, relative and percent variations of the demographic variables for mortality and morbidity were computed. Regression models were used to assist in investigating the relationships between the dependent variables and the independent variables. Logistic regression was used to analyze the CVD morbidity and mortality variables from the ICD-9 and ICD-10 codes to identify the relevant diagnoses. In addition, interaction variables were identified and used with regression modelling to better understand the relationships among the variables.

**Absolute Difference and Relative Difference.** The absolute difference is calculated by subtracting the rate for a reference population from the rate from the other populations. The relative difference is obtained by dividing the absolute difference by the rate for the reference population and the result is expressed as a percentage of the rate for the reference population. In this study, the absolute and relative differences in CVD outcomes for racial/ethnic groups were calculated by identifying the Race/Ethnic group with the best CVD outcomes and considering them to be the reference group. This reference group is compared to the other Race/Ethnic groups.

Table10 aligns the research questions with the relevant study variables and statistical analyses that were utilized in this research study.

Table 10

*Statistical Analyses*

| Research Questions | Variable(s) | Analyses |
|---|---|---|
| RQ1: Are there significant differences in the selected CVD morbidity outcomes between hypertensive subpopulations, ages 30 years and up, experiencing health disparities and the best group (i.e., the subpopulation with the best CVD morbidity outcomes) in the United States for hypertension and when three or more indicators (i.e., race, gender, education, income) intersect?<br>The following variables include: CVD morbidity as a dependent variable; age, education level, household income, race/ethnicity, body mass index (BMI), and gender are the independent variables. Other covariates are hypertension medications, taking cardiovascular medications, smoking, and cardiovascular fitness. | Demographics: Age, Gender, Race/Ethnicity, Education & Income<br>Hypertension Indicators & CVD Morbidity from NDI<br>Demographics by Morbidity (Hospitalizations) from NDI, Hypertension Indications and CVD Covariates | Descriptive Statistics<br>Bivariate Analysis<br>Multivariate Analysis<br>Regression Models, Logistic Regression and Interaction Variable<br>Absolute and Relative Differences |

| | | |
|---|---|---|
| RQ2: What are the significant differences in CVD mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group (i.e., the subpopulation with the best CVD mortality outcomes) with hypertension in the United States when three or more indicators (i.e., race, gender, education, income) intersect? The following variables that are relevant to this question include: CVD mortality as a dependent variable; education level, household income, race/ethnicity, BMI, and gender are the independent variables. Other covariates are: hypertension medications, taking cardiovascular medications, smoking, and cardiovascular fitness. | Demographic: Age, Race, Education, & Income<br><br>Hypertension Indicators & CVD Mortality from NDI<br><br>Demographics by Mortality from NDI, Hypertension Indications and CVD conditions | Descriptive Statistics and Variable Scores<br><br>Bivariate Analysis<br><br>Multivariate Analysis<br>Regression Models, Logistic Regression and Interaction Variable<br>Absolute and Relative Differences |

## Research Questions and Hypotheses

The following research questions and hypotheses were used to test the cumulative effect of demographic variables on CVD morbidity and mortality among persons with hypertension in the United States.

RQ1: Are there significant differences in the selected CVD morbidity outcomes between hypertensive subpopulations, ages 30 years and older, experiencing health disparities and the best group (i.e., the subpopulation with the best CVD morbidity

outcomes) in the United States for hypertension and when three or more of the following indicators intersect?

**Indicators** among individuals within certain subpopulations include race, gender, age, education, and income.

**Selected CVD morbidity** include reporting severe pain in the chest more than half hour and pain or discomfort in chest reported by participants in NHANES. Coronary heart disease, acute myocardial infarction, cardiac dysrhythmia, and heart failure reported in NDI survey.

$H1_0$: There are no significant differences in cardiovascular disease morbidity outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States for hypertension and when three or more indicators intersect.

$H1_A$: There are significant differences in cardiovascular disease morbidity outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States for hypertension and when three or more indicators intersect.

RQ2: What are the significant differences in cardiovascular disease mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group (i.e., the subpopulation with the best CVD mortality outcomes) in the United States for hypertension and when three or more of the following indicators intersect?

**Indicators** among individuals within certain subpopulations include race, gender, age, education, and income.

**Selected CVD mortality** include coronary heart disease, acute myocardial infarction, cardiac dysrhythmia, and heart failure reported in the NDI survey.

$H2_0$: There are no significant differences in cardiovascular disease mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States for hypertension and when three or more indicators intersect.

$H2_A$: There are significant differences in cardiovascular disease mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States for hypertension and when three or more indicators intersect.

Descriptive statistics, bivariate analyses, and multivariate analyses with Regression Models were used to test the cumulative effect of demographic variables on CVD morbidity and mortality among persons with hypertension in the United States for the research questions and hypotheses. Specifically, descriptive statistics described the basic features of the data and provided summaries. A bivariate analysis was conducted to analyze hypertension and CVD to determine the empirical relationship between them, as well as test simple hypotheses of association. Multivariate analyses were performed to assess changes in the risk for CVD morbidity and mortality among those with hypertension who may have numerous health disparities risk factors. The absolute, relative and percent differences of the demographic variables for mortality and morbidity were computed. The specific variables that were presented are the following dependent variables: 1) CVD morbidity – hospitalizations for pain or discomfort in the chest and

coronary heart disease, acute myocardial infarction, heart failure and cardiac dysrhythmia diagnoses. 2) CVD mortality – death as a result of coronary heart disease, acute myocardial infarction, heart failure and cardiac dysrhythmia diagnoses. Independent variables are education level, age, household income, race/ethnicity, body mass index (BMI), and gender. Having hypertension is an inclusion criterion for this study. Other covariates are: hypertension medications, taking cardiovascular medications, smoking, and cardiovascular fitness, cholesterol levels, and hemoglobin A1-C levels. This study will use CVD event surveillance data and secondary data analysis to respond to the research questions.

Descriptive statistics were performed on the following demographic variables: age, gender, race/ethnicity, education and income. Bivariate analysis using the hypertension indicators on CVD morbidity and mortality from the NDI. Regression analyses will be done using the demographics by morbidity and mortality from NDI, hypertension indications and CVD conditions. Interaction variables will be identified and used with regression modelling to better understand the relationships among the variables.

## Threats to Validity

This study focuses on relationships between hypertension, cardiovascular disease and indicators of health disparities. Given that this study is both cross-sectional and correlational, causation was not assessed. Internal validity is much stronger for experimental designs than for correlational designs. The interview portion of NHANES is retrospective. Difficulty remembering is a major limitation of retrospective studies.

For example, recalling if they were told that they had high blood pressure two or more times may be difficult for some of the participants. This may result in inaccurate or biased recall. Additionally, it cannot be assumed that correlation leads to causation. Since the intent of this study is to determine if a relationship exist between the indicators for health disparities and hypertension and CVD, a correlational design was appropriate in spite of its limitations.

## Ethical Procedures

NHANES serves as the primary data source for this research project. The ethical concerns regarding access to participants and the treatment of data were addressed by the researchers who plan and execute NHANES. Agreements to access data are not needed because it is available for public use. Data were stored and maintained in an electronic file on a computer that is password protected and will be kept for at least five years. Human participation is not a factor because this is secondary data. However, all guidelines were followed and relevant approval from Walden IRB regarding the treatment of human subjects and data was obtained. Data was anonymous and confidential. The primary researcher has access to the data along with the two committee members.

## Summary

This research study examined whether there are differences in health outcomes among subpopulations with hypertension who have numerous demographic characteristics that are health disparities indicators for CVD in comparison to subpopulations with hypertension who have one or fewer health disparities indicators.

This cross-sectional observational study analyzed multiple demographic characteristics among people with hypertension that are indicators for health disparities and generalized from large samples to the U.S. population using surveillance data from NHANES. The demographic characteristics were analyzed and compared based on the relevant CVD and hypertension variables from NHANES. The cumulative effect of variables was determined by quantifying the variables that merge across CVD and morbidity and mortality among people with hypertension in the study population to assess disparities and changes in disparities.

The next chapter discusses the data analysis and results. In Chapter 4, the cumulative effect of indicators (i.e., race, gender, education, and income) will be analyzed to determine if there are significant differences in CVD morbidity and mortality outcomes among hypertensive subpopulations experiencing health disparities. Additionally, the multivariate analysis, the relative risks of the combined variables, and the index of disparity results for each of the groupings will be analyzed.

# Chapter 4: Results

## Introduction

The purpose of this research was to explore the cumulative effect of demographic characteristics such as race, gender, age, education, and income to determine if there are significant differences in CVD morbidity and mortality outcomes among hypertensive subpopulations that are linked to CVD and hypertension health disparities. The research questions and hypotheses were:

RQ1: Are there significant differences in the selected CVD morbidity outcomes between hypertensive subpopulations, ages 30 years and older, experiencing health disparities and the best group (i.e., the subpopulation with the best CVD morbidity outcomes) in the United States for hypertension and when three or more of the following indicators intersect?

$H1_0$: There are no significant differences in cardiovascular disease morbidity outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States for hypertension and when three or more indicators intersect.

$H1_A$: There are significant differences in cardiovascular disease morbidity outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States for hypertension and when three or more indicators intersect.

RQ2: What are the significant differences in cardiovascular disease mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group (i.e., the subpopulation with the best CVD mortality outcomes) in the United States for hypertension and when three or more of the following indicators intersect?

$H2_0$: There are no significant differences in cardiovascular disease mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States for hypertension and when three or more indicators intersect.

$H2_A$: There are significant differences in cardiovascular disease mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States for hypertension and when three or more indicators intersect.

This chapter is organized into the following sections: data analysis, results, and summary.

## Data Collection

The data were collected by the NHANES from 1999-2010 from the U.S. population residing in 15 counties per year in the United States (CDC, 2017). The 45,033 respondents from all age and gender groups were recruited from various counties across the United States. 9,296 respondents with hypertension who were 30 years and older met the criteria and were found to be eligible for the research study. It was also necessary to identify study participants who were taking prescribed hypertension medication. There were 8,781 participants with hypertension who stated that they were prescribed medication to control their blood pressure. Additionally, 7,236 participants were identified who stated that they are now taking prescribed hypertension medication). Amongst people with hypertension, the hypertension medication use of the subpopulations with at least two or more health disparity indicators were compared to those with one or less health disparity indicator in Table 11 (CVD Morbidity) in order to assess whether there was a confounding effect. It was found that no significant difference in medication use existed between those persons with 0 to 1 health disparity indicators (i.e., age, education, race, gender and income) who were taking hypertension

medications and those with 2 or more health disparity indicators who were taking medication for hypertension for CVD morbidity.

Table 11

*Odds Ratios with Point Estimates for Persons Taking Hypertension Medication Among Health Disparity Indicator Categories for Adults 30 Years and Older With Hypertension for CVD morbidity*

| Hypertension Medication Use among Health Disparity Indicator Categories | Point Estimates Odds Ratios | (95% CL) |
|---|---|---|
| BP Medication Cat 2 vs 1 | 1.083 | (0.896-1.307) |
| BP Medication Cat 3 vs 1 | 1.003 | (0.811-1.240) |
| BP Medication Cat 4 vs 1 | 1.065 | (0.761-1.491) |

Table 12 contains the descriptions, types and coding for the independent and dependent variables of this study. I found no discrepancies in the data collection for the plan that was presented in Chapter 3. The sample included participants from all race/ethnicities who were hypertensive, 30 years and older of both genders. A complex, multistage probability design with a larger sample size is used by NHANES in order to increase the reliability and accuracy of the health status of the target population, and to ensure the representativeness of sample (CDC, 2015).

Table 12

*Independent and Dependent Variable Coding*

| Variables<br>Independent Variables | Type of variable | Data coding |
|---|---|---|
| Highest Education Level Achieved | Categorical | 1= Less Than High School<br>2= High School Diploma<br>3=Some college or AA degree<br>4=College graduate or above |
| Race/Ethnicity | Nominal | 1=Caucasian or White<br>2=Black<br>3=Hispanic<br>4= Other Race (Including Multi-racial) |
| Poverty Income Ratio (PIR) | Categorical | 1=Income below poverty level<br>0= Income above poverty level |
| Gender | Categorical | 1=Male<br>2=Female |
| Age | Interval<br>Categorical | 30 Years and older<br>1=30-44 years<br>2=45-54 years<br>3=55-64 years<br>4=66-74 years<br>5=75-79 years<br>6=80+ years |
| Told to take BP Medication | Categorical | 1=Yes<br>2=No |
| Now Taking BP Medication | Categorical | 1=Yes<br>2=No |
| Dependent Variables | Type of Variable | Data coding |
| Morbidity | Categorical | 1=Yes<br>2=No |
| Mortality | Categorical | 1=Yes<br>2=No |
| Hypertension | Categorical | 1=Yes<br>2=No |

## Results

Data for this study were analyzed using SAS v. 9.4. The types and data coding for the independent and dependent variables are listed in Table 12. The unweighted totals, row percent, standard errors, and categories for the variables in this study are presented in Table 13. The crude associations with unweighted frequencies and row percent for CVD morbidity among hypertensive adults 30 years and older are presented in Table 14. Participants who were between the ages of 66-74 years-old (*n*=505), male gender (*n*=958), participants whose income is above the poverty level (*n*=1,259), Caucasians or Whites (n=1,018), and persons with less than a high school diploma (*n*=709) had the highest frequency in each of their categories. The crude associations with unweighted frequencies and row percent for CVD mortality among hypertensive adults 30 years and older are found in Table 15. Participants who were 80+ years-old (*n*=218), male gender (*n*=350), participants whose income is above the poverty level (*n*=406), Caucasians or Whites (*n*=345), and persons with less than a high school diploma (*n*=283) had the highest frequency of CVD mortality in each of their categories. However, the findings differed in many of the indicators when the dataset was analyzed to identify those subpopulations who bear the highest burden of CVD-associated morbidity and mortality.

Table 13.

*Characteristics of U.S. Adults aged 30 Years and Older with Hypertension, 1999-2010, n=9296.*

| | | Unweighted n | Row Percent | Standard Error |
|---|---|---|---|---|
| Total | | 9296 | | |
| Age | | | | |
| | 30-44 years | 962 | 14.42 | 0.677 |
| | 45-54 years | 1474 | 23.22 | 0.737 |
| | 55-64 years | 2103 | 22.44 | 0.553 |
| | 66-74 years | 2346 | 21.09 | 0.525 |
| | 75-79 years | 939 | 8.25 | 0.354 |
| | 80+ years | 1472 | 10.57 | 0.405 |
| Gender | | | | |
| | Male | 4514 | 46.84 | 0.569 |
| | Female | 4782 | 53.16 | 0.569 |
| PIR | | | | |
| | Income below poverty level | 1513 | 11.93 | 0.512 |
| | Income above poverty level | 6981 | 88.06 | 0.512 |
| Race/Ethnicity | | | | |
| | Caucasian or White | 4744 | 73.73 | 1.49 |
| | Black | 2266 | 13.75 | 1.084 |
| | Hispanic | 2002 | 8.37 | 1.282 |
| | Other (Including Multi-racial) | 765 | 4.14 | 0.349 |
| Education Level | | | | |
| | Less Than High School | 3402 | 24.76 | 0.735 |
| | High School Diploma | 2299 | 28.09 | 0.713 |
| | Some college | 2172 | 27.15 | 0.783 |
| | College graduate | 1398 | 19.99 | 0.793 |
| CVD | | | | |
| | Morbidity | 1729 | 18.11 | 0.654 |
| | Mortality | 599 | 1.21 | 0.259 |

Table 14.

*Crude Associations for CVD Morbidity Among Adults 30 Years and Older With Hypertension, n=1,729.*

| Health Disparity Indicators | | Frequency | Percent |
|---|---|---|---|
| Age | 30-44 years | 47 | 0.702 |
| | 45-54 years | 151 | 2.22 |
| | 55-64 years | 339 | 3.73 |
| | 66-74 years | 505 | 5.27 |
| | 75-79 years | 257 | 2.59 |
| | 80+ years | 430 | 3.59 |
| Gender | Male | 958 | 9.28 |
| | Female | 771 | 8.82 |
| Poverty Income Ratio (PIR) | Income below poverty level | 312 | 2.83 |
| | Income above poverty level | 1259 | 15.17 |
| Race/Ethnicity | White | 1018 | 14.08 |
| | Black | 388 | 2.35 |
| | Mexican American | 219 | 0.539 |
| | Other Race (Including Multi-racial) | 104 | 1.14 |
| Education Level | Less Than High School | 709 | 5.98 |
| | High School Diploma | 431 | 5.16 |
| | Some college or AA degree | 403 | 4.74 |
| | College graduate or above | 180 | 2.21 |

Table 15.

*Crude Associations for CVD Mortality Among Adults 30 Years and Older With Hypertension, n=599.*

| Health Disparity Indicators | | Frequency | Percent |
|---|---|---|---|
| Age | | | |
| | 30-44 years | 17 | 0.227 |
| | 45-54 years | 38 | 0.531 |
| | 55-64 years | 79 | 0.690 |
| | 66-74 years | 162 | 1.322 |
| | 75-79 years | 85 | 0.701 |
| | 80+ years | 218 | 1.539 |
| Gender | | | |
| | Male | 350 | 2.231 |
| | Female | 249 | 2.779 |
| PIR | | | |
| | Income below poverty level | 130 | 0.925 |
| | Income above poverty level | 406 | 3.987 |
| Race/Ethnicity | | | |
| | | 345 | 3.867 |
| | Caucasian or White | | |
| | | 135 | 0.683 |
| | Black | | |
| | Hispanic | 85 | 0.033 |
| | Other Race (Including Multi-racial) | 34 | 0.307 |
| Education Level | | | |
| | | 283 | 1.8505 |
| | Less Than High School | | |
| | | 133 | 1.3358 |
| | High School Diploma | | |
| | Some college or AA degree | 126 | 1.297 |
| | College graduate or above | 55 | 0.5312 |

**Research Question 1**

I derived the following statistical findings from two primary research questions and associated hypotheses that were aligned with the relevant study variables and statistical analyses.

RQ1: Are there significant differences in the selected CVD morbidity outcomes between hypertensive subpopulations, ages 30 years and older, experiencing health disparities and the best group (i.e., the subpopulation with the best CVD morbidity outcomes) in the United States for hypertension and when three or more of the following indicators intersect? (Health disparity indicators-age, gender, PIR, race/ethnicity, and education level).

$H_0$1: There are no significant differences in the selected CVD morbidity outcomes between hypertensive subpopulations experiencing health disparities and the best group with hypertension in the United States when three or more indicators intersect was the null hypothesis that was rejected. Of the 9,296 participants with hypertension, there were 686 cases of CVD reported. I conducted multivariable analyses within and across the five disparity indicators (i.e., age, sex, race/ethnicity, poverty-income ratio, and education level) to examine CVD morbidity among participants with hypertension who are 30 years and older. As indicated in Table 16, CVD morbidity increased as: participants got older (i.e., participants who were 80+ years-old were ten times more likely than those who were between the ages of 30-44 years); in males versus females; participants with incomes below the poverty level were 1.5 times more likely to report CVD morbidity than those whose income was above the poverty level; and in those participants who are

Black. Participants were also less likely to experience CVD morbidity as their education level increased. Those with less than high school education were 2.5 times more likely to report CVD morbidity in comparison to participants who were college graduates are above.

Table 16.

*Odds Ratios with Point Estimates for CVD Morbidity Among Adults 30 Years and Older With Hypertension, n=9,296.*

| | Point Estimates Odds Ratios | (95% CL) |
|---|---|---|
| Age | | |
| 30-44 years | Comparison grp. | |
| 45-54 years | 1.974 | (1.311-2.972) |
| 55-64 years | 3.752 | (2.476-5.686) |
| 66-74 years | 6.505 | (4.515-9.370) |
| 75-79 years | 8.791 | (6.202-12.460) |
| 80+ years | 10.153 | (6.878-14.989) |
| Sex | | |
| Male | Comparison grp. | |
| Female | 0.766 | (0.673-0.873) |
| Poverty-income ratio | | |
| Income below poverty level | 1.544 | (1.308-1.822) |
| Income above poverty level | Comparison grp. | |
| Race/ethnicity | | |
| Caucasian or White | Comparison grp. | |
| Black | 0.890 | (0.755-1.050) |
| Hispanic | 0.641 | (0.520-0.790) |
| Other Race (Including Multi-racial) | 0.716 | (0.488-1.049) |
| Education level | | |
| Less Than High School | 2.514 | (2.035-3.107) |
| High School Diploma | 1.837 | (1.420-2.375) |
| Some college or AA degree | 1.741 | (1.397-2.169) |
| College graduate or above | Comparison grp. | |

I determined health disparities among people with hypertension in this research study by identifying those subpopulations within the health disparity indicators (i.e., age, gender, PIR, race/ethnicity, and education level) who were bearing the highest burden of

CVD morbidity. I assessed interactions between the health disparity indicators and morbidity outcomes by assigning Health Disparity Indicator Scores to the health disparity indicators. The subcategories in the health disparity indicators were assigned a score of 0 for the comparison group (i.e., college graduate or above for education level) or 1 for the group with the highest disparity (i.e., less than high school for education level). According to Table 17, there were significant differences in CVD morbidity outcomes between hypertensive subpopulations experiencing health disparities when three or more indicators intersect in comparison to 0 or 1 health disparity indicator.

Table 17

*Odds Ratios with Point Estimates for Health Disparity Indicator Scores for CVD Morbidity Among Adults 30 Years and Older With Hypertension*

| Number of Health Disparity Indicators (HDI) | Point Estimates Odds Ratios | (95% CI) |
|---|---|---|
| HDI 1 vs. 0 | 9.215 | (1.969-43.131) |
| 2 vs. 0 | 12.797 | (2.725-60.093) |
| 3 vs. 0 | 15.710 | (3.232-76.356) |
| 4 vs. 0 | 12.516 | (2.544-61.580) |

However, Health Disparity Indicator Score Categories for the health disparity indicators (i.e., age, gender, PIR, race/ethnicity, and education level) were created to combine scores with small frequencies and large confidence intervals. Category 1

contains 0 to 1 health disparity indicators, Category 2 contains two health disparity indicators, category 3 contains 3 health disparity indicators, and category 4 contains 4 to 5 health disparity indicators. Table 18 shows that the CVD morbidity increases significantly as the number of health disparity indicators increase. There were significant differences in CVD morbidity outcomes between hypertensive subpopulations who were 30 years and older experiencing health disparities when up to three health disparity indicators intersect in comparison to participants with 0 to 1 health disparity indicator.

Table 18.

*Odds Ratios with Point Estimates for Health Disparity Indicator Score Categories for CVD Morbidity Among Adults 30 Years and Older With Hypertension*

| Number of Health Disparity Indicator Categories | Point Estimates Odds Ratios | (95% CL) |
|---|---|---|
| HDI Cat 2 vs 1 | 1.519 | (1.208-1.908) |
| Cat 3 vs 1 | 1.864 | (1.421-2.446) |
| Cat 4 vs 1 | 1.485 | (1.024-2.154) |

It should also be noted that point estimates for Health Disparity Indicator Score Categories for CVD morbidity among adults 30 years and older were higher for all adult participants (i.e., with and without hypertension) than for the hypertensive study participants according to Table 19.

Table 19.

*Odds Ratios with Point Estimates for Health Disparity Indicator Score Categories for CVD Morbidity Among Adults 30 Years and Older*

| Number of Health Disparity Indicator Categories | Pt. Estimates<br>Odds Ratios | (95% CL) |
|---|---|---|
| Category 2 vs 1 | 2.210 | (1.842-2.652) |
| Category 3 vs 1 | 2.833 | (2.242-3.580) |
| Category 4 vs 1 | 3.201 | (2.364-4.335) |

**Research Question 2**

RQ2: What are the significant differences in CVD mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group (i.e., the subpopulation with the best CVD mortality outcomes) in the United States for hypertension and when three or more of the following indicators intersect? (Health disparity indicators-age, gender, PIR, race/ethnicity, and education level).

$H_0$2: There are no significant differences in CVD mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group with hypertension in the United States when three or more indicators intersect was the null hypothesis that was rejected. Multivariable analyses were conducted within and across the five disparity indicators to examine CVD mortality among participants with hypertension who are 30 years and older. As indicated in Table 20, CVD mortality hazard ratios increased as: participants got older (i.e., the hazard ratio was 21.1 for participants who were 80+ years-old in comparison to 1.00 for those who were between the ages of 30-44 years); in males versus females; participants with incomes below the poverty level was 1.8 times more likely to report CVD mortality than those whose

income was above the poverty level; and in those participants who are Caucasian or White. Participants were also less likely to experience CVD mortality as their education level increased. Those with less than high school education were 3 times more likely to report CVD mortality in comparison to participants who were college graduates are above.

Table 20.

*Hazard Ratios with Point Estimates for CVD Mortality Among Adults 30 Years and Older With Hypertension*

| | Point Estimates | Hazard Ratios |
|---|---|---|
| Age | | |
| 30-44 years | Comparison grp. | 1.000 |
| 45-54 years | 0.6144 | 1.849 |
| 55-64 years | 0.9466 | 2.577 |
| 66-74 years | 1.7268 | 5.623 |
| 75-79 years | 2.1616 | 8.685 |
| 80+ years | 3.0521 | 21.16 |
| Sex | | |
| Male | Comparison grp. | 1.000 |
| Female | -0.3909 | 0.676 |
| Poverty-income ratio | | |
| Income below poverty level | 0.6067 | 1.834 |
| Income above poverty level | Comparison grp. | 1.000 |
| Race/ethnicity | | |
| White | Comparison grp. | 1.000 |
| Black | -0.0869 | 0.917 |
| Hispanic | -0.4001 | 0.670 |
| Other Race (Including Multi-racial) | -0.4957 | 0.609 |
| Education level | | |
| Less Than High School | 1.1377 | 3.120 |
| High School Diploma | 0.7089 | 2.032 |
| Some college or AA degree | 0.6906 | 1.995 |
| College graduate or above | Comparison grp. | 1.000 |

Interactions were assessed between disparity indicators by assigning Health Disparity Indicator Scores to the health disparity indicators. According to Table 21, there were significant differences in CVD mortality outcomes between hypertensive

subpopulations experiencing health disparities when three or more health disparity indicators intersect.

Table 21.

*Odds Ratios with Point Estimates for Health Disparity Indicator Scores for CVD Mortality Among Adults 30 Years and Older With Hypertension*

| Number of Health Disparity Indicators | Pt. Estimates Odds Ratios | (95% CL) | Frequency | Standard Error |
|---|---|---|---|---|
| HDI Score=0 | Comparison grp. | | 82 | 0.281 |
| 1 vs. 0 | 5.881 | (3.434-10.073) | 86 | 0.7474 |
| 2 vs. 0 | 9.512 | (5.484-16.498) | 2978 | 0.6664 |
| 3 vs. 0 | 12.192 | (6.717-22.129) | 2149 | 0.6339 |
| 4 vs. 0 | 13.771 | (7.515-25.235) | 1207 | 0.3421 |

Health Disparity Indicator Score Categories were created to combine scores with small frequencies and large confidence intervals. Category 1 contains 0 to 1 health disparity indicators, category 2 contains 2 health disparity indicators, category 3 contains 3 health disparity indicators, and category 4 contains 4 to 5 health disparity indicators. Table 22 shows that the CVD mortality increases significantly as the number of health disparity indicators increase (i.e., hazard ratios were 1.59 and 2.44 for 3 and 4 or more health disparity indicators in comparison to 0 to 1 health disparity indicator). There were significant differences in CVD mortality outcomes between hypertensive subpopulations who were 30 years and older experiencing health disparities when three or more indicators intersect in comparison to participants with 0 to 1 health disparity indicator.

Table 22.

*Health Disparity Indicator Score Categories with Hazard Ratios Among Adults 30 Years and Older With Hypertension*

| Number of CVD Death Disparity Indicator Categories | Point Estimates | Standard Errors | Hazard Ratios |
|---|---|---|---|
| HDI Cat 1 | 0 | | 1.000 |
| HDI Cat 2 vs Cat 1 | 0.4809 | 0.176 | 1.618 |
| HDI Cat 3 vs Cat 1 | 0.4636 | 0.252 | 1.590 |
| HDI Cat 4 vs Cat 1 | 0.8942 | 0.215 | 2.445 |

## Summary

In summary, findings of this study indicated that there were significant differences in CVD morbidity outcomes between hypertensive subpopulations who were 30 years and older experiencing health disparities when up to three health disparity indicators intersect in comparison to participants with 0 to 1 health disparity indicator. It was also found that these significant differences in CVD morbidity outcomes also exist among all adults 30 years and older with and without hypertension when up to four health disparity indicators intersect in comparison to participants with 0 to 1 health disparity indicator. Additionally, there were significant differences in CVD mortality outcomes between hypertensive subpopulations in the United States who were 30 years and older experiencing health disparities when three or more health disparity indicators intersect. Chapter 5 will discuss the interpretation of the findings, the limitations, the recommendations, and the implications of the study.

# Chapter 5: Discussion, Conclusions, and Recommendations

## Introduction

The purpose of this research was to investigate whether significant differences in CVD morbidity and/or mortality outcomes existed between persons with hypertension who experience three or more health disparities indicators and the best identified group with hypertension in the United States. I designed this cross-sectional quantitative study to determine the significance of the convergence of multiple indicators for health disparities (i.e. race, gender, education, income, and age) on the CVD outcomes of people with hypertension. The research population consisted of NHANES participants with hypertension, ages 30 years and older, for the years 1999 to 2010.

I assessed the descriptive statistics, bivariate analyses, multivariate analyses, odds ratios, hazard ratios, as well as interactions between health disparity indicators in the data analyses. Independent variables were education level, age, poverty income ratio, highest education level completed, race/ethnicity, and gender. The dependent variables were CVD morbidity and CVD mortality. I performed this research study was to investigate whether the intersection of at least three of the independent variables had an impact on the prevalence of CVD morbidity and mortality among 1999 to 2010 NHANES participants with hypertension between the ages of 30 years and up. I considered the impact of blood pressure medication. I also identified those participants with hypertension who were taking prescribed medication to control their blood pressure. Key findings from the data analysis showed that the following null hypotheses could be rejected. First, there are no significant differences in cardiovascular disease morbidity

outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States for hypertension and when three or more indicators intersect. Second, there are no significant differences in cardiovascular disease mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States for hypertension and when three or more indicators intersect. This means that NHANES 1999-2010 participants who were at least 30 years-old with hypertension were more likely to be affected by CVD morbidity and mortality as a result of the cumulative effect of at least three health disparities indicators.

## Interpretation of Findings

It is well-established in the literature that certain populations experience health disparities and are disproportionately impacted by CVD and hypertension. According to Duran and Perez-Stable (2019), there are research findings which "demonstrate that health disparities exist, even without poverty, and with high education and adequate access to care" (p. S8). The emphasis of this study was on hypertension and its impact on certain populations. According to the Institute of Medicine (IOM) in 2010, it was estimated that direct and indirect hypertension costs were 73.4 billion in 2009 alone. This research study extends the knowledge base. My research found that there were significant differences in CVD morbidity and mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States (i.e., the hypertensive subpopulations with 0-1 HDI) when three or more health disparities indicators intersect. The impact of blood pressure must be considered alongside other risk factors. This aligns with what was described in the literature review

(Ritchey, et al., 2014; Duran and Perez-Stable, 2019) and is reinforced in the findings of this research. Education, age, gender, poverty income ratio, and race/ethnicity are the health disparities indicators that were used as independent variables. There are also risk factors for hypertension that must be considered. The following risk factors contributed substantially to the burden of hypertension: overweight and obesity, high sodium intake, unhealthy diet, and decreased physical activity (Institute of Medicine, 2010).

Gender, age, education, race/ethnicity, and poverty-income ratio on the national level among adults are the health disparity indicators that were the foci of this research. Interventions and policies that are needed to eliminate these health disparities are far-reaching and include social determinants of health that often exceed the resources and capabilities of public health. Population-based policy interventions and interventions directed at systems-level improvements should be considered when seeking ways to prevent hypertension in the general population, as well as those who are disproportionately impacted. In a report brief titled: *A Population-based Policy and Systems Change Approach to Prevent and Control Hypertension*, the Institute of Medicine (2010) suggests integrating hypertension prevention and control interventions into the policies and programs of public health practices in ways that ways that not only support healthy eating, active living, and obesity, but also align their with populations who are most likely to be affected by hypertension. These efforts should be multifaceted. According to Agurs-Collins, et al. (2019), the wide ranging and multi-faceted factors that cause health disparities comprise every level of the socioecological model. From a research perspective, the National Institutes of Health has appealed for more research

utilizing a multi-level approach to address the health needs of disadvantaged populations (Agurs-Collins, et al., 2019). This reinforces the theoretical basis of this research study.

In the next section I describe the two research questions with the accompanying null hypotheses and alternative hypotheses. I also discuss whether each of the alternative hypotheses were supported by my research findings.

**Research Question One**

*RQ1:* Are there significant differences in the selected CVD morbidity outcomes between hypertensive subpopulations, adults who are 30 years and older, experiencing health disparities and the best group (i.e., the subpopulation with the best CVD morbidity outcomes) in the United States for hypertension and when three or more indicators (race, gender, education, age and income) intersect?

$H_0$1: There are no significant differences in the selected CVD morbidity outcomes between hypertensive subpopulations experiencing health disparities and the best group with hypertension in the United States when three or more indicators intersect.

$H_a$2: There are significant differences in the selected CVD morbidity outcomes between hypertensive subpopulations experiencing health disparities and the best group with hypertension in the United States when three or more indicators intersect. The results of this research study supported the alternative hypothesis for three or more health disparity indicators among people with hypertension 30 years or older.

Many of the disparities that were discussed in the literature review were supported in the findings of my research. The findings of the study showed that CVD morbidity increased as participants: got older; in males versus females; when incomes were below

the poverty level; among Blacks; and among those with less than high school education. This is confirmed by findings in the literature review that examined up to two health disparity indicators (Liao, et al., 2011; Liu, et al., 2011; Ritchey, et al., 2014). This research study expands the knowledge base by examining the morbidity and mortality CVD outcomes that result from the intersection of three or more health disparity indicators. There were significant differences in CVD morbidity outcomes between hypertensive subpopulations who were 30 years and older experiencing health disparities when three health disparity indicators intersect in comparison to participants with 0 to 1 health disparity indicator. In similar research study by Gupta (2014), the researcher examined multiple risk factors for CVD in Delaware using the BRFSS. The researcher found that more persons with CVD reported multiple risk factors. Additionally, the prevalence of multiple risk factors was higher for the aged, less educated, and unemployed (Gupta, 2014).

**Research Question Two**

*RQ2:* What are the significant differences in CVD mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group (i.e., the subpopulation with the best CVD mortality outcomes) with hypertension in the United States when three or more indicators (race, gender, education, age and income) intersect?

$H_0$2: There are no significant differences in CVD mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group with hypertension in the United States when three or more indicators intersect. *Ha2*: There are significant differences in CVD mortality outcomes between hypertensive subpopulations

experiencing health disparities and the best group with hypertension in the United States when three or more indicators intersect. The research study results found that the alternative hypothesis was correct for three health disparity indicators among persons 30 years or older with hypertension.

The likelihood of CVD mortality increased in the research study as: participants got older; in males; with incomes below the poverty level; in Whites; and among those with less than high school education. This is consistent with the findings of Perez-Stable, (2019) in the literature review. Regarding the CVD mortality outcomes, it must also be noted that Whites were found to be disproportionately impacted. This differs with a study in the literature review that found higher mortality rates among hypertensive men than hypertensive women, and among hypertensive Blacks than hypertensive Whites (Ford, 2011). However, the research finding in this study regarding Whites does relate to the finding in another study that CVD is a more common cause of death at older ages and that Whites were found to have a higher life expectancy in comparison to most other race/ethnic groups in the United States (Kochanek et al., 2015).

My research study found significant differences in CVD mortality outcomes between hypertensive subpopulations experiencing health disparities when three or more health disparity indicators intersect in comparison to 0 to 1 health disparity indicator. I also found that the higher HDI groups were associated with worse CVD outcomes overall regardless of hypertensive status. No comparison research was published in the literature at the time of this research study.

## Theoretical Framework: Systems Theory

The findings of this research suggest that when three or more health disparity indicators intersect in persons with hypertension, then this may result in a cumulative effect that exacerbates CVD morbidity and mortality. In addition to the impact of health disparities and the social determinants of health, Duran and Perez-Stables (2019) stated that developments in science suggest additional health determinants need to be considered in multilevel etiologic analyses to understand the contributors of health disparities. According to Argur-Collins, et al., (2019), "the factors that underlie disparities are wide ranging and multifaceted; these factors encompass every socioecological level, including individual, interpersonal, community, and societal" (p. S86). These multilevel interventions can be tailored to focus on specific subpopulations. For example, Timmons, et al. (2017) described a patient-centered intervention that aligns with Systems theory and the socioecological model which addresses hypertension-related health disparities. The researchers identified three multilevel elements (i.e., social support, lifestyle coaching, and personalized medical management) that are believed to be critical components of interventions that can successfully manage hypertension in at-risk Blacks.

## Limitations of the Study

The NHANES survey was the source of the large data sample but such factors as selection bias and response rate may have impacted the research study outcomes. Limitations in areas such as generalizability, validity, trustworthiness, and reliability arose from my execution of this cross-sectional correlational study. Generalizability is

limited because this is a correlational study that in which causation cannot be assumed. My findings also cannot be generalized to noninstitutionalized populations. I also have concerns regarding internal validity and trustworthiness because of the health interview portion of the data collection. The health interview relies on the participant to remember specific events which subjects the study to recall bias. Difficulty with memory among the participants was also a limitation. Finally, data from the NHANES survey was collected during the years of 1999 to 2010 for this research study. The age of the dataset is also a limitation that must be considered.

I did not analyze the confounding variables such as smoking, obesity, and diabetes that may also influence CVD outcomes in this study. As result, this may indicate the need for further research that includes these contributing factors. Additionally, the impact of taking hypertension medication must also be considered across the health disparity indicators. When I compared taking hypertension medication across the health disparity indicators, there were no significant difference across them with 95% CIs, and 1.08, 1.00- and 1.06-Point Estimates for Health Disparity Indicator Categories vs. Taking Hypertension Medication.

## Recommendations for Study

Findings from this research study showed that there were significant differences in CVD morbidity and mortality outcomes between hypertensive subpopulations experiencing health disparities and the best group in the United States for hypertension when three or more indicators intersect amongst 1999-2010 NHANES participants 30 years and older.

I suggest the following recommendations as I considered the strengths and limitations of this research study based on the literature that I reviewed. The principles of Systems theory can be applied to future interventions that are designed to eliminate the health inequities and address the social determinants of health that are associated with hypertension and CVD. The theoretical framework that Systems theory provides should be used in future research to examine the relationships between different subareas of health disparities indicators related to hypertension and CVD. The outcome of this research study suggests that more research and public health interventions are needed on issues related to hypertension and CVD among subpopulations who are impacted by multiple health disparity indicators (i.e., three or more) and risk factors. Additional research that compares hypertension and CVD health outcomes of people with hypertension and non-hypertensives, as well as comparing those who take hypertension medication with those who do not take hypertension medication is needed. Confounding variables such as smoking, obesity, and diabetes that may also influence CVD outcomes were not analyzed in this study. As result, this may indicate the need for further research that includes these contributing factors.

## Implications for Positive Social Change

The findings of my research study may have potential impact on hypertension and CVD morbidity and mortality outcomes through changes in clinical and public health practice by increasing the knowledge and awareness of providers, public health practitioners, and policymakers. Healthcare practitioners and providers can utilize the

findings of this study to increase focus on those patients with multiple health disparity indicators. Other changes in clinical practice may result in the use of clinical data and aggregate reports to pinpoint gaps in clinical care for patients (such as patients that are hiding in plain sight or patients that are diagnosed, but uncontrolled) and implement innovative activities to improve health outcomes among the patient population. Public health practitioners could use the results of this research study to enhance surveillance and tailor interventions to serve persons with hypertension who are faced with multiple health disparity indicators. Public health practice may be expanded to address the social determinants of health by directly impacting care such as medication coverage/costs, transportation to medical appointments, housing instability and food insecurity. Policymakers are also crucial to the needs of persons with hypertension. They can develop and promote policies that address the multiple health disparities and social determinants of health that impact the health outcomes of persons with hypertension. If this is achieved, then this research may contribute to positive social change by contributing to the reduction of morbidity and mortality from CVD, decreasing the burden of hypertension, improving the quality of life, and impacting positive changes on multiple levels (i.e., individual, interpersonal, organizational, community, and public policy) of society.

Systems theory was used as the theoretical basis which has implications when exploring the connections between multiple perspectives, components, and subareas on the macro level. Its focus on the inter-relations of multiple perspectives from complex systems, multiple variables, as well as the ability to simultaneously explore these

connections between different components and subareas on the macro level is relevant. In their study outlining the skills needed and the challenges associated with multilevel interventions, Agurs-Collins et al., (2019) recommends that resources are directed to multilevel interventions that target the broader community, societal, and environmental contexts that produce greater reductions in health disparities versus approaches targeting a single level. The findings from this research study may help to advance public health practice, generate new research, and influence clinical practice by contributing to the knowledge base in the areas of CVD and hypertension health inequities and health disparities.

## Conclusion

In conclusion, I utilized a cross sectional quantitative study design to examine whether there were significant differences in the selected CVD morbidity and mortality outcomes between hypertensive subpopulations of adults who are 30 years and older, experiencing health disparities and the best group (i.e., the subpopulation with the best CVD morbidity outcomes) in the United States for hypertension and when three or more health disparity indicators (race, gender, education, age and income) intersect. The findings showed that there were significant differences among people with hypertension in morbidity and mortality CVD outcomes when three or more health disparity indicators intersected. Education, income, gender, poverty income ratio, and race/ethnicity are key health disparities indicators that intersect and must be considered when seeking ways to reduce hypertension and CVD inequities among persons 30 years and older who are at an increased risk of CVD morbidity and mortality.

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