EXPLORING THE ROLE OF INTERSECTIONALITY ON CARDIOVASCULAR DISEASE RISK IN SEXUAL MINORITIES

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctorate of Psychology at Virginia Commonwealth University

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Table of Contents

List of Tables

Page

List of Figures

Page

Abstract

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Background: Previous research has shown that sexual minority individuals (SM) are twice as likely to smoke, twice as likely to be overweight or obese, and less likely to be physically active than heterosexual persons; all of which place SMs at an increased risk for cardiovascular disease (CVD). While information on CVD risk by race/ethnicity and socioeconomic status is well documented, there is scant literature examining race, gender, and the potential CVD risk in SMs. The purpose of this study was to examine CVD risk in sexual minorities.

Method: The current study used data from the National Longitudinal Study of Adolescent Health (Add Health). The Framingham multiple-risk assessment, which uses a calculation of age, smoking, BMI, and blood pressure, was used to predict vascular age and the risk of experiencing CVD event in the next 10 years. 54% of the sample was male, 62% white,

and 4% identified as a SM. The sample was split into three groups: 1) 100% heterosexual (*N*=4363); 2) mostly heterosexual (*N*=509); and 3) SM (*N*=188).

Results: There was a trend towards significance, $p = .056$, for mean differences in vascular age/actual age, for SM participants (*M*=10.07), compared to 100% heterosexual (*M*=9.1) and mostly heterosexual (*M*=8.66) participants. Mostly heterosexual participants were 1.62 times more likely, and SM participants were 1.97 times more likely to be current smokers when compared to 100% heterosexual participants. SM participants endorsed having significantly more drinks ($M = 4.50$) when compared to both 100% heterosexual ($M = 3.80$) and mostly heterosexual ($M = 3.38$) participants. SM participants were 1.7 times more likely to endorse having 5 or more drinks on one occasion. SM participants also reported significantly higher stress levels than the other two groups

Conclusion: While the data for the current study did not provide sufficient evidence to suggest sexual orientation differences in Framingham risk scores, the findings remain noteworthy. SM showed increased risk in smoking and stress levels. Additionally, the Population-based longitudinal studies and surveillance data are essential and necessary in order to minimize disparities in risk factors and to reduce the likelihood of subsequent disease in SM population.

Exploring the Role of Intersectionality on
Trajectories of Cardiovascular Risk among Sexual Minorities

Heart and blood vessel disease, also known as cardiovascular disease (CVD), is the leading cause of death and disability in the United States with one in every three deaths a direct result of a CVD related condition (Go et al., 2014; Roger et al., 2012a). In 2008, 33% of CVD related deaths occurred before the age of 75, which is well before the current average life expectancy age of 77.9 years (Roger et al., 2012a). As the estimated cost of CVD is expected to exceed $1 trillion by 2030, it is important for research to focus on primary prevention. Exploring potential disparities in CVD risk in emerging adults is one such way to mitigate risk in advance of the development of CVD related illnesses. While information on CVD risk by race/ethnicity and socioeconomic status is well documented, there is scant literature examining the potential risk in sexual minority populations. This introductory section will provide a rationale for the exploration of CVD risk in sexual minorities. The section will begin with an introduction to CVD and the current research on risk factors related to sexual orientation, and end with an explanation of the significance of this study.

What is Cardiovascular Disease?

CVD includes a number of disorders including coronary heart disease, heart attack, and stroke. Many of these problems are related to a process called atherosclerosis, a condition that develops when plaque builds up in the walls of the arteries. This buildup narrows the blood vessels, making it harder for blood to flow through. If a blood clot forms, it stops the flow of blood, causing a heart attack or stroke (Go et al., 2014). Heart disease and stroke can be fatal, but can also result in significant disability, such as paralysis, speech difficulties, psychosocial issues and decreased quality of life. Together, heart disease and stroke are among the most widespread and costly health problems facing the nation today, accounting for more than $300 billion

annually in health care expenditures and lost productivity (Ritchey et al., 2014). Yet, while mortality rates from CVD conditions are steadily declining, the economic burden continues to rise (Joo, George, Fang, & Wang, 2014).

After the American Heart Association (AHA) achieved its major Impact Goals for 2010, the AHA created a new set of Impact Goals for the current decade (Schiller, Donham, Anderson, Dingledein, & Strebel, 2010). Specifically, the AHA committed to "improving the cardiovascular health of all Americans by 20%, while reducing deaths from cardiovascular diseases and stroke by 20% by 2020 *(p. e10)*(Mozaffarian, Benjamin, Go, Arnett, Blaha, Cushman, de Ferranti, et al., 2015; Roger et al., 2012b). Taking a novel approach, the goals include a focus on cardiovascular health, which incorporates seven health metrics, four of which are health risk behaviors. Ideal cardiovascular health is defined not only by the absence of a clinical CVD diagnosis, but also the simultaneous presence of optimal levels of the 7 health metrics. These health metrics include (1) having lean body mass, (2) the avoidance of smoking, (3) participation in physical activity, (4) having a health dietary intake consistent with what is recommended by the Dietary Approaches to Stop Hypertension (DASH)[1], (5) maintaining healthy metabolic and lipid levels (<200 mg/dL total cholesterol), (6) blood pressure <120/80 mm Hg, and (7) fasting blood glucose <100 mg dL).

The concept of "ideal cardiovascular health" is essential to the current study in that there is a substantial body of literature indicating that sexual minorities have higher rates of smoking (Brennan, Ross, Dobinson, Veldhuizen, & Steele, 2010; King, Dube, & Tynan, 2012; J. G. Lee, Griffin, & Melvin, 2009), higher body mass index (BMI) (Hatzenbuehler, McLaughlin, & Slopen, 2013) and elevated metabolic and lipid levels (Hatzenbuehler, McLaughlin, et al., 2013).

[1] DASH is an eating plan created by the National Heart, Lung, and Blood Institute that

And while disparities in adult CVD risk by race/ethnicity (Mays, Cochran, & Barnes, 2007; Wyatt et al., 2003), gender (Pan et al., 2011; Peek, 2011; Sablotzki et al., 2003), and socioeconomic status (Silberman et al., 2003; Williams, Mohammed, Leavell, & Collins, 2010) have been well documented in the literature, critical information gaps remain regarding the potential for increased risk of CVD in lesbian, gay, and bisexual (LGB) persons.

Historical Trends in Research on LGB Populations

Historically, much of the research in lesbian, gay, and bisexual populations has focused primarily on mental health. Decades of research have continuously demonstrated that LGB individuals experience disparate levels of psychological distress due to social stigma, homonegative prejudice and discrimination (Bostwick, Boyd, Hughes, & McCabe, 2010; Bostwick, Boyd, Hughes, West, & McCabe, 2014; M. S. Friedman et al., 2011; Meyer, 2003). Studies around the globe, including Canada (Brennan et al., 2010), South Korea (S. Kim & Yang, 2015), the Netherlands (de Graaf, Sandfort, & ten Have, 2006), England and Wales (Warner et al., 2004), have found analogous results, providing further evidence of poorer psychological health in this population. Health researchers have attributed these outcomes to the stress associated with being a member of a marginalized group.

The minority stress theory suggests that stressors unique to an individual's minority status can have deleterious effects on health (Meyer, 2003) by directly influencing biological stress responses (e.g. higher circulating levels of E-selectin) (E. M. Friedman, Williams, Singer, & Ryff, 2009) or indirectly by influencing health behaviors (e.g. smoking and hazardous drinking)(Wilsnack et al., 2008). Yet, outside of a framework of substance abuse and/or sexual deviance or sexually transmitted infections (STIs), public health researchers have largely ignored other health problems for which LGB individuals could be at increased risk of developing (Boehmer, 2002). For example, previous research has shown that lesbian and bisexual women

are less likely to participate in preventive screenings in reproductive health (Phillips-Angeles et al., 2004; Reiter & McRee, 2015), yet there is little research examining whether sexual minority women are at increased risk for reproductive cancers (e.g. breast, ovarian, etc.) than heterosexual women.

Despite increasing social and legal acceptance of LGB individuals, sexual minority populations have not seen the same level of scientific inquiry regarding physical health, as heterosexual populations. A review of the literature shows that while sexual minorities account for between 1-10% of the U.S. population, LGB issues account for a mere 0.1% of research studies (Boehmer, 2002), with the vast majority of those related to HIV/AIDS and other sexually transmitted infections (STIs). And while research in this area remains critical, the lack of research in other areas of physical health exposes a problematic research disposition that fuses sexual orientation and sexual deviance. LGB identity extends well beyond sexual behavior. Hence, it is important to explore how LGB identity can affect all facets of health and well-being.

In 2001, the Gay and Lesbian Medical association documented the need for research in health risk disparities in sexual minority populations (Sell & Becker, 2001). Yet in 2011, the Institute of Medicine's committee on lesbian, gay, bisexual, and transgender health found that very little had been learned over the past decade and even less on subpopulations, particularly racial and ethnic groups (Institute of Medicine Committee on Lesbian, Transgender Health, Research, & Opportunities, 2011).

Historically, LGB individuals had been viewed as having a mental disorder as it relates to their sexual orientation. Although the debate on this classification ended in 1973 with the removal of homosexuality from the second edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-II), the imprint and heritage of viewing alternative sexual identities as a dysfunctional state has remained. This legacy, from the very outset, has influenced research on

LGB individuals by linking the higher prevalence of mental disorders to an orientation rather than stigmatization (Meyer, 2003).

Even with the change in the DSM-II, the diagnosis of homosexuality was replaced with a diagnosis of sexual orientation disturbance (SOD). With this compromise only those individuals who were comfortable with their orientation were no longer considered to have a mental disorder, while those that experienced any form of discomfort or internal conflict remained pathological. It wasn't until 1986 that the diagnosis was removed from the DSM. Even still, homosexual behavior remained a pathological diagnosis in the revised DSM-III occurring under *Sexual Disorders Not Otherwise Specified,* which included persistent and marked distress about one's sexual orientation. With the introduction of the DSM 5, homosexuality has been completely removed as disorder. As such, gender nonconforming individuals who had been given a diagnosis of Gender Identity Disorder (GID), are no longer considered psychologically "disordered," with the diagnostic label now being referenced as Gender Dysphoria.

This chronicle of research and pathology in sexual minorities is important in that it provides a context and a rationale for the lack of CVD research in this population. Historically, public health researchers have not recognized sexual minorities as a population with health issues that exist outside of a framework of sexual deviance. Until the 1980s, the primary focus of research in this population focused on explicating the etiology of homosexuality, later shifting to HIV/AIDS and sexual orientation as an indicator or measure of STI risk. What this history exposes is not only a lack of understanding the needs of this population, but also reveals a neglect of the important nuances of public health research in these populations. Essentially, sexual minorities have been misrepresented and underrepresented as research subjects in the history of scientific inquiry. When research in the population occurs, it unfortunately mirrors the history of population research focusing primarily on white men, with little regard for differences

by race and gender. A recent meta-analysis of publications between 1980 and 1999 yielded 3,777 research articles (0.1% of the total research during this time). Eighty percent of those research studies focused on gay men, 39% focused on bisexual men, and 85% completely omitted the racial/ethnic background of the sample (Boehmer, 2002).

In 2014, another literature review examined the proportion of studies funded by the National Institutes of Health (NIH) that focused on health in LGBT populations from 1989 to 2011 (Coulter, Kenst, Bowen, & Scout, 2014). NIH funded 628 studies concerning LGBT health, and, excluding projects about HIV/AIDS and other sexual health matters, only 0.1% (n=113) of all NIH-funded studies were health related. Eighty-six percent of the studies focused on sexual minority men and 13.5% studied sexual minority women. Overall, 79% of the research in LGBT populations focused on HIV/AIDS and 31% on illicit drug use, 23% on mental health and 13% on alcohol abuse, with 202 studies examining LGBT health-related interventions. What these findings reveal is a need for a paradigm shift that recognizes the varied cultural and social identities that exist within sexual minority populations, and how those experiences shape and influence health.

Intersecting Marginalized Identities

In 1851, freed slave Sojourner Truth gave her seminal *Ain't I a Woman?* speech extemporaneously at the Women's Convention in Akron, Ohio (Stowe, 1863). Her speech is the earliest recorded account of an interrogation of the intersections of race and gender. During a time when to be black meant being a man, and to be white meant that one was a women, Sojourner Truth found herself at an intersection of seemingly exclusive identities. Petitioning for freedom and recognition for an identity lost between the abolition of slavery and women's suffrage, she asserts,

> That man over there says that women need to be helped into carriages, and lifted over ditches, and to have the best place everywhere. Nobody ever helps me into carriages, or over mud-puddles, or gives me any best place! And ain't I a woman?

Here in lies the problem for those who find themselves at the cross-section of who they are and who society dictates that they can or cannot be.

On December 18, 2008 the Advocate, the oldest and largest LGBT publication in the U.S., caused much controversy by proclaiming on its cover "Gay is the new black" (Gross, 2008). This proclamation generated a firestorm of criticism, particularly from the African American community. A great deal of the disagreement found roots in many believing that this statement not only trivialized the 300 years of transatlantic slavery, but did a great disservice to activist who endured state sanctioned beatings, fire hoses, police dogs, lynching and the oppression of Jim Crow in the years following emancipation (Stone & Ward, 2011). Additionally, this proclamation undervalued the woman suffrage movement and the struggle for equal voting rights for women (Spade & Willse, 2014). In this gendered and racially charged debate as to whether LGBT rights were as the Advocate proclaimed, "the last great civil rights struggle," there was a question that remained largely unaddressed. Can one be gay and black, and if so, where and how does this debate address their situation? Much like Sojourner Truth, finding oneself at the intersection of marginalized identities all too often renders one invisible.

Comparable to what is observed in the general U.S. population, sexual minority persons are diverse in terms of cultural background, race/ethnicity, age, education, socioeconomic status, and geographic location. In turn, the degree to which sexual orientation or gender identity is central to one's self-concept could vary depending on a number of sociocultural factors. Identity and self-concept can influence the level of affiliation with the LGB community and other persons within that community. Additionally, depending on other sociocultural factors central to the self, like race and gender, the rejection or acceptance of societal stereotypes and prejudice vary

greatly among individuals according to their own unique experiences. For example, studies have found that women who identify as lesbian or bisexual are at increased risk for substance abuse problems when compared to heterosexual women (T. Hughes, Szalacha, & McNair, 2010; Wilsnack et al., 2008). Researchers have also found that sexual minority women of color are at greater risk of substance abuse than heterosexual women of color (H. J. Kim & Fredriksen-Goldsen, 2012), whereas sexual minority men of color are at comparable or lower risk of substance abuse than heterosexual men of color (T. Hughes et al., 2010). These findings highlight the need for examining the intersections of minority identity, or *intersectionality*, as it pertains to race/ethnicity, gender, and sexual orientation, particularly as it relates to CVD risk.

Literature Review

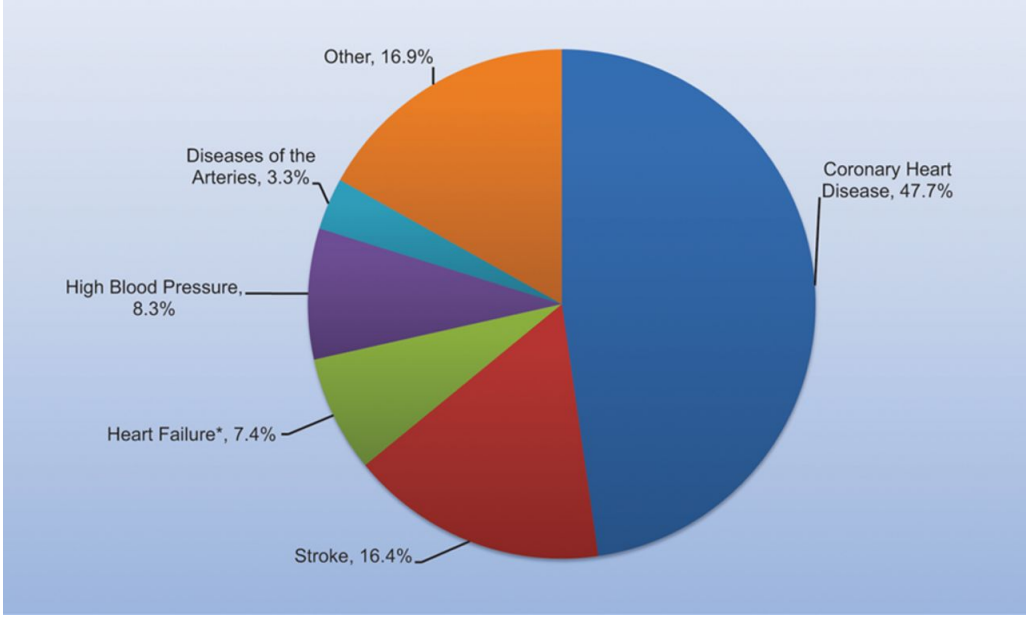
This section begins with an overview of CVD and health behaviors related to increased risk. The psychobiology of chronic stress and its relationship to CVD risk will also be discussed, followed by a review of relevant literature on intersectionality and minority stress, including a description of each construct and the historical context in which it was developed. The relation of intersectionality and minority stress to cardiovascular health risk behaviors will be reviewed followed by a brief summary of the literature review.

CVD: A Brief Overview

From 2001 to 2011, the CVD mortality rate declined by 30.8%. Despite this decline, CVD still accounts for 31.3% of all deaths, or roughly 1 of every 3 deaths in the United States. On the basis of this mortality rate; more than 2150 people die each day from a CVD related condition, averaging out to approximately 1 death every 40 seconds (Mozaffarian, Benjamin, Go, Arnett, Blaha, Cushman, de Ferranti, et al., 2015). CVD claims more American lives than all forms of cancer combined making it the country's most significant threat to health and well-being.

As mentioned earlier, “cardiovascular” or “heart disease" refers to several types of heart conditions, including coronary heart disease, cerebrovascular disease, hypertensive heart disease, and myocardial infarction or heart attack (Figure 1). An estimated 85.6 million U.S. adults, roughly 1 in 3, have some form of CVD. Of these, 43.7 million are estimated to be below the age of 60. The 2011 overall mortality rate attributable to CVD was 229.6 per 100,000 Americans with mortality rates reaching 275.7 for males and 192.3 for females. Each of the aforementioned forms of CVD will be discussed with regard to prevalence rates and disparities.

Figure 1: Percentage breakdown of deaths attributable to cardiovascular disease (United States: 2011)

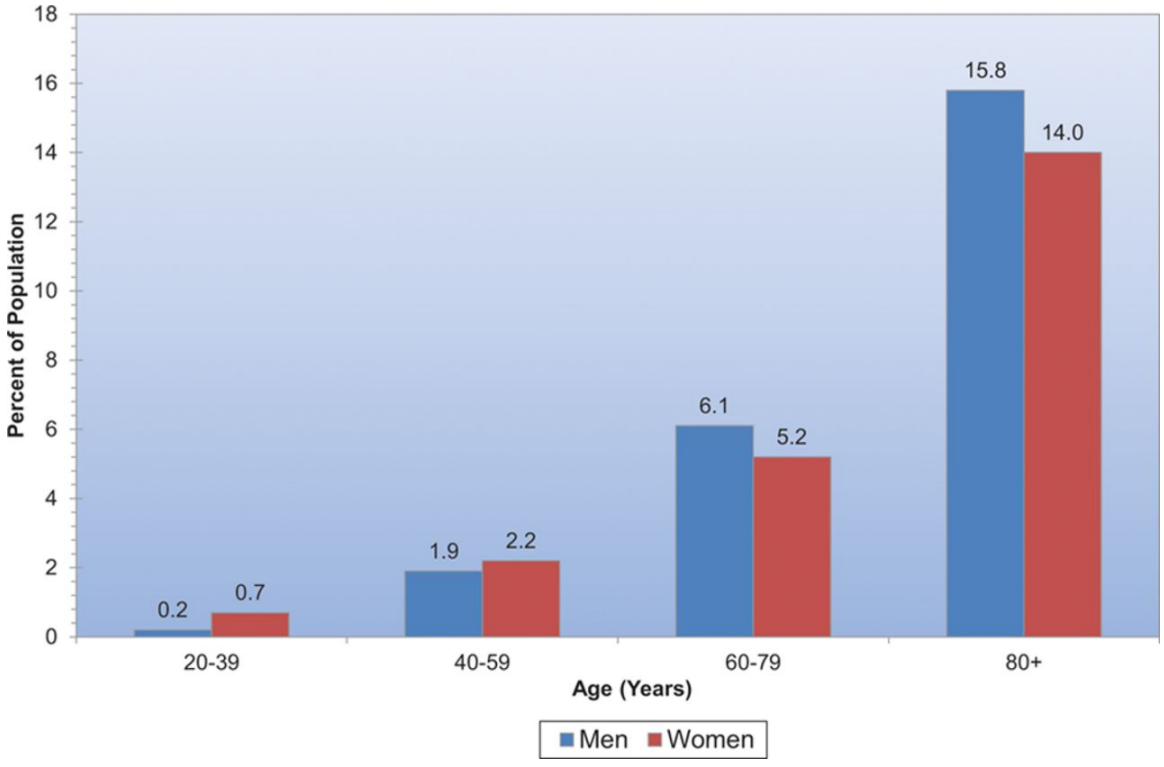


Coronary Heart Disease. In the United States, the most common form of CVD is coronary heart disease (CHD). CHD alone caused roughly 1 of every 7 deaths in the United States in 2011. CHD is caused by plaque buildup in the walls of the arteries that supply blood to the heart (called coronary arteries) and other parts of the body. This plaque is made up of deposits of cholesterol and other substances in the artery. Plaque buildup causes the inside of the arteries to narrow over time, which could partially or totally block the blood flow leading to

heart failure or stroke (Mozaffarian, Benjamin, Go, Arnett, Blaha, Cushman, de Ferranti, et al., 2015).

Cerebrovascular Disease. The second most common form of heart disease, and also the fifth leading cause of death, is cerebrovascular disease, or stroke. A stroke occurs when a blood vessel in the brain bursts or when the blood supply to the brain is suddenly interrupted, spilling blood into the spaces that surround the brain cells. In 2011, stroke caused roughly 1 of every 20 deaths in the United States. On average, every 40 seconds, someone in the United States has a stroke, and someone dies of one approximately every 4 minutes. Figure 2 shows the prevalence of stroke among men and women by age group.

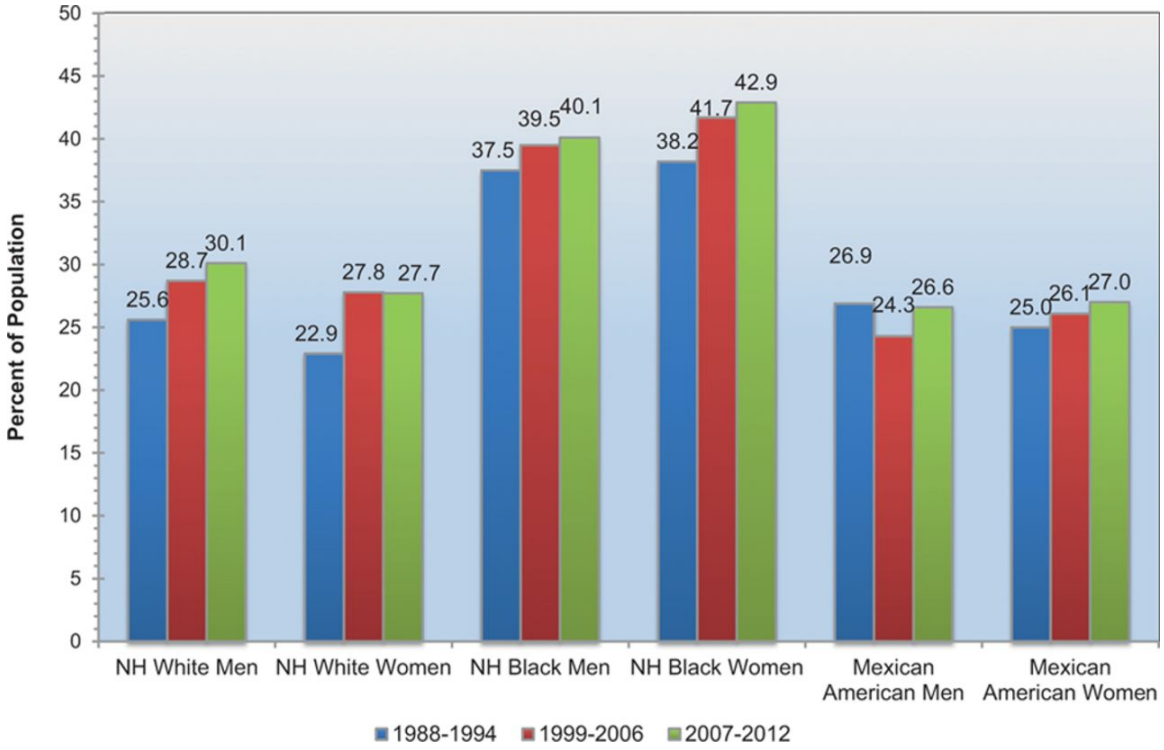
Figure 2: Prevalence of stroke by age and sex (National Health and Nutrition Examination Survey: 2009–2012).



Hypertensive Heart Disease. High blood pressure, or hypertension, is by far one of the most critical risk factor for CVD (Ritchey et al., 2014). Based on data collected between 2009 and 2012, 32.6% of US adults over the age of 20 have hypertension, representing around 80.0

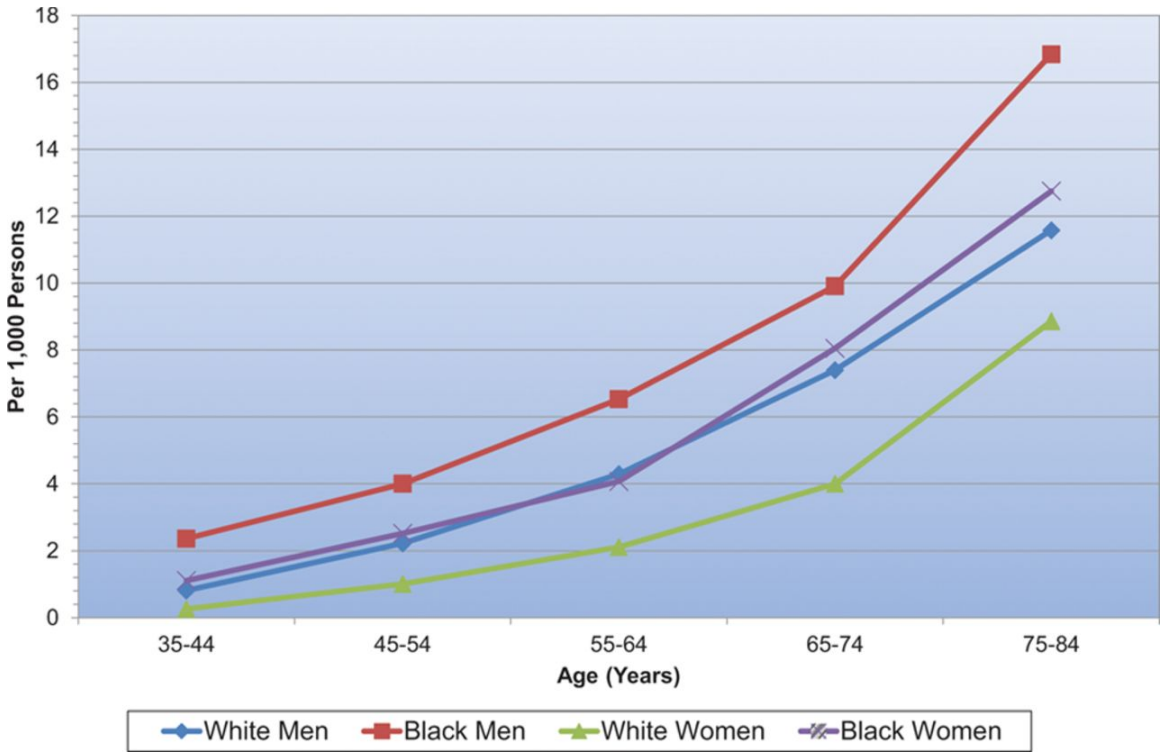
million adults. The AHA recommends that adults maintain systolic and diastolic levels <120/<80 mm Hg for adults aged ≥20 years (Mozaffarian, Benjamin, Go, Arnett, Blaha, Cushman, de Ferranti, et al., 2015). Yet from 2011 to 2012, less than half (42.2%) of U.S. adult meet these criteria. Figure 3 displays trends for high blood pressure by race/ethnicity and sex.

Figure 3: Age-adjusted prevalence trends for high blood pressure in adults ≥20 years of age by race/ethnicity, sex, and survey (National Health and Nutrition Examination Survey: 1988–1994, 1999–2006, and 2007–2012).



Myocardial Infarction. Each year, an estimated 635,000 Americans have a new coronary attack (defined as first hospitalized myocardial infarction) and 300,000 have a recurrent attack. It is estimated that an additional 155,000 silent first myocardial infarctions occur each year. Approximately every 34 seconds, 1 American has a coronary event, and approximately every 1 minute 24 seconds, an American will die of one (Mozaffarian, Benjamin, Go, Arnett, Blaha, Cushman, de Ferranti, et al., 2015). Figure 4 shows the incidence of heart attack by age, sex, and race.

Figure 4: Incidence of heart attack or fatal coronary heart disease by age, sex, and race (Atherosclerosis Risk in Communities Surveillance: 2005–2011).



CVD in Racial and Sexual Minorities

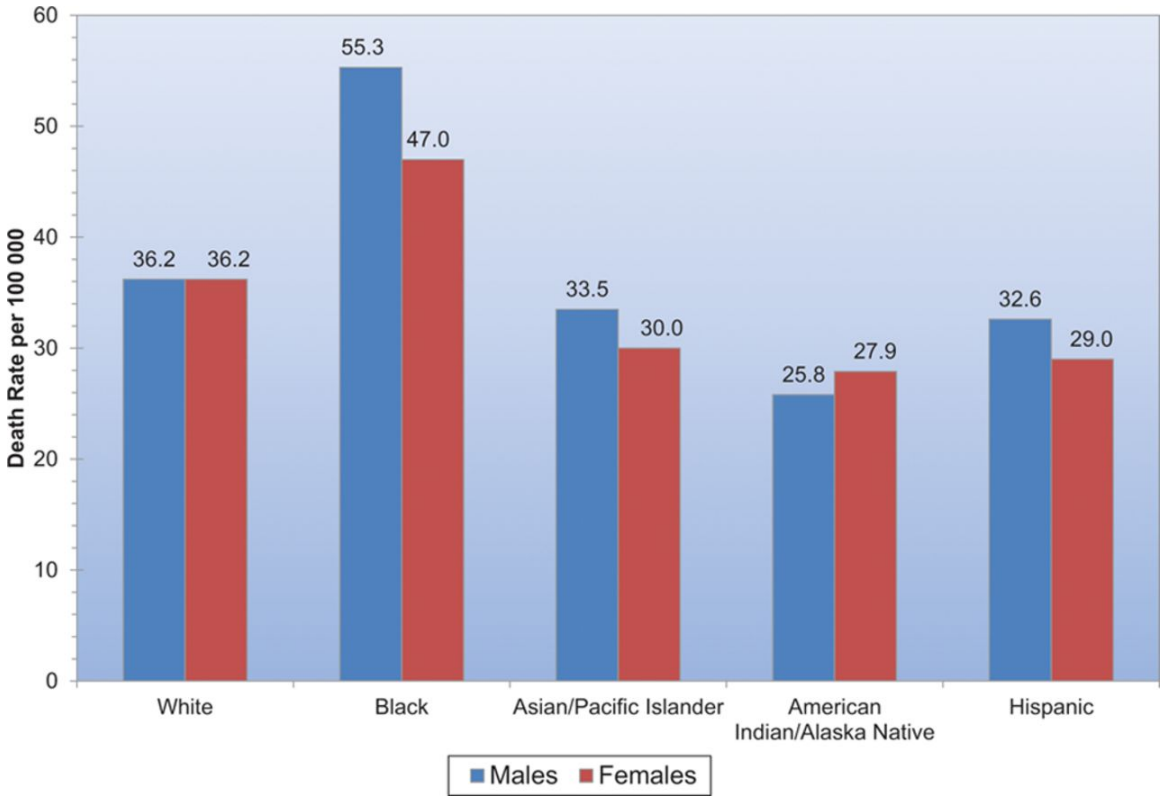
CVD and Race. While there have been significant improvements in the treatment and prevention of CVD over the last decade (Yeh et al., 2010), racial minority groups continue to bear a disproportionate burden of CVD morbidity and mortality, seeing very little improvement in life expectancy during the past 40 years (Levine et al., 2001). In 2010, African Americans were 30% more likely to die from heart disease than non-Hispanic whites with a mortality rate of 215.5 per 100,000 in African Americans compared to 171.1 in non-Hispanic whites (Go et al., 2014).

Additionally, the presence of CVD risk factors is higher among African Americans than that of non-Hispanic whites as well. The prevalence of *hypertension* in African Americans in the

U.S. is among the highest in the world. From 2011 to 2012, non-Hispanic African Americans had significantly higher rates of hypertension (42.1%) compared to non-Hispanic whites (28.0%), and Hispanics (24.7%) (Mozaffarian, Benjamin, Go, Arnett, Blaha, Cushman, de Ferranti, et al., 2015). Also, African Americans tend to have an average blood pressure that is significantly higher than that of whites and develop hypertension earlier in life (Hertz, Unger, Cornell, & Saunders, 2005).

Stroke kills almost 130,000 Americans each year—that's 1 out of every 20 deaths, or one American every four minutes (Mozaffarian, Benjamin, Go, Arnett, Blaha, Cushman, de Ferranti, et al., 2015). Stroke is the fifth leading cause of death for Americans, but the risk of having a stroke varies by race/ethnicity (Figure 5). Compared with whites, African Americans are almost twice as likely (1.8) to have a fatal stroke (Figure 5) and 1.3 times more likely to experience a nonfatal stroke. Similarly, the risk of having a *first* stroke is nearly twice as high for blacks than for whites, and blacks are more likely to die following a stroke than are whites. Hispanics' risk for stroke falls between that of whites and blacks (Mozaffarian, Benjamin, Go, Arnett, Blaha, Cushman, de Ferranti, et al., 2015).

Figure 5: Age-adjusted death rates for stroke by sex and race/ethnicity, 2011. (Atherosclerosis Risk in Communities Surveillance: 2005–2011).

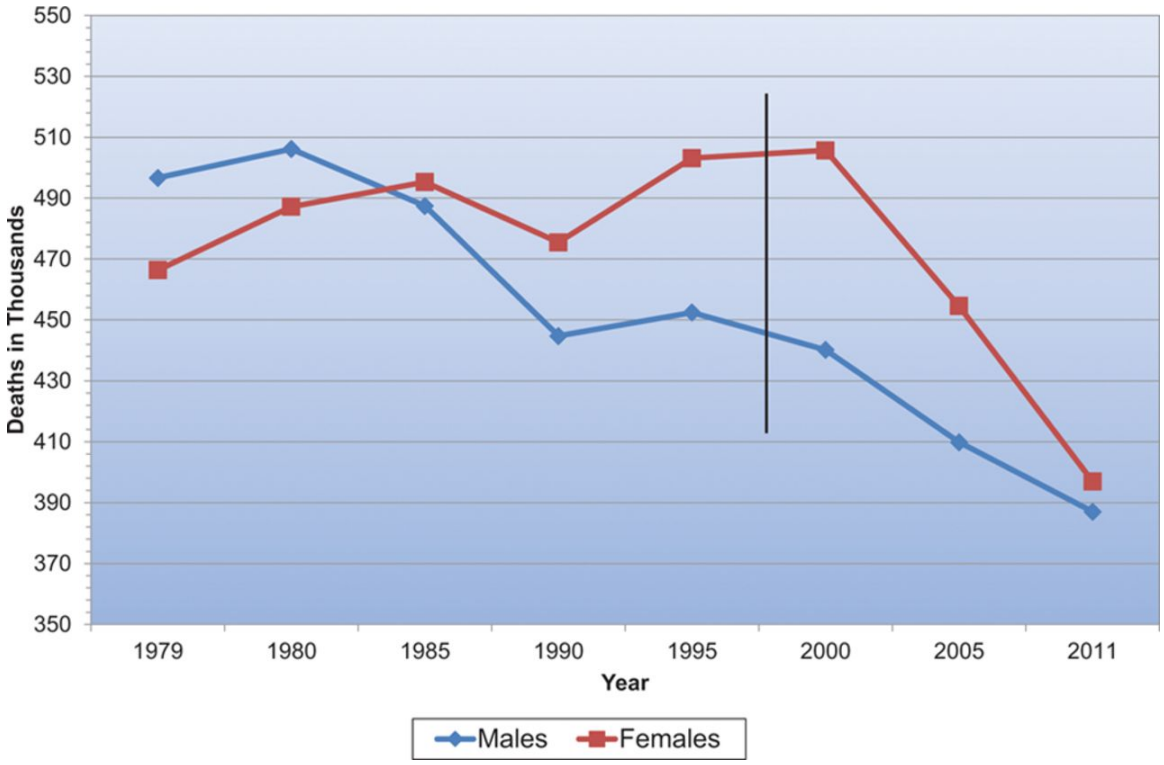


Differences by race have also been demonstrated in the incidence of myocardial infarction. Using data from the Translational Research Investigating Underlying Disparities in Acute Myocardial Infarction Patients' Health Status (TRIUMPH), researchers sought to explore whether there are racial differences in outcomes after acute myocardial infarction. The authors of this study found that African American patients experience a disproportionate share of death and disability from heart disease following MI even after controlling for treatments received, site of care, socioeconomic status, and genetic and metabolic biomarkers (Arnold et al., 2011).

CVD and Gender. Every minute in the United States, someone's wife, mother, daughter or sister dies from some form of heart disease. While heart disease mortality rates among men have declined steadily over the last 25 years, rates among women have fallen significantly less (Figure 6). Men are two to three times more likely than women to receive an implantable

defibrillator for the prevention of sudden cardiac death. Given these numbers, it is not surprising that women age 45 and younger are more likely than men to die within a year of their first heart attack.

Figure 6: Cardiovascular disease (CVD) mortality trends for males and females (United States: 1979–2011).



From 2009 to 2012, the age-adjusted prevalence of hypertension was 44.9% and 46.1% among non-Hispanic African America men and women, respectively; 32.9% and 30.1% among non-Hispanic white men and women, respectively; and 29.6% and 29.9% among Hispanic men and women, respectively. According to data used from the National Health and Nutrition Examination Survey (NHANES), men tend to have higher rates of hypertension until age 45. From 45 to 64 years of age, the percentages of men and women with hypertension are similar. After the age of 64, women have higher rates of hypertension than men.

According to data from the 2013 Behavioral Risk Factor Surveillance System (BRFSS) conducted by the Centers for Disease Control, 2.7% of men and 2.7% of women 18 years of age

and older had a history of stroke. Each year, approximately 55,000 more women experience a stroke than men, and subsequently, suffer greater disability (Mozaffarian, Benjamin, Go, Arnett, Blaha, Cushman, de Ferranti, et al., 2015). A prospective study from a Michigan-based stroke registry found that, compared to men, women had a 63% lower probability of achieving independence in activities of daily living three months after discharge, even after controlling for age, race, subtype, pre-stroke ambulatory status, and other patient characteristics (Gargano, Reeves, & Paul Coverdell National Acute Stroke Registry Michigan Prototype, 2007).

CVD and Sexual Orientation. Prior research examining sexual identity differences in individual CVD risk factors has found that sexual minority individuals are at elevated risk of many CVD risk factors. There have been two published studies using the ADD Health dataset to examine CVD risk factors in sexual minorities. Hatzenbuehler, McLaulin, & Slopen (2013) examined the sexual orientation disparities in biomarkers of early cardiovascular risk. Using data from wave IV, Hatzenbuehler et al., examined C-reactive protein, glycosylated hemoglobin, systolic and diastolic blood pressure, and pulse rate. Analysis included gender-stratified models that controlled for demographics (age, race/ethnicity); SES (income, education); health behaviors (smoking, regular physical activity, alcohol consumption); and BMI. A total of 520 respondents identified as lesbian, gay, or bisexual. Hatzenbuehler et al., found sexual minorities had more CVD risk factors such as smoking, heavy alcohol consumption, and higher BMI. Additionally, the researchers found that gay and bisexual men had significant elevations in C-reactive protein, diastolic blood pressure, and pulse rate, compared to heterosexual men. Yet, despite having more risk factors for cardiovascular disease, including smoking, heavy alcohol consumption, and higher BMI, lesbians and bisexual women had lower levels of C-reactive protein than heterosexual women in fully adjusted models.

Another study by the same authors examined whether sexual minority young adults were more vulnerable to developing cardiometabolic risk following exposure to stressful life events than heterosexual young adults (Hatzenbuehler, Slopen, & McLaughlin, 2014). A total of 306 lesbian, gay, and bisexual (LGB) respondents and 6,667 heterosexual respondents met inclusion criteria for this analysis. The researchers found that gay/bisexual men exposed to 1-2 and 5+ stressful life events had a statistically significant elevation in cardiometabolic risk, controlling for demographics, health behaviors, and socioeconomic status. Additionally, in models controlling for all covariates (demographics, health behaviors, and socioeconomic status), lesbian/bisexual women with 5+ stressful life events had a statistically significant elevation in cardiometabolic risk. There was no relationship between stressful life events and cardiometabolic risk among heterosexual men or women (Hatzenbuehler, McLaulin, & Slopen, 2014).

The current study is unique in that it incorporates a longitudinal view of intersectionality and how demographic factors can influence health outcomes. Rather than exploring the constructs of race, gender and sexual orientation as autonomous descriptive categories to be adjusted and controlled for, the current study seeks to analyze these variables as interlocking systems that create unique experiences that may influence CVD risk.

Cardiovascular Health Risk Behaviors in Sexual Minorities

CVD risk factors are divided into two categories: major and contributing. Major risk factors are those that have been proven to increase the risk of heart disease, while contributing risk factors are those that can *lead* to an increased risk of heart disease.

In addition to minority stress, previous research has indicated that sexual minority individuals are especially vulnerable to CVD due, at least in part, to poorer health behaviors and modifiable risk factors (Hatzenbuehler, McLaughlin, et al., 2013). According to the literature, sexual minority individuals are more likely to smoke (Marshal, Friedman, Stall, & Thompson,

2009), be overweight/obese (Boehmer & Bowen, 2009), have poorer diets and exercise less (Calzo et al., 2014), and have higher levels of harmful/hazardous drinking (T. L. Hughes, 2005; Sell & Becker, 2001).

A meta-analysis examining the relationship between sexual orientation and adolescent substance use found that the odds of substance use for sexual minority youth were, on average, 190% higher than for heterosexual youth (Marshal et al., 2008). There were two main inclusion criteria for the meta-analysis: (1) studies had to report a statistical test of the relationship between sexual orientation and some measure of substance use; and (2) a sample with a mean age of 18 years or less, and the upper bound of the age range not older than 21 years. The final sample for the meta-analysis included 18 studies using self-report measures of attraction and behavior to define sexual orientation. There were substantial differences found when looking at subpopulations of LGB youth as the odds of substance use for bisexual youth were 340% higher than heterosexual youth, and 400% higher among female LGB youth.

Cigarette Smoking. Tobacco use is the leading preventable cause of premature death, disease and disability in the United States (U.S. Department of Health and Human Services, 2010). Contrary to popular belief, tobacco causes more deaths per year from heart disease than it does for lung cancer (Ritchey et al., 2014). Cigarette smoking harms nearly every organ of the body, is the cause of many chronic conditions, and significantly reduces the health of smokers in general (U.S. Department of Health and Human Services, 2010).

Cigarette smoking alone has been estimated to cause close to 500,000 deaths per year in the United States, with approximately 50,000 attributed to exposure to secondhand smoke (Ritchey et al., 2014). CVD is the leading cause of death in the United States, and cigarette smoking is responsible for 30% of all heart disease related fatalities (U.S. Department of Health

and Human Services, 2010). Individuals that smoke are two to four times more likely to develop CVD (Services, 2014).

It has been well documented that LGB individuals have higher rates of smoking than the general population. In 2001, (Ryan, Wortley, Easton, Pederson, & Greenwood, 2001) published the first systematic review exploring smoking in sexual minority populations. The researchers found 12 articles reporting on smoking behaviors in sexual minorities. While the review found evidence for a higher smoking prevalence among sexual minorities, the findings were limited by poor sampling methodology (homogenous convenient samples), and varied definitions of sexual orientation and smoking.

In a more recent systematic review of literature from 1987 to May 2007, researchers searched seven different databases for peer-reviewed research including Cumulative Index to Nursing and Allied Health Literature (CINAHL), Cochrane Library via Wiley InterScience, Education Resources Information Center (ERIC), Health Source: Nursing/Academic, Institute for Scientific Information (ISI) Web of Science, PsycINFO via EBSCO Host and PubMed (J. G. Lee et al., 2009). The review, which included 42 articles, found that those who identified as a sexual minority were at increased risk for smoking with odds ratios ranging from 1.5 to 2.0 for lesbian and bisexual women compared with heterosexual women and 2.0–2.5 for gay and bisexual men compared with heterosexual men.

Research collected from the 2009-2010 National Adult Tobacco Survey (NATS) is consistent in finding disparities in smoking by sexual orientation. Research from the NATS indicated that 32.8% of lesbian, gay men, bisexual, and transgender individuals reported being a current smoker, compared to 19.5% of heterosexual individuals (King et al., 2012). Further, a secondary analysis of the NATS data revealed that sexual minority women had a significantly younger age of initiation, with bisexual women having started smoking at the youngest age,

followed by lesbian women, then heterosexual women who had the oldest age of smoking initiation. Additionally, bisexual women smoked 6.7 more cigarettes per day than heterosexual women, and lesbian women were 2.3 times more likely to be nicotine dependent when compared to heterosexual women.

Further, there is evidence suggesting that sexual minority youth progress more quickly in smoking behaviors than their heterosexual counterparts. Using a school-based, longitudinal study of health-related behaviors in adolescents and their outcomes in emerging adulthood, (Marshal et al., 2009) examined the growth of substance use in LGB and heterosexual youth. The researchers found that self-identified LGB youth reported higher initial rates of smoking and on average their smoking behaviors increased over time more rapidly than did smoking among heterosexual youth.

Excessive Drinking. The relationship between alcohol and CVD is unique in that research has shown that alcohol can be both a risk and protective factor depending on the rate of consumption (Agarwal & Srivastava, 2001; Hvidtfeldt et al., 2010; Marmot, 2001; Roerecke & Rehm, 2014). A recent meta-analysis of research studies from 1950 – 2009 found that the relationship between CVD and alcohol consumption was curved or J-shaped, with light to moderate alcohol consumption being associated with a reduced risk of CVD (Ronksley, Brien, Turner, Mukamal, & Ghali, 2011). Researchers for this study found that alcohol drinkers, relative to non-drinkers, had lower pooled adjusted relative risks for CVD. Relative risk were 0.75 for CVD mortality (21 studies), 0.71 for CHD morbidity (29 studies), 0.75 for CHD mortality (31 studies), 0.98 for stroke (17 studies), and 1.06 for stroke mortality (10 studies). Additionally, a dose-response analysis revealed that the lowest risk of CHD mortality occurred with 1–2 drinks per day, but for stroke mortality it occurred with ≤1 drink per day. Secondary

analysis of mortality from all causes showed lower risk for drinkers compared with non-drinkers with a relative risk of 0.87 (Ronksley et al., 2011).

Several studies have found that light to moderate alcohol consumption decreases CVD risk. One prospective study, using a sample of 490,000 men and women, found that the rates of CVD death were lowest among those reporting at least one drink daily during the nine years of follow-up (Thun et al., 1997). Similarly, a prospective study that followed men in France for more than 10 years found a significant association between moderate wine consumption and lower CVD mortality (Renaud, Gueguen, Schenker, & d'Houtaud, 1998). Based on previous research, the evidence suggests that the risk of CVD for those that consume moderate levels of alcohol is lower than that for nondrinkers, and dose-response analysis suggested a J- or U-shaped association between alcohol and risk of CVD with an inflection point at 1 to 2 drinks per day (Matsumoto, Miedema, Ofman, Gaziano, & Sesso, 2014).

However, alcohol presents as a CVD risk for LGB persons due to increased levels of consumption. Several decades of research have shown that there are higher rates of substance misuse and alcohol use disorders in sexual minority populations (Cochran, Mays, Alegria, Ortega, & Takeuchi, 2007; Hatzenbuehler, Corbin, & Fromme, 2011; Kang, Magura, & Shapiro, 1994; Marshal et al., 2008; McCabe, Hughes, Bostwick, West, & Boyd, 2009; Stall et al., 2001). This finding is especially pronounced among women, who drink at higher rates than their heterosexual peers (Bostwick et al., 2010; T. Hughes et al., 2010; Mereish & Bradford, 2014). The disparate outcome by sexual orientation and gender further demonstrate the need for an intersectional approach to uncovering, understanding, and adequately addressing health disparities in often overlooked populations. While experimentation with alcohol and excessive drinking are widespread during adolescence into emerging adulthood, sexual minority youth tend to have an earlier age of initiation (Corliss, Rosario, Wypij, Fisher, & Austin, 2008), use more

substances and escalate much more rapidly than their heterosexual peers (Corliss et al., 2008; Marshal et al., 2008; Talley, Sher, & Littlefield, 2010).

Is Alcohol a CVD Risk Factor or is it Protective? Though the moderate use of alcohol can serve as protection from CVD risk, excessive drinking can significantly increases the risk for CVD though it's negative relation to other cardiometabolic functions. For example, a number of studies have found an association between alcohol consumption and hypertension (Grogan & Kochar, 1994; Husain, Ansari, & Ferder, 2014). A 1999 meta-analysis reported a 40% increase in the relative risk of developing hypertension in those drinking more than 25 g alcohol/day and a greater than fourfold increase in risk in those drinking more than 100 g/day (Corrao, Bagnardi, Zambon, & Arico, 1999).

Additionally, excessive alcohol consumption has been linked to the risk of diabetes and obesity. A cohort study using data from the Stockholm Diabetes Prevention Program investigated the influence of alcohol consumption and specific alcoholic beverages on the risk of developing pre-diabetes and Type 2 diabetes in middle-aged Swedish men and women. Excessive consumption was defined as at least 12 glasses (each glass being 4 cl) in men per week, and at least four glasses per week for women. Men in high consumption group showed a more than twofold greater risk of Type 2 diabetes compared with the reference group (OR 2.07, 95% CI 1.14–3.78) (Cullmann, Hilding, & Ostenson, 2012).

Researchers using data from the Health Survey for England 2006 (n = 8864) investigated the contribution of alcohol to obesity. The odds of obesity were significantly higher with increased consumption of alcohol calories. This association remained after adjustment for demographic, socioeconomic, and lifestyle factors, with those in the highest alcohol calorie quartile at 70% ($p < .001$) greater risk for obesity than those in the bottom quartile (Shelton & Knott, 2014).

While the findings on the relationship of alcohol to CVD are mixed, it's relationship to other cardiometabolic risk factors are well documented. Excessive drinking can raise triglyceride levels, or fat in the blood (Bean, 2002). Additionally, it can lead to high blood pressure, heart failure (Koloverou et al., 2015) and an increased calorie intake (Shelton & Knott, 2014), which can then lead to obesity (Traversy & Chaput, 2015) and diabetes (Koloverou et al., 2015). As such the American Heart Association recommends that drinking be done in moderation, or an average of one to two drinks per day for men and one drink per day for women (Pearson, 1996), where drink is one 12 oz. beer, 4 oz. of wine, 1.5 oz. of 80-proof spirits, or 1 oz. of 100-proof spirits.)

Though the relationship between alcohol and CVD risk remains complex, the research is unanimous on the harmful effects of hazardous drinking on other cardiometabolic risk factors. LGB individuals, both adolescent and adult, are at a high risk for alcohol misuse and alcohol use disorders. As such, it is important to not only examine the causal mechanisms that develop overtime, but also how these may lead to an increased risk for other chronic conditions, like CVD.

Exercise. The 2008 Physical Activity Guidelines for Americans recommends that individuals of all ages get a minimum of 2-1/2 hours, or 45 minutes on at least 3 days, per week of moderate-intensity aerobic activity (Burns, 2010). There is substantial evidence indicating that physically active individuals have lower rates of CHD and CVD. It is estimated that physical inactivity is responsible for as much as 12% of the risk in developing a CVD (Mozaffarian, Benjamin, Go, Arnett, Blaha, Cushman, de Ferranti, et al., 2015).

In 2008, the federal government issued its first-ever physical activity guidelines for Americans (Haskell et al., 2007), basing the guidelines on a comprehensive and systematic review of studies published since the 1996 Surgeon General's report on physical activity and

health. A recent review of exercise and CVD found that the most active individuals, when compared to the least active, have a 30% - 40% CVD risk reduction. Those with moderate amounts or intensity of physical activity had 20% - 25% reduced risk of CHD and those with high amounts or intensity had 30% - 35% risk reductions (Shiroma & Lee, 2010).

Another 2012 meta-analysis examined the association between physical activity and CVD risk with 21 prospective cohort studies of men and women who were free of CVD at study entry. The overall population size reached beyond 650,000 adult individuals, followed-up over a period that ranged from 5 - 32 years. Among both men and women, the researchers found that a high level of leisure time physical activity reduced the risk of CVD in a range of about 20 %-30%, compared to the risk of those with low level of physical activity. Moderate leisure time physical activity decreased the risk by about 10% – 20%, suggesting a dose-response relationship (Li & Siegrist, 2012).

Previous research suggests that sexual minority individuals are significantly more likely to be physically inactive (Boehmer & Bowen, 2009). Using data from the 1999-2005 waves of the Growing Up Today Study (GUTS), a US national epidemiologic cohort study, researchers examined how many hours per week of overall moderately vigorous physical activity were engaged in by heterosexual and sexual minority youth ages 12 to 22 years old (Calzo et al., 2014). Sexual minorities reported 1.21-2.62 hours/week less moderately vigorous physical activity and were 46%-76% less likely to participate in team sports than same-gender heterosexuals.

Another recent study used data from the 2012 Dane County Youth Assessment to examine sexual orientation disparities in physical activity, sports involvement, and obesity among 13,933 adolescents in grades 9 through 12 in 22 high schools in Wisconsin. The authors found that heterosexual males were twice as likely to be physically active than sexual minority

males. Similarly, heterosexual females were twice as likely to participate in team sports when compared to sexual minority females and were about 3 times less likely to be overweight or obese (Mereish & Poteat, 2015).

Diet. Insufficient fruit and vegetable consumption accounts for between 20 - 30% of cardiovascular diseases worldwide (Lock, Pomerleau, Causer, Altmann, & McKee, 2005; Puska, 2002). A 2004 comparative risk assessment of disease burden found that the total worldwide mortality attributable to inadequate consumption of fruit and vegetables was estimated to be approximately 2.6 million deaths in 2000 alone (Ezzati et al., 2003).

While dietary choices among sexual minorities are not well studied, research has suggested that diets low in fruit and vegetables are significantly more prevalent among sexual minorities than heterosexual (Boehmer & Bowen, 2009). A research study examining eating, exercise, sleeping, and health in women found that a greater proportion of women who identified as lesbian skipped breakfast and exercised less than heterosexual women (Brown, Morrison, Calibuso, & Christiansen, 2008).

Skipping meals, specifically breakfast, has been found to be associated with a number of cardiometabolic factors, including obesity (Geliebter, Astbury, Aviram-Friedman, Yahav, & Hashim, 2014), hypertension (Djousse & Gaziano, 2007), insulin resistance (Mekary et al., 2013), and elevated triglyceride and lipid levels (Poppitt, van Drunen, McGill, Mulvey, & Leahy, 2007). A recent study found that eating breakfast was associated with a significantly lower risk of developing coronary heart disease (Cahill et al., 2013). In this study, the researchers prospectively examined eating habits and risk of CHD in a cohort of male health professionals and found that men who skipped breakfast had a 27% higher risk of CHD compared with men who did not (Cahill et al., 2013). Similarly, researchers examining the associations between regular breakfast consumption, eating frequency, and diabetes risk in

women found that irregular breakfast consumption was associated with a higher type 2 diabetes risk (Mekary et al., 2013).

BMI. According to the 2009 - 2012 National (NHANES) data, 73% of men, 65% of women, and overall, 69% of U.S. adults are considered overweight or obese. Being overweight and obese are typically classified by the use of BMI cutoffs. Over the past two decades, a growing body of literature has shown that sexual minority women weigh more than heterosexual women, prompting concern that they may be at high risk for disparities in chronic metabolic conditions (Andersen, Hughes, Zou, & Wilsnack, 2014; Boehmer & Bowen, 2009; Bowen, Balsam, & Ender, 2008; Eliason et al., 2015; H. J. Kim & Fredriksen-Goldsen, 2012; Roberts, Dibble, Nussey, & Casey, 2003).

Researchers conducted a meta-analysis on health outcomes in sexual minority women; searching PubMed, PsycInfo, CINAHL, Dissertation Abstracts Online, LGBT-Life, Web of Science, and Google Scholar. Using sources of information from July 2006 to August 2014, the author's identified 20 population-based studies and 17 convenience sample studies. A significant majority of the studies found that lesbian and bisexual women had significantly greater BMI or a higher percentage with a BMI over 30 than heterosexual women (Eliason et al., 2015). Additionally, it is important to note that the differences in BMI were consistent across the lifespan, with the weight differences beginning as early as adolescence. This furthers the need to explore the possible presence of risk behaviors that can lead to chronic illness later in life. If developmental risk trajectories are identified early, developmental patterns of risk could be attenuated, significantly reducing the cost and burden of CVD disparities.

Theoretical Framework

The current project is guided by three theoretical frameworks: intersectionality, minority stress theory, and the stress and coping model. The term *intersectionality* was

coined in 1989 by Kimberle Crenshaw in her seminal work "Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics." Initially, Crenshaw created the term as a theoretical framework to address the continued abstention of the unique situation of African American women in the single axis frameworks found in both antiracist and feminist theory(Crenshaw, 1989). Since that time, intersectionality has been seeded in discourse and methodology across various disciplines ranging from political science to public health (Carbado, Crenshaw, Mays, & Tomlinson, 2013; G. Miller, Chen, & Cole, 2009). While, at it's inception, intersectionality was created as framework for critique in feminist and critical race theory, this model has much to offer in understanding how multiple constructs work in tandem, rather than independently, to produce disparate outcomes in health and wellbeing.

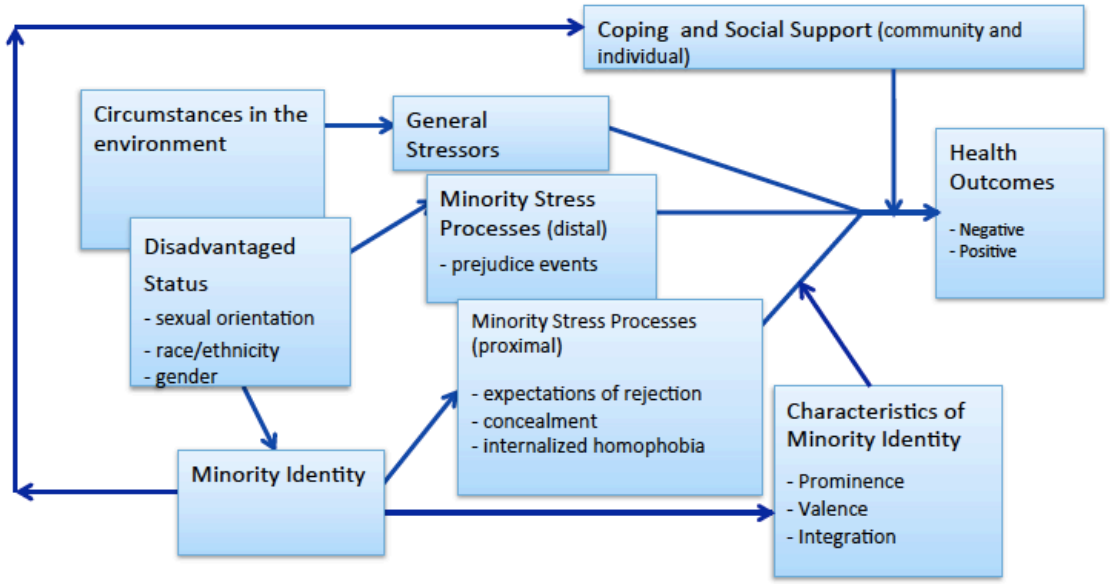
Minority stress is defined as the stress associated with a "categorically ascribed inferior status and blocked access to legitimate social and economic opportunities" (Brooks, 1981) (pg. 78). Brooks (1981), in her ground break work, *Minority Stress and Lesbians*, goes on to further define minority stress as:

> … a state intervening between the sequential antecedent stressors of culturally sanctioned, categorically ascribed inferior status, resultant prejudice and discrimination, the impact of these forces on the cognitive structure of the individual, and the consequent readjustment or adaptational failure. (p. 84)

In 1995, Meyer extended this work by designing the minority stress model (Figure 7). In an effort to re-conceptualize the antiquated view of sexual orientation as pathological, the minority stress model posits that the correlations between poorer health and sexual orientation are due to the distress that arises from being part of a marginalized group, rather than from sexual orientation itself. Hence, the theoretical approach of the minority stress model examines the unique ways in which stressors experienced by minority individuals relate to the disparities found in health (Meyer, 2003). According to Meyer, there are three primary stressors that are

unique to the experiences of sexual minorities. These are *internalized homophobia*, referring to the directing of societal negativity toward one's self; *perceived stigma*, which relates to the expectations of rejection and discrimination; and the actual experiences of *discrimination* (Meyer, 1995).

Figure 7: Minority Stress Model Meyer (2003)



Intersectionality and minority stress theory have been implicated in the increased risk of smoking (Lehavot & Simoni, 2011; Newcomb, Heinz, Birkett, & Mustanski, 2014), hazardous drinking (T. Hughes, 2011; Mereish & Bradford, 2014), poor diet (Bianchi, 2004) being overweight/obese (Boehmer & Bowen, 2009) and physical inactivity (Oshri, Handley, Sutton, Wortel, & Burnette, 2014) in sexual minority populations. Yet, research addressing how these behaviors may increase the risk of developing chronic diseases has received little empirical attention. And, if the subsequent stress due to discrimination, victimization, and stigmatization underlie health risks by increasing the likelihood of substance misuse, poorer diet, and other maladaptive coping behaviors (Meyer, 2003), it stands to reason that these risk factors could increase the risk of developing chronic conditions, particularly cardiovascular diseases.

Stress, Coping, and Physical Health

There is an overwhelming body of research demonstrating that discrimination can lead to psychological distress (Bos, Boschloo, Schoevers, & Sandfort, 2015; R. Clark, Anderson, Clark, & Williams, 1999; Mays & Cochran, 2001; Utsey & Hook, 2007; van Beusekom, Baams, Bos, Overbeek, & Sandfort, 2015). These psychological stress responses often lead to maladaptive coping behaviors. Experiences of perceived discrimination were found to be the best predictor of substance use disorders in sexual minorities above age, marital status, and education (Landrine & Klonoff, 2000). Similarly, experiences of heterosexism have been found to be related to increased risk of depression and anxiety (T. Hughes et al., 2010), excessive alcohol consumption (Wilsnack et al., 2008), and the misuse of substance such as marijuana, inhalants, and cocaine in sexual minorities (McCabe et al., 2009; Mereish & Bradford, 2014).

In addition to maladaptive coping, there are also more direct pathways through which heterosexist based stress affects wellbeing. When an individual perceives an experience as heterosexist, this initiates a series of biological processes that results in the activation of the hypothalamic pituitary adrenal cortical (HPA) system. The activation of the HPA system then triggers release of the stress hormone cortisol leading to changes in immune and cardiovascular functioning (R. Clark et al., 1999). And, while most of the literature has focused on the psychological effect of perceived discrimination, there is a recent literature documenting the potential consequences of heterosexist discrimination on physical health (Oshri et al., 2014).

According to the cardiovascular reactivity (CVR) hypothesis, individuals are more at risk for CVD when they frequently experience physiological responses to psychological stressors (Potempa, 1994). CVD risk increases as a result of a dysregulation of the autonomic nervous system (ANS). The ANS includes the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). These systems are essential to the body's ability to adapt to physiological and environmental stressor, as daily stressor can activate the ANS and promote

the release of pituitary and adrenal hormones. The chronic activation of these hormones leads to the weakening of the immune system. Additionally, if these individuals are unable to retreat or have little to no control over their social environments, their weakened immunologic state only increases thus fostering the development of chronic diseases. For example, previous research has demonstrated that chronic psychological distress can lead to the expression/reactivation of the latent Epstein-Barr virus (EBV). Most adults have been exposed to EBV, but do not display any symptoms of the virus due to the suppression of their immune system (Cacioppo et al., 2002).

Summary

Approximately every 34 seconds, 1 American has a coronary event, and approximately every 1 minute 24 seconds, an American will die of one. While the relation between perceived stress and CVD risk is compelling; few empirical studies have examined this relationship in LGB populations. The proposed project is significant because it addresses an important gap in the literature regarding CVD risk in a vulnerable and, quite possibly, a high-risk population.

Statement of the Problem

There is a substantial body of literature that addresses substance abuse and maladaptive coping in LGB populations, but significantly less research examining how these patterns of abuse develop over time (T. Hughes & Eliason, 2002). There is emerging evidence of sexual orientation disparities in CVD-related outcomes (Hatzenbuehler, Bellatorre, et al., 2014; Hatzenbuehler, Birkett, Van Wagenen, & Meyer, 2014; Hatzenbuehler, Phelan, & Link, 2013); however, there is no research examining the developmental trajectories of cardiovascular health risk behaviors (CHRB) and CVD risk in LGB individuals compared to heterosexuals. Exposure to stressful life events, including the repeated experience of stigma and discrimination associated with being part of a marginalized group, has been consistently linked to increased risk for CVD (Mays et al., 2007; Meyer, 2003). Additionally, over 20 years of research has shown that the

abuse of substances (i.e. smoking, hazardous drinking, illicit drugs use), obesity and being overweight, physical inactivity, and diets low in fruit and vegetables are significantly more prevalent among LGB individuals (Cochran, Ackerman, Mays, & Ross, 2004). Each of these health risk behaviors significantly increases the risk of developing CVD.

Many CHRB emerge early in development (Adair & Dahly, 2005), suggesting that the relationships between stressful life events, CHRB, and risk for CVD might be evident in adolescence. Yet the vast major of research on stressful life events, health risk behaviors, and CVD risk has been conducted among middle-aged and older adults (Everson-Rose & Lewis, 2005). Research has also been limited by cross-sectional data (McCabe et al., 2009), which may only reflect developmental 'bursts' (Kerr et al., 2009) in CHRB, rather than possible developmental patterns of risk that could be attenuated. The current study seeks to address these gaps in the literature by examining the trajectories of CHRB overtime. Secondary data analysis was conducted using an ongoing nationally representative study of health-related behaviors of adolescents and their outcomes in young adulthood using data from the National Longitudinal Study of Adolescent Health (Add Health). The current study will use CHRB collected in waves I-III between 1994-2009 to examine if there is a significant change in CHRB over time. The aims of the current study are to:

Aim 1: Examine the trajectories of CHRB among a sample of adolescents through adulthood and to test whether or not those trajectories are significantly different based on sexual orientation.

Hypothesis 1: It is hypothesized that LGB participants will have engaged in more CHRB and will have sharper increases in this behavior over time than their heterosexual counterparts.

Aim 2: Assess and compare the 10-year risk of developing a heart attack or coronary heart disease and the vascular age by sexual orientation. The Framingham multiple-risk-factor assessment use behavioral and metabolic information to predict the risk of suffering a heart attack or CVD related mortality in the next 10 years. The equation is a calculation of age, smoking status, BMI, and a physician diagnosis of diabetes or/and hypertension diagnosis. Each of these variables is available in the Add Health dataset.

Hypothesis 2A: It is hypothesized that sexual minority participants will be at an increased risk of developing a heart attack or cardiovascular disease when compared to heterosexuals.

Hypothesis 2B: It is hypothesized that sexual minority participants will have a vascular age that is significantly higher than heterosexuals.

Aim 3: Assess and compare the experiences of stressful life events among heterosexual and sexual minority participants and the influence of these events on CVD risk and vascular age.

Hypothesis 3A: It is hypothesized that sexual minority participants will experience more stressful life events.

Hypothesis 3B: It is hypothesized that sexual orientation will moderate the relationship between stressful life events and the 10-year risk of developing a heart attack or cardiovascular disease.

Hypothesis 3C: It is hypothesized that sexual orientation will moderate the relationship between stressful life events and vascular age.

Aim 4: Assess the role of intersectionality in modifying the 10-year likelihood of developing a heart attack and/or CVD risk and vascular age. This aim examines the possible within group differences in cardiovascular risk as a function of race, gender, and

sexual orientation. Using an intersectional approach, potential interactions by sexual orientation, race, and gender will be examined.

Method

The Add Health Study

Overview. The National Longitudinal Study of Adolescent Health (Add Health) is an ongoing nationally representative study of health-related behaviors of adolescents and their psychosocial and physiological outcomes in young adulthood. To date there have been four waves of data collection completed, beginning with wave-I (1994-1995), wave-II in 1996, wave-III (2001-2002), and wave-IV (2008-2009). At wave I, participants were between the ages of 13-18 and were in grades 7-12.

Recruitment. The primary sampling frame for the Add Health Study was derived from the Quality Education Database (QED). A list of 26,666 U.S. High Schools was sorted on enrollment size, school type, region, location, and the percentage of white students and then divided into groups for sampling. Eighty high schools were selected from this list with probability proportional to enrollment size. High schools that did not include 7th or 8th grades supplied names of middle schools that contributed students to the incoming class. For each of these high schools, a single feeder school was selected with probability proportional to the percentage of the high schools' entering class that came from the feeder school. A total of 52 feeder (junior high & middle) schools were selected. Administrators at each school were asked to fill out a special survey that captured attributes of the school (K. M. Harris, Halpern, Smolen, & Haberstick, 2006). Overall, 79 percent of the schools that were contacted agreed to participate in the study. School size varied from fewer than 100 students to more than 3,000 students.

From September 1994 until April 1995, in-school questionnaires were administered to students in these schools. Each questionnaire administration occurred on a single day within one

45-to 60-minute class period. In-school questionnaires were collected from over 90,000 students. The in-school questionnaire provided measurement on the school context, friendship networks, school activities, future expectations, and a variety of health conditions. School administrators also completed a 30-minute questionnaire in the first and second waves of the study (K. Harris et al., 2004).

Add Health researchers obtained rosters of all enrolled students in each school. From the students who completed in-school questionnaires, a sample of adolescents was chosen for a 90-minute in-home interview constituting the wave I in-home sample. To form a core sample, students were stratified in each school by grade and sex and randomly chosen yielding a total of approximately 200 adolescents from each pair of schools. (Students who did not participate in the in-school survey were eligible to be selected for participation in the in-home sample.) The core in-home sample is self-weighting, and provides a nationally representative sample of N=20,745 American adolescents in grades 7 to 12. The current study uses data from the in-home samples.

Add Health Research Questions. The following section will first briefly describe the data collected for the Add Health study, and then outline the measures and statistical methods that will be used to answer the research questions presented by the current study. Table 1 provides sample question from areas covered by the study:

Table 1

Topic	Sample Question
health status	In general, how good is your health?
health-facility utilization	What kept you from seeing a health professional when you really needed to?
nutrition	In the last seven days, on how many days did you eat breakfast?
risk behavior	How many times have you given someone sex in exchange for drugs or money?
substance use	During the past 30 days, on how many days did you smoke cigarettes?

sexual partnerships	Are you currently married to/cohabitating with/in a romantic or sexual relationship?
psychological well-being	How you ever been diagnosed with depression?
physical activity/inactivity	Do you use a physical fitness or recreation center in your neighborhood?

In 1996, all adolescents in grades 7 through 11 in wave I were followed up one year later for the wave II in-home interview (N=14,738). Waves I and II constitute the adolescent period in the Add Health study and contain unique data about family context, school context, and peer networks, along with health behaviors.

Add Health researchers conducted a wave III follow-up interview with original wave I respondents as they entered the transition to adulthood. With the longitudinal data from adolescence, this third wave of in-home interviews provide a unique opportunity to map early trajectories of adolescent health and to document how adolescent experiences and behaviors are related to decisions, behavior, and health outcomes in the transition to adulthood. Add Health researchers completed interviews on 15,170 respondents at wave III, resulting in a 76% response rate. A fourth in-home interview was conducted in 2008 with the original wave I respondents.

Wave IV was designed as a follow-up of the nationally representative sample of adolescents first interviewed in 1994 and 1995. At wave IV 15,701 original Add Health respondents were re-interviewed to assess the developmental and health trajectories across the life course of adolescence into young adulthood (up to 32 years old). Similar to wave III, wave IV uses an integrative approach that combines social, behavioral, and physical measurements in addition to biological data. Anthropometric data included measures of weight, height, body mass index [BMI], and waist circumference. Cardiovascular measures included blood pressures and pulse rate. Trained and certified interviewers also obtained whole blood spots via finger prick, then dried and shipped them to study laboratories for assay of a lipid panel (total cholesterol [TC], high-density lipoprotein cholesterol [HDL-C], total triglycerides [TG]); fasting glucose;

glycosylated hemoglobin (HbA1c); high sensitivity C-reactive protein (hsCRP); and Epstein-Barr virus (EBV) antibody (K. Harris et al., 2004). Measures specific to the current study will be outline and discussed in the section labeled measures.

Due to the design of the study, retention rate is not an appropriate statistic to use to describe study participation. 12th graders from wave I were not selected to be interviewed at wave II; thus, any calculated retention rate would be misleading. Instead, the response rate (wave I=79%, wave II=88.6%, wave III=77.4%, wave IV=80.3%) at each wave is a better indicator to use.

The Current Study

There is emerging evidence of sexual orientation disparities in CVD-related health outcomes (Hatzenbuehler, Bellatorre, et al., 2014; Hatzenbuehler, Birkett, et al., 2014; Hatzenbuehler, Phelan, et al., 2013); however, there is no research examining the developmental trajectories of CHRB and CVD risk in sexual minority individuals compared to heterosexuals. The current study used data on stress and health behaviors (collected from all four waves) and cardiovascular biomarkers (collected in wave-IV) to assess the relationship between minority status (e.g., gender, race, sexual orientation) and CVD risk.

Inclusion/Exclusion Criteria. To be included in analysis, respondents were required to (a) have participated in all four waves of data collection, (b) have complete data for all CHRB (smoking, drinking, diet, exercise, and BMI) and on all variables required for the Framingham multiple-risk-factor assessment (age, smoking, cholesterol, and blood pressure), and (c) have complete data on sexual orientation at wave IV.

Measures Used in the Current Study

Sexual orientation. Self-identified sexual orientation was assessed at wave IV with an item asking participants to "*Please choose the description that best fits how you think about*

yourself." Six response options were given including (a) 100% heterosexual, (b) mostly heterosexual but somewhat attracted to people of your own sex, (c) bisexual, (d) mostly homosexual, but somewhat attracted to people of the opposite sex, (e) 100% homosexual, (f) not sexually attracted to either males or females. These categories were combined and labeled as (a) 100% heterosexual, (b) mostly heterosexual but somewhat attracted to people of your own sex, and (c) LGB or sexual minority.

Stressful Life Events. Table 2 displays the list of stressful life events that were included in the analyses and the waves in which they were assessed. An additive index variable was created to measure cumulative exposure to stressful life events across all four waves using the endorsement of the specific events. This was summed to create a stressful life events score and examined as a continuous variable, similar to what has been done in previous research (Hatzenbuehler, Slopen, et al., 2014).

Table 2

Stressful Life Events Index

Item	Wave I	Wave II	Wave III	Wave IV
1. Childhood physical abuse (before 18)				x
2. Childhood sexual abuse (before 18)				x
3. Kicked out of home (ever)			x	
4. Homeless (ever)			x	
5. Witnessed violence (past 12 months)	x	x	x	x
6. Threatened by knife or gun (past 12 months)	x	x	x	x
7. Shot or stabbed (past 12 months)	x	x	x	x
8. Physical intimate partner		x	x	x
9. Sexual intimate partner violence (ever)			x	x
10. Physical forces sex (ever)				x
11. Non-physical forced sex (ever)				x

Cardiovascular Health Risk Behaviors. CHRB include current smoking, alcohol consumption, physical activity, and diet (See Table 3). Participants were asked about their health behaviors in each wave of interviews. An index variable of CHRB were created from the sum of health related behaviors similar to those used in previous research (Frech, 2012). The CHRB

variable value was created by assigning each behavior a value of "1" or "0", depending on the participant's response. A value of "1" indicates that the individual engages in the behavior and "0" if the individual does not report engaging in the behavior. The following is a description of the CHRB examined and how each was collected.

Cigarette smoking. Participants were defined as a smoker if reporting smoking at least one whole cigarette daily during the last 30 days.

Alcohol Misuse. Previous research has found an association between binge drinking to poor health outcomes in adolescents and emerging adults (Eaton et al., 2008; Jones, Pezzi, Rodriguez-Lainz, & Whittle, 2016; J. W. Miller, Naimi, Brewer, & Jones, 2007). Alcohol misuse was based on the question, "Think of all the times you have had a drink during the past 12 months. How many drinks did you usually have each time? A 'drink' is a glass of wine, a can of beer, a wine cooler, a shot glass of liquor, or a mixed drink." Participants were assigned a value of "1" if they endorse usually having five or more drinks each time, and "0" if they endorse usually having four or fewer.

Diet. While the Add Health study collected data on breakfast eating habits from waves I-III, the measures used to assess breakfast eating habits were not consistent. In wave I, participants were asked, "What do you usually have for breakfast on a weekday morning?" They were then provided with the following options, "Coffee or tea, milk, cereal, fruit or juice, eggs, meat, snack foods, bread, toast or rolls, other items, or nothing." At wave II and III, participants were asked, "On how many of the past seven days did you eat breakfast--that is, a meal within an hour of getting up?" These questions were coded as "1" for participants that reported eating breakfast at all, and "0" for those that reported eating nothing.

Exercise. The Add Health study includes measures of frequency and type of exercise in each wave of data collection. Participants were given the following optional responses, "not at

all, 1 or 2 times, 3 or 4 times 5 or more times." Participants were assigned a value of "1" if they endorsed having exercised at least three or more times in the last week, and "0" if they had not.

BMI. Anthropometric measures of height and weight were taken at the time of interview and used to calculate BMI for respondents. The Add Health study used the World Health Organization (WHO) obesity classifications to establish BMI as follows: underweight (BMI < 18), healthy weight (BMI ≥ 18 and BMI < 25), overweight (BMI > 25 and BMI ≤30), obese class I (BMI > 30 and BMI ≤35), obese class II (BMI > 35 and BMI ≤40), or obese class III (BMI > 40).

Table 3

Cardiovascular Health Risk Behaviors	
Cigarette Smoking	A smoker if reporting smoking at least 1 whole cigarette daily during the last 30 days
Alcohol Consumption	5 or more drinks (i.e. glass of wine, can of beer, shot of liquor, or mixed drink) on at least 1 occasion during the past year
Diet	"What do you usually have for breakfast on a weekday morning?"
Exercise	"How often do you exercise?"
BMI	underweight (BMI < 18), healthy weight (BMI ≥ 18 and BMI < 25), overweight (BMI > 25 and BMI ≤30), obese class I (BMI > 30 and BMI ≤35), obese class II (BMI > 35 and BMI ≤40), or obese class III (BMI > 40).

10-year Cardiovascular Disease Risk and Vascular Age. The Framingham multiple-risk-factor assessment uses behavioral and metabolic information to predict the risk of suffering a heart attack or CVD related mortality in the next 10 years. The equation is a calculation of age, smoking, cholesterol, and blood pressure, all of which are available in wave IV of the ADD Health dataset. See appendix A for more details.

Data Analysis Plan

Power Analysis. A power analysis was performed using the statistical software nQuery+nTerim 2.0. When the sample size is n=18, a single-group repeated measures ANOVA with a .05 significance level will have 80% power to detect a difference in CHRB means across

the three waves with an effect size of .2 (small effect). With a sample size of *n*=66 per group, multiple linear regression tests of $R^2=0$ ($\alpha=.05$) for three normally distributed covariates (race, gender, and sexual orientation) will have 80% power to detect differences in 10-year CVD risk with a small effect, or an R^2 of 0.15. For analysis with *n*<66, non-parametric test (i.e., Chi-Square and Fisher's Exact Test) will be used, as distribution-free methods have less stringent assumptions and are not subject to the central limit theorem in leading to normality of averages.

Preliminary Analysis. Data were analyzed using SAS 9.2. All variables were assessed for univariate normality and multivariate outliers. Preliminary analysis revealed 5,060 eligible respondents who were present in all four waves of data. Fifty-four percent of the sample was male, 62% white, and 4% identified as a sexual minority.

In order to evaluate the association of sexual orientation with CVD risk factors, the sample was split into three groups: 1) 100% heterosexual (*N*=4363); 2) mostly heterosexual (*N*=509), but still somewhat attracted to people of their own sex; and 3) LGB or sexual minority (*N*=188), which includes bisexual, mostly homosexual, but somewhat attracted to people of the opposite sex, and homosexual. Each was assigned according to self-reported categorizations.

Regression analysis requires a minimum ratio of five cases per variables (5:1), and, if possible, 10:1 is better.

Univariate Outliers. An outlier refers to an unusual score that is not representative of the rest of the data points, or a score that is very different from the rest of the data. This assumption was tested by checking the standardized values (z-scores) of each variable to assure that no points were extremely high or low. For this assumption to be met, 5% or less of the sample should have absolute values greater than 1.96, only 1% should have values greater than 2.58, and no absolute values should be greater than 3.29.

Univariate Normality. In order for this assumption to be met, each variable used in analysis should be normally distributed. This is assessed by checking for skewed and kurtotic values greater than +/-1 and conducting transformations (i.e., square root, natural log, or inverse transformation) of the data as necessary.

Multivariate Outliers. This assumption is tested by calculating Mahalanobis distance and assessing if any of the values obtained exceed the critical chi-square values associated with the number of independent variables to be tested.

Multicollinearity. Multicollinearity occurs when predictor variables are highly correlated. This assumption is violated if correlation coefficients are higher than 0.7. Multicollinearity can also be tested by examining the tolerance and variance inflation factor (VIF) levels; tolerance values lower than 0.10 and VIF values higher than 10 indicate a violation of this assumption.

Linearity. Examining this assumption requires plotting the data on a scatterplot in order to assess for nonlinear relationships between the independent and dependent variables.

Normality or Residuals, Linearity of Residuals, Homoscedasticity. The normality of residuals assumption presumes that each predictor variable will have residuals that are normality distributed. Linearity of residuals assumes that there is a linear relationship between residuals and predicted values. Homoscedasticity assumes that the variance at each level of each predictor be approximately the same. Each of these assumptions are assessed through a visual inspection of residuals scatterplots.

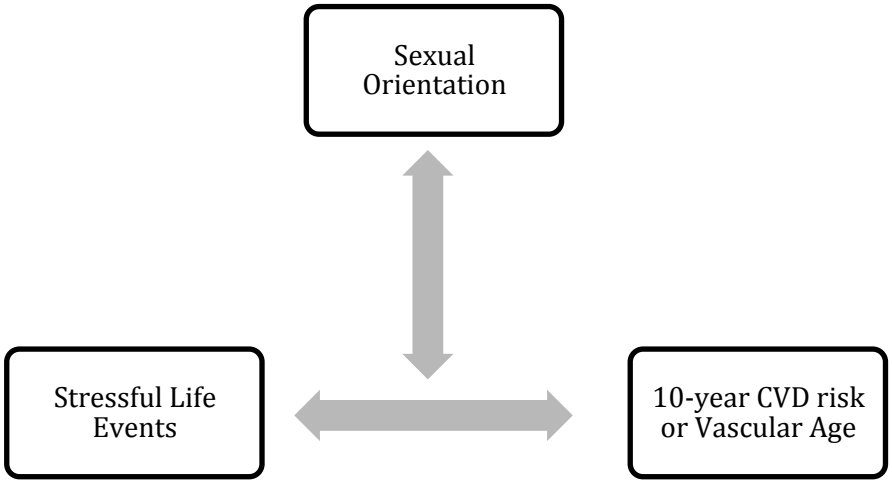
Hypothesis Testing. *Hypothesis 1: It was hypothesized that LGB participants would have engaged in more CHRB and will have sharper increases in this behavior over time than that of their heterosexual counterparts.* Repeated measures ANOVA were used to assess the change in CHRB between waves I-III, and to explore the degree to which sexual orientation influences CHRB overtime. Using data from waves I-III, it was hypothesized that LGB

participants will engage in more CHRB and will have greater increases over time, when compared to 100% heterosexual.

Hypothesis 2: (A) It was hypothesized that sexual minority participants will be at an increased risk of developing a heart attack or cardiovascular disease when compared to heterosexuals. (B) It was hypothesized that sexual minority participants will have a vascular age that is significantly higher than heterosexuals. A one-way ANOVA was used to assess whether there are differences in the 10-year sum score indicating risk of developing a heart attack, or CVD related event, between groups by sexual orientation. Another one-way ANOVA was used to assess the means for vascular age by sexual orientation.

Hypothesis 3: (A) It was hypothesized that sexual minority participants would experience more stressful life events. (B) It was hypothesized that sexual orientation would moderate the relationship between stressful life events and the 10-year risk of developing a heart attack or cardiovascular disease. (C) It was hypothesized that sexual orientation would moderate the relationship between stressful life events and vascular age. An ANOVA was used to assess mean differences by sexual orientation in the stressful life events additive index, and a regression analysis (Chi-Square or Fisher's Exact Test when necessary) was used to assess whether sexual orientation moderates the relationship between stressful life events and the likelihood of developing a heart attack and/or CVD based on the Framingham Risk Assessment score (see Appendix B). A regression analysis was also used to assess whether sexual orientation moderates the relationship between stressful life events and vascular age (See Figure 8).

Figure 8: Stressful Life Events Mediation Analysis



Exploratory Analysis. Finally, the role of intersectionality in modifying the likelihood of developing a heart attack and/or CVD risk was assessed. Both two way interactions (sexual orientation x race, sexual orientation x gender, gender x race) and three way interactions (sexual orientation x race x gender) were tested using standard regression analysis.

Results

Preliminary Analysis

Participant Inclusion. Data were analyzed using SAS 9.2. Preliminary descriptive analyses were conducted to screen data for outliers and violations of assumptions of ANOVA and standard regression. Preliminary analysis revealed 5,060 eligible respondents with sexual orientation data present at wave IV. Fifty-four percent of the sample was male, 62% white, and 4% identified as a sexual minority. In order to evaluate the association of sexual orientation with CVD risk factors, the sample was split into three groups: 1) 100% heterosexual (*N*=4363); 2) mostly heterosexual (*N*=509), but still somewhat attracted to people of their own sex; and 3)

LGB or sexual minority (*N*=188), which includes bisexual, mostly homosexual, but somewhat attracted to people of the opposite sex, and homosexual. Each participant was grouped according to his/her self-reported sexual orientation. Less than 1% of the sample endorsed being "not sexually attracted to either males or females." These respondents were not included in the analyses.

To be included in hypothesis testing, respondents were required to (a) have participated in all four waves of data collection, (b) have complete data for all CHRB (smoking, drinking, diet, and exercise) and on all variables required for the Framingham multiple-risk-factor assessment (age, smoking, BMI, and blood pressure), and (c) have complete data on sexual orientation at wave IV.

Missing Data. The initial sample of 5,060 was based on the number of participants with sexual orientation data available at wave IV. A total of N=409, or 8% of participants had missing data on other variables, of which N=201 had no available data on race. The PROC MI command in SAS was used to rule out the possibility of patterns in missing observations. This analysis indicated that the data were missing completely at random (Schafer & Graham, 2002). Missing observations were excluded using listwise deletion as there was no threat to the integrity of the sample [p.713 (Woodward, 2013)].

There are two major concerns when using listwise deletion. First, when the incomplete cases that are removed differ from the cases that remain in the sample, there is the chance that the once random sample will be biased yielding biased results. Analysis of missing observations provided evidence that missing observations were missing completely at random (Woodward, 2013).

The second concern with listwise deletion is that removing cases from the data set can reduce the sample size and adversely affect power. Because the percentage of missing

observation was negligible given the large sample size (N=4651), the sample maintains adequate power to detect meaningful effects in the data (Grace-Martin & Sweet, 2008). The paragraphs that follow will outline the process of checking for violations of the assumptions for ANOVA and standard regression.

Assumption Checking

Normality. In order for this assumption to be met, each variable used in analysis should be normally distributed. This is assessed by checking for skewed and kurtosis values greater than +/-1. Skewness refers to the symmetry of the distribution. A variable is skewed if the mean of the distribution is not at the center. Kurtosis refers to the peakedness of the distribution, indicating a departure from normality. A variable is considered kurtotic if the distribution is too flat or too peaked. Upon examination of skewness and kurtosis scores, the Stressful Life Events Index Score was identified as leptokurtotic, having a highly positive peak in the data around the midpoint. A constant of '5' was added to bring the values to at least 1, then a square root transformation was used to normalize the data. These transformations reduced the kurtosis of the data from 3.46 to 1.5, which is within an interpretable range.

Multicollinearity. Multicollinearity refers to high correlations among predictor variables. This assumption is violated if correlation coefficients are higher than 0.7. Multicollinearity was assessed by computing a correlation table and examining correlations among predictor variables. If predictor variables are highly correlated (correlations higher than .7, tolerance less than .10, and VIF greater than 10), centering is done to decrease the correlation and increase the interpretability of the findings (Aiken & West, 1991). Centering of predictor and moderator variables is recommended when testing interaction effects (Aiken & West, 1991;Darlington, 1990). Centering is complete when the mean score of a variable is subtracted from all scores (establishing a new mean of 0). This strategy does not change the assessment of significance of a

predictor variable (Garson, 2008). The correlation matrix did not indicate correlations higher than 0.7, as such, no variables were centered.

Normality or Residuals, Linearity of Residuals, Homoscedasticity. The normality of residuals assumption presumes that each predictor variable will have residuals that are normality distributed. Linearity of residuals assumes that there is a linear relationship between residuals and predicted values. Homoscedasticity assumes that the variance at each level of each predictor be approximately the same. Each of these assumptions is assessed through a visual inspection of residuals scatterplots. This assumption was assessed during the hypothesis testing and reported in the results. Heteroscedasticity can be a byproduct of a violation of the assumptions of linearity. However, scatterplots did not suggest a curvilinear relationship between the Stressful Life Events Index and the Framingham CVD risk scores or Vascular Age scores.

Descriptive Statistics for Demographic Variables

A priori research has shown that age, education, and income are related to cardiovascular health (Cooper et al., 2000; Go et al., 2014; Mozaffarian, Benjamin, Go, Arnett, Blaha, Cushman, Das, et al., 2015; Ritchey et al., 2014; Roger et al., 2012a; Yousaf et al., 2014). Additionally, there is an increased risk of bias, or confounding, in non-experimental studies as baseline covariates are independently related to the outcome of interest. In the presence of confounding, any association between the covariates and the outcome can at least partly be attributed to the covariates (Ferdinand, Otto, & Weiss, 2016; Spreeuwenberg et al., 2010). For this reason, a propensity score variable was created in order to control for the impact of these variables during hypothesis testing.

Propensity scores are commonly used in epidemiological studies as a data reduction method. This method reduces the covariates into a single score that can be used to adjust for the effects of the variables of interest on the outcome. Using a single variable rather than several

individual covariates lowers the degrees of freedom by adjusting for a single propensity score rather than multiple covariates. This presents a statistical advantage and makes for slightly more robust findings. Results from the hypothesis testing include findings from both adjusted and unadjusted models when analyzing Framingham cardiovascular scores.

Sexual orientation was significantly related to age, education, and income. Participants reporting that they were 100% heterosexual were significantly older than the mostly heterosexual and the sexual minority group and had a significantly higher income than sexual minority participants. Mostly heterosexual participants endorsed having attained higher educational status when compared to both 100% heterosexual and sexual minority participants.

See Table 4 for a summary of descriptive statistics for demographic/independent variables and Table 5 for dependent and mediating variables.

Biological Sex. Forty-six percent (n = 2,124) of participants were male, while 54.33% (n = 2,527) were female.

Race. Sixty-five percent (n = 3038) of participants identified as white, 24% (n = 1,118) as black, or African American, and 10.64% (n = 495) identified as Hispanic.

Sexual Orientation. Eighty-six percent (n = 4011) of participants identified as 100% heterosexual, 10% (n = 465) as mostly heterosexual, but somewhat attracted to the same sex, and 3.76% (n = 175) identified as a sexual minority.

Age. At wave IV, participants ranged in age from 24 – 33 (M = 28.37, SD = 1.8). Heterosexual participants were older (M = 28.43, SD = 1.8) compared to both mostly heterosexual participants (M = 28.06, SD = 1.8) and sexual minority participants (M = 27.86, SD = 1.7), $F(2) = 15.71$, $p < 0.001$.

Income. Participant income ranged from $0 to $800,000 per year at wave IV. The mean income of participants was $34,300 with a standard deviation of $36,597, and a median of $30,000.

Education. Participants varied in educational attainment. Seven percent (*n* = 356) reported having less than a high school diploma, 15.72% (*n* = 731) a high school diploma, 10.35% (*n* = 481) technical or vocational training, 33.76% (*n* = 1,570) some college, 23.59% (*n* = 1,097) a bachelor's degree, 7.81% (*n* = 391) a master's degree, and 0.54% (*n* = 25) reported having a doctorate.

Table 4

Demographic Variables

Variable	N	Mean	SD	Range
Biological Sex				
Male	2124 (46%)			
Female	2527 (54%)			
Sexual Orientation				
100% Heterosexual	4011 (86%)			
Mostly Heterosexual	465 (10%)			
Sexual Minority	175 (4%)			
Race				
White	3038 (65%)			
Black	1118 (24%)			
Hispanic	495 (11%)			
Age (Wave IV)		28.37	1.8	24 – 33
Income		$34,300	36,597	0 – 800,000

Descriptive Statistics for Dependent and Moderator Variables

Framingham CVD Risk Scores. CVD risk was assessed using the Framingham multiple-risk-factor assessment tool. See Table 5 for a descriptive summary of the variables included for

scoring. Framingham CVD risk scores range from -3 – 15. Participants had a mean risk score of $M = 1.96$ and a mean vascular age of $M = 37.46$. Framingham CVD risk scores are arranged into risk categories (low, moderate, moderately high, high). Participants with less than a six percent chance of a cardiac event within ten years are considered low risk, 6% - 10% is a moderate risk, 11% - 20% moderately high risk, and greater than 20% is considered a high risk of experiencing a cardiac event within ten years. There were no participants that met criteria for the high-risk group. Thirty-four participants (0.73%) scored within the moderately high category, 726 (15.61%) for moderate risk, and 3,891 (83.66%) were rated low risk.

Smoking status. Thirty percent of participants (n =1,372) identified as current smokers at wave IV. Heterosexual participants were significantly less likely to be a current smoker, $F(2) = 17.15$, $p = 0.0002$. Mostly heterosexual participants were 1.3 times more likely, and sexual minority participants 1.8 times more likely to be current smokers when compared to 100% heterosexual participants. Thirty percent of participants that identified as 100% heterosexual were current smokers compared to 41% of mostly heterosexual participants and 45% of sexual minority participants.

Alcohol Use. Alcohol misuse was assessed by the question, "Think of all the times you have had a drink during the past 12 months. How many drinks did you usually have each time? A 'drink' is a glass of wine, a can of beer, a wine cooler, a shot glass of liquor, or a mixed drink." Sexual minority participants endorsed having significantly more drinks ($M = 4.50$) when compared to both 100% heterosexual ($M = 3.80$) and mostly heterosexual ($M = 3.38$) participants, $F(2) = 7.385$ $p = .001$. Sexual minority participants were 1.7 times more likely to endorse having 5 or more drinks on one occasion.

Reported diabetes status. Three percent of participants (n =132) reported having diabetes. There were no significant differences in diabetes diagnosis by sexual orientation.

Systolic blood pressure. Systolic blood pressure values ranged from 77 to 212 (M = 124.40 SD = 13.62). Mostly heterosexual participants had significantly lower systolic blood pressure (M = 121.11) when compared to 100% heterosexual participants (M = 124.79) and sexual minority participants (M = 124.26), $F(2) = 15.331$ $p < .001$.

BMI. BMI ranged from 15.4 to 70.3 (M = 29.06 SD = 7.30). Based on the World Health Organization's (WHO) classification, the mean BMI for this sample is categorized as overweight. There were no significant differences found in BMI by sexual orientation.

Table 5

Descriptive Statistics for Moderator and Dependent Variables

Variable	N	Mean	SD	Range
Framingham Risk Scores				
CVD Risk Score		1.96	3.28	-3 – 14
Vascular Age		37.46	6.78	30 – 73
CVD Risk Category				
Low (<6%)	3891			
Moderate (6% - 10%)	726			
Moderately High (11% - 20%)	34			
High (>20%)	0			
Cardiovascular Health Risk Behavior Index Score				
Wave I		1.30	.77	0 – 4
Wave II		1.17	.82	0 – 4
Wave III		1.31	.79	0 – 4
Stressful Life Events Index Score		2.58	.35	2.24 – 4.36
Current Smoker (%)	1,372 (30%)			
Diabetic (%)	132 (3%)			
Systolic Blood Pressure		124.40	13.62	77 – 212
BMI		29.06	7.30	15.4 – 70.3

Descriptive bivariate analysis indicated that race was a significant predictor of the Framingham CVD risk scores such that African Americans had significantly higher mean risk

scores (M = 2.09) when compared to Hispanic (M = 1.65) and white participants (M = 1.96). Biological sex was a significant predictor for both the Framingham CVD risk score and for vascular age such that male participants had significantly higher mean CVD risk scores (M = 2.92) compared to women (M = 1.15). The differences between vascular age and actual age were larger for male participants (M = 11.04) when compared to female participants (M = 7.46).

Mostly heterosexual participants were 1.70 times more likely, and sexual minority participants 1.97 times more likely to be current smokers when compared to 100% heterosexual participants. Mostly heterosexual participants had lower systolic blood pressure than 100% heterosexual participants and sexual minority participants.

Hypothesis Testing

Hypothesis 1: Sexual minority participants will have engaged in more CHRB and will have sharper increases in this behavior over time when compared to 100% heterosexual participants. A repeated measures ANOVA was used to assess the change in CHRBs between waves I-III, and to explore the degree to which sexual orientation influenced CHRB over time. Assumptions of independence, normality were met. The assumption of sphericity was violated, $\chi^2(2) = 6.74$, p = .034; thus, degrees of freedom were corrected using the Huynh-Feld statistic. The results of the main effect of time was significant, $F(1.999, 9290.535) = 10.332$, $p < 0.001$, indicating that CHRBs changed significantly overtime. A post-hoc Tukey Test indicated a significant difference between wave I vs. wave III. However, sexual orientation did not effect that relationship, $F(3.994,9282.552) = 1.927$, $p = 0.103$. Figure 9 illustrates how the reported CHRBs vary over the three waves. Consequently, when comparing CHRB by sexual orientation from wave I to wave III, not including wave II in the analysis (Figure 10), results trended towards significance, $F(2, 4648) = 2.661$, $p = 0.070$, as differences between sexual orientation and the two waves become more pronounced. The effects of these differences were

minor with a partial eta squared of .003, indicating an effect of about .3%. These findings will be reviewed further in the Discussion of Hypotheses section.

Figure 9

CHRB Index Scores for waves I-III

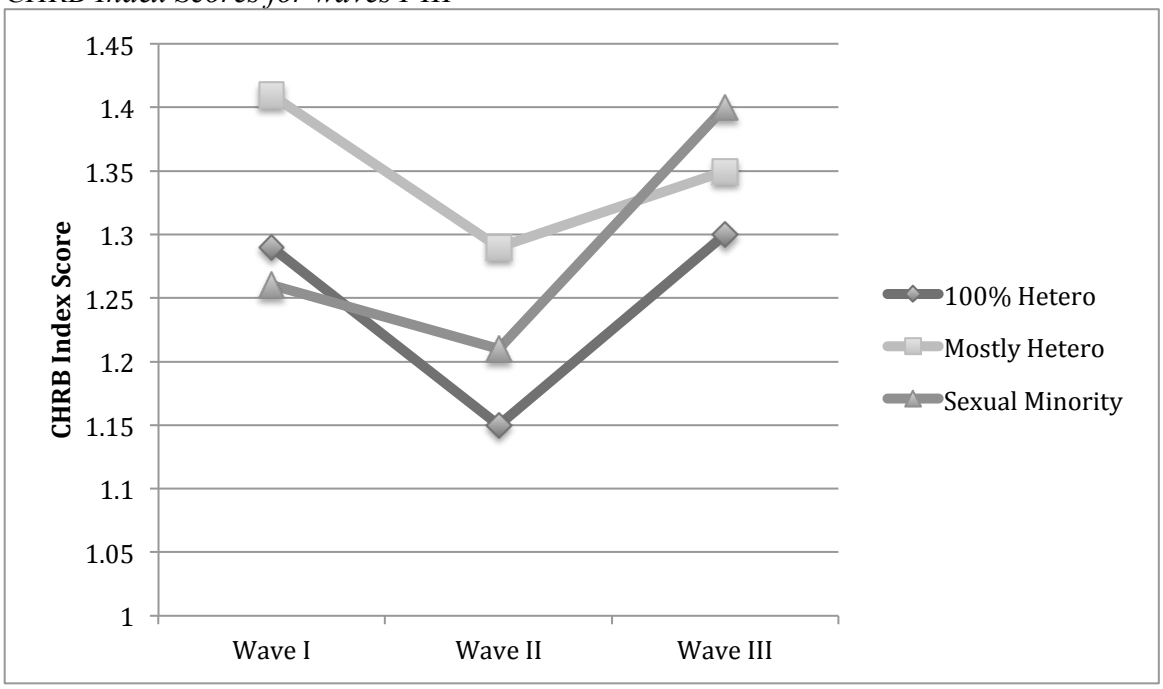
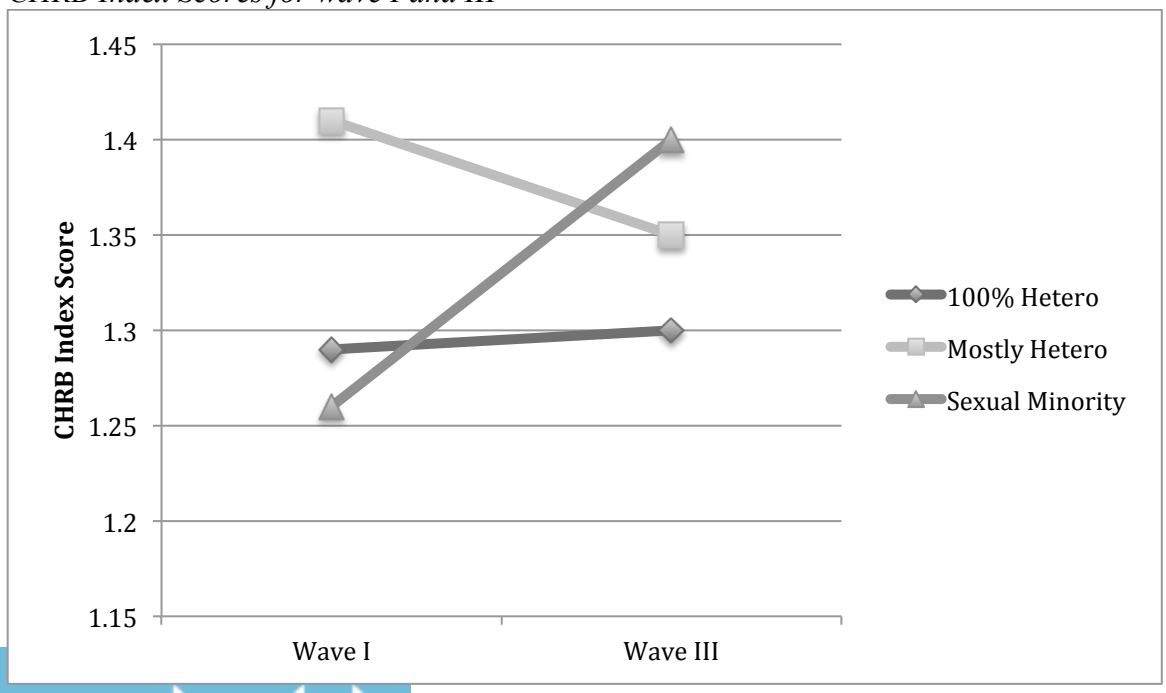


Figure 10

CHRB Index Scores for wave I and III



Hypothesis 2: (A) Sexual minority participants will be at an increased risk of developing a heart attack or cardiovascular disease when compared to heterosexuals as evidenced by a larger Framingham cardiovascular 10-year sum score. A one-way ANOVA was used to assess differences in the Framingham 10-year sum score indicating risk of developing a heart attack, or CVD related event, between groups by sexual orientation. Results indicated that there was not a significant effect of sexual orientation on the 10-year risk of experiencing a cardiac event, $F(2, 4648) = 2.40$, $p = .091$; and $F(3, 4647) = 2.44$, $p = .087$ for adjusted model. Table 6 displays mean scores by sexual orientation.

Table 6

Framingham Index Scores

Sexual Orientation	Mean	SD	Range
100% Heterosexual	1.98	3.277	-3 - 14
Mostly Heterosexual	1.69	3.277	-3 - 12
Sexual Minority	2.25	3.206	-3 - 13

(B) It is hypothesized that the difference in actual age and vascular age will be significantly larger in sexual minority participants when compared to heterosexuals. Another one-way ANOVA was used to assess mean differences between vascular age and actual age by sexual orientation. Results, displayed in Table 7, indicated that there was not a significant effect of sexual orientation on mean differences in vascular age and actual age, $F(2, 4648) = 2.66$, $p = .070$, $R^2 = .010$; $F(3, 4647) = 2.89$, $p = .056$, $R^2 = .081$ for the adjusted model. However, there appears to be a trend as the mean difference in age is $M = 10.07$ for sexual minority participants, compared to $M = 9.1$ for 100% heterosexual and $M = 8.66$ for mostly heterosexual participants. This will also be explored further in the discussion section.

Table 7

Difference between Actual Age and Vascular Age by Sexual Orientation

Sexual Orientation	Mean Difference	SD	Range
100% Heterosexual	9.1	6.957	-3 – 45
Mostly Heterosexual	8.66	6.724	-2 – 38
Sexual Minority	10.07	6.753	-3 - 45

Hypothesis 3: (A) It is hypothesized that sexual minority participants will experience more stressful life events. An ANOVA was used to assess mean differences by sexual orientation in the stressful life events additive index score. Results revealed a small effect of 0.011 by sexual orientation, $F(2, 4648) = 30.06$, $p < .0001$. Scores for mostly heterosexual participants and sexual minority participants were significantly higher than scores for 100% heterosexual participants. In other words, mostly heterosexual participants and sexual minority participants endorsed experiencing more stressful life events when compared to 100% heterosexual participants. Table 8 displays means for the Stress Life Events Index Score.

Table 8

Stressful Life Events Index Score

Sexual Orientation	Mean	SD	Range
100% Heterosexual	1.7	1.962	0 - 14
Mostly Heterosexual	2.26	1.886	0 - 11
Sexual Minority	2.38	2.221	0 - 14

(B) Sexual orientation will moderate the relationship between stressful life events and the 10-year risk of developing a heart attack or cardiovascular disease. First, a standard linear regression was used to assess the relationship between stressful life events and the Framingham CVD risk scores. Stressful life events was a significant predictor of CVD risk

scores in both adjusted, $F(2, 4648) = 93.98$, $p < .001$, $R^2 = .039$, and unadjusted models $F(1, 4649) = 106.67$, $p < .001$, $R^2 = .0228$. An interaction term was created using the stressful life events index score and sexual orientation. Sexual orientation and the interaction term were both entered into the model, and while the models remained significant, $F(5, 4645) = 23.30$, $p < .001$ neither sexual orientation, $F(2, 4648) = 0.50$, $p = 0.6057$, nor the interaction term, $F(2, 4648) = 0.66$, $p = 0.5175$, were significant, leaving stressful life events as the only significant predictor of the likelihood of developing a heart attack, $F(1, 4649) = 19.60$, $p < .001$. In models adjusted for the age, education and income propensity score, the model was significant, $F(6, 4644) = 32.51$, $p < .001$, as was the propensity score variable, $F(1, 4649) = 76.67$, $p < .001$. Again neither sexual orientation, $F(2, 4648) = 0.72$, $p = 0.4728$, nor the interaction term, $F(2, 4648) = 0.75$, $p = 0.4728$, were significant, leaving stressful life events and the propensity score as significant predictors.

(C) Sexual orientation will moderate the relationship between stressful life events and vascular age. A regression analysis was used to assess the relationship between stressful life events and the mean differences in actual age vs. vascular age, $F(1, 4649) = 94.32$, $p < .001$, $R^2 = .01988$. An interaction term was created using the stressful life events index score and sexual orientation. Sexual orientation and the interaction term were both entered into the model, and while the model remained significant, $F(3, 4647) = 32.31$, $p < .001$, neither sexual orientation, $F(1, 4649) = 2.24$, $p < .1346$, nor the interaction term, $F(1, 4649) = 2.45$, $p = 0.1175$, were significant, leaving only stressful life events as a significant predictor, $F(1, 4649) = 26.70$, $p < 0.001$. In models adjusted for the age, education and income propensity score, the model remained significant, $F(4, 4646) = 33.11$, $p < .001$, but again neither sexual orientation, nor the interaction term were significant, leaving stressful life events and the propensity score as significant predictors.

Exploratory Analysis. The goal of the exploratory analysis was to assess the potential role of intersectionality in modifying the 10-year likelihood of experiencing a cardiac event. The Framingham Risk Assessment score was used to assess the participant's risk category placement (low, moderate, moderately, high). There were no participants that met criteria for the high-risk group. Thirty-four participants (0.73%) scored within the moderately high category, 726 (15.61%) for moderate risk, and 3,891 (83.66%) were rated low risk.

A three-way contingency table was used to assess the possible interactions of race, biological sex, and sexual orientation in predicting the Framingham risk category for the 10-year likelihood of experiencing a cardiac event. Fisher's exact test did not indicate a significant three-way interaction between sexual orientation, race, and biological sex in predicting the Framingham risk category for any of the comparative cells (race*biological sex*sexual orientation). Neither sexual orientation, $\chi^2(4) = 5.77$, $p = 0.217$, nor race $\chi^2(4) = 0.967$, $p = 0.915$ was successful at independently predicting the Framingham risk category. Biological sex was a predictor for the Framingham risk category, $\chi^2(2) = 93.40$, $p < 0.001$. Twenty-one percent of male participants were at moderate risk of having a CVD related event, compared to 11% of female participants.

Additional exploratory analyses, outside of the stated hypotheses, were conducted in order to further assess key study findings. As reported earlier, sexual minority participants were nearly twice as likely to be current smokers ($OR = 1.97$) and to endorse binge drinking ($OR = 1.70$). A relationship between stressful life events and smoking status was detected using logistic regression, $\chi^2(1) = 171.38$ $p < 0.001$, such that participants were more likely to be smokers as the number of stressful life experiences increased. Sexual orientation was an effect modifier, $\chi^2(2) = 6.85$, $p = 0.033$. Specifically, the positive relation between stressful life events and the likelihood of being a smoker was stronger for sexual minority participants than for 100%

heterosexual participants.

Summary

In sum, results of the hypothesis testing provide partial support for the hypotheses. While the exploratory analysis did not yield results indicating a significant relationship between intersectionality and the Framingham risk categories, results did indicate a significant relationship between biological sex and the Framingham risk categories. Results also indicated that sexual minority participants were more likely to be smokers when compared to heterosexual participants. Additionally, results showed that sexual orientation amplified the relationship between stressful life events and the likelihood of being a smoker.

Discussion

The current study makes a significant contribution for a number of reasons. The results further existing research suggesting an increased risk of stressful life events, substance abuse, and maladaptive coping behaviors in sexual minority populations. Previous research has demonstrated that perceived discrimination, and the ensuing stress, was the best predictor of substance use disorders in sexual minorities; more so than age, marital status, and education (Landrine & Klonoff, 2000). Results for the current study were analogous; specifically in findings that sexual orientation amplified the relationship between stressful life events and smoking status.

Additionally, the current study is significant in that it provides evidence warranting the examination of both race and gender in public health research in sexual minority populations. Sexual minority persons are diverse in terms of cultural background, race/ethnicity, age, education, socioeconomic status, and geographic location. The degree to which sexual orientation is central to one's self-concept could vary depending on a number of sociocultural factors. A person's self-concept influences the level of affiliation with the LGB community and

other persons within that community. Additionally, depending on other sociocultural factors central to the self, like race and gender, the rejection or acceptance of societal stereotypes and prejudice vary greatly among individuals according to their own unique experiences. For example, studies have found that women who identify as lesbian or bisexual are at increased risk for substance abuse problems when compared to heterosexual women (T. Hughes et al., 2010; Wilsnack et al., 2008).

While there was not sufficient evidence to implicate Intersectionality in the current study, results do indicate a trend toward an increasing CHRB in sexual minority populations. In order to mitigate risk, future research will need to consider the possible effect that an intersectional identity (i.e. race/ethnicity, gender, and sexual orientation) can have on a person's CVD risk profile. The next section provides an overview of the findings for the research hypotheses, followed by a discussion of study implication ending with the conclusion.

Overview of the Hypotheses

Hypothesis 1: While the data for the current study did not provide sufficient evidence to support all of the stated hypotheses, the findings remain noteworthy. Aim 1 of the study was to examine the effect of sexual orientation on CHRBs among a sample over three waves of data. The CHRBs included current smoking, alcohol consumption, physical activity, and diet. Though there was not enough evidence to support hypothesis 1, as there were no significant differences in the CHRB index score by sexual orientation, sexual minority participants were nearly twice as likely to be current smokers (OR = 1.97) and to endorse binge drinking (OR = 1.70). Additionally, the within subject test indicated that there was no significant sexual orientation effects over time. Yet, according to post-hoc Tukey Tests, when comparing wave I to wave III, between subjects results trended towards significance, $F(2) = 2.66$, $p = 0.070$. The differences in CHRBs by sexual orientation appear to become more pronounced when Wave II data are

removed from the analyses. The effects of these differences were minor with a partial eta squared of .003, indicating an effect of about .3%.

Data from waves I and II were collected one year apart with wave I beginning in 1994 and wave II ending in 1996. Data collection for wave III began in 2001. It is possible that assessing differences in behaviors between waves I and III are more appropriate than assessing differences at waves I, II, and III. Results from waves I and II are more susceptible to attentional bias or response bias than waves I and III given the brief time period between waves I and II (one year). It is possible that having answered these questions only months earlier may increase the likelihood of response bias, and that the period between waves I and III are a more accurate representation of behavioral changes over time, especially given that the results support this trend.

Hypothesis 2: Aim 2 of the current study was to assess and compare the 10-year risk of developing a heart attack or coronary heart disease and the vascular age by sexual orientation using the Framingham multiple-risk-factor assessment tool. Hypothesis 2 was that sexual minority participants would have a higher Framingham cardiovascular 10-year sum scores and that the difference in actual age and vascular age would be significantly larger in sexual minority participants when compared to heterosexuals. Results from the current study did not provide evidence indicating a significant relationship between sexual orientation and the Framingham risk score, vascular age differences, or risk categories.

The lack of significant findings for Hypothesis 2 could be due to the age of the sample. The mean age of the current sample was 28, which is much younger than samples typically are when using the Framingham risk assessment tool. This instrument has been found to be most effective with persons 50 years of age or older. Though there was no evidence to indicate a significant relationship, it does appear that the data on vascular age differences by sexual

orientation may be trending towards significance. Future research should monitor CVD health risk data among sexual minority participants overtime, particularly as there is a possible trend present with age and CVD risk increases with age.

Hypothesis 3: The third aim was to assess and compare the experiences of stressful life events among participants and the influence of these events on CVD risk and vascular age. Hypothesis 3 was that sexual minority participants would experience more stressful life events, and that sexual orientation would moderate the relationship between stressful life events and CVD risk and vascular/actual age difference. Consistent with previous research, the current study found that sexual minority participants experienced significantly more stressful life events when compared to heterosexual participants. Additionally, data from the current study show that stressful life events were significantly related to CVD risk, such that as the number of stressful life events increased, Framingham CVD risk scores also increased. While sexual minority participants endorsed experiencing significantly more stressful life events, the data did not demonstrate that sexual orientation influenced the relationship between stressful life events and CVD risk.

However, it is important to note that the events that were included as part of the stressful life events index score were not sexuality specific. In other words, the events that were included in the Add Health study were not experiences that were limited by a person's sexual orientation. What this suggests is that in addition to experiencing discrimination, homophobia, and general maltreatment related to their sexual orientation, it is possible that sexual minority populations also experience more stressful life events in general.

Previous research has continuously demonstrated that social oppression and marginalization can lead to psychological distress (Bos et al., 2015; R. Clark et al., 1999; Mays & Cochran, 2001; Utsey & Hook, 2007; van Beusekom et al., 2015). These psychological stress

responses often lead to maladaptive coping behaviors, like excessive drinking, smoking or the abuse of other substances. Experiences of perceived discrimination were found to be the best predictor of substance use disorders in sexual minorities above age, marital status, and education (Landrine & Klonoff, 2000). Similarly, experiences of heterosexism have been found to be related to increased risk of depression and anxiety (T. Hughes et al., 2010), excessive alcohol consumption (Wilsnack et al., 2008), and the misuse of substance such as marijuana, inhalants, and cocaine in sexual minorities (McCabe et al., 2009; Mereish & Bradford, 2014).

Additionally, it is well documented that stress is significantly related to CVD outcomes. Stress has been implicated as a CVD risk in studies examining biomarkers like C-Reactive protein (Hingorani, Shah, Casas, Humphries, & Talmud, 2009) and salivary cortisol (Roux et al., 2016). Given the increased stress levels among sexual minorities, it will be important to monitor CVD risk in this population.

Analogous Results with previous Add Health Studies

Results from the current study are also analogous with previous research using this data. Hatzenbuehler, McLaughlin, & Slopen (2013) used data from wave IV of the Add Health study (*N*=12,451) to determine whether there were sexual orientation disparities in CVD biomarkers in young adults. The authors found evidence for sexual orientation disparities in health behaviors biomarkers (i.e. blood pressure, C-reactive protein [CRP], and glycosylated hemoglobin [HbA1c])(Hatzenbuehler, McLaughlin, et al., 2013). Sexual minority women (*n*=307) reported significantly more risk factors for CVD than did heterosexual women (*n*=5,706) including smoking, greater alcohol consumption, higher BMI and systolic blood pressure(Hatzenbuehler, McLaughlin, et al., 2013).

Another significant contribution of both the current study and Hatzenbuehler, McLauglin, et al., (2013) is the assessment of important biomarkers (i.e. systolic blood pressure) that have

been implicated in CVD risk, as opposed to being limited to self-report data. Numerous studies have indicated that CRP (an symptom of inflammation, tissue damage, and infection) and HbA1c (a long-term measure of blood glucose control) are contemporaneously and prospectively associated with an increased risk for CVD (Cho et al., 2016; Selvin et al., 2010; Willeit et al., 2016). However, in the Hatzenbuehler, McLauglin, et al., (2013) study, sexual minority women had lower levels of CRP than heterosexual women in fully adjusted models, despite having more risk factors for cardiovascular disease. Much like the current study, Hatzenbuehler, McLauglin, et al., (2013) noted that the mean age for participants (28.9 years) could have had an impact on the nonsignificant results, as these biomarkers tend to become problematic later in life.

Another study used data from wave IV to explore differences in hypertension by sexual orientation(Everett & Mollborn, 2013). Of the 7,555 female respondents, 6,072 (80%) identified as heterosexual; 1,345 (17.8%) as bisexual; and 138 (1.8%) as gay. The researchers found no difference in hypertension by sexual orientation; however, binge drinking was significantly higher among lesbians (18%) and bisexual women (3%) when compared to heterosexual women (1.5%). Also, bisexual women (30%) and lesbians (29%) had a higher prevalence of smoking compared to heterosexual women (20%). Research has shown that women have a lower prevalence of hypertension when compared to men, until around the age of 60 (Cutler et al., 2008). Much like the previous study, the authors of this study noted that the non-significant findings could be a result of the age of the sample (mean age=28.7) and suggested that future research continue to investigate the potential risk of elevated hypertension among older sexual minority women(Everett & Mollborn, 2013).

Additionally, Hatzenbuehler, McLaughlin & Slopen (2014) used data from waves I-IV to examine the relationship between stressful life events and cardiometabolic risk by sexual orientation. The authors created a cardiometablic risk score using blood pressure, pulse rate,

CRP, HbA1c, and waist circumference. The authors also created a stressful life events index score to measure the cumulative exposure to a wide range of events across all four waves of data collection(Hatzenbuehler, Slopen, et al., 2014). Sexual minority women (*n*=189) reported significantly more stressful life events when compared to heterosexual women (*n*=3,369). While there was no difference in cumulative cardiometabolic risk scores by sexual orientation alone, models adjusted for demographic characteristics displayed a statistically significant elevation in cardiometabolic risk (β=0.52, *p*=0.046) among sexual minority women endorsing five or more stressful life events. Yet, there was no statistical relationship between cardiometabolic risk and stressful life event exposure among heterosexual women. It is also important to again note that the stressful life events that were measured were not sexual orientation specific and included a wide range of life events based on previous research(Hatzenbuehler, Slopen, et al., 2014).

Data from the Add Health study was also used to examine long-term CVD risk disparities by sexual orientation (C. J. Clark et al., 2015). Researchers used a Framingham-based prediction model to estimate the 30-year risk of a CVD event. The sample included a total of 7,087 women, 5,713 heterosexuals, 1,089 mostly heterosexuals, 154 bisexuals, 60 mostly homosexuals, and 71 homosexuals. When compared to heterosexuals, the long-term CVD risk was higher among all subgroups of sexual minority females. The differences were most pronounced among mostly heterosexual and mostly homosexual women, who had a 0.8% and 2.8% higher risk of CVD, respectively, when compared to heterosexual women (C. J. Clark et al., 2015).

Implications

Historically, much of the research in sexual minority populations has focused primarily on mental health. Decades of research have continuously demonstrated that sexual minority individuals experience disparate levels of psychological distress due to social stigma, homonegative prejudice, and discrimination (Bostwick et al., 2010; Bostwick et al., 2014; M. S.

Friedman et al., 2011; Meyer, 2003). Previous research has indicated that these outcomes are attributed to the stress associated with being a member of a marginalized group.

Implications for Healthcare Providers. Results from this study are consistent with previous research indicating that sexual minority populations have increased levels of poor health behaviors that increase the risk of CVD. These findings highlight important clinical concerns for healthcare providers when working with sexual minority populations. Patient-centered care requires that the provider knows the patient, and, as shown in the current study, a person's sexual orientation can have an impact on physical health and well-being. Gathering demographic data from patients is a necessary component to providing adequate health care as sexual minority populations have unique health needs and risk factors. However, studies indicate that most healthcare providers do not ask questions about sexual orientation, neither during initial medical history nor during annual exams (Dahan, Feldman, & Hermoni, 2008). Sexual minorities have distinct healthcare needs that are instrumental to the physician in making a diagnosis and in selecting suitable treatment. It is essential that healthcare providers collect sexual orientation data, be knowledgeable of the increased levels of health risk behaviors and receive the appropriate training in cultural sensitivity.

In a California survey conducted in 2007, nearly one-fifth of physicians endorsed homophobic viewpoints. Eighteen percent reported feeling uncomfortable treating gay or lesbian patients, with an overwhelming majority displaying both conscious and unconscious favorable biases for their heterosexual clients (Smith & Mathews, 2007). This, of course, is counter-productive in the quest of improving physical health and is the complete antithesis of reducing health care disparities.

One of the most significant medical risks for sexual minority persons is the avoidance of routine preventative care. For example, The American Cancer Society guidelines for early

detection of breast cancer recommend yearly mammograms for women starting at age 40 and a clinical breast exam every three years for women in their 20s and 30s. For early detection of cervical cancer, women should have a Pap test every three years beginning at the age of 21. At age 30, an HPV test should be added to the Pap test and screenings can begin to occur less frequently (every 5 years) under the condition that the last three consecutive pap screenings returned normal (American Cancer Society, 2014). However, studies have suggested that sexual minority women have significantly lower preventive health screening rates than heterosexual women (Solarz, 1999), which also places them at greater risk for breast and cervical cancers. Given this disparity, it will be important for healthcare practitioners to be diligent in working to ensure that sexual minorities are aware of their risk and that they are taking the right steps to avoid poor health outcomes.

Implications for Smoking Cessation Development. Results from the current study are consistent with previous literature documenting increased rates of tobacco and alcohol misuse. These findings also highlight an important clinical concern for healthcare providers when working with substance misuse in sexual minority populations. It is not uncommon for minority groups to have higher rates of substance misuse than the general population. More than a quarter of the differences in mortality between social groups (i.e. race, gender, sexual orientation, etc) can be attributed to smoking (Berger & Mooney-Somers, 2016).

Evidence regarding smoking cessation and prevention programs among sexual minority populations is limited and the development and evaluation of smoking cessation programs in sexual minority populations can be challenging. Additionally, applying existing interventions that have been developed, evaluated and normed based on a heterosexual orientation may not translate for sexual minority groups. A recent review of the literature found that nearly half of the evidence identified regarding tobacco dependence treatment and smoking cessation among

sexual minority populations is not in the peer-reviewed literature (J. G. L. Lee, Matthews, McCullen, & Melvin, 2014). The authors of this review highlight the need for tailored programs noting that "Promising LGBT-specific group cessation curricula exist, and their implementation has been shown feasible in LGBT-serving settings. Evidence-based systems to promote assessment of tobacco use and increase counseling by healthcare providers are feasible in LGBT-serving healthcare settings."(J. G. L. Lee et al., 2014). It will be important for substance prevention and intervention programs to focus on the unique challenges faced by sexual minority populations.

Sexual minority persons may have limited access to smoking prevention programs offered through primary care for a number of reasons. For example, sexual minorities have a greater likelihood of lacking health insurance, and often delay or avoid health care for fear of discriminatory treatment from healthcare provides. Factors related to tobacco use in sexual minority persons include chronic stress, depression, alcohol use, and victimization (J. Blosnich, Lee, & Horn, 2013). Results from the current study support the notion that the relationship between stressful life events and smoking is amplified by sexual orientation such that sexual minorities are more likely to smoke.

The Last Drag is a smoking cessation program created especially for and by the LGBT community and certified by the American Lung Association (ALA). The Last Drag program is based on materials from another ALA program entitled *Freedom from Smoking*. The Last *Drag* provides education within an LGBT-supportive group, using LGBT-specific innovative activities and smoking information. Studies of the efficacy of smoking cessation support groups in the general population estimate quit rates to be about 5–10% and the use of behavioral therapy group treatments yield success rates of 20–30%. The Last Drag produced comparable results with an estimated quit rate between 36% and 72% (Eliason, Dibble, Gordon, & Soliz, 2012).

Results indicating that sexual orientation moderate the relationship between stressful life events and smoking provide important insights to smoking prevention and intervention programs for sexual minorities. For example, smoking cessation programs could include stress reduction techniques and methods to help further elucidate the relation between perceived stress and nicotine cravings. Sexual minority individuals report more stressors and fewer coping resources compared to heterosexuals (Meyer, 2003). Smoking prevention and intervention programs could include methods to help improve coping strategies and increasing self-efficacy. If sexual minority persons are better equipped to manage stressful life events, this may reduce the likelihood of maladaptive coping behaviors, such as smoking and could also reduce the likelihood of a relapse. The same could be said for alcohol and illicit drug abuse.

Implications for Research. Though findings from the current study did not indicate any significant differences in CVD risk category due to intersectional identities, the framework of Intersectionality should be deployed in research assessing the needs of the sexual minority communities. A common mistake, among healthcare practitioners and public health researchers alike, is the assumption that sexual minorities are a homogenous group. However, there are other social identities that can have an influence on physical and mental health in sexual minority populations. Public health research should continue to examine the possible impact of membership in multiple social groups.

Decades of research have demonstrated how different social identities are important in the identification of potential risk in health. For example, socioeconomic status, whether it is measured by education, occupation, or income, has consistently been shown to be a consistent predictor of health (House et al., 1994). Additionally, there is an overwhelming body of research suggesting that experiences of racial discrimination can lead to psychological distress (R. Clark et al., 1999; Utsey & Hook, 2007). Experiences of perceived racism were found to be the best

predictor of smoking among African Americans above income and gender (Landrine & Klonoff, 2000).

Using the framework of Intersectionality in the assessment of CVD risk in sexual minorities also provides an occasion for addressing potential health disparities. For example, one study examined the general health status and health risks of lesbians using the Multisite Women's Health Study (MWHS). The authors of this study found that African-American and other lesbians of color were more likely than their White counterparts to report that they currently smoked. Also, African-American lesbians were more likely to be current smokers than were African-American heterosexual women or White lesbians (Tonda L. Hughes, Johnson, & Matthews, 2008). Without considering intersectional social identities, this disparity by race in sexual minority women would remain unknown and unaddressed. Further research is necessary in order to identify the varied mechanisms that perpetuate the relationships among sexual orientation and substance abuse. Additionally it is imperative that this research considers how other social identities like race, sex or gender can work to create unique challenges for different subgroups.

Limitations

The current study had a number of limitations. The Add Health study is a longitudinal study of a nationally representative sample of adolescents in grades 7-12 in the United States. The first wave of data was collected during the 1994-95 school year. This database presents a wealth of information on sociocultural, environmental, biological and behavioral health data. However, the targeted objectives of the Add Health study were not to assess CVD risk in sexual minority populations, as such, index scores generated from study variables for CHRBs and stressful life events were used in lieu of the presence of standardized instruments.

Having a large population-based dataset can be helpful in assessing prevalence, but if the

ultimate goal is to reduce risk, having prevalence data is necessary, but not sufficient. In order to adequately address the disparities in CVD risk in sexual minorities, there is a need for guided research that focuses on the etiology of risk and how risk develops overtime in this particular population. Knowing the prevalence of risk factors is crucial, but understanding and addressing the mechanisms that undergird the disparate outcomes is key in addressing CVD risk in sexual minorities.

For example, this investigation found that sexual orientation amplified the relationship between stressful life events and smoking. Without examining the effect of stressful life events, we would be left with a disparity in smoking status without understanding how important sexual orientation is to the relationship between stress and smoking. While the use of secondary data presents a limitation, the data collected is useful in a number of ways. This study would not be feasible if not for the dataset, as collecting data over a 10 year period is not feasible for a dissertation project. Having access to a longitudinal database provides an opportunity to address potential trends in the data that would not be available using cross-sectional data.

Another limitation is the use of BMI as an indicator of cardiovascular risk. Researchers are beginning to question the utility of BMI as a health indicator as BMI is not an accurate measure of body fat and how body fat is distributed. The argument is that other anthropometric measures, such as waist circumference and waist-to-hip ratio, are better predictors of disease outcome (Antonisamy et al., 2016; Grant et al., 2008; Sperrin, Marshall, Higgins, Renehan, & Buchan, 2016). The current study was also limited in that the use of cholesterol is the preferred method of evaluation using the Framingham assessment. However, the dataset did not have cholesterol data available and thus BMI had to be used instead. Additionally, BMI presents a unique problem in that typically men have higher BMIs than do women. When using BMI as a health indicator, researchers should assess differences by gender and account for those

differences in analysis. Additionally, it will be important for future studies to assess whether BMI is the most effective tool to use in predicting risk.

Due to a limited sample size for some groups, the current study required the use of a nonparametric method (the Fisher's Exact Test) to examine how intersectional identities might predict Framingham risk group category. The Framingham Risk Assessment score was used to place participants into four different risk categories (low, moderate, moderately, high). Though the current study did not find significant evidence of a relationship between Intersectionality and Framingham risk group category, the sample size only allowed for the examination of the DV as a categorical variable. Further research should exam Intersectionality in CVD risk without the restrictions that limited group sample sizes and categorical data pose.

Another limitation of the study is a lack of consistency among the measures across waves particularly those items that assess stressful life events and diet. To address this limitation an index score was created and used to assess the magnitude to which participants experience stressful life events. However, items related to participant diet were limited to breakfast intake. A recent study found that eating breakfast was associated with a significantly lower risk of developing coronary heart disease (Cahill et al., 2013). While breakfast intake can be a good measure of a person's diet, it is important that future research consider other eating habits that may place sexual minority persons at greater risk.

Another limitation of the current study is the lack of a standardized measure of sexual orientation. Historically, data collection methods used to distinguish sexual orientation are typically defined and measured in terms of three dimensions—behavior, attraction, and identity. Ideally, the dimensions are determined by the research goals of the study (Academies, 2011). For example, a study examining HIV risk among men who have sex with men (MSM) would focus more so on behavior, where focusing on identity would be more appropriate in a study exploring

healthcare discrimination in sexual orientation. The current study used self-reported data on sexual identity, and while using identity as a measure is sufficient, research on sexual minority populations in general could benefit from a more standardized form of measurement.

Conclusions

Public health policy and research have begun to address the substantial health disparities that exist in sexual minority populations, with research focusing primarily on mental health. This investigation includes important inferences for health risk behaviors in sexual minority individuals. The relationship between stressful life events and CVD risk is compelling; few empirical studies have examined this relationship in sexual minority populations. The current study adds to the literature suggesting increased stress levels and increased health risk behaviors in sexual minorities. This study is significant because it not only addresses an important gap in the literature regarding CVD, but also provides more evidence of the pernicious effects of stress on health.

Adding to the Add Health studies, results from the current study extended research in the area of cardiovascular health in sexual minority populations. The trend towards an increased likelihood of a cardiac event uncovered in this study warrants further research in the long-term outcomes among sexual minorities. Theories on minority stress can help provide a framework for teaching coping strategies, and should be included in the development of substance abuse prevention and intervention programs.

Previous research has indicated that discrimination, such as peer and family rejection and social isolation, can contribute to elevated health risk among sexual minorities (J. R. Blosnich, Farmer, Lee, Silenzio, & Bowen, 2014). Research has shown that having adequate social support, participating in group and/or individual therapy, having access to healthcare, and having culturally competent health care providers has been very helpful in this population. Healthcare

providers should be trained in issues regarding the care of sexual minorities and the disparities in health risk behaviors unique to this population. Researchers should explore protective factors that could help mitigate the health risks that are associated with discrimination and victimization. Future studies should work to identify potential protective factors as well as potential barriers when creating harm reduction programs for sexual minority populations.

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Appendix A

Cardiovascular Health Risk Behavior Index Score Questions

Item	Wave I	Wave II	Wave III
1. During the past 30, on the days you smoked, how many cigarettes did you smoke each day?	x	x	x
2. Think of all the times you have had a drink during the past 12 months. How many drinks did you usually have each time?	x	x	x
3.1. What do you usually have for breakfast on a weekday morning?	x		
3.2. On how many of the past seven days did you eat breakfast?		x	x
4.1. In the past seven days, how many times did you participate in gymnastics, weight lifting or strength training?			x
4.2. During the past week, how many times did you play an active sport?	x	x	
4.3. During the past week, how many times did you go roller-blading, roller-skating, skateboarding, or bicycling?	x	x	

Appendix B

Stressful Life Events Index Score Questions

Item	Wave I	Wave II	Wave III	Wave IV
1. Childhood physical abuse (before 18)				x
2. Childhood sexual abuse (before 18)				x
3. Kicked out of home (ever)			x	
4. Homeless (ever)			x	
5. Witnessed violence (past 12 months)	x	x	x	x
6. Threatened by knife or gun (past 12 months)	x	x	x	x
7. Shot or stabbed (past 12 months)	x	x	x	x
8. Physical intimate partner		x	x	x
9. Sexual intimate partner violence (ever)			x	x
10. Physical forces sex (ever)				x
11. Non-physical forced sex (ever)				x

Appendix C

Framingham Risk Assessment Questionnaire

CVD Points for Women – Simple Model with Office-based non-laboratory Predictors

POINTS	Age	BMI	SBP Not Treated	SBP Treated	Smoker	Diabetic	
-3			<120				
-2							
-1				<120			
0	30-34	<25	120-129		NO	NO	
1		25-<30	130-139				
2	35-39	≥30		120-129			
3			140-149	130-139			
4			150-159		YES		
5	40-44		160+	140-149		YES	
6	45-49			150-159			
7							
8	50-54			160+			
9							
10	55-59						
11	60-64						
12	65-69						
13							
14	70-74						
15	75+						TOTAL POINTS
Points Allotted							

CVD Risk for Women - Simple Model with Office-based non-laboratory Predictors					
POINTS	RISK	POINTS	RISK	POINTS	RISK
-2 or less	Below 1%	**6**	3.4%	**14**	11.6%
-1	1.0%	**7**	3.9%	**15**	13.5%
0	1.1%	**8**	4.6%	**16**	15.6%
1	1.5%	**9**	5.4%	**17**	18.1%
2	1.8%	**10**	6.3%	**18**	20.9%
3	2.1%	**11**	7.4%	**19**	24.0%
4	2.5%	**12**	8.6%	**20**	27.5%
5	2.9%	**13**	10.0%	**21+**	Above 30%

Heart age/vascular age for Women: Simple Model with Office-based non-laboratory Predictors			
POINTS	HEART AGE	POINTS	HEART AGE
Less than 0	Younger than 30	**8**	51
0	32	**9**	54
1	34	**10**	58
2	36	**11**	61
3	38	**12**	65
4	41	**13**	69
5	43	**14**	73
6	46	**15**	77
7	48	**16+**	Older than 80

CVD Points for Men - Simple Model with Office-based non-laboratory Predictors

POINTS	Age	BMI	SBP Not Treated	SBP Treated	Smoker	Diabetic	
-2			<120				
-1							
0	30-34	<25	120-129	<120	NO	NO	
1		25-<30	130-139				
2	35-39	≥30	140-159	120-129			
3			160+	130-139		YES	
4				140-159	YES		
5	40-44			160+			
6							
7	45-49						
8	50-54						
9							
10	55-59						
11	60-64						
12							
13	65-69						
14	70-74						
15	75+						TOTAL POINTS
Points Allotted							

CVD Risk for Men - Simple Model with Office-based non-laboratory Predictors					
POINTS	RISK	POINTS	RISK	POINTS	RISK
-5 or less	Below 1%	**3**	4.0%	**11**	15.7%
-4	1.1%	**4**	4.7%	**12**	18.5%
-3	1.4%	**5**	5.6%	**13**	21.7%
-2	1.6%	**6**	6.7%	**14**	25.4%
-1	1.9%	**7**	8.0%	**15**	29.6%
0	2.3%	**8**	9.5%	**16+**	Above 30%
1	2.8%	**9**	11.2%		
2	3.3%	**10**	13.3%		

Heart age/vascular age for Men: Simple Model with Office-based non-laboratory Predictors			
POINTS	HEART AGE	POINTS	HEART AGE
Less than -1	Younger than 30	**8**	52
-1	31	**9**	55
0	33	**10**	58
1	35	**11**	62
2	37	**12**	65
3	39	**13**	69
4	41	**14**	73
5	44	**15**	78
6	46	**16+**	Older than 80
7	49		

Vita

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