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Racial Differences in the Impact of a Worksite Wellness Program on Cardiovascular Biomarkers

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Abstract

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MPAS, University of Nebraska, 2000

BS, Touro College, 1984

Dissertation Submitted in Partial Fulfillment

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Doctor of Philosophy

Public Health

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Abstract

Cardiovascular disease (CVD) is responsible for approximately 600,000 deaths in the United States each year, with African Americans (AAs) disproportionately affected. Individual-level approaches to reducing CVD remain ineffective, mobilizing a movement that advocates for population-based solutions. Workplace wellness programs (WWPs) have gained considerable traction as a viable strategy for ameliorating CVD burden among workers in general. However, no studies have looked at the efficacy of WWPs in ameliorating CVD specifically among AA employees—a knowledge gap that this investigation aimed to close. Based on the health belief model and the social cognitive theory, this retrospective cohort study used de-identified secondary data to evaluate the racial differences in the mean change in CVD biomarkers between 163 AAs and 228 Caucasians civilian workers participating in a U.S. Marine Corp self-directed WWP. The 4 CVD biomarkers evaluated were systolic blood pressure (SBP), diastolic blood pressure (DBP), and waist-to-hip ratio. Repeated measures MANCOVA analysis was used to establish the contribution of the independent variable (race) to SBP, DBP, LDL cholesterol, and waist-to-hip ratio. Results showed an overall significant main effect of time for changes in SBP and DBP even after controlling for race, sex, age, and days from baseline. However, there was no overall main effect of time for changes in LDL cholesterol or waist-to-hip ratio. Further research using randomization, a comprehensive health risk appraisal, and a larger sample size may yield additional benefits to AAs. Implications for positive social change include reduction of the extraordinarily high CVD disease burden and disparity among AAs.

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Dedication

This body of work is dedicated to all my teachers and patients who, over the years, have unwittingly taught me how to be a caring and compassionate clinician—the foundational principles of being a successful healthcare provider.

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I am most grateful to Yuko for being my wife, wise friend, and my sounding board. Thank you for allowing me to rob our family of the five long years I spent on this doctoral work. To Kevin, Meg, Michael, and Vanessa, thank you for the privilege of being your father. You guys rock! Mom and dad, your unconditional love and support are always cherished. To Dr. Dunn, Dr. Williams, and Dr. Rohrer, thank you for your guidance and support throughout this excruciatingly arduous process. I will be forever grateful. Finally, I profusely thank all my relatives and friends who directly and indirectly helped me complete this body of work.

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Chapter 1: Introduction to the Study

Introduction

The Centers for Disease Control and Prevention (CDC) has characterized cardiovascular disease (CVD) as a major public health burden, and the leading cause of death among adult American men and women (CDC, 2014a). Cardiovascular disease, which includes coronary heart disease, stroke, heart failure, and hypertension, is responsible for an estimated 600,000 deaths in the United States each year and, according to the World Health Organization (WHO), 17.3 million deaths worldwide (CDC, 2014a; WHO, 2013a). Table 1 depicts the percentage of deaths caused by heart disease across all racial and ethnic groups in the United States in 2008 (CDC, 2014a). Moreover, the direct and indirect costs of CVD to American taxpayers is about $315.4B annually—64% higher cost than that of cancer, which is the second leading cause of morbidity and mortality among Americans (Go et al., 2014).

According to the CDC (2014a), major risk factors for CVD include hypertension (or high blood pressure), low-density lipoprotein (LDL) cholesterol, overweight/obesity, diabetes, physical inactivity, tobacco use, and alcohol abuse. The American Heart Association recommended that CVD risk reduction be made a foremost public health priority and urged the adoption of multidisciplinary efforts to help people ameliorate CVD risk factors (Lloyd-Jones et al., 2010). The National Prevention Strategy, championed by the U.S. Surgeon General, included a call for continued multifaceted research to mitigate the burden of CVD (National Prevention Council, 2012). Kline and Huff (2008) urged health promoters to be aware of the disproportionate CVD disease burden among African Americans (AAs) compared to Caucasians, and the behavioral, sociocultural, and biological underpinnings that drive these racial differences. Researchers also demonstrated that there are racial differences in outcomes in CVD clinical trials (Wright et al., 2008). Investigating the racial differences in the outcomes of cardiovascular health promotion interventions, such as workplace wellness programs (WWPs), can inform future efforts to achieve best possible race-based CVD outcomes. Currently, there are no studies examining the racial differences in the impact on CVD biomarkers among WWP participants.

The goal of this dissertation investigation was to determine if there were racial differences in the impact on CVD biomarkers between AA and Caucasian employees who participated in a U.S. Marine Corps-sponsored self-directed WWP. Biomarkers are “surrogate endpoints (that) predict disease risk, monitor disease status, and provide information that might be useful for life-saving or health-promoting interventions” (Albert 2011, p. S9). Albert (2011) noted that there has been a surge in interest about biomarkers such as blood pressure and LDL cholesterol in the last decade, due to their predictive value. The four CVD biomarkers that were evaluated in this dissertation were systolic blood pressure (SBP), diastolic blood pressure (DBP), LDL cholesterol, and waist-to-hip ratio, a measurement of central obesity and sensitive predictor of CVD (Huxley, Mendis, Zheleznyakov, & Chan, 2010). In this cohort study, I analyzed secondary data to determine, retrospectively, if there were statistically significant differences in the mean change in the aforementioned CVD biomarkers.

Table 1.

Percentages of all Deaths Caused by Heart Disease

Race of Ethnic Group	% of Deaths from Heart Disease
African Americans	24.5
American Indians or Alaska Natives	18.0
Asians or Pacific Islanders	23.2
Hispanics	20.8
Whites	25.1
All	25.0

Background of the Study

Four major risk factors for CVD are hypertension, elevated LDL cholesterol, and overweight and obesity (CDC, 2014a). Hypertension (i.e., blood pressure ≥140/90 mm Hg) is a leading risk factor for CVD and one of the most common chronic diseases among adult Americans (CDC, 2013a). In fact, hypertension affects approximately 1 in 3 American adults (approximately 67 million people) with AAs disproportionately burdened (i.e., 44.3% prevalence among non-Hispanic Blacks, 32.6% among non-Hispanic Whites, and 28.3% among Mexican Americans) (CDC, 2013a). Therefore, reducing the incidence and prevalence of high blood pressure among American adults is of high priority in order to reduce the overall CVD burden—especially among non-Hispanic Blacks (CDC, 2013a). Table 2 delineates blood pressure classifications for all American adults as catalogued in the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (Chobanian et al., 2003). Hypertension refers to elevation of the SBP (the so-called top number in the blood pressure reading) and/or the DBP (the so-called bottom number in the blood pressure reading). An estimated 30 million U.S. adults have prehypertension (SBP between 120 and 139 mm Hg or DBP between 80 and 89 mm Hg) that puts them at increased risk for damage to their kidneys and other vital organs (Chobanian et al., 2003). Furthermore, many individuals with prehypertension eventually develop hypertension, so these patients are strongly advised to take steps to reduce their blood pressure to <120/80 mm Hg (Chobanian et al., 2003). For this dissertation study, blood pressure control was defined as levels <120/80 mm Hg (Chobanian et al., 2003).

Table 2.

Blood Pressure Classifications for all U.S. Adults

Classification	Systolic Blood Pressure (mm Hg)	Diastolic Blood Pressure (mm Hg)
Normal	<120	and <80
Prehypertension	120-139	or 80-89
Stage I Hypertension	140-159	or 90-99
Stage II Hypertension	≥160	or ≥100

Reducing blood LDL cholesterol—the so-called bad cholesterol—is another important strategy for reducing the incidence and prevalence of CVD among American adults. An estimated 71 million American adults age 20 and older (i.e., 34% of the adult population) suffer from high LDL cholesterol or are taking cholesterol-lowering medication (Kuklina, Shaw, & Hong, 2011). In the Third Report on the Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, the National Cholesterol Education Program of the National Institutes of Health (NIH) identified LDL cholesterol as the primary target of therapy in the clinical management of high blood cholesterol (NIH, 2002). The report further pointed out that AAs are at the highest risk for heart disease and that this group should be aggressively targeted for intervention (NIH, 2002). In a meta-analysis of 26 randomized clinical trials that involved 170,000 patients, the Cholesterol Treatment Trialists' (CTT) Collaboration found that intensive reductions in LDL cholesterol was associated with concomitant reductions in the incidence of heart attacks (CTT, 2010). Table 3 delineates blood cholesterol classifications for all U.S. adults as contained in the Third Report on the Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (NIH, 2002). For this dissertation investigation, optimal LDL cholesterol was <100 mg/dL (NIH, 2002).

Table 3.

Cholesterol Classification for all U.S. Adults

LDL Cholesterol (mg/dL)	
<100 mg/dL	Optimal
100-129 mg/dL	Near optimal/above optimal
130-159 mg/dL	Borderline high
160-189 mg/dL	High
≥190 mg/dL	Very high
Total Cholesterol (mg/dL)	
<200 mg/dL	Desirable
200-239 mg/dL	Borderline high
≥240 mg/dL	High
HDL Cholesterol (mg/dL)	
<40 mg/dL	Low
≥40 mg/dL	High

Achieving ideal body weight can effectively help to reduce the incidence and prevalence of CVD. The CDC (2012a) estimated that 69% of U.S. adults are overweight (body mass index [BMI] between 25 kg/m^2 and 29.9 kg/m^2), with 35.7% classified as obese (BMI ≥30 kg/m^2). The CDC (2012a) also reported that the prevalence of obesity is highest among AAs (47.8%) compared to Hispanics (42.5%), non-Hispanic Whites (32.6%), and non-Hispanic Asians (10.8%). In a report published by the American Heart Association, overweight and obesity were blamed for excess all-cause morbidity and mortality, including fatal heart attacks (Roger et al., 2011). According to Hammond and Levine (2010), obesity also imposes negative socioeconomic consequences, with obese individuals incurring higher direct and indirect healthcare costs compared to their normal-weight counterparts. Finally, obesity was determined to be associated with reduced productivity and presenteeism, and increased absenteeism among employees (Hammond & Levine, 2010). Table 4 delineates body weight classification for all American adults (CDC, 2012a). Instead of BMI, the WWP being evaluated for this dissertation used waist-to-hip ratio, a measurement of body composition and a reliable biomarker that betrays CVD risk (Huxley et al., 2010). Table 5 depicts the normal waist-to-hip ratio for men and women (Huxley, Mendis, Zheleznyakov, & Chan, 2010).

Table 4.

Body Weight Classification for all U.S. Adults

Weight Status	Body Mass Index (BMI)
Underweight	Below 18.5 kg/m^2
Normal	18.5-24.9 kg/m^2
Overweight	25.0-29.9 kg/m^2
Obese	30.0 kg/m^2 or higher

Table 5.

Waist-to-hip Ratio Classification for all U.S. Adults

Gender	Normal Waist-to-hip Ratio
Men	<0.95
Women	<0.86

Individual-level approach to treating and controlling CVD remains ineffective on a wide scale, and this shortfall has mobilized a movement that has advocated for community-level, population-based solutions (Ferdinand et al., 2012). For example, the Institute of Medicine (IOM) recommended that the CDC spearhead a hypertension management paradigm that leverages community-level, population-based, behavioral strategies in order to better prevent and control high blood pressure (IOM, 2010). Middleton (2009) proposed that the strategy for improving blood pressure control among AAs should be culturally sensitive, community-based, and guided by the health belief model and the social cognitive theory. In the past few decades, novel community-level interventions, such as barbershop-based and faith-based health promotion programs, have been shown to effectively identify and manage hypertension among AAs (Dodani, 2011; Victor et al., 2009). The socioecological approach to overweight and obesity prevention and management has been successfully implemented in many communities (Cheadle, 2010; Rejeski et al., 2011). Similar community-based measures have been shown to reduce abnormal lipid profiles and other CVD risk factors among 840 male and female Tehranian participants (Mirmiran, Noori, Zavareh, & Azizi, 2009).

A large body of research has shown that lifestyle, behavioral modifications enjoy more success when pursued in a supportive environment such as faith-based places of worship, and the workplace (Ard, 2010; CDC, 2007). In recent years, the workplace has emerged as a powerful environment for supporting employees' efforts to adopt healthy behaviors (Arena et al., 2013). Indeed, WWPs have gained considerable traction as effective community-level opportunities for promoting and sustaining regular exercise and other healthy lifestyle changes among workers (Carnethon et al., 2009; Merrill, Anderson, & Thygerson, 2011; & Renaud, 2008). Baicker, Cutler, and Song (2010) noted that 77% of large manufacturing employers offer some form of wellness programs to their workers, in recognition of the positive economic and health benefits of this health promotion strategy. Besides the huge financial windfall for employers, WWPs accrue positive health outcomes for a significant number of participating employees (Baicker, Cutler, & Song, 2010; Milani & Lavie, 2009). The WHO (2014) found that the workplace provides an opportunity to reach a large number of people who would otherwise be unreachable. Indeed, the workplace is a priority setting for promoting healthy behaviors, an environment in which large numbers of people can simultaneously be influenced to eat healthy, engage in regular physical activity, manage their stress, stop smoking, and adopt other healthy behaviors (WHO, 2014).

In their evaluation of a Canadian onsite employee wellness program, Chung, Melnyk, Blue, Renaud, and Breton (2009) demonstrated a significant reduction in multiple CVD risk factors such as high BMI, elevated lipids, and high blood pressure. In a similar study done by Davis et al. (2009), workers at an Austin, Texas worksite showed impressive gains in physical activity levels, reduction in body fat, and decrement in elevated blood pressure. The evidence-based strategic value of WWPs led the United

States Department of Health and Human Services (DHHS) to include WWPs as an important objective in its *Healthy People 2020* health improvement priorities (DHHS, 2013a). For its educational and community-based objectives, *Healthy People 2020* set its goal for 85% of worksites with 50 or more employees to offer onsite health promotion programs (DHHS, 2013a).

Problem Statement

The main problem addressed in this dissertation study was the limited knowledge about the efficacy of WWPs in ameliorating the CVD burden and disparity among AAs compared to Caucasians who participate in WWPs. Despite the evidence of the efficacy of WWPs in reducing CVD risk factors among the general workforce, there are no studies that have specifically examined WWPs as a community-based model for improving CVD biomarkers among AA workers—a knowledge gap that warranted investigation. This dissertation inquiry evaluated the racial differences in the mean change in four CVD biomarkers between AA and Caucasian employees participating in a U.S. Marine Corps-sponsored self-directed WWP.

Cardiovascular disease is a group of diseases that include coronary heart disease, stroke, heart failure, and hypertension, with each condition exerting excessive morbidity and mortality rates and severe socioeconomic consequences (CDC, 2014a). Controlling each risk component will go a long way in mitigating their collective lethal consequences. Unfortunately, only 46% of American hypertensives have their blood pressure under control (i.e., blood pressure <120/80 mm Hg), leaving the rest—54% of hypertensives—vulnerable to poor health outcomes such as blindness, stroke, heart attack, congestive heart failure, and end-stage kidney disease (CDC, 2013a). More troubling is that blood pressure control rates among AA women (36%) and AA men (29.9%) are even lower than the poor national average (46%) and well below the *Healthy People 2020* blood pressure control goal of 61.2% (CDC, 2013a; DHHS, 2013b). In analyzing data from the National Health and Nutrition Examination Survey from 2001 to 2006, Redmond, Baer, and Hicks (2010) found that among 21,489 American adults older than 20 years, non-Hispanic Blacks had a 90% higher odds of poorly controlled SBP and DBP compared with non-Hispanic Whites. Consequently, experts such as Odedosu, Schoenthaler, Vieira, Agyemang, and Ogedegbe (2012) have pointed out that hypertension is the single biggest contributor to the mortality gap between AAs and Caucasian Americans.

According to the expert joint panel for the American Heart Association, and the American College of Cardiology, decades of genetic, biochemical, epidemiological, ecological and in vitro studies have established a clear association between higher levels of LDL cholesterol and greater risk of CVD (Stone et al., 2014). Based on its epidemiological dataset, the CDC reported that people with high LDL cholesterol levels incur twice the risk for heart disease compared to their counterparts with lower levels of LDL cholesterol (CDC, 2014b). African Americans have higher rates of CVD compared with Caucasian even though LDL cholesterol rates among Whites (34.5%) were higher than among Blacks (30.4%), according to Kuklina, Shaw, and Hong (2011).

Overweight and obesity are recalcitrant public health issues that are major contributors to most chronic diseases among Americans (Jensen et al., 2014). The CDC

(2014) reported that AAs have the highest prevalence of obesity (47.8%) when compared with Hispanics (42.5%), non-Hispanic Whites (32.6%), and non-Hispanic Asians (10.8%). In a pooled analysis of 20 prospective studies from multiple countries, Kitahara et al. (2014) found that class III obesity (BMI 40.0-59.9 kg/m^2) was associated with very high rates of mortality, mostly due to cancer, diabetes, and heart disease when compared to normal weight (BMI 18.5-24.9 kg/m^2).

The workplace offers potentially supportive social networks that can motivate and inspire employees' to adopt and sustain CVD-lowering behaviors such as eating healthy and staying physically active (Merrill, Anderson, & Thygerson, 2011). According to the Task Force on Community Preventive Services (TFCPS), the workplace is an enduring environment that provides behavioral cues such as shared peer-to-peer perceptions of health risks and the need for behavioral modifications (TFCPS, 2010). As a microcosm of society, the workplace is a place where human networks are cultivated, and these relationships offer unique opportunities to create a culture of health and wellness (Anderko et al., 2012; O'Donnell, 2010). In addition to the obligation to provide a safe work environment for employees, employers also have a unique opportunity to protect and advance the health and wellness of the 139 million workers who spend the majority of their waking hours on the job (CDC, 2013b).

Purpose of the Study

The IOM, the DHHS, and others have called for the establishment of population-based infrastructures for promoting health and preventing chronic diseases such as CVD. Community-level health promotion programs require fewer resources, reach more people, and produce higher rates of compliance among patients when compared to clinic- and hospital-based systems (IOM, 2010). *Health People 2020* listed primary schools, universities, and worksites as potential community-level settings for promoting the health of a large number of people from diverse sociodemographic backgrounds (DHHS, 2013b). There is a large and growing body of evidence that shows the efficacy of the various workplace settings in mitigating multiple CVD risk factors among employees in general. Successful WWPs operate in a work environment that supports healthy lifestyles, characterized by executive-level endorsement and participation, pro-health promotion policies (e.g., a smoke-free workplace), and financial incentives for health and wellness achievements (Anderko et al., 2012). Supportive worksites promote a series of small, creative strategies engineered to encourage health-related behavioral change among employees. These strategies include: posting signs reminding workers to take the stairs instead of the elevator, offering healthy food choices in company-run cafeterias, and providing healthy food choices in vending machines on company premises (Gould & Johnson, 2009). Researchers have shown that these strategies produce substantial results in terms of promoting and sustaining healthy habits (Gould & Johnson, 2009).

Despite the large body of work showing the efficacy of WWPs in ameliorating CVD risk factors among employees in general, there is a gap in the scientific literature on whether or not AA workers benefit from employer sponsored WWPs. This gap in knowledge represents a lack of racial and ethnic-based data to address disproportionate CVD rates and disparity in the AA community. African Americans comprise a priority population with unique cultural perspectives that influence their perceptions of health and wellness and drive their health seeking and self-directed disease control behaviors (Middleton, 2009). Therefore, one cannot assume that the success of WWPs among the general workforce can be extrapolated to AA employees without doing a race-specific scientific inquiry. In other words, the success of WWPs in ameliorating CVD risk factors among Caucasian and Hispanic workers might or might not hold true when it comes to AA workers. Given the disparity in heart disease prevalence among AAs, the high rates of CVD risk factors among this priority population, and the need for innovative disease control strategies, evaluation of AAs in a worksite setting is a worthy inquiry.

The purpose of this study was to determine if there were racial differences in the mean change in CVD biomarkers between AA and Caucasian employees who voluntarily participated in a U.S. Marine Corps-sponsored onsite, self-directed WWP. The four CVD biomarkers evaluated were SBP, DBP, LDL cholesterol, and waist-to-hip ratio, a measurement of central obesity and sensitive biomarker of CVD. The independent variable for this study was race and the four dependent or outcome variables were SBP, DBP, LDL cholesterol, and waist-to-hip ratio. Covariates were the time from baseline measurement of biomarkers to follow-up measurement of biomarkers, age, and sex.

Nature of the Study

This was a retrospective cohort study in which "both the exposures and outcomes have already occurred when the study begins" (Aschengrau & Seage, 2008, p. 147). This study design is a commonly used nonexperimental design in which participants are pre-tested, given some treatment, and then post-tested (Frankfort-Nachmias & Nachmias, 2008). If the results of the baseline and follow-up test differ significantly, then the difference may be attributed to the independent variable. In this study, the before-and-after CVD biomarkers of AA employees were compared with the before-and-after CVD biomarkers of Caucasian employees who simultaneously participated in a WWP.

This dissertation study examined the before-and-after (i.e., baseline and follow-up) biometric data collected from employees during the 4-year period between 2009 and 2013. It compared the dependent biomarker variables between AA and Caucasian WWP participants. The independent variable for this study was race, with Whites serving as the comparison group. The four dependent or outcome variables were SBP, DBP, LDL cholesterol, and waist-to-hip ratio. The waist-to-hip ratio (normal is <0.95 for men, and <0.86 for women) is a measurement of central obesity with a CVD predictive value similar to BMI. In fact, Huxley, Mendis, Zheleznyakov, and Chan (2010), found no difference in sensitivity between BMI, waist circumference, and waist-to-hip ratio as predictors of CVD. For this study, blood pressure control was defined as SBP <120 mm Hg and DBP <80 mm Hg, based on national standards established by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (Chobanian et al., 2003). Normal LDL cholesterol was defined as <100 mg/dL (NIH, 2002).

An important covariate for this investigation was the time from baseline measurement of biomarkers to follow-up measurement of biomarkers. Additional covariates were age and sex. The source population for this study was a 2,000-person civilian workforce employed by the U.S. Marine Corps to provide community support services (e.g., restaurants, libraries, and recreation programs) for American military personnel and their families. The multiracial workforce was comprised of Asians, Caucasians, Hispanics, and AAs. The company offered a free, comprehensive onsite health promotion program in which all employees were eligible to participate. The program was run by a fully staffed Health Promotion Department that included wellness educators and certified personal trainers.

After informed consent was obtained, participants completed initial and follow-up modified health risk assessments that captured date screened, age, race, gender, nutrition habits, and physical activity patterns. Family history and medication use were not captured. Participants then underwent the following initial and follow-up biometric measurements: waist-to-hip ratio, SBP, DBP, and lipid levels. Health educators conducted individualized counseling for each participant based on health history and biomarker test results. The WWP staff also educated participants via optional free literature, newsletters and classes on nutrition, stress management, tobacco cessation, and other health promotion interventions. In addition, employees had unfettered access to fitness facilities, group fitness classes, year-round swimming pools, and other health promoting modalities, free of charge.

All study analyses were performed using Statistical Package for the Social Sciences (SPSS) version 16.0 (SPSS Inc., Chicago, IL). Confidence level was set at 95% and alpha set at <0.05. Repeated measures multivariate analysis of covariance (MANCOVA) was used to test the hypotheses.

Research Questions and Hypotheses

The research questions (RQs), the null hypotheses (H_o), and alternative hypotheses (H_a) for this study were:

RQ1: Is there a statistically significant difference in the mean change in SBP between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_1 = change in SBP from baseline to follow-up.

a. Research H_o1: There is no statistically significant difference in the mean change in SBP between AA and Caucasian participants in a worksite wellness program.
b. Research H_a1: There is a statistically significant difference in the mean change in SBP between AA and Caucasian participants in a worksite wellness program.

RQ2: Is there a statistically significant difference in the mean change in DBP between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_2 = change in DBP from baseline to follow-up.

a. Research H_o2: There is no statistically significant difference in the mean change in DBP between AA and Caucasian participants in a worksite wellness program.

b. Research H_a2: There is a statistically significant difference in the mean change in DBP between AA and Caucasian participants in a worksite wellness program.

RQ3: Is there a statistically significant difference in the mean change in LDL cholesterol levels between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_3 = change in LDL cholesterol from baseline to follow-up

a. Research H_o3: There is no statistically significant difference in the mean change in LDL cholesterol levels between AA and Caucasian participants in a worksite wellness program.

b. Research H_a3: There is a statistically significant difference in the mean change in LDL cholesterol levels between AA and Caucasian participants in a worksite wellness program.

RQ4: Is there a statistically significant difference in the mean change in waist-to-hip ratio between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_4 = change in waist-to-hip ratio from baseline to follow-up.

a. Research H_o4: There is no statistically significant difference in the mean change in waist-to-hip ratio between AA and Caucasian participants in a worksite wellness program.

b. Research H_a4: There is a statistically significant difference in the mean change in waist-to-hip ratio between AA and Caucasian participants in a worksite wellness program.

Theoretical Framework

The health belief model and the social cognitive theory (also called the social learning theory) grounded this dissertation study and informed my understanding of why individuals elected to participate or not participate in health promoting activities (Bandura, 2004; Glanz & Bishop, 2010; Middleton, 2009).

Health Belief Model

The health belief model was developed in the 1950s to help researchers understand why people opted to participate or not participate in free public health services (Glanz & Bishop, 2010). Today, investigators and community health planners use the model to explain and predict the factors and variables that drive health-related behaviors such as participation in community health programs like getting an annual influenza vaccination (McKenzie, Neiger, & Thackeray, 2009). The health belief model proposed that four perceptions drive human health-related behaviors: perceived seriousness, perceived susceptibility, perceived benefits, and perceived barriers (McKenzie et al., 2009). These perceptions are modulated by two factors: cues to action and self-efficacy.

According to the model, people who perceive a disease to be serious (e.g., the very high mortality rate of Ebola virus disease) are more inclined to take necessary precautions (Janz & Becker, 1984). Individuals who perceive that they are susceptible to a disease (e.g., daily news of new cases of measles in one's hometown) are more inclined to take action such as to get vaccinated (Janz & Becker, 1984). People are generally not moved to act when the perceived benefit of an action is low such as healthy eating may add two extra years at the backend of your lifespan (Janz & Becker, 1984). When barriers are perceived to be too great to overcome (e.g., high cost of a medication), people are less inclined to act (Janz & Becker, 1984). Table 6 lists examples of the four constructs and examples of the health belief model (Glanz & Bishop, 2010).

Table 6.

The Four Constructs of the Health Belief Model

Construct	Example
Perceived seriousness	"High blood pressure can't be that bad; it doesn't cause pain like migraine headaches do"
Perceived susceptibility	"I have been smoking for 25 years, if I haven't develop lung cancer yet it is unlikely to happen"
Perceived benefits	"My cousin lives a healthy life and he *still* developed high blood pressure; all that sacrifice seems useless"
Perceived barriers	"Why bother trying to control my salt intake; salt is in everything I can afford to eat"

The health belief model was relevant to this dissertation inquiry because its constructs helped explain the health-related beliefs and behaviors of AAs whose perceptions of health and illness can be inconsistent with the biomedical model (Middleton, 2009). In this study, AAs had higher baseline blood pressure compared to their Caucasian peers, and this might have to do with AAs perception of hypertension, a mostly symptomless disease, as being less serious than a painful migraine (Middleton, 2009). Wexler, Elton, Pleister, and Feldan (2009) found that AAs' perception of the seriousness of hypertension was lower than other groups because health programs and literature had low cultural resonance for them. Another explanation might be that the nutrition recommendations offered to WWP participants may not have resonated with AA participants. Kline and Huff (2008) stated that high prevalence of hypertension among AAs is due, in part, to lifestyle choices such as the "the preferred foods among Black Americans, including pork products, fried foods, and baked goods" (Kline & Huff 2008, p. 297).

Another aspect of the health belief model that was relevant to this dissertation investigation was the cues to action where the external health promotion messages may have been culturally inappropriate. In deciding whether or not to act, people are influenced by credible cues, such as who is delivering the message (Janz & Becker, 1984).

Social Cognitive Theory

As a largely lifestyle-induced disease with multiple behavioral and social antecedents, and spanning a wide demographical spectrum, CVD prevention can be approached from the conceptual framework of the social cognitive theory (Bandura, 2004). This theory can help researchers understand how and why individuals develop and manage chronic diseases by examining three interconnected domains: behavioral, physiological, and environmental factors (Bandura, 2004). People learn and behave by observing others, and are motivated to continue or discontinue a learned behavior by positive or negative reinforcement (Bandura, 2004). The social cognitive theory can help explain how the workplace environment shapes, maintains, and constrains health-related behaviors—a concept called reciprocal determinism.

The CDC asserted that the health of workers and their work environments are inextricably linked because, like at home, the work environment has a potent influence on health-related behaviors (CDC, 2013b). In other words, both good and poor health outcomes are cultivated at home as well as at work. From this information, researchers and health programmers can anticipate and mitigate barriers and implement strategies to influence desired behaviors (Bandura, 2004). Moreover, while illuminating the concept of self-efficacy, the social cognitive theory can help individuals develop self-monitoring and self-management skills to improve their health outcomes (Bandura, 2004).

The social cognitive theory's relevance to this dissertation study has to do with leveraging the triads of the theory to explain observed findings, and rate the efficacy of the WWP. For example, self-efficacy was shown to be a significant predictor of CVD health-related behavioral change (Sarkar, Ali, & Whooley, 2007). Persons who believe they have the ability to adopt a new activity, like a new walking program, are more inclined to do so than persons who do not believe so. In addition, the physical environment can be instrumental in driving health-related behavioral change (Cummins, Curtis, & Diez-Roux, 2007). Employees have a mutually reinforcing and reciprocal relationship with their workplace and co-workers and are inclined to assimilate the norms of their workplace, including physical activity. Finally, personal thoughts were shown to be powerful impetus for directing behavioral changes (Bandura, 2004). This has to do with internal self-monitoring and self-regulation thoughts that remind a WWP participant to eat healthy or to go for a 30minute walk.

Definition of Terms

Biometric data: This term pertains to a broad spectrum of biological, physiological, and behavioral information that identifies the unique features of individuals such as fingerprint, voice pattern, and genetic endowment (Rhoads & Ferrara, 2012). For this dissertation study, biometric data refers to personal health screening information that included measurements of the waist-to-hip ratio, blood lipids, and systolic and diastolic blood pressure.

Blood pressure: This refers to the force that blood exerts on the walls of blood vessels as it circulates from the heart to other parts of the body (Smulyan & Safar, 1997). Blood pressure is measured in two phases: the SBP (representing pressure generated when the heart contracts), and DBP (representing pressure generated when the heart relaxes) (Smulyan & Safar, 1997). Table 2 delineates blood pressure classifications for American adults as promulgated in the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (Chobanian et al., 2003). High blood pressure or hypertension is defined as blood pressure ≥140/90 mm Hg (Chobanian et al., 2003). Normal blood pressure is defined as blood pressure <120/80 mm Hg. SBP between 120 and 139 mm Hg or DBP between 80 and 89 mm Hg is termed prehypertension. For this dissertation study, blood pressure control was defined as levels <120/80 mm Hg (Chobanian et al., 2003).

Body mass index (BMI): BMI offers a standardized way to measure overweight and obesity by combining body height and weight in the following formula: weight (in pounds) divide by height (in inches) multiplied by 703 and expressed in kilograms per meter squared (kg/m^2). A healthy BMI is between 18.5 kg/m^2 and 24.9 kg/m^2. Overweight is defined as a BMI between 25 kg/m^2 and 29.9 kg/m^2. Obesity is defined as a BMI ≥30 kg/m^2 (CDC, 2012). The WWP from which the dataset for this dissertation study was generated did not use BMI as a CVD biomarker; instead, it utilized the waist-to-hip ratio.

Diastolic blood pressure: This phase of blood pressure is the relatively low-level force that blood exerts on the blood vessel walls when the heart relaxes between beats. It is the so-called bottom number in a blood pressure reading (Smulyan & Safar, 1997).

Hypertension: Also called high blood pressure, this condition is present when either the systolic or diastolic phase or both phases of blood pressure are abnormally high. This standard is based on scientific evidence of normal and abnormal pressures (Chobanian et al., 2003). Blood pressure is considered high if it is ≥140/90 mm Hg (Chobanian et al., 2003). Systolic blood pressure between 120 and 139 mm Hg or DBP between 80 and 89 mm Hg is termed prehypertension, and blood pressure control is defined as levels <120/80 mm Hg (Chobanian et al., 2003).

Lipid levels: This refers to the various forms of cholesterols, triglycerides, and other fats contained in the diet that have been implicated in the development of CVD. Among the various lipids, high LDL cholesterol level is associated with the increased risk for CVD (CDC, 2014a).

Obesity: Obesity refers to excessive body fat and is defined as a BMI ≥ 30 kg/m^2 (CDC, 2012).

Overweight: Overweight refers to excessive body fat and is defined as a BMI between 25 kg/m^2 and 29.9 kg/m^2 (CDC, 2012).

Systolic blood pressure: This phase of blood pressure is the relatively high-level force that blood exerts on the blood vessel walls when the heart contracts in an effort to circulate blood throughout the body. It is the so-called top number in a blood pressure reading (Smulyan & Safar, 1997).

Waist-to-hip ratio: This term refers to the ratio of the circumference of the waist to that of the hips, a measure of central obesity. Normal value is: <0.95 for men, and <0.86 for women. The waist-to-hip is a sensitive predictor of cardiovascular health. Huxley, Mendis, Zheleznyakov, and Chan (2010), found similar sensitivity between BMI, waist circumference, and waist-to-hip ratio as predictors of CVD risk.

Workplace wellness program: Also referred to as worksite health promotion program, or employee wellness program, this describes a variety of paid and free health services offered to workers. The most common services offered include those that pertain to nutrition, lipid levels, body weight, tobacco use, stress management, and blood pressure control.

Assumptions

I made three major assumptions due to the context of the study. The American Heart Association emphasized that worksite CVD screening should be voluntary (Carnethon et al., 2009). I assumed that participants in this study voluntarily participated in the WWP being evaluated and that they were not coerced into doing so. I also assumed that the participation behavior of AAs and Caucasians in the source population of this study (e.g., they were motivated to adopt healthy behaviors based on results of their biometric testing and health education) was representative of that of AAs and Caucasians in the general population. Finally, I assumed that the self-reported data used in the study, such as age, race, ethnicity, and gender, were accurate and not skewed by recall bias.

Limitations

This retrospective cohort study was not randomized and this limits the generalizability of the results. The study evaluated AA and Caucasian workers who voluntarily participated in a company-sponsored WWP. As volunteers, study subjects may have been more motivated than nonparticipants to participate in the WWP and to make healthy choices that resulted in improvements in CVD biomarkers. In a worksite wellness study among minority and underserved populations, Thompson, Smith, and Bybee (2005) found that the unhealthiest workers were the least likely to participate in health promotion activities. Therefore, it could be argued that the cohort of WWP participants in this dissertation inquiry represented a skewed sample, and this might make it difficult to generalize the results. Another potential limitation is the accuracy of biometric measurements. For example, the accuracy of waist-to-hip measurements may have varied from health educator to health educator doing the measurement. The source population was taken from employees who worked in a U.S. Marine Corps community service organization with unique environmental cues and features (e.g., physical fitness is widely modeled and advocated), and this might limit the generalizability of the results to the general populations. Finally, because secondary data were used for this retrospective cohort study, additional confounding factors such as workplace stress and medication use by participants were not evaluated and controlled.

Delimitations

The major delimitation of this study was that the self-directed interventions in this WWP, such as physical exercise and dietary modifications, were not fully quantified. For instance, participants were asked to report the frequency but not the intensity of their physical activity. This might have implications for dose-dependent impact on CVD biomarker changes. Another delimitation is that some WWP participants may have used personal trainers and other extra-motivational strategies to achieve their goals, producing more impressive changes in CVD biomarker outcomes. These delimitations could influence external validity and the duplicability of study results.

Significance of the Study

In comparison to other racial and ethnic groups in the United States, AAs suffer disproportionate rates of four powerful CVD biomarkers—SBP, DBP, LDL cholesterol, and obesity. The International Society on Hypertension in Blacks pointed out that hypertension, as defined by elevations in SBP and/or DBP, is a pernicious disease that imposes inordinate rates of morbidity and mortality on the AA community (Flack et al., 2010). The NIH reported that AAs have high rates of LDL cholesterol and attendant risks for CVD (NIH, 2002). Compared with other racial and ethnic groups, American Blacks also suffer from the highest prevalence of obesity, according to the CDC (2012a).

Unfortunately, individual-level efforts to control prevalent CVD and ameliorate racial disparity in CVD rates have not achieved impressive results (Ferdinand et al., 2012; IOM, 2010). On the other hand, population-level interventions are emerging as attractive options for controlling CVD biomarkers. For instance, in a review of multiple workplace interventions to help employees modify their high-risk lifestyles, Groeneveld, Proper, van der Beek, Hildebrandt, and van Mechelen (2010) found strong evidence that these community-level efforts reduced multiple CVD biomarkers among workers. Missing in the research literature, however, are studies specifically looking into whether or not WWP interventions offer an effective strategy for reducing prevalent CVD and CVD disparity among AAs.

This dissertation study demonstrated a statistically significant difference in the mean changes in SBP and DBP, two important CVD biomarkers, between AA and Caucasian participants in a WWP. The results could also add to the CVD-reduction armamentarium and best practice methods of multiple stakeholders including health promotion and public health professionals, medical clinicians, and policy makers. Health and life insurance companies, and employee trade unions might also have an interest in the results of this dissertation inquiry. Moreover, this investigation could bring positive social change to the AA community, a priority group badly in need of innovative strategies for reducing their chronic disease burden. Reducing the disparity in CVD risk could, in turn, reduce the rates of blindness, stroke, congestive heart failure, heart attack, and end-stage kidney disease among AAs (CDC, 2014a). Finally, a reduction in disease burden can reduce the high rates of individual and society expenditure associated with CVD-induced poor health outcomes.

Summary and Transitions

This dissertation study is presented in five chapters. In Chapter 1, I discussed my plan for employing a retrospective cohort design to determine whether or not there were racial differences in the mean change in CVD biomarkers between AA and Caucasian employees participating in a company-sponsored WWP. In Chapter 2, I reviewed the literature related to this research and, based on a gap in the literature, the need for this dissertation study. I focused on research design and approach, setting and sample, data collection and analysis, hypothesis testing, and the protection of human subjects in Chapter 3. Chapter 4 delineates the results of the study, and Chapter 5 offers a comprehensive discussion of the key findings of this investigation and recommendations for future research and public health practices.

Chapter 2: Literature Review

Introduction

According to the CDC, CVD encompasses a group of ubiquitous, chronic diseases that include coronary heart disease, heart failure, hypertension, and stroke (CDC, 2014a). The CDC estimates that CVD is responsible for approximately 600,000 deaths in the United States each year and, according to the WHO, 17.3 million deaths worldwide (CDC, 2014a; WHO, 2013a). The disease imposes a $315.4B annual price tag on American taxpayers—64% higher cost than that of cancer, the second leading cause of morbidity and mortality among Americans (Go et al., 2014). Cardiovascular disease risk factors include diabetes, physical inactivity, tobacco use, alcohol abuse, hypertension (as depicted by elevated SBP and/or DBP), elevated LDL cholesterol, and overweight and obesity (CDC, 2014a).

Prevalent CVD disproportionately affects African Americans (AAs) compared to other racial and ethnic groups (CDC, 2014a). Indeed, non-Hispanic Blacks suffer from higher rates of coronary heart disease, stroke, and hypertension when compared with non-Hispanic Whites, Hispanics, and Asians (CDC, 2014a). In fact, AA adults experience coronary heart disease at more than twice the rate of their Asian or Pacific Islander counterparts, and hypertension at one-and-one-half times higher than the prevalence among Mexican Americans (Department of Health and Human Services [DHHS], 2013a). The CDC, the DHHS's *Healthy People 2020*, the Institute of Medicine (IOM), and other sources have called for innovative steps to reduce the disparity of CVD among AAs (CDC, 2014a; DHHS, 2014; IOM, 2004).

The purpose of this retrospective cohort study was to determine whether or not there were racial differences in the mean change in CVD biomarkers between AA and Caucasian participants in a U.S. Marine Corps-sponsored, self-directed worksite wellness program (WWP). This dissertation inquiry analyzed secondary data generated between 2009 and 2013 as part the WWP. The four CVD biomarkers evaluated were SBP, DBP, LDL cholesterol, and waist-to-hip ratio, a measurement of central obesity and sensitive predictor of CVD (Huxley, Mendis, Zheleznyakov, & Chan, 2010).

In this chapter, I reviewed the literature relevant to CVD biomarkers including tobacco use, alcohol abuse, SBP, DBP, LDL cholesterol, and overweight and obesity. In addition, a history of employee wellness programs, WWP-associated health outcomes, and the theoretical frameworks that inform health-related behaviors were examined. Finally, I discussed the methodological differences between this dissertation study and previous community-based CVD studies. I used the electronic databases CINAHL Plus with Full Text, MEDLINE with Full Text, PubMed, Academic Search Complete, and Cochrane Central Register of Controlled Trials to conduct the search for peer-reviewed literature. I also used the CDC, the American College of Cardiology, Google Scholar, and the American Heart Association Websites. The keywords used for the search were: *cardiovascular trends United States, cardiovascular biomarkers, hypertension trends United States, low-density lipoprotein cholesterol trends United States, biomarker testing wellness programs, worksite wellness programs, worksite health promotion, African American participation in worksite health promotion, and African American versus*

Caucasian in cardiovascular disease outcomes. The initial search turned up approximately 800 articles, of which 160 were used for this dissertation study.

Cardiovascular Disease Risk Factors

The CDC (2014a) identified eight modifiable CVD biomarkers, namely tobacco use, alcohol abuse, poor nutrition practices, diabetes, physical inactivity, overweight and obesity, elevated LDL cholesterol, and hypertension. Together, these risk indicators are responsible for most cardiovascular morbidity and mortality in the United States. IJzelenberg et al. (2012) have demonstrated the value in mitigating modifiable CVD biomarkers even among pharmacologically treated patients with stable CVD. Blacks develop CVD risk factors earlier and experience higher rates of CVD morbidity and mortality than their White counterparts (CDC, 2014a). Nonmodifiable CVD risks include advancing age, family history, male gender, and AA race (CDC, 2014a). Clearly, nothing can be done about the nonmodifiable biomarkers, but primary and secondary, population-level interventions can be aggressively leveraged against the modifiable CVD biomarkers (CDC, 2014a). Table 7 lists the modifiable and non-modifiable cardiovascular disease risk factors for all American adults (CDC, 2014a).

Table 7.

Cardiovascular Disease Risk Factor for all U.S. Adults

Modifiable Risk Factors	Non-Modifiable Risk factors
Tobacco use	Advancing age
Alcohol abuse	Family history
Poor nutrition practices	Male gender
Diabetes	African American race
Physical inactivity	
Elevated LDL cholesterol	
Overweight and Obesity	
Hypertension	

Tobacco Use

In a report promulgated by the DHHS, the U.S. Surgeon General characterized tobacco use as the leading cause of preventable morbidity and mortality among Americans (DHHS, 2014a). In fact, between 1965 and 2014, smoking and secondhand smoke were responsible for more than 20 million deaths among Americans from a variety of diseases, including CVD (DHHS, 2014a). Tobacco use affects virtually every organ system in the body, and has been linked to numerous types of cancers, a number of respiratory diseases, immune dysfunction, connective tissue disorders, diabetes, reproductive and sexual dysfunctions, and CVD (DHHS, 2014a). Although rates of tobacco use among American adults have declined sharply in the past 50 years (from 50% to 20% use prevalence), disparity in use prevalence remains across socioeconomic strata, educational levels, and race and ethnicity (DHHS, 2014a). Today’s adult smoker is typically from a minority group, is less education, and command fewer socioeconomic resources than his or her non-smoking counterpart. Most adult smokers began their habit during the teen years, making teens an important target for public health tobacco cessation intervention (DHHS, 2014b).

Smoking cessation is an important strategy for CVD reduction, and the authors of *Healthy People 2020* set national tobacco use prevalence goals at 12%—an 8% reduction goal from current rates (DHHS, 2014b). In a population-based cohort, tobacco cessation was associated with a lower risk for CVD events among participants with diabetes, despite the resulting weight gain (Clair, et al., 2013). The CDC devotes robust resources to tobacco cessation and youth tobacco use prevention at the state and local levels. In addition to funding media campaign and surveillance programs, the CDC provides practical tobacco cessation tips for the individual tobacco user (CDC, 2013d).

Alcohol Abuse

Excessive alcohol use is the third leading cause of lifestyle-related deaths among Americans, claiming 88,000 lives each year (CDC, 2014b). According to the CDC (2014b), alcohol abuse resulted in 3.9 million medical visits in 2006, and cost taxpayers an estimated $223.5B. Binge drinking is defined as ≥4 drinks in one sitting for women and ≥5 drinks in one sitting for men, while heavy drinking refers to ≥8 drinks in one sitting for women and ≥15 drinks in one sitting for men. Both practices are dangerous and can result in accidents, injuries, violence, risky sexual behaviors, and obstetrical problems (CDC, 2014b). Over time, excessive alcohol use can lead to liver disease, neurological disease, CVD, psychiatric illness, some cancers, and many social problems (CDC, 2014b).

Interestingly, however, alcohol use is associated with both cardiovascular protection and adverse CVD outcomes. While higher levels of intake incur an increased risk for CVD, light to moderate alcohol consumption (i.e., 1 drink per day for women or 1 to 2 drinks per day for men) has been shown to be cardioprotective (O'Keefe, Bhatti, Bajwa, DiNicolantonio, & Lavie, 2014). A meta-analysis of 84 studies related to the association of alcohol consumption and CVD showed that 1 to 2 drinks per day protected against coronary heart disease and all-cause mortality, but $\leq$1 drink per day protected against stroke (Ronksley, Brien, Turner, Mukamal, & Ghali, 2011).

The following individuals should refrain from using any form of alcohol: recovering alcoholics, pregnant women, people taking drugs that negatively interact with alcohol, persons under 21 years old, individuals who drive or operate heavy machinery, and patients with medical conditions that can be worsened by alcohol (CDC, 2014b). People who chose to consume alcohol should do so responsibly. Women who drink should not exceed 1 drink per day and men should keep their alcohol consumption to 1 to 2 drinks per day (CDC, 2014b).

Poor Nutrition Practices

Poor dietary habits are strongly associated with an increased risk for CVD. In fact, in multiple epidemiological studies, CVD has been linked to low intake of dietary fibers, and high consumption of sugars, sodium, unhealthy fats, and excessive calories (Mozaffarian, Appel, & Van Horn, 2011). Conversely, high fiber via increased intake of fruits and vegetables has been associated with a reduction in CVD risk (He, Nowson, Lucas, & McGregor, 2007). In a randomized control study of 7447 persons followed for almost 5 years, two versions of the Mediterranean diet (one emphasizing extra-virgin olive oil; the other, nuts) were associated with a significant reduction in CVD biomarkers (Estruch et al., 2013). Esposito et al. (2004) suggested biological reasons for the cardioprotective properties of the Mediterranean style of eating, namely that it augments endothelial function and reduces vascular inflammation biomarkers.

Studies suggest that some micronutrients might be associated with positive and negative CVD outcomes. Pilz et al. (2011) stated that, despite the paucity of conclusive randomized clinical trials, the epidemic of vitamin D deficiency is likely linked to an increase in CVD risk. A modest reduction in sodium intake has been associated with substantial reductions in cardiovascular events (Bibbins-Domingo et al., 2010). Omega-3 polyunsaturated fatty acids have been recommended as a supplement for CVD prevention (Mozaffarian et al., 2011).

A large body of rigorously obtained evidence now point to cardioprotective dietary habits. In order to reduce the risk for CVD, Mozaffarian et al. (2011) recommended components of the following dietary patterns: Mediterranean, vegetarian, Okinawan, and DASH (Dietary Approaches to Stop Hypertension). These diets are comprised of the following nutrients: nuts, which contain so-called healthy fats and vegetable proteins; fiber from so-called healthy carbohydrates such as whole grains; protein, mostly from fish and beans; and low-fat dairy products which contain calcium, vitamin D, potassium, magnesium, and other micronutrients. Finally, maintaining energy balance (i.e., a balance between calories consumed and expended) is important in ameliorating multiple CVD biomarkers such as overweight and obesity (Mozaffarian et al., 2011).

Diabetes

Diabetes refers to a group of diseases characterized by elevated blood sugar levels due to defect in insulin production, utilization, or a combination of both (CDC, 2014c). An estimated 29.1 million Americans (9.3% of the American population) have diabetes (CDC, 2014c). Of this number, 27.8% (8.1 million people) have undiagnosed diabetes and are in danger of serious complications (CDC, 2014c). Another 37% of American adults have pre-diabetes, and are at increased risk for developing diabetes. American Indians and Alaska natives (15.9%), non-Hispanic Blacks (13.2%), and Hispanics (12.8%) are disproportionately affected compared with Asian Americans (9.0%) and non-Hispanic Whites (7.6%) (CDC, 2014c). The disease is the seventh leading cause of death in the United States and it levies approximately $245B in direct and indirect costs, annually.

Diabetes affects multiple organ systems such as the eyes, kidneys, heart and blood vessels, and controlling blood sugar levels has been shown to reduce diabetic-induced complications (CDC, 2014c). Analysis of the Framingham database showed that the proportion of CVD attributable to diabetes has risen in the past 50 years (Fox et al., 2007). A meta-analysis of 102 prospective studies showed that diabetes incurs a two-fold excess risk for developing a variety of CVDs (Sarwar et al., 2010). Diabetes is managed via a multi-pronged approach that includes regular physical exercise, weight loss, and medication, if needed (CDC, 2014c). An important goal of diabetic management is the elimination of other CVD risks such as high blood pressure, elevated LDL cholesterol levels, and tobacco use.

Physical Inactivity

Sedentary lifestyle is associated with increased risks for multiple diseases including CVD, and regular physical activity has been shown to attenuate these risks. In a joint position paper, the American College of Cardiology and the American Heart Association declared that there is an inverse, dose-response relationship between higher levels of physical activity and lower rates of many chronic diseases, including CVD (Eckel et al., 2013). According to the CDC (2011), less than half (48%) of Americans get the 2008 recommended amount of physical activity, with men significantly more compliant (52.1%) than women (42.6%). Only an estimated 22.8% of non-Hispanic Whites and 17.3% of non-Hispanic Blacks achieve the recommended level of aerobic and muscle-strengthening physical activity (CDC, 2011).

Physical activity minimizes the risk for CVD, in part, by improving blood lipid profile and blood pressure levels. In addition, physical activity can improve blood sugar level, improve cognitive function and mood, control body weight, strengthen bones and muscles, and reduce the risk of some cancers (CDC, 2011). The American College of Cardiology and the American Heart Association recommended that adults engage in 40 minutes of moderate- to vigorous-intensity physical activity 3 to 4 times per week (Eckel et al., 2013).

Overweight and Obesity

Excessive body weight is a common contributing factor to CVD (CDC, 2014a). Overweight and obesity and their attendant sequelae, such as some cancers, type 2 diabetes, and CVD, remain recalcitrant pubic health issues in the United States (CDC, 2012a). Approximately 69% of American adults are overweight (body mass index [BMI] between 25 kg/m^2 and 29.9 kg/m^2), with 35.7% classified as obese (BMI $\geq$30 kg/m^2), according to the CDC (2012). The CDC (2012) reported that non-Hispanic Blacks suffer disproportionate rates of prevalent obesity (47.8%) compared with Hispanics (42.5%), non-Hispanic Whites (32.6%), and non-Hispanic Asians (10.8%). In a report published by the American Heart Association, overweight and obesity were blamed for excess all-cause morbidity and mortality, including CVD and CVD-related fatalities (Roger et al., 2011). According to Hammond and Levine (2010), obesity also imposes negative socioeconomic consequences, with obese individuals incurring higher direct and indirect healthcare costs compared with their normal weight counterparts. Obesity is also associated with reduced productivity and presenteeism at work as well as increased absenteeism (Hammond & Levine, 2010). Table 4 delineates body weight classification for all United States adults (CDC, 2012a).

Elevated LDL Cholesterol

LDL cholesterol is a major biomarker for CVD risk (CDC, 2014a). According to experts on a joint panel for the American Heart Association, and the American College of Cardiology, decades of genetic, biochemical, epidemiological, ecological and in vitro studies have established a clear association between higher levels of LDL cholesterol and greater risk of CVD (Stone et al., 2014). Based on its epidemiological dataset, the CDC reported that people with high LDL cholesterol levels incur twice the risk for heart disease compared to their counterparts with lower levels of LDL cholesterol (CDC, 2014a). In a meta-analysis of research data obtained from 170,000 patients in 26 randomized trials, the Cholesterol Treatment Trialists' (CTT) Collaboration found that aggressive reductions in LDL cholesterol was associated with concomitant reductions in the incidence of heart attacks (CTT, 2010).

According to the CDC (2014e), approximately 71 million American adults have high LDL cholesterol levels. Unfortunately, only 1 in 3 adults with high LDL cholesterol have their condition under control. Table 3 lists the cholesterol standards for American adults. Optimal LDL cholesterol should be <100 mg/dL. Persons with elevated LDL cholesterol should exercise daily (see Physical Inactivity, above), consume a healthy diet (see Poor Nutrition Practices, above), achieve ideal body weight and body composition (see Overweight and Obesity, above), and refrain from tobacco use (see Tobacco Use, above).

Hypertension

Hypertension (i.e., blood pressure ≥140/90 mm Hg) is a major risk factor for CVD and one of the most common chronic diseases among adult Americans (CDC, 2013a). In fact, high blood pressure affects approximately 1 in 3 American adults (approximately 67 million people) with AAs disproportionately burdened (i.e., 44.3% prevalence among non-Hispanic Blacks, 32.6% among non-Hispanic Whites, and 28.3% among Mexican Americans) (CDC, 2013a). This racial and ethnic disparity is observed even during pregnancy. In a 10-year longitudinal population-based inquiry among pregnant women in New York State, AA women across all socioeconomic strata and neighborhoods showed the highest gestational-related hypertension when compared to Hispanic and non-Hispanic White women (Tanaka et al., 2007). According to Fuchs (2011), the precise reasons for the racial and ethnic variance in hypertension among AAs remain an enigma but evidence points to a complex interplay of socioeconomic, genetic, behavioral, and environmental risk factors. Reducing the incidence and prevalence of high blood pressure among American adults should be of preeminent importance—especially among non-Hispanic Blacks (CDC, 2013a).

Table 2 delineates blood pressure classifications for all American adults as articulated in the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (Chobanian et al., 2003). Hypertension can involve SBP and DBP. An estimated 30 million American adults have prehypertension (SBP between 120 and 139 mm Hg or DBP between 80 and 89 mm Hg) and are at increased risk for damage to their kidneys and other vital organs (Chobanian et al., 2003). Furthermore, many individuals with prehypertension eventually develop hypertension, so these patients are strongly advised to take steps to reduce their blood pressure to <120/80 mm Hg (Chobanian et al., 2003). For this dissertation study, blood pressure control was defined as levels <120/80 mm Hg (Chobanian et al., 2003).

Despite effective advanced treatment options, only 46% of American adult hypertensives managed via traditional settings, such as clinics and hospitals, have achieved good blood pressure control (CDC, 2013). More troubling are the poor blood pressure control rates among AA women (36%) and men (29.9%) hypertensive, which are well below the *Healthy People 2020* blood pressure control goal of 61.2% (CDC, 2013a; DHHS, 2013b). This shortfall in control rates has prompted the IOM and others to call for population-level strategies to improve blood pressure control rates (IOM, 2010; Middleton, 2009).

In the past few decades, novel community-level interventions, such as barber shop-based and faith-based health promotion programs, have emerged as effective strategies for identifying and managing hypertension among AAs (Dodani, 2011; Victor et al., 2009). WWPs have been shown to be effective options for motivating employees to adopt the behavioral measures (e.g., regular physical activity and healthy eating) that have been shown to control elevated blood pressure (Arena et al., 2013). For example, among a cohort of WWP participants, Chung, Melnyk, Blue, Renaud, and Breton (2009) demonstrated significant reductions in multiple cardiovascular risk factors such as high BMI, elevated lipids, and high blood pressure. Similarly, a longitudinal study among WWP participants showed significant reductions in blood pressure and other cardiovascular risk factors among workers, especially among those in high-risk groups (Neville, Merrill, & Kumpfer, 2011).

Worksite Wellness Promotion

The workplace offers a unique opportunity to positively impact the health of a captive audience by leveraging groups' problem solving dynamics (Bandura, 2004). The WHO pointed out that the workplace provides an opportunity to reach a large number of people who would otherwise be unreachable. The WHO characterized the workplace as a priority setting for promoting healthy behaviors, an environment in which large numbers of people can be simultaneously influenced to eat healthy, engage in regular physical activity, manage their stress, and stop smoking (WHO, 2014). Recognizing the potential benefit of the workplace, *Healthy People 2020* set an increase in the proportion of worksites that offer WWP to employee as one of its goals (DHHS, 2013a). The authors of *Healthy People 2020* also pointed out that unhealthy behaviors such as smoking and sedentary pursuits are at the core of the development of the top disease killers of Americans, and that WWP are tailor-made to reverse these behavioral trends (DHHS, 2013c).

There are many examples of rigorous efforts to understand the dynamics of promoting health and wellness in the workplace. In order to understand the durability of a fire department's WWP, Mabry, Elliott, MacKinnon, Thoemmes, and Kuehl (2013) conducted a follow-up qualitative inquiry five years after a controlled worksite wellness trial. The researchers found that workplace relationships provided reciprocal reinforcement, created a measure of constructive competitiveness, and ultimately produced a culture of wellness as the workplace norm (Mabry et al., 2013). In another qualitative study done to understand the factors that encourage or discourage workers participation in onsite WWPs, Makrides, Heath, Farguharson, and Veinot (2007) found that the convenience of the onsite location was an important factor that attracted participation, along with incentives and recognition for employees, and a supportive culture that fostered employees' efforts to get healthy. On the other hand, a lack of commitment on the part of managers and a lack of employee awareness of the services offered were disincentives for WWP participation (Makrides et al., 2007).

African Americans have unique barrier to receiving health promotion efforts. Wexler, Elton, Pleister, and Feldan (2009) found that AAs' perception of the seriousness of hypertension was lower than other groups because health programs and literature had low cultural resonance for them. In addressing the approach to promoting health among the AA community, Kline and Huff (2008) urged health promoters to recognize the shared cultural characteristics and perception of American-born Blacks. The authors pointed out that the high prevalence of hypertension among AAs is due, in part, to lifestyle choices such as the "the preferred foods among Black Americans, including pork products, fried foods, and baked goods" (p. 297). Therefore, health promotion programmers are urged to incorporate cultural awareness into program planning.

In the past few decades in the United States, employee wellness programs have proliferated and emerged as popular ways to encourage healthy behaviors among workers (Hochart & Lang, 2011). Although there is some skepticism, the business case for these programs has been improved workers health, reduced absenteeism, increased productivity, and reduced costs for employer share of employee health insurance premiums and workers' compensation (Berry & Mirabito, 2011; Hochart & Lang, 2011). For example, Johnson and Johnson's health promotion program accrued an average annual savings of $565 for each employee, and the company's return on investment for the program was between $1.88 and $3.92 for every dollar invested (Henkel, Goetzel, McHugh, & Isaac, 2011). Today, an estimated 50% of all mid-size and large-size companies, universities, and healthcare facilities offer some form of employee wellness program (Mattke et al., 2013). The recently enacted United States federal healthcare reform, formally known as the Patient Protection and Affordable Care Act (ACA), includes provisions that fund grants to help small businesses with 50 or fewer employees develop WWPs (O'Donnell, 2010).

The power of the workplace lies in its facilitation of a participatory process, a concept needed to reach disadvantaged populations (WHO, 2014). Middleton (2009) has characterized AAs as a priority population that is receptive to health promotion interventions based on the principles of community-based participatory research. Successful community-level health promotion programs targeting AA communities integrated cultural competence and enlisted participants as stakeholders (Dodani, 2011). Barbershops, beauty shops, and faith-based facilities are familiar gathering places for Black men and women, and these institutions hold important cultural significance in AA communities. In a cluster randomized trial used to study hypertensive AA men, 18 years and older who patronized 17 barbershops over a 10-month period, hypertension control rates significantly improved among hypertensive patrons whose barbers were trained to offer blood pressure measurements and recommend appropriate physician follow-up (Victor et al., 2011). In a 12-week culturally sensitive, faith-based weight loss intervention among AA women, those exposed to an active faith component did better than those not so exposed (Fitzgibbon et al., 2005).

In terms of programs and services offered, employee wellness programs come in many varieties, running the gamut from employer-subsidized gymnasium memberships to onsite full-service health and fitness facilities offering the services of physicians, nurses, psychologists, and dietitians (Hochart & Lang, 2011). The most common services WWPs offer include those that: promote healthy nutrition, lipid levels, and BMI; tobacco abstinence; stress management; and blood pressure control (Kaspin, Gorman, & Miller, 2013). Studies show that the most effective WWPs: are structurally accessible to all workers; conduct heath risk assessment; offer free or subsidized biometric evaluations; and provide individual risk reduction interventions such as health education, tobacco cessation counseling, and annual influenza immunization (Kaspin et al., 2013; Mattke et al., 2013).

Employee Health Risks

The top-five leading causes of death in the United States continue to be heart disease, cancer, respiratory diseases, stroke, and unintentional injuries (Hoyert & Xu, 2012). As expected, the health profiles of American workers mirror that of the general population. In a study of a comprehensive WWP done to evaluate the health risks of 9,637 employees, workers were found to have a mix of lifestyle disease risks similar to the general population (Hochart & Lang, 2011). Loeppke, Edington, and Beg (2010) found similar risk prevalence among 2,606 employees from employer groups who participated in a comprehensive WWP. In screening nearly 1,000 men and women participating in a WWP, Godefroi et al. (2005) found a 25% prevalence of metabolic syndrome, a rate similar to the general population.

Unhealthy behaviors such as smoking, poor diet, and physical inactivity are the fundamental causes of the majority of chronic diseases (DHHS, 2013a; Pronk et al., 2010). Individual-level disease management paradigms have been ineffective in ameliorating the behaviorally driven chronic diseases such as type 2 diabetes and high blood pressure (IOM, 2010). In fact, the pathogenesis of poorly controlled blood pressure goes beyond access to conventional healthcare. After analyzing the NHANES 2003-2010 data, Valderrama et al. (2012) estimated that almost 90% of the 35.8 million American adults with uncontrolled hypertension had health insurance coverage, access to clinical health care and, in fact, received health care in the previous year.

As behavioral health research illuminates the social determinants of health, population-based, community-level health promotion is rapidly gaining popularity as both primary and adjunctive strategies for identifying, preventing, and managing many chronic diseases (Vesely, 2011). The National Institute for Health Care Management (NIHCM) and others have highlighted the fact that people live in social systems (e.g., the workplace) that shape norms and perceptions and reinforce health-related behaviors (NIHCM, 2011; Thompson, Smith, & Bybee, 2005). In fact, population-level health management programs such as the *Million Hearts* and *WISEWOMAN* were initiated in order to reach a larger percentage of underserved populations as well as leverage the influence that social relationships at home, work, and the community can have on health-related behaviors and health outcomes (Frieden & Berwick, 2011; Hayashi, Farrell, Chaput, Rocha, & Hernandez, 2010). As Ferdinand et al. (2012) pointed out, the CDC's *Racial and Ethnic Approaches to Community Health* initiative has successfully ameliorated the chronic disease burden among some disadvantaged groups in a number of American communities.

Worksite Wellness Promotion and Health Outcomes

A large body of work has delineated the impact of WWPs on employees' health and wellness. The WWP-related literature is populated with well-designed studies showing short-term and long-term CVD health benefits for participating workers. Positive health outcomes were observed in the following areas: (a) improved nutrition practice, (b) increased physical activity, (c) reduction in lipid levels, (d) weight loss, and (e) reduction in blood pressure. This evidence-based trend prompted the American Heart Association to promulgate a policy statement in support of worksite-based wellness programs as a powerful strategy for preventing CVD among a broad spectrum of individuals (Carnethon et al., 2009). WWPs have also improved the mental health of workers (Anshel, Brinthaupt, & Kang, 2010). Recognizing the clear value of WWPs, the CDC has aggressively championed the concept of worksite wellness and has developed guidelines for WWP implementation (CDC, 2012).

Milani and Lavie (2009) conducted a 6-month randomized controlled cardiac rehabilitation intervention trial of 308 employees and 31 spouses connected to a single company in the greater New Orleans area. The aim was to evaluate the efficacy and cost-effectiveness of a cardiac rehabilitation program among a cohort of workers. At the end of the study period, treated participants showed a significant change in health behavior and risk factors, including a reduction in DBP ($p = 0.01$). In a hypertension intervention trial *BP DownShift* among school bus drivers with elevated blood pressure, Doyle, Severance-Fonte, Morandi-Matricaria, and Wogen (2010) demonstrated significant improvements in blood pressure levels among employees at follow-up (58%) versus baseline (38%) (p <0.001).

In a small workplace study (n = 60), Allen, Lewis and Tagliaferro (2012) showed that worksite health promotion interventions effectively lowered metabolic syndrome markers among employees (p = <0.05). The authors concluded that workplace interventions are effective models for influencing change in lifestyle habits (Allen, Lewis, & Tagliaferro, 2012). In a 12-week worksite intervention (i.e., diet, exercise, and monthly workshops), White and Jacques (2007) demonstrated the efficacy of this strategy in reducing total cholesterol to HDL cholesterol ratio (p = 0.015), LDL cholesterol (p = 0.018), and body weight (p = 0.01)—major risk factors for CVD. The authors concluded that their 12-week pilot study showed that WWPs effectively reduce CVD risks (White & Jacques, 2007). Among employees in a rural manufacturing plant, Byrd, Silliman, and Morris (2008) demonstrated significant reductions in total cholesterol (p = 0.05), LDL cholesterol (p = 0.01), and triglycerides levels (p = 0.01), and increase in HDL levels (p = 0.05). In an observational study among Chrysler autoworkers' participating in a WWP, Jackson et al. (2011) found that the program helped reduce mean SBP from a baseline value of 133 mm Hg to 129 mm Hg (p <0.0001). The program also helped reduce mean DBP from 85 mm Hg to 82 mm Hg (p <0.0001). The authors concluded that hypertension awareness, education and blood pressure control all improved during the implementation of the WWP. Finally, with regards to long-term health behavior outcomes associated with WWP participation, LeCheminant and Merrill (2012) evaluated the WWP-inspired health behavior modifications of 267 participants and observed that exercise, fruits, vegetables consumption, and requests for wellness coaching persisted over 12 to 24 months. The authors concluded that this is likely to result in future positive health outcomes and employee productivity (LeCheminant & Merrill, 2012).

Unfortunately, none of the reviewed studies of WWP outcomes have looked at the health outcomes specifically among AAs. This constituted the gap in knowledge that was the basis for this dissertation inquiry. This gap in knowledge represents a lack of race- and ethnic-based data to address CVD rates and disparity in the AA community. Therefore, this dissertation study evaluated the difference in the mean change in CVD biomarkers between AA and Caucasian participants in a U.S. Marine Corps-sponsored self-directed worksite WWP.

Theoretical Framework

The health belief model and the social cognitive theory (also called the social learning theory) grounded this dissertation study and informed my understanding of why individuals elect to participate or not participate in health promoting activities (Bandura, 2004; Glanz & Bishop, 2010; Middleton, 2009).

Health Belief Model

The health belief model was developed in the 1950s to help researchers understand why people opted to participate or not participate in free public health services (Glanz & Bishop, 2010). Today, investigators and community health planners use the model to explain and predict the factors and variables that drive health-related behaviors such as participation in community health programs like getting an annual influenza vaccination (McKenzie, Neiger, & Thackeray, 2009). The health belief model proposed that four perceptions drive human health-related behaviors: perceived seriousness, perceived susceptibility, perceived benefits, and perceived barriers (McKenzie et al., 2009). These perceptions are modulated by two factors: cues to action and self-efficacy.

According to the model, people who perceive a disease to be serious (e.g., the very high mortality rate of Ebola) are more inclined to take necessary precautions (Janz & Becker, 1984). Individuals who perceive that they are susceptible to a disease (e.g., daily news of new cases of measles in one's hometown) are more inclined to take action such as to get vaccinated (Janz & Becker, 1984). People are generally not moved to act when the perceived benefit of an action is low such as healthy eating may add two extra years at the back end of your lifespan (Janz & Becker, 1984). When barriers are perceived too great to overcome, such as high cost of a medication, people are less inclined to act (Janz & Becker, 1984). Table 6 lists examples of the four constructs and examples of the health belief model (Glanz & Bishop, 2010).

The health belief model was relevant to this dissertation inquiry because its constructs helped explain the health-related beliefs (and behaviors) of AAs whose perceptions of health and illness can be inconsistent with the biomedical model (Middleton, 2009). In this study, AAs had higher baseline blood pressure compared to their Caucasian peers, and this might have to do with AAs perception of hypertension (a mostly symptomless disease) as being less serious than a painful migraine (Middleton, 2009). Wexler, Elton, Pleister, and Feldan (2009) found that AAs' perception of the seriousness of hypertension was lower than other groups because health programs and literature had low cultural resonance for them. Another explanation might be that the nutrition recommendations offered to WWP participants may not have resonated with AA participants. Kline and Huff (2008) stated that the high prevalence of hypertension among AAs is due, in part, to unhealthy food choices such as pork products, fried foods, and baked goods.

Another aspect of the health belief model that was relevant to this dissertation investigation was the cues to action where the external health promotion messages may have been culturally inappropriate. People are influenced by credible cues (e.g., who is delivering the message) when deciding whether or not to act (Janz & Becker, 1984).

Social Cognitive Theory

As a largely lifestyle-induced disease with multiple behavioral and social antecedents, and spanning a wide demographical spectrum, CVD prevention can be approached from the conceptual framework of the social cognitive theory (Bandura, 2004). With its origins in the 1930s and made famous by Albert Bandura in the 1980s, this theory can help researchers understand how and why individuals develop and manage chronic diseases by examining three interconnected domains: behavioral, physiological, and environmental factors (Bandura, 2004). People learn and behave by observing others, and are motivated to continue or discontinue a learned behavior by positive or negative reinforcement (Bandura, 2004). The social cognitive theory can help explain how the workplace can influence health-related behaviors.

The CDC asserted that the health of workers and their work environments are inextricably linked because, like at home, the work environment has a potent influence on health-related behaviors (CDC, 2013b). In other words, both good and poor health outcomes are cultivated at home as well as at work. From this information, researchers and health programmers can anticipate and mitigate barriers and implement strategies to influence desired behaviors (Bandura, 2004). Moreover, while illuminating the concept of self-efficacy, the social cognitive theory can help individuals develop self-monitoring and self-management skills to improve their health outcomes (Bandura, 2004).

The social cognitive theory's relevance to this dissertation study has to do with leveraging the triads of the theory to explain observed findings, and rate the efficacy of the WWP. For example, self-efficacy was shown to be a significant predictor of CVD health-related behavioral change (Sarkar, Ali, & Whooley, 2007). Persons who believe they have the ability to adopt a new activity (e.g., the ability start a walking program) are more inclined to do so than persons who do not believe so. In addition, the physical environment can be instrumental in driving health-related behavioral change (Cummins, Curtis, & Diez-Roux, 2007). Employees have a mutually reinforcing and reciprocal relationship with their workplace and co-workers and are inclined to assimilate the norms of their workplace (e.g., physical activity). Finally, personal thoughts were shown to be powerful impetus for directing behavioral changes (Bandura, 2004). This has to do with internal self-monitoring and self-regulation thoughts that remind a WWP participant to eat healthy or go for a 30-minute walk.

Literature Review of Related Methodology

As discussed earlier, multiple studies have shown that WWPs effectively ameliorate multiple CVD biomarkers. For example, in a 12-week WWP pilot study among 50 university employees at risk for CVD, participants showed significant improvement between pre-intervention and post-intervention in multiple CVD biomarkers including LDL cholesterol levels (White & Jacques, 2007). According to the authors, there was a significant correlation between the level of commitment to diet changes and LDL levels (White & Jacques, 2007). The study did not evaluate the results by race and ethnicity. A 2-year-long quasi-experimental WWP study among professional and sales employees of Dow Chemical showed that environmental modification can help control weight and body mass index (Goetzel et al., 2010). This study did not investigate differences based on race and ethnicity.

In a large WWP study *Blood Pressure Success Zone: You Auto Know* (BPSZ), Jackson et al. (2011) conducted a prospective, pre and post assessment study of 1125 employees of Chrysler Corporation. Participants had elevated blood pressure on worksite screening or were diagnosed with hypertension by their healthcare provider. The intervention consisted of education, awareness, and support over a 6-month period. The study aimed to measure the impact of the intervention on employee awareness of hypertension, lifestyle modifications, and hypertension control. Of the 539 employees who completed the follow-up visit at six months (48% of enrolled participants), 407 (77%) were White and 83 (16%) were Black. The study authors had the opportunity to but did not evaluate the racial difference in impact of BPSZ on AA versus Caucasian participants. This dissertation inquiry evaluated the racial differences in impact on CVD biomarkers between AA and Caucasian employees who participated in a company-sponsored WWP.

Another limitation of BPSZ was that many of the participants' measurements were self-reported, which are invariably fraught with recall bias and missing information (Jackson et al., 2011). In my dissertation investigation, except for self-reported gender, age, and smoking status, no data were self-reported; a full-time Health Promotion staff performed all biometrics measurements. Finally, the BPSZ study was limited by a lack of occupational diversity among study participants who were all autoworkers, limiting generalizability. In contrast, my dissertation inquiry evaluated participants from a cross-section of occupations including auto mechanics, librarians, bartenders, accountants, architects, and psychologists.

In another study of a WWP named *BP DownShift*, Doyle et al. (2010) evaluated the impact of a hypertension awareness and educational program on school bus drivers in a southern American state. Of the 208 drivers who consented to the study at baseline, 120 (58%) returned for follow-up evaluation; 73% of participants were female and 72% were AAs. The intervention was primarily educational in which participants received four mailings of blood pressure education over a 4-month period. Blood pressure machines were also installed at all bus terminals, and participants had access to free dietitian consultation and gym memberships. At follow-up evaluations, 42% of participants had reductions in SBP and 44% had reductions in DBP (Doyle et al., 2010). While participants in this WWP were predominantly AAs, a major limitation is that study participants were 100% bus drivers, making generalization to the entire population very difficult. This dissertation study evaluated participants from a cross-section of occupations including bus drivers, accountants, human resource specialists, and social workers. This makes the results of this dissertation study more generalizable.

Unfortunately, these studies of WWP CVD outcomes have not looked at the health outcomes specifically among AAs. This gap in knowledge represents a lack of race- and ethnic-based data to address CVD rates and disparity in the AA community and was the basis for this dissertation inquiry.

Study Population

This dissertation investigation evaluated secondary data collected as part of an employee wellness program between 2009 and 2013. The source population for this study was the 2,000-member civilian workforce employed by the U.S. Marine Corps to provide community support services such as restaurants, libraries, and recreation programs for U.S. military personnel and their families. The multicultural workforce was comprised of Asians, Caucasians, Hispanics, and AAs. The company offered a free, comprehensive, onsite wellness program in which all employees were eligible to participate. The WWP was run by a fully staffed Health Promotion Department that included wellness educators and certified personal trainers.

After informed consent was obtained, participants underwent the following initial and follow-up biometric measurements: waist-to-hip-ratio, systolic and diastolic blood pressure, and lipid levels. Workers also complete an initial and follow-up modified health risk assessment questionnaire that captured date screened, age, race, gender, nutrition habits, and physical activity patterns. Participants were not asked to fill out a comprehensive health risk assessment. Health Educators conducted individualized counseling for each participant, based on identified biomarkers. The WWP staff also educated participants via optional free literature, newsletter and classes on nutrition, stress management, tobacco cessation, and other health promotion interventions. In addition, employees had free access to gymnasium facilities, group fitness classes, year-round swimming pools, and other health promoting modalities.

Independent and Dependent Variables for this Study

Table 7 lists the variables this study examined. The primary independent variable for this study was race. The four dependent or outcome variables for this study were changes in SBP, DBP, LDL cholesterol, and waist-to-hip ratio. The waist-to-hip ratio (normal is <0.95 for men, and <0.86 for women) is a measurement of body composition that betrays CVD risk similar to body mass index. In fact, Huxley et al. (2010), found no difference in sensitivity between body mass index, waist circumference, and waist-to-hip ratio as predictors of CVD. For this study, blood pressure control was defined as SBP <120 mm Hg and DBP <80 mm Hg, based on national standards established by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (Chobanian et al., 2003). An important covariate for this investigation was time from baseline measurement of biomarkers to follow-up measurement of biomarkers. Additional covariates were age and sex.

Statistical Analysis

All study analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 19.0 (SPSS Inc., Chicago, IL). Confidence level was set at 95% and alpha was set at <0.05. The de-identified data were transferred into *Microsoft Excel* file before being uploaded to SPSS version 19.0 for analysis. This dissertation research employed descriptive and inferential statistics.

Summary and Transitions

In this chapter, I reviewed the literature relevant to CVD biomarkers including SBP, DBP, LDL cholesterol, and waist-to-hip ratio. In addition, I examined the history of worksite health and wellness promotion, WWPs-associated health outcomes, and the theoretical frameworks that inform health-related behaviors. Finally, a methodology discussion examined the methodological differences between this dissertation study and previous community-based CVD studies. Chapter 3 delineates the methods, research design, the source population, secondary data used, data analysis, and steps taken to ensure that ethical principles were observed.

Chapter 3: Research Method

Introduction

The previous chapter reviewed the literature relevant to CVD biomarkers including SBP, DBP, LDL cholesterol, and overweight and obesity. In addition, a history of WWPs, WWPs-associated health outcomes, and the theoretical frameworks that inform health-related behaviors were examined. Finally, a methodology discussion examined the methodological differences between this dissertation study and previous community-based CVD studies.

In this chapter, I discuss the research method for this dissertation study. First, the research design and approach are discussed followed by a discussion of the RQs and H_o and H_a testing. Next, the population and sampling are delineated. The data collection and statistical analyses are also discussed. Threats to internal and external validity are identified. Finally, this chapter addresses the importance of protection of human subjects.

This dissertation study analyzed secondary data to determine retrospectively if there were statistically significant racial differences in the mean change in the aforementioned CVD biomarkers between African American (AA) and Caucasian participants of a WWP. The goal of this dissertation investigation was to determine if, compared to Whites, the CVD biomarkers among Blacks changed while participating in a U.S. Marine Corps-sponsored self-directed WWP. Biomarkers are "surrogate endpoints (that) predict disease risk, monitor disease status, and provide information that might be useful for life-saving or health-promoting interventions" (Albert 2011, p. S9). Albert (2011) noted that there has been a surge in interest about biomarkers such as blood pressure and LDL cholesterol in the last decade, as their predictive values become elucidated. The four CVD biomarkers that this dissertation evaluated were SBP, DBP, LDL cholesterol, and waist-to-hip ratio, a measurement of central obesity and sensitive predictor of CVD.

In the past few decades, WWPs have emerged as effective options for motivating participating employees to adopt the lifestyle measures, such as regular physical activity and healthy eating, that have been shown to control CVD risks (Arena et al., 2013; Allen, Lewis, & Tagliaferro, 2012; Milani & Lavie, 2009). Among a cohort of WWP participants, Chung, Melnyk, Blue, Renaud, and Breton (2009) demonstrated significant reductions in multiple cardiovascular risk factors such as high BMI, elevated lipids, and high blood pressure. Similarly, a longitudinal inquiry among WWP participants showed significant reductions in blood pressure and other cardiovascular risk factors among workers, especially among those in high-risk groups (Neville, Merrill, & Kumpfer, 2011). Despite the growing evidence of the efficacy of WWPs in reducing CVD risk factors among the general workforce, there are no studies that have specifically examined WWPs as a community-based model for improving CVD biomarkers among AA workers. Given the racial and ethnic disparities in CVD prevalence and poor CVD outcomes among AAs, this is a gap worthy of investigation.

Research Design and Approach

The RQs and testable hypotheses were addressed using a retrospective cohort study design. According to Aschengrau and Seage (2008), in cohort studies “both the exposures and outcomes have already occurred when the study begins” (p. 147). A major advantage of retrospective cohort studies is that the exposures and outcomes have occurred so there are no time constraints (Aschengrau & Seage, 2008). Retrospective cohort studies are inexpensive compared to other studies and this study design allows for multiple outcomes. This study design is a commonly used non-experimental design in which a single group of participants is pre-tested, given some treatment, then post-tested (Frankfort-Nachmias & Nachmias, 2008). If the results of the baseline and follow-up tests differ significantly, then the difference may be attributed to the independent variable. In this study, the before-and-after CVD biomarkers of AA employees were compared with the before-and-after CVD biomarkers of Caucasian employees who simultaneously participated in a WWP.

This dissertation study examined biometric data collected during the 4-year period between 2009 and 2013. Figure 1 depicts the study's approach. The independent variable for this study was race, with Whites serving as the comparison group. The four dependent or outcome variables for this study were changes in SBP, DBP, LDL cholesterol, and waist-to-hip ratio. The waist-to-hip ratio (normal is <0.95 for men, and <0.86 for women) is a measurement of central obesity with the CVD predictive value similar to BMI. In fact, Huxley, Mendis, Zheleznyakov, and Chan (2010), found no difference in sensitivity between BMI, waist circumference, and waist-to-hip ratio as predictors of CVD. For this study, blood pressure control was defined as SBP <120 mm Hg and DBP <80 mm Hg, based on national standards established by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (Chobanian et al., 2003). Normal LDL cholesterol was defined as <100 mg/dL (NIH, 2002). An important covariate for this investigation was the time from baseline measurement of biomarkers to follow-up measurement of biomarkers. Additional covariates were age, and sex.

The health belief model was relevant to this dissertation inquiry as its constructs helped explain the health-related beliefs (and behaviors) of AA study participants that might be inconsistent with biomedical model of CVD (Middleton, 2009). These constructs—perceived seriousness, perceived susceptibility, perceived benefits, and perceived barriers—helped explain the observed research findings. For example, the observed results showed higher baseline blood pressure among AA participants compared to their Caucasian peers, and part of this explanation might be that AA perceived CVD, an insidious and often symptomless disease, to be less serious than one that produces pain, such as migraine headaches (Middleton, 2009). The cues to action might help explain AA participants' perceived self-efficacy after watching a culturally appropriate video of a prominent AA discussing how he successfully eliminated sodium from his diet. Table 5 lists examples of the four health belief model constructs and cues to action (Glanz & Bishop, 2010).

The social cognitive theory's relevance to the dissertation study has to do with leveraging the triads of the theory—behavioral, physiological, and the environment—to explain observed findings, and rate the efficacy of the WWP. For example, self-efficacy was shown to be a significant predictor of CVD health-related behavioral change (Sarkar, Ali, & Whooley, 2007). Persons who believe they have the ability to adopt a new activity such as the ability start a walking program are more inclined to do so than persons who do not believe so. In addition, the physical environment can be instrumental in driving health-related behavioral change (Cummins, Curtis, & Diez-Roux, 2007). Employees have a mutually reinforcing and reciprocal relationship with their workplace and are inclined to assimilate the norms of their workplace (e.g., physical activity). Finally, personal thoughts were shown to be powerful impetus for directing behavioral changes (Bandura, 2004). This has to do with self-monitoring and self-regulation such as cues that remind a WWP participant to watch what he or she eats.

Research Questions and Hypotheses Testing

This quantitative study focused on the mean changes in SBP, DBP, LDL cholesterol, and waist-to-hip ratio between AA and Caucasian WWP participants. As Creswell (2009) pointed out, quantitative RQs "inquire about the relationships among variables that the investigator seeks to know" (p. 132). Meanwhile, quantitative hypotheses represent predictions the investigator makes regarding the expected relationships among the variables being studied (Creswell, 2009). For this dissertation study, the cohort design offered the best approach to answering the following RQs and testing the H_o and H_a:

RQ1: Is there a statistically significant difference in the mean change in SBP between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_1 = change in SBP from baseline to follow-up.

c. Research H_o1: There is no statistically significant difference in the mean change in SBP between AA and Caucasian participants in a worksite wellness program.

d. Research H_a1: There is a statistically significant difference in the mean change in SBP between AA and Caucasian participants in a worksite wellness program.

RQ2: Is there a statistically significant difference in the mean change in DBP between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_2 = change in DBP from baseline to follow-up.

c. Research H_o2: There is no statistically significant difference in the mean change in DBP between AA and Caucasian participants in a worksite wellness program.

d. Research H_a2: There is a statistically significant difference in the mean change in DBP between AA and Caucasian participants in a worksite wellness program.

RQ3: Is there a statistically significant difference in the mean change in LDL cholesterol levels between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_3 = change in LDL cholesterol from baseline to follow-up

c. Research H_o3: There is no statistically significant difference in the mean change in LDL cholesterol levels between AA and Caucasian participants in a worksite wellness program.

d. Research H_a3: There is a statistically significant difference in the mean change in LDL cholesterol levels between AA and Caucasian participants in a worksite wellness program.

RQ4: Is there a statistically significant difference in the mean change in waist-to-hip ratio between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_4 = change in waist-to-hip ratio from baseline to follow-up.

c. Research H_o4: There is no statistically significant difference in the mean change in waist-to-hip ratio between AA and Caucasian participants in a worksite wellness program.

d. Research H_a4: There is a statistically significant difference in the mean change in waist-to-hip ratio between AA and Caucasian participants in a worksite wellness program.

Population and Sample

The source population for this study was a 2,000-person workforce of civilians employed by the U.S. Marine Corps to provide community services (e.g., restaurants, libraries, counseling, and recreation programs) for U.S. military personnel and their families. The men (40%) and women (60%) were full-time and part-time employees. The multicultural workforce (*n* = 2,000) is comprised of Caucasians (70%), Hispanics (13%), AAs (11%) and others (6%). Employees range in age from 15 to 73 years.

The company offers a free, comprehensive onsite wellness promotion program in which all adult employees can voluntarily elect to undergo baseline and follow-up health screenings at six months. All full-time and part-time adult employees 18 years and older were eligible to participate in the WWP from the first day of employment. There were no monetary or other incentives for participating or for achieving health goals. The goal of the WWP was to support the efforts of employees as they worked to improve or maintain their overall health status. Participants were offered free health information via handouts, a monthly wellness newsletter via e-mail, and free classes or one-on-one counseling on nutrition, stress management, tobacco cessation, and other health promotion topics. A comprehensive Intranet site announced these services and resources. In addition, employees had unfettered access to fitness facilities, group fitness classes, year-round swimming pools, and other health promoting modalities, free of charge.

Power Analysis

Sample size has fundamental implication for the fidelity of a research inquiry. Aschengrau and Seage (2008) pointed out that sample size provides power to a research and helps the investigator arrive at the correct inferences and enhances generalizability. In general, researchers should opt for a large sample size when type I error (probability of rejecting the null hypothesis when it is true) and type II errors (failure to reject a false null hypothesis) are small, and when the anticipated magnitude of the association gleaned from previous studies is small (Aschengrau & Seage, 2008). The significance level, power, and effect size influence the sample size.

A power estimate was performed for each dependent variable. The CDC's free public health statistics calculator, *openepi.com*, was used to calculate the sample size for this dissertation study. An alpha value of p = .05 was used. This means that the probability that the results are due to chance alone is .05, or 5%, and 95% of the time a difference found between the two groups being studied will be statistically significant and due to the manipulation or treatment. A power estimate of 0.8 was used for calculating the sample size via *openepi.com*. The two-sided confidence interval of 95% was used to calculate the power of comparing two means. With a confidence level of 95% and population size of 2,000, a confidence level was calculated to be 7.96, which yielded a sample size of 217. There were 163 AA participants and 228 Caucasian participants in the dataset.

Descriptive Analysis

Descriptive analysis was used to describe information collected from the study sample. The data in this dissertation inquiry was organized via frequency distributions. Correlation analysis was used to evaluate the relationships among the dependent variables. Pearson coefficient was used to evaluate the relationship between variables. Repeated measures MANCOVA analysis, which can only explains observed relationship and not causality, was used to establish the contribution of the independent variables to SBP, DBP, LDL cholesterol, and waist-to-hip ratio.

Data Collection

The investigation employed de-identified secondary data obtained from 506 employees (the unit of analysis) who voluntarily participated in a U.S. Marine Corps-sponsored self-directed WWP over a 4-year period of time between 2009 and 2013. The Marine Corps granted permission for me to use a de-identified copy of the dataset (see Appendix A). All steps were taken to thoroughly ensure that no personally identifiable information was contained in the working dataset.

The WWP was administered by a fully staffed Health Promotion Department that was comprised of trained health promotion professionals. WWP health screenings were offered quarterly at multiple worksite locations to facilitate accessibility. After informed consent was obtained, including assurance of confidentiality, workers completed an abbreviated health risk appraisal that captured their contact information, the date of their health screen, age, race, gender, nutrition habits, and physical activity level. No information was obtained on family history, past medical history, socioeconomic status (i.e., income, education, and occupation), marital status, or alcohol use.

Participants underwent the following initial and follow-up biometric measurements: waist-to-hip ratio, SBP, DBP, and LDL cholesterol level. This WWP measured waist-to-hip ratio, a biometric measurement that is as sensitive as BMI in predicting cardiovascular risk (Huxley, Mendis, Zheleznyakov, & Chan, 2010). Blood samples for lipid measurements were obtained between 7:00 am and 9:00 am via the finger stick route, after participants had fasted for 12 hours. Employees who failed to fast for 12 hours were asked to return another day in the fasting state for lipid testing. Polymer Technology Systems, Inc., manufactured the cholesterol-testing machine.

The following operational definitions apply to the dependent variables. DBP refers to the phase of blood pressure when the circulating blood exerts relatively low-level force on the blood vessel walls. It is the so-called *bottom number* in a blood pressure reading and normal is <80 mm Hg (Smulyan & Safar, 1997). SBP is the relatively high-level force the circulating blood exerts on the blood vessel walls when the heart contracts in an effort to circulate blood throughout the body. It is the so-called *top number* in a blood pressure reading and normal is <120 mm Hg (Smulyan & Safar, 1997). Among the various lipids, high LDL cholesterol level is associated with the highest risk for CVD and normal LDL cholesterol is <100 mg/dL (CDC, 2014a). Waist-to-Hip Ratio refers to ratio of the circumference of the waist to that of the hips, a measure of central obesity. Normal value is: <0.95 for men; and <0.86 for women. The waist-to-hip is a sensitive predictor of cardiovascular health. Huxley, Mendis, Zheleznyakov, and Chan (2010), found similar sensitivity between BMI, waist circumference, and waist-to-hip ratio as predictors of CVD risk.

Trained health promotion counselors discussed the results of the health screening with each participant and provided customized lifestyle-related recommendations for health improvement. Participants with abnormal results (e.g., blood pressure reading ≥140/90 mm Hg or LDL cholesterol >100 mg/dL) were provided appropriate lifestyle counseling, referred to their physician for evaluation, and were invited to continue to follow up with the WWP. Those in the pre-hypertension blood pressure range (i.e., SBP between 120 and 139 mm Hg or DBP between 80 and 89 mm Hg) were educated about the implications of these readings, provided appropriate lifestyle counseling, and encouraged to work to achieve blood pressures <120/80 mm Hg (Chobanian et al., 2003).

Dependent and Independent Variables for this Study

Blood pressure level is influenced by a number of non-genetic, lifestyle factors such as tobacco use, sodium intake, physical activity level, nutritional patterns, and body weight (Chobanian et al., 2003). The relative weight of each of these lifestyle-related factors on blood pressure has been the subject of debate. For example, there is no consensus on whether obesity is more potent than high sodium intake in driving up blood pressure (Appel et al., 2003). Regardless, though, a comprehensive change in lifestyle habits has resulted in lower blood pressure (Appel et al., 2003; Chobanian et al., 2003). This WWP study comprised a multi-pronged intervention: education, awareness, and support that helped participants develop new and healthy habits.

Table 8.

Variables Examined in this Dissertation Study

Independent Variable	Dependent Variables	Covariates
Race	Systolic blood pressure	Gender
	Diastolic blood pressure	Age
	Waist-to-hip ratio	Time from baseline to follow-up
	LDL Cholesterol	

Table 8 lists the variables examined in this dissertation research, and Table 9 lists the level of measurement used for each variable. The primary independent variable for this study was race and ethnicity coded as non-Hispanic White, Hispanic American, Asian, and non-Hispanic Black. Covariates for this inquiry included self-reported gender, age, and objectively measured days from baseline. The primary dependent or outcome variables for this research were SBP, DBP, LDL cholesterol, and waist-to-hip ratio.

Table 9.

Levels of Measurements used for each Variable

Variable	Type of Variable	Level of Measurement
Systolic blood pressure	Dependent	Continuous
Diastolic blood pressure	Dependent	Continuous
Waist-to-hip ratio	Dependent	Continuous
LDL cholesterol	Dependent	Continuous
Race and ethnicity	Independent	Categorical
Gender	Covariate	Dichotomous
Age	Covariate	Continuous
Time difference between baseline and follow-up	Covariate	Continuous

Statistical Analysis

According to Sullivan (2012), statistical analysis has to do with organizing research data in a manner that permits the testing of the research hypothesis. Table 10 provides statistical details of the approaches that were used to answer the RQs. All study analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 16.0 (SPSS Inc., Chicago, IL). Confidence level was set at 95% and the alpha was set at <0.05. This dissertation research employed descriptive and inferential statistics.

Table 10.

Statistical Analysis Used to Evaluate the Research Questions

Research Question	Statistical Analysis
RQ1: Is there a statistically significant difference in the mean change in systolic blood pressure between African American and Caucasian participants in a worksite wellness program?	Repeated measures MANCOVA
RQ2: Is there a statistically significant difference in the mean change in diastolic blood pressure between African American and Caucasian participants in a worksite wellness program?	Repeated measures MANCOVA
RQ3: Is there a statistically significant difference in the mean change in blood cholesterol LDL levels between African American and Caucasian participants in a worksite wellness program?	Repeated measures MANCOVA
RQ4: Is there a statistically significant difference in the mean change in waist-to-hip ratio between African American and Caucasian participants in a worksite wellness program?	Repeated measures MANCOVA

Descriptive Analysis

Descriptive analysis was used to describe information collected from the study sample. The data in this dissertation inquiry was organized via frequency distributions. At the outset of the analysis, the plan was to utilize the difference in differences (DID) statistical technique—i.e., subtracting the baseline results from the outcome results and comparing the results between two groups in a cohort, in this case, between AAs and Caucasians participating in a WWP (Jiao et al., 2014). DID requires data collected at two or more different time periods. However, upon creating the DID, the changes revealed distributions that did not adhere to the assumptions of regression analysis. Also, the four dependent variables were highly correlated with each other. Therefore, rather than applying a Bonferroni correction to the alpha, I performed a repeated measures multivariate analysis of covariance (MANCOVA) analysis.

Inferential Statistics

For this dissertation investigation, I employed MANCOVA, a multivariate test, to evaluate the effect of race on SBP, DBP, LDL cholesterol, and waist-to-hip ratio. The study compared the differences in the mean changes in SBP, DBP, LDL cholesterol, and waist-to-hip ratio between AA and Caucasian participants. Hispanic and Asian participants were left in the analysis but the focus of this study were AAs and Caucasians. For each participant, the mean change was calculated by subtracting the initial results from the follow-up results. The average change in the dependent variables was significantly different between AAs and Caucasians after controlling for the covariates, allow me to reject the null hypothesis.

Threats to Validity

In research studies, there are two major forms of validity: internal validity and external validity. Threats to internal validity include the study design, definitions, composition of the study population, and measurement of variables (Creswell, 2009). Threats to external validity include "incorrect inferences from the sample data" that would prevent generalization of the study findings beyond the group studied (Creswell, 2009, p. 162). For this dissertation inquiry, a major threat to internal and external validity was the lack of randomization. Self-reported data can be biased by recall and lack of accuracy (Aschengrau & Seage, 2008). In this investigation, age, race, and sex were self-reported information representing additional threats to internal and external validity. Multiple health promotion staff members performed biometric measurements (e.g., manual blood pressure and waist-to-hip ratio), which posed the risk of operator variability that can also threaten validity.

Protection of Human Subjects

This dissertation study was conducted in strict accordance with Walden University's Institutional Review Board (IRB) ethical standards and research protocols, even though secondary data without personal identifiers was used. Permission to use the de-identified secondary data was obtained from the U.S. Marine Corps and this written authorization was submitted to Walden University IRB (see Appendix A). IRB approval was obtained before the commencement of the evaluation of the dataset. Walden University IRB gave the proposal approval number 09-24-14-0248679. The data was password protected on an external hard drive with only this researcher having access, and will be kept in two different locations for a period of seven years. A National Institute of Health certificate of completion of the course *Protecting Human Research Participants* was obtained (see Appendix B).

Summary and Transitions

The ultimate goal in Chapter 3 was to present the hypotheses and provide the rationale and assumptions that underscore the hypotheses testing. This was accomplished by describing the: research design and approach, RQs and hypotheses, population and sampling, data collection and statistical analyses, threats to validity, and the protection of human subjects. In Chapter 4, I will discuss the results of the data analysis, and in Chapter 5 I will offer a full discussion of the key findings and recommendations for future research.

Chapter 4: Results

Introduction

The primary purpose of this retrospective cohort study was to determine whether or not there were racial differences in the mean change of CVD biomarkers between AA and Caucasian participants in a U.S. Marine Corps-sponsored self-directed WWP between 2009 and 2013. The WWP was a self-management model augmented by health education provided by trained health promoters. The four CVD biomarkers evaluated were SBP, DBP, LDL cholesterol, and waist-to-hip ratio. Similar to body mass index, waist-to-hip ratio is a measurement of body composition and a reliable CVD biomarker (Huxley, Mendis, Zheleznyakov, & Chan, 2010). This observational study analyzed de-identified secondary data collected from AA, Caucasian, Hispanic, and Asian WWP participants between 2009 and 2013. Even though the dataset used in this analysis included relatively few Hispanic and Asian WWP participants, AAs and Caucasians were the focus of this inquiry. African Americans are disproportionately burdened with CVD and there is call for community-level intervention strategies to ameliorate this disparity (CDC, 2014a; Ferdinand et al., 2012). In recent years, the workplace has emerged as a powerful environment for supporting employees' efforts to adopt healthy behaviors (Arena et al., 2013). An aim of this dissertation investigation was to see if AAs showed statistically significant improvements in CVD biomarkers compared to their Caucasian counterparts.

This chapter contains the results of this quantitative analysis. First, I will review the RQs, the H_o and the H_a that were evaluated, as well as the data collection and sample demographics. Next, I will discuss the statistical analyses and finish with a detailed account of the findings. At the outset of the analysis, the plan was to utilize the difference in differences (DID) statistical technique—i.e., subtracting the baseline results from the outcome results and comparing the results between two groups in a cohort, in this case, between AAs and Caucasians participating in a WWP (Jiao et al., 2014). DID requires data collected at two or more different time periods. However, upon creating the DID, the change revealed distributions that did not adhere to the assumptions of regression analysis. Also, the four dependent variables were highly correlated with each other. Therefore, rather than applying a Bonferroni correction to the alpha, I performed a repeated measures MANCOVA analysis. The independent variable for this study was race and the dependent variables were SBP, DBP, LDL cholesterol, and waist-to-hip ratio. Sex, age, and time from baseline to follow-up were covariates. The data are presented separately for each dependent variable and hypothesis.

Research Questions and Hypotheses Testing

The subjects in this observational study were not randomized, so adjustments were made for covariates in order to preclude confounding. A randomized inquiry has stronger internal validity than a non-randomized one, but this retrospective cohort investigation used a secondary dataset that did not lend itself to randomization. The following RQs, H_o and H_a were evaluated:

RQ1: Is there a statistically significant difference in the mean change in SBP between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_1 = change in SBP from baseline to follow-up.

e. Research H_o1: There is no statistically significant difference in the mean change in SBP between AA and Caucasian participants in a worksite wellness program.

f. Research H_a1: There is a statistically significant difference in the mean change in SBP between AA and Caucasian participants in a worksite wellness program.

RQ2: Is there a statistically significant difference in the mean change in DBP between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_2 = change in DBP from baseline to follow-up.

e. Research H_o2: There is no statistically significant difference in the mean change in DBP between AA and Caucasian participants in a worksite wellness program.

f. Research H_a2: There is a statistically significant difference in the mean change in DBP between AA and Caucasian participants in a worksite wellness program.

RQ3: Is there a statistically significant difference in the mean change in LDL cholesterol levels between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_3 = change in LDL cholesterol from baseline to follow-up

e. Research H_o3: There is no statistically significant difference in the mean change in LDL cholesterol levels between AA and Caucasian participants in a worksite wellness program.

f. Research H_a3: There is a statistically significant difference in the mean change in LDL cholesterol levels between AA and Caucasian participants in a worksite wellness program.

RQ4: Is there a statistically significant difference in the mean change in waist-to-hip ratio between AA and Caucasian participants in a worksite wellness program? This hypothesis was tested using a repeated measures MANCOVA analysis to adjust for possible effects of covariates.

DV_4 = change in waist-to-hip ratio from baseline to follow-up.

e. Research H_o4: There is no statistically significant difference in the mean change in waist-to-hip ratio between AA and Caucasian participants in a worksite wellness program.

f. Research H_a4: There is a statistically significant difference in the mean change in waist-to-hip ratio between AA and Caucasian participants in a worksite wellness program.

Data Collection and Sample Demographics

The WWP was available to members of a 2,000-person organization, the source population, and was administered by a fully staffed Health Promotion Department that was comprised of personal trainers, and wellness educators. WWP health screenings were offered quarterly at multiple worksite locations to facilitate accessibility. Table 11 lists the standards for the CVD biomarkers employed by the WWP that generated the analyzed dataset. Wellness program participants underwent the following initial and follow-up biometric measurements to screen for CVD: SBP, DBP, LDL-cholesterol levels, and waist-to-hip ratio. This particular WWP measured waist-to-hip ratio for body composition, as this measurement is just as sensitive as body mass index in predicting cardiovascular risk (Huxley, Mendis, Zheleznyakov, & Chan, 2010). For this dissertation study, blood pressure control was defined as levels <120/80 mm Hg, based on national standards established for American adults by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (Chobanian et al., 2003). For this investigation, optimal LDL cholesterol was <100 mg/dL (NIH, 2002). Normal waist-to-hip ratio was defined as <0.95 for men, and <0.86 for women (Huxley, Mendis, Zheleznyakov, & Chan, 2010).

Table 11.

Standards for Biomarkers Used in the Workplace Wellness Program

Biomarker	Normal Value
Systolic blood pressure	<120 mm Hg
Diastolic blood pressure	<80 mm Hg
LDL	<130 mg/dL
Waist-to-hip ratio	<0.95 for men; <0.86 for women

After informed consent was obtained, including assurance of confidentiality, participants completed an abbreviated health risk assessment questionnaire that captured their contact information, the date of their health screen, age, race, gender, nutrition habits, and physical activity level. No information was obtained on family history, current and past medical history, medication use, socioeconomic status, marital status, tobacco use, or alcohol use. Consequently, this study did not consider factors related to comorbidities, social status, substance use, or medication use.

Blood samples for lipid measurements were obtained between 7:00 am and 9:00 am via the finger stick route, after participants had fasted for 12 hour. Participants who failed to fast for 12 hours were asked to return another day in the fasting state for lipid testing. Polymer Technology Systems, Inc., manufactured the cholesterol-testing machine. Trained health counselors conducted the testing, discussed the results of the health screening with each participant, and provided customized, self-directed, lifestyle-related recommendations for health improvement. Participants also received health education materials. Participants with abnormal results (e.g., blood pressure reading ≥140/90 mm Hg or LDL cholesterol >130 mg/dL) were referred to their primary care physician for evaluation, but were also invited to continue to follow-up in the WWP. Information on participants encounter was recorded on an Excel data collection sheet.

Table 12 delineates the demographic variables and Table 13 lists the descriptive statistics of the study sample. The study sample involved adult employees who voluntarily participated in a company-sponsored WWP (*n* = 506), 64.6% of whom were females (*n* = 327), and 35% were males (*n* = 177). Among study participants, 45.1% were

Caucasians (*n* = 228), 32.2% were AAs (*n* = 163), 12.3% were Hispanics (*n* = 62), and 10.3% were Asians (*n* = 52). The minimum age of this cohort was 18 years, and the maximum age was 73 years, with a mean age of 36.3 years (*SD* = 10.97).

Table 12

Demographic Variables of the Study Sample

Variable	Frequency	Percent	Valid Percent	Cumulative Percent
Gender				
Male	177	35	35.1	35.1
Female	327	64.6	64.9	100
Missing	2	0.4		
Total	506	100	100	
Race				
Asian	52	10.3	10.3	10.3
African American	163	32.2	32.3	42.6
Caucasian	228	45.1	45.1	87.7
Hispanic	62	12.3	12.3	100
Missing	1	0.2		
Total	506	100	100	

As Table 13 shows, the number of days from baseline to follow-up of CVD measurements ranged from 78 to 714, with a mean of 194.8 days (*SD* = 60.88). The mean LDL cholesterol at baseline was 114.5 mg/dL (*SD* = 35.35) and at follow-up was 106.1 mg/dL (*SD* = 29.79). The mean waist-to-hip ratio at baseline was .823 (*SD* = .091) and at follow-up was .814 (*SD* = .837). The mean SBP at baseline was 121.6 mm Hg (*SD* = 14.51) at and follow-up was 119.6 mm Hg (*SD* = 12.41). Finally, The mean DBP at baseline was 79.8 mm Hg (*SD* = 9.82) at and follow-up was 78.1 mm Hg (*SD* = 8.10).

Table 13

Descriptive Statistics of the Study Sample

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Age	506	18	73	36.348	10.9706
Days from Baseline	503	78	714	194.84	60.886
LDL Cholesterol					
Baseline	505	18	261	114.52	35.359
Follow-up	505	45	226	106.19	29.795
Waist-to-Hip Ratio					
Baseline	506	.60	1.18	.8234	.09109
Follow-up	505	.60	1.10	.8142	.8376
Systolic Blood Pressure					
Baseline	506	86	181	121.63	14.518
Follow-up	505	90	174	119.61	12.411
Diastolic Blood Pressure					
Baseline	506	56	119	79.80	9.829
Follow-up	505	58	104	78.14	8.104

Multivariate Analysis of Covariance Analysis

All study analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 19.0 (SPSS Inc., Chicago, IL). Confidence level was set at 95% and alpha was set at <0.05. The de-identified data were transferred into *Microsoft Excel* file before being uploaded for analysis to SPSS version 19.0. Table 14 delineates the multivariate tests of the study sample. For this dissertation investigation, all hypotheses were tested using repeated measures MANCOVA to compare the differences in the mean changes in SBP, DBP, LDL cholesterol, and waist-to-hip ratio between AA and Caucasian participants. The relatively few Hispanic and Asian participants in the sample were left in the analysis but AAs and Caucasians were the focus of this study.

MANCOVA is a form of analysis of variance (ANOVA) used when two or more dependent variables are analyzed and there is a need to control for covariates (Mertler & Vannatta, 2002). Repeated measures MANCOVA, essentially a series of ANOVAs, allows the researcher to factor out the errors introduced by the covariates, and to increase statistical power in evaluating the true relationship between independent and dependent variables (Mertler & Vannatta, 2002). The following three assumptions were explored and tested:

1. Normality or the normal distribution of results for each dependent variable. The Levine test, which is a test of normality, was run and showed a *p*-value of more than .05 for each dependent variable.
2. Homogeneity of variances. This was tested with the Mauchly's test of sphericity, which had a level of 1 for Mauchly's W, 0 for Approximate Chi-Square, 0 for *df*, and blank for significance.
3. Homogeneity of covariances. Using the Box's *M* test, the intercorrelation matrix between dependent variables was equal across the independent variable, F (108, 98627.236) =2.073, p = .000.

Table 14

Multivariate Tests of the Study Sample

Effect	Error	Sig	Partial Eta Squared
Between Subjects			
Race			
Wilks. Lambda	1288.772	.000	.025
Within Subjects			
Time			
Wilks. Lambda	487.000	.042	.020
Time X Race			
Wilks. Lambda	1288.772	.045	.014

I performed repeated measures MANCOVA models to examine the hypotheses using the four dependent variables for change from baseline to follow-up for SBP, DBP, LDL cholesterol, and waist-to-hip ratio. The key independent variable for the model was race, with covariates for age, sex, and the number of days from baseline included. The variables were subjected to two tests: the *within-subject* effect, and the *between-subject* effect. The multivariate tests (Table 14) revealed that there was an overall significant difference between-subjects effect of race ($p < .000$), and significant within-subjects effects of both time ($p = < .042$) and the interaction term race × time ($p = .045$). Therefore, we can be reasonably confident that any statistically significant effects unveiled for the individual dependent variable models (i.e., SBP, DBP, LDL cholesterol, and waist-to-hip ratio) were not due to random chance resulting from iterative testing of highly correlated dependent variables (i.e. Type I error).

Table 15

Univariates Tests of the Study Sample

Source	Measure		F	Sig	Partial Eta Squared
Time	SBP change				
		Sphericity Assumed	5.173	.023	.010
		Greenhouse-Geisser	5.173	.023	.010
		Huynh-Feldt	5.173	.023	.010
		Lower-bound	5.173	.023	.010
	DBP change				
		Sphericity Assumed	5.821	.016	.012
		Greenhouse-Geisser	5.821	.016	.012
		Huynh-Feldt	5.821	.016	.012
		Lower-bound	5.821	.016	.012
Time	LDL change				
		Huynh-Feldt	1.111	.292	.002
	Waist-to-Hip Ratio change				
		Sphericity Assumed	.015	.902	.000
		Greenhouse-Geisser	.015	.902	.000
		Huynh-Feldt	.015	.902	.000
		Lower-bound	.015	.902	.000
Time × Race	SBP change				
		Sphericity Assumed	2.653	.048	.016
		Greenhouse-Geisser	2.653	.048	.016
		Huynh-Feldt	2.653	.048	.016
		Lower-bound	2.653	0.048	.016
	DBP change				
		Sphericity Assumed	1.673	.172	.010
		Greenhouse-Geisser	1.673	.172	.010
		Huynh-Feldt	1.673	.172	.010
		Lower-bound	1.673	.172	.010
	LDL change				
		Sphericity Assumed	1.686	.169	.010
		Greenhouse-Geisser	1.686	.169	.010
		Huynh-Feldt	1.686	.169	.010
		Lower-bound	1.686	.169	.010
	Waist-to-Hip Ratio change				
		Sphericity Assumed	.641	.589	.004
		Greenhouse-Geisser	.641	.589	.004
		Huynh-Feldt	.641	.589	.004
		Lower-bound	.641	.589	.004

Table 15 lists the results of the univariate tests of the study sample. There was an overall significant main effect of time for change in SBP, F (1, 490) = 5.17, p = .023, η^2_p = .010, and change in DBP, F (1, 490) = 5.82, p = .016, η^2_p = .012, but no overall main effect of time for LDL change, F (1, 490) = 1.11, p = .292, η^2_p = .002, or waist-to-hip ratio change, F (1, 490) = .02, p = .902, η^2_p < .001. This indicates that, after controlling for race, sex, age, and days from baseline, there was no significant downward trend in LDL levels or waist-to-hip ratios from baseline to follow-up. However, the downward trend in SBP and DBP remained significant even after including the key independent variable, race, and the covariates.

Although the overall multivariate test for race × time was statistically significant, the only specific dependent variable for which race × time was statistically significant was change in SBP from baseline to follow-up, F (3, 490) = 2.653, p = .048, η^2_p = .016 (Table 16). To examine whether there was a change over time in SBP within each racial category, several pairwise comparisons were conducted across time for each of the four levels of race (Table 17). SBP levels for AA participants significantly decreased from baseline (M = 120.56, SD = 13.55) to follow-up (M = 118.82, SD = 11.94), p = .001. Similarly, SBP levels among Caucasians decreased from baseline (M = 125.46, SD = 15.16) to follow-up (M = 122.17, SD = 12.70), p = .002. However, SBP among Asians (p = .628) and Hispanics (p = .121) did not significantly change over time (see Table 17).

Among AAs, DBP significantly decreased from baseline (M = 82.02, SD = 9.25) to follow-up (M = 79.86, SD = 8.15), p = .000. Among Caucasians, DBP significantly decreased from baseline (M = 79.18, SD = 9.45) to follow-up (M = 77.39, SD = 7.84), p =

.000. Hispanics participants did not show a significant decrease in DBP from baseline (*M* = 78.63, *SD* = 10.1) to follow-up (*M* = 79.06, *SD* = 8.46), *p* = .835. Asian participants also did not show a significant decrease in DBP from baseline (*M* = 77.59, *SD* = 11.95) to follow-up (*M* = 75.65, *SD* = 7.59), *p* = .062.

Table 16

Pairwise Comparisons based on Race × Time

Measure	Race	(I) Time	(J) Time	Mean Difference (I-J)	Std Error	Sig
SBP change	Asian	1	2	-.585	1.206	.628
		2	1	.585	1.206	.628
	African	1	2	3.162	.663	.000
	American	2	1	-3.162	.663	.000
	Caucasian	1	2	1.723	.564	.002
		2	1	-1.723	.564	.002
	Hispanic	1	2	1.669	1.075	.121
		2	1	-1.669	1.075	.121
DBP change	Asian	1	2	1.887	1.008	.062
		2	1	-1.887	1.008	.062
	African	1	2	2.125	.555	.000
	American	2	1	-2.125	.555	.000
	Caucasian	1	2	1.758	.471	.000
		2	1	-1.758	.471	.000
	Hispanic	1	2	-.187	.898	.835
		2	1	.187	.898	.835

In addition to examining differences across time for each level of race, I also conducted pairwise tests to examine differences among racial categories at baseline and follow-up. For SBP levels, there was a significant effect of race at baseline, simple effects F (3, 490) = 8.11, p = .001, η^2_p = .047. As Table 16 depicts, Asian WWP participants showed significantly lower SBP levels at baseline than AA, Caucasian, and

Hispanic participants (*p* = .01). African American participants showed significantly higher SBP levels at baseline than Asian and Caucasian participants (*p* = .01) but not Hispanic participants (*p* = .248). At follow-up, Asian participants showed significantly lower SBP levels than AA and Hispanic participants (*p* = .05), but not Caucasian participants (*p* = .101). African American participants showed significantly higher SBP levels at follow-up than Asian and Caucasian participants (*p* = .05) but not Hispanic participants (*p* = .703).

Although there were no other significant findings for the race × time interaction term, there were significant overall main effects between AA and Caucasian participants for all of the dependent variables except for waist-to-hip ratio F (12, 1289) = 3.07, p = .001, η^2_p = .025.

Table 17

Pairwise Comparisons based on Race × Race

Measure	(I) Race	(J) Race	Mean Difference (I-J)	Std Error	Sig
SBP change	1 Asian	2 African American	-7.242	1.729	.000
		3. Caucasian	-3.909	1.670	.020
		4. Hispanic	-5.890	2.027	.004
	2 African American	1. Asian	7.242	1.729	.000
		3. Caucasian	3.333	1.093	.002
		4. Hispanic	1.352	1.585	.394
	3 Caucasian	1. Asian	3.909	1.670	.020
		2. African American	-3.333	1.093	.002
		4. Hispanic	-1.981	1.524	.194
	4 Hispanic	1 Asian	5.890	2.027	.004
		2 African American	-1.352	1.585	.394
		3. Caucasian	1.981	1.524	.194
DBP change	1 Asian	2 African American	-3.393	1.195	.005
		3. Caucasian	-1.155	1.153	.317
		4. Hispanic	-2.173	1.400	.121
	2 African American	1. Asian	3.393	1.195	.005
		3. Caucasian	2.238	.755	.003
		4. Hispanic	1.220	1.095	.266
	3 Caucasian	1. Asian	1.155	1.153	.317
		2. African American	-2.238	.755	.003
		4. Hispanic	-1.018	1.053	.334
	4 Hispanic	1 Asian	2.173	1.400	.121
		2 African American	-1.220	1.095	.266
		3. Caucasian	1.018	1.053	.334
LDL change	1 Asian	2 African American	-12.614	4.752	.008
		3. Caucasian	-5.378-	4.588	.242
		4. Hispanic	12.472	5.571	.026
	2 African American	1. Asian	12.614	4.752	.008
		3. Caucasian	7.236	3.004	.016
		4. Hispanic	.142	4.357	.974
	3 Caucasian	1. Asian	5.378	4.588	.242
		2. African American	-7.236	3.004	.016
		4. Hispanic	-7.094	4.189	.091
	4 Hispanic	1 Asian	12.472	5.571	.026
		2 African American	-.142	4.357	.974
		3. Caucasian	7.094	4.189	.091

(Table continues)

Measure	(I) Race	(J) Race	Mean Difference (I-J)	Std Error	Sig
Waist-to-Hip Ratio change	1 Asian	2 African American	-.031	.011	.004
		3. Caucasian	-.034	.010	.001
		4. Hispanic	-.037	.012	.003
	2 African American	1. Asian	.031	.011	.004
		3. Caucasian	-.003	.007	.608
		4. Hispanic	-.006	.010	.514
	3 Caucasian	1. Asian	.034	0.10	.001
		2. African American	.003	.007	.608
		4. Hispanic	-.003	.009	.756
	4 Hispanic	1 Asian	.037	.012	.003
		2 African American	.006	.010	.514
		3. Caucasian	.003	.009	.756

In conclusion, the hypothesis for RQ1, regarding the statistically significant difference in the mean change in SBP in race × race between AA and Caucasian WWP participants, did satisfy the requirements when accounting for other variables (p = .002) as depicted in Table 17. The hypothesis for RQ2, regarding the statistically significant difference in the mean change in DBP in race × race between AA and Caucasian WWP participants, did satisfy the requirements when accounting for other variables (p = .003) as depicted in Table 17. Therefore, the null hypotheses for RQ1 and RQ2 can be rejected in favor of the alternative hypotheses.

The hypothesis for RQ3, regarding the statistically significant difference in the mean change in LDL cholesterol levels in race × race between AA and Caucasian WWP participants, did not satisfy the requirements when accounting for other variables (p = .06) as depicted in Table 17. Therefore, the null hypothesis for RQ3 cannot be rejected in favor of the alternative hypothesis. The hypothesis for RQ4, regarding the statistically significant difference in the mean change in waist-to-hip ratio in race × race between AA and Caucasian WWP participants, did not satisfy the requirements when accounting for other variables (*p* = .608) as depicted in Table 17. Therefore, the null hypothesis for RQ4 cannot be rejected in favor of the alternative hypothesis.

Summary and Transitions

This retrospective cohort study was undertaken to determine whether or not there were racial differences in the mean change in CVD biomarkers between AA and Caucasian participants in a U.S. Marine Corps-sponsored, self-directed WWP between 2009 and 2013. The four CVD biomarkers evaluated were SBP, DBP, LDL cholesterol, and waist-to-hip ratio. The results are summarized in Table 18.

Table 18.

Summary Table

Hypothesis	Statistical Analysis	Result
Research H_o1: There is no statistically significant difference in the mean change in SBP between AA and Caucasian participants in a worksite wellness program.	Repeated measures MANCOVA	Reject the null hypothesis
Research H_o2: There is no statistically significant difference in the mean change in DBP between AA and Caucasian participants in a worksite wellness program.	Repeated measures MANCOVA	Reject the null hypothesis
Research H_o3: There is no statistically significant difference in the mean change in blood cholesterol LDL levels between African American and Caucasian participants in a worksite wellness program	Repeated measures MANCOVA	Cannot reject the null hypothesis
Research H_o4: There is no statistically significant difference in the mean change in waist-to-hip ratio between African American and Caucasian participants in a worksite wellness program?	Repeated measures MANCOVA	Cannot Reject the null hypothesis

The goal in chapter 4 was to present the findings of this analysis. After controlling for race, sex, age, and days from baseline, there was significant difference between AA and Caucasian participants in pairwise comparison for SBP and DBP. However, there was no significant difference between AA and Caucasian participants in pairwise comparison for LDL cholesterol, or waist-to-hip ratio. Therefore, research H_o1 can be rejected in favor of the research H_a1, and H_o2 can be rejected in favor of H_a2 (Table 18). On the other hand, research H_o3, and H_o4 cannot be rejected (Table 18).

Chapter 5 will offer a full discussion of the key findings and limitations of this investigation. There will also be a discussion on this study's implication for social change, and recommendations for future research.

Chapter 5: Discussions, Conclusions, and Recommendations

Introduction

The primary purpose of this nonrandomized cohort study was to determine if there were racial differences in the mean change in CVD biomarkers between African AA and Caucasian WWP participants in a self-directed WWP sponsored by the U.S. Marine Corps between 2009 and 2013. The effect was determined by retrospectively comparing the following baseline and follow-up CVD biomarkers: SBP, DBP, LDL cholesterol, and waist-to-hip ratio. Similar to body mass index, waist-to-hip ratio is a measurement of body composition and a reliable CVD biomarker (Huxley, Mendis, Zheleznyakov, & Chan, 2010). This observational study analyzed de-identified secondary data collected from AA, Caucasian, Hispanic, and Asian WWP participants. Even though the dataset used in this analysis included relatively few Hispanic and Asian WWP participants, AAs and Caucasians were the focus of this inquiry.

In this final chapter, I will discuss the results of this nonrandomized, retrospective study within the context of the theoretical framework that guided the inquiry. First, I will offer an interpretation of the findings relative to the RQs and hypotheses. Then I will discuss the limitations of this study. Additionally, I will offer recommendations for action and how these results may advance knowledge in the field. Finally, I will touch upon the positive social change implications of this dissertation investigation.

Discussion

African Americans are disproportionately burdened with CVD and there have been calls for community-level intervention strategies to help ameliorate this disparity

(CDC, 2014a; Ferdinand et al., 2012). In recent years, the workplace has emerged as a powerful environment for supporting employees' efforts to adopt healthy behaviors (Arena et al., 2013). The WHO pointed out that the workplace provides an opportunity to reach a large number of people who would otherwise be unreachable (WHO, 2014). WHO characterized the workplace as a priority setting for promoting heart-healthy behaviors, an environment in which large numbers of people can be simultaneously influenced to eat healthy, engage in regular physical activity, manage their stress, and stop smoking (WHO, 2014). Recognizing the potential health promoting benefits of the workplace, the authors *Healthy People 2020* set an increase in the proportion of worksites that offer WWP to employees as a strategic goal (DHHS, 2013a). Despite the burgeoning evidence of the efficacy of WWPs in reducing CVD risk factors among the general workforce, there have not been any studies specifically examining WWPs as a community-based model for improving CVD biomarkers among AA workers—a gap in knowledge that this study investigated.

The health belief model and the social cognitive theory, as discussed in chapter 2, grounded this study and informed my understanding of the health-related beliefs and behaviors of study participants (Bandura, 2004; Glanz & Bishop, 2010). The constructs of the health belief model—perceived seriousness, perceived susceptibility, perceived benefits, and perceived barriers—helped explain the observed research findings. According to Middleton (2009), AAs espouse health-related beliefs and behaviors that can be inconsistent with the biomedical model of CVD (Middleton, 2009). For example, AA might perceive hypertension, a largely symptomless disease, to be less serious than one that produces pain, such as migraine headaches (Middleton, 2009).

The three interconnected variables of the social cognitive theory—behavioral, physiological, and environmental factors—informed my understanding of how and why individuals develop and self-manage chronic diseases (Bandura, 2004). Furthermore, the triads of the theory have relevance to the findings of this dissertation study. For example, the social cognitive theory helped explain how the environment (e.g., the workplace) shapes, maintains, and constrains health-related behaviors—a concept called reciprocal determinism. Self-efficacy is another important construct in the social cognitive theory, as this was shown to be a significant predictor of CVD health-related behavioral change (Sarkar, Ali, & Whooley, 2007). Persons who believe they have the ability to adopt a new activity (e.g., the ability start a walking program) are more inclined to do so than persons who do not believe so. In addition, the physical environment can be instrumental in driving health-related behavioral change (Cummins, Curtis, & Diez-Roux, 2007). Employees have a mutually reinforcing and reciprocal relationship with their workplace and are inclined to assimilate the norms of their workplace (e.g., physical activity). Subjects in this dissertation study may have been influenced by physical fitness cues typical of a U.S. Marine Corps environment.

Interpretation of the Findings

As discussed in Chapter 4, I employed repeated measures MANCOVA analysis to test the hypotheses using the four dependent variables for change from baseline to follow-up for SBP, DBP, LDL cholesterol, and waist-to-hip ratio. The key independent variable for the model was race, with age, sex, and the number of days from baseline included as covariates. The variables were subjected to two tests: the *within-subject* effect, and the *between-subject* effect. The multivariate tests revealed that there was an overall significant difference in between-subjects effect of race (p = .000), and significant difference in within-subjects effects of both time (p = .042) and the interaction term race × time (p = .045). Therefore, one can be reasonably confident that any statistically significant effects unveiled for the individual dependent variable models were not due to random chance resulting from iterative testing of highly correlated dependent variables (i.e. Type I error).

There was an overall significant main effect of time for downward changes in SBP and DBP among AA and Caucasian participants, and this downward trend remained significant even after including the key independent variable, race, and the covariates. These results support the findings in previous studies that showed the efficacy of community-level health promotion in reducing SBP and DBP (Dodani, 2011; Victor et al., 2009). Blood pressure is influenced by many lifestyle-related factors such as level of sodium intake, amount of physical activity, and tobacco use (Chobanian et al., 2003). SBP and DBP reduction are common success stories of WWPs, and the observed downward trends of these CVD biomarkers are consistent with previous short-term and long-term WWP interventions (Doyle, Severance-Fonte, Morandi-Matricaria, & Wogen, 2010; Kaspin 2013; Loeppke, Edington, & Beg, 2010). Although AA had higher SBP and DBP at baseline compared to Caucasians, AA showed significantly higher mean changes in SBP (p = .002) and DBP (p = .003). This is consistent with another WWP study by Burton, Chen, Li, Schultz, and Edington (2013) in which AA had a significantly higher average number of health risks at baseline, but showed the greatest improvement in health risk by time. One can argue that the higher number of risks created a higher magnitude of improvement.

This dissertation investigation did not show a significant downward trend in LDL cholesterol levels or waist-to-hip ratios from baseline to follow-up. These results failed to corroborate previous studies showing significant downward trends in LDL cholesterol (Byrd, Silliman, & Morris; White & Jacques, 2007), and weight loss (Fitzgibbon et al., 2005) among WWP participants. One reason for the variance in outcomes between this study and others might be that participants in this dissertation cohort engaged in self-managed, self-directed activities, without sustained active engagement (e.g., supervised walking program and group health coaching) by the health promotion staff. In contrast, employees who engaged in a 12-week WWP study that involved nutrition counseling, multiple hour-long workshops, grocery shopping tours, and yoga experienced a significant reduction in LDL cholesterol (p = .002) and weight (p = .01) in a relatively short period of time (White & Jacques, 2007). The authors of *Healthy People 2020* pointed out that successful worksite health promotion programs are supportive, integrated, and engage participants (DHHS, 2013a).

Another reason for a lack of downward trend in LDL cholesterol and waist-to-hip ratio in this study might be the relatively short duration of data collection from baseline to follow-up (M = 194.84 days) and a lack of within-group participation. In a 3-year onsite wellness program at a rural manufacturing company in Northern California, employees demonstrated a 9% sustained reduction in LDL cholesterol ($p < 0.01$), a significant CVD biomarker reduction (Byrd et al., 2008). Hospital and nursing home employees enrolled in a within-group weight loss program showed more effective weight loss (7.6 lbs) than individual weight loss (4.2 lbs) and body fat (1.7% versus 0.9%, respectively) after 8 weeks (Rigsby, Gropper, & Gropper, 2009).

For this dissertation study, research H_o1 can be rejected in favor of the research H_a1, and H_o2 can be rejected in favor of H_a2. On the other hand, research H_o3, and H_o4 cannot be rejected.

Limitations of the Study

The premier limitation of this observational study is that subjects were not randomized, which can limit generalization of the results. A randomized inquiry has stronger internal validity than a non-randomized one, but this retrospective cohort investigation used a secondary dataset that did not lend itself to randomization. This study evaluated workers who voluntarily participated in a company-sponsored WWP. As volunteers, study subjects might have been more motivated than their nonparticipant peers to make healthy choices that resulted in CVD risk reductions. In a worksite wellness study among minority and underserved populations, Thompson, Smith, and Bybee (2005) found that the unhealthiest workers were the least likely to participate in health promotion activities. Therefore, it could be argued that this cohort of WWP participants represented a skewed sample.

The dataset used in this analysis was incomplete. The health risk assessment that WWP participants filled out was not sufficiently comprehensive as it did not elicit pertinent bio-behavioral and demographic information such as tobacco and alcohol use, sleep pattern, comorbidities, education attainment, employment history, income, or marital status. According to Grossmeier et al. (2013), a long list of bio-behavioral and demographic variables such as education attainment, health habits, and marital status powerfully influence health outcomes. Olson and Chaney (2009) asserted that a major reason for the failure of employee wellness programs is inadequate health risk assessments.

Sample size has fundamental implication for the fidelity of a research inquiry. Aschengrau and Seage (2008) pointed out that sample size provides power to a research and helps the investigator arrive at the correct inferences and enhances generalizability. Barkan (2015) pointed out that a small sample size limits the transferability of research findings to other populations. The sample size in this dissertation investigation was small, which may have limited the power of the analysis and generalization to other populations.

The source population for this sample was taken from civilian employees working in a U.S. Marine Corps environment with unique environmental features and cues (e.g., physical fitness is widely modeled and advocated), and this might limit the generalizability of the results to the general populations. Many of these employees were spouses of U.S. Marines. According to the social cognitive theory, environmental cues can shape, maintain, and constrain health-related behaviors (Bandura, 2004).

Finally, multiple health promotion staff members performed biometric measurements (e.g., manual blood pressure and waist-to-hip ratio), which posed the risk of operator variability that can also threaten validity. Finally, because secondary data were used for this retrospective cohort study, additional confounding factors such as workplace stress and medication use by participants were not evaluated and controlled.

Recommendations for Action

The results of this dissertation study provide insight into the potential benefits of WWP in mitigating certain CVD biomarkers over time. The results also lay the foundation for future WWP studies. In this dissertation inquiry, the downward trend in SBP and DBP remained significant even after including the key independent variable, race, and the covariates. Moreover, the results showed that there were significant overall main effects between AA and Caucasian participants for two out of four dependent variables. Given the lack of WWP studies among AA employees—the gap that underscores the reason for this study—consideration should be given to further evaluate the full extent of beneficial impact of WWP participation on CVD biomarkers among AA employees. Researchers should be mindful of the importance of cultural competence when developing a WWP (Kline & Huff, 2008).

An important consideration for future WWP studies is to randomize AA employees to participate in a CVD reduction group and a control group of Caucasian employees. Future studies should be of longer duration in order to show possible mechanisms by which associations occur. Consideration should be given to employing a comprehensive health risk assessment that captures pertinent bio-behavioral and demographic information such as tobacco and alcohol use, sleep pattern, comorbidities, stress levels, education attainment, employment history, income, and marital status.

While the number of participants in this cohort study was adequate for data analysis, a larger sample size would add power to the observed correlation. Future research efforts should evaluate a larger sample size to increase power. Instead of a single WWP, researchers should evaluate multiple WWPs to improve generalizability of results. Future studies should also evaluate methods of communicating supportive health-related information between WWP health promoters and employees. There is qualitative evidence that tailored e-mails can effectively improve health-related behaviors (Yap & James, 2010). Lastly, successful WWP are buttressed by environmental and policy changes that support healthy behaviors (DHHS, 2013a). For example, installing automatic blood pressure machines at all bus terminal increased awareness and blood pressure-lowering behavior among predominantly AA bus drivers (Doyle et al., 2010). With regards to policy changes, carefully crafted workplace health-related policies, without unintended consequences, can create a culture of wellness and improve overall health for all (Kaspin et al., 2013).

Implications for Positive Social Change

Positive social change refers to the application of transformational strategies at multiple ecological levels (e.g., the individual, families, and communities) that result in positive human and social outcomes (Maton, 2008). Compared to Caucasians and other racial and ethnic groups, AAs have disproportionately higher rates of hypertension, LDL cholesterol, and overweight and obesity (CDC, 213a; CDC, 2012a; NIH, 2002). This dissertation inquiry can inform a transformation in intervention strategies for reducing CVD disparity among AAs. Results of this study support previous investigations showing the efficacy of community-level health promotion in reducing blood pressure, such as those showing the benefits of barbershop and faith-based initiatives (Dodani, 2011; Victor et al., 2009). Moreover, this study showed a potential option for public health educators working to lower the burden of CVD among AAs via worksite wellness interventions.

Like their racial and ethnic peers, employed AAs spend a large portion of their waking hours at work, and develop enduring social and behavioral networks with co-workers. These networks provide unique opportunities to positively impact the health of a captive audience by leveraging groups' problem solving dynamics (Bandura, 2004). Health promoters can capitalize on these dynamics and results from research such as this one to bring positive social change to the AA community by reducing their disproportionate chronic disease burden. Reducing the disparity in CVD risk can, in turn, reduce the rates of blindness, stroke, congestive heart failure, heart attack, and end-stage kidney disease among AAs (CDC, 2014a). Finally, a reduction in disease burden can reduce the high rates of individual and societal expenditure associated with CVD-induced poor health outcomes. Reducing disease prevalence and healthcare costs are positive social changes in an era of chronic disease epidemic and runaway healthcare costs.

Conclusion

A large number of studies have shown the benefits of WWP in ameliorating CVD biomarkers such as SBP, DBP, LDL cholesterol, and body mass index. There is limited knowledge about the efficacy of WWPs in ameliorating the CVD burden and disparity among AAs who participate in WWPs. This gap in knowledge represents a lack of race-and ethnic-based data to address disproportionate CVD rates and disparity in the AA community. This dissertation investigation set out to determine whether or not there were racial differences in the mean change in CVD biomarkers between AA and Caucasian participants in a U.S. Marine Corps-sponsored, self-directed WWP. This quantitative, cohort study showed an overall significant main effect of time for changes in SBP and DBP even after controlling for race, sex, age, and days from baseline. However, there was no overall main effect of time for changes in LDL cholesterol or waist-to-hip ratio. In pairwise comparison for race × race, the only statistically significant dependent variables between AAs and Caucasians were SBP and DBP. Therefore, research H_o1 can be rejected in favor of the research H_a1, and H_o2 can be rejected in favor of H_a2. On the other hand, research H_o3, and H_o4 cannot be rejected.

Results of this study support previous investigations showing the efficacy of community-level health promotion in reducing blood pressure, such as those showing the benefits of barbershop and faith-based initiatives. This study has laid the foundation for future workplace-level studies to further close the gap in knowledge of the CVD benefit of WWP to at-risk AA employees. This study also serves to inform future workplace wellness programming that can reduce CVD risks among all employees.

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Appendix A: Permission to use De-identified Dataset

5300
MF
12 DEC 2014

From: Director, Marine and Family Programs Division
To: Mr. Ceabert J. Griffith

Subj: ENDORSEMENT OF PROPOSAL TO EVALUATE DATASET FROM EMPLOYEE WELLNESS PROGRAM

1. Marine and Family Programs Division (MF) supports the research proposed by Mr. Ceabert J. Griffith to evaluate de-identified dataset generated as part of an employee wellness program administered by Marine Corps Community Services (MCCS), Okinawa. Mr. Griffith will use this information to obtain his PhD in Public Health at Walden University. The objective of the study is to determine if health education efforts were effective in encouraging participants to adopt healthy lifestyles.

2. The study will not be conducted with human participants. Instead, it will involve statistical analysis of blood pressure, cholesterol, and body composition collected as part of the MCCS, Okinawa employee wellness program. There is no existing research pertaining to the efficacy of any MCCS administered employee health promotion efforts. Information from this data analysis will assist MCCS leadership in modifying or continuing current employee wellness programs.

3. It is requested that a summary of the results and copies of relevant briefings/reports be sent to the Director, Marine and Family Programs Division.

4. Our point of contact is Catherine Ficadenti, Branch Head, Semper Fit and Recreation at ficadentica@usmc-mccs.org or 703-784-6398.

R. A. C. Sanborn

R. A. C. SANBORN

Appendix B: Certificate of Training: Protecting Human Research Participants

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Ceabert Griffith** successfully completed the NIH Web-based training course “Protecting Human Research Participants”.
Date of completion: 03/24/2013
Certification Number: 1149178