# EXAMINING RACE DIFFERENCES IN CARDIOVASCULAR HEALTH AMONG YOUNG MEN: THE ROLE OF RESIDENTIAL SEGREGATION

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**ABSTRACT**

Samuel Leroy Keith Baxter: Examining race differences in cardiovascular health among young men: The role of residential segregation
(Under the direction of Morris Weinberger)

**Background:** Racial residential segregation (RRS) is a fundamental cause of racial disparities in cardiovascular disease (CVD) risk and prevalence. While the effects of RRS on Black-White disparities in CVD have been well documented, knowledge about the effect of RRS on CVD disparities among men is limited. Cardiovascular health (CVH) is inversely associated with CVD risk and may prevent CVD disparities in later adult years if better understood. Thus, the goal of this dissertation is to examine whether RRS influences the emergence of race differences in CVH among young Black and White men in the US.

**Methods:** Data for aims 1 and 2 were drawn from the National Longitudinal Study of Adolescent to Adult Health (Add Health). In aim 1, we used logistic regression to examine whether RRS influenced the association between race and CVH among young men (ages 24-32; N=5,080). In aim 2, we used mixed effects latent growth modeling to examine whether RRS during adolescence contributed to alternative body mass index (BMI), sleep, and cigarette use male trajectories by race from adolescence to young adulthood (ages 13-31; (N=8,612). Lastly, aim 3 used concept mapping data collected from a community sample of 30 young Black men residing in two southern Black communities to understand their conceptualizations of how CVH is linked to residential context.

**Results:** In aim 1,we observed race disparities in ideal CVH when young Black and White men reside in neighborhoods comprised of 55% or more White residents. In aim 2, BMI, sleep, and cigarette use trajectories differed by neighborhood RRS during adolescence for White males. However, adolescent RRS caused different trajectories only for BMI among Black males. In aim 3, the final concept map depicted eight conceptual domains classified into two overarching domains of neighborhood features that were either *protective* or *harmful* to Black men's CVH.

**Conclusion:** Overall, study findings advance knowledge of the extent that RRS influences Black-White differences in CVH among young men. Taken together, findings from this dissertation have the potential to inform research, healthcare delivery, and policy solutions to better serve young men within their residential contexts and attenuate racial disparities in CVD.

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| | |
|---|---|
| Add Health | National Longitudinal Study of Adolescent to Adult Health |
| AFFH | Affirmatory Furthering Fair Housing |
| AHA | American Heart Association |
| BIC | Bayesian Information Criterion |
| BMI | Body mass index |
| CES-D | Center for Epidemiological Studies Depression Scale |
| CM | Concept mapping |
| CVD | Cardiovascular disease |
| CVH | Cardiovascular health |
| EHDIC | Exploring Health Disparities in Integrated Communities |
| FHA | Federal Housing Authority |
| HCA | Hierarchical cluster analysis |
| HEP | Healthy Environments Partnership |
| HOLC | Home Owners' Loan Corporation |
| LS7 | Life's Simple Seven |
| MDS | Multidimensional scaling |
| MESA | Multi-Ethnic Study of Atherosclerosis |
| MLGM | Mixed effects latent growth modeling |
| NC | North Carolina |
| RRS | Racial residential segregation |
| RUCA | Rural-urban commuting area |
| SES | Socioeconomic status |

| | |
|---|---|
| US | United States |

# CHAPTER 1: INTRODUCTION

## Background

Cardiovascular disease (CVD) remains the leading cause of death for adult men in the United States (US) with an estimated 121.5 million Americans experiencing some form of CVD complication (Benjamin et al., 2019; Heron, 2019). By 2030, 40% of all Americans are projected to suffer from CVD (Heidenreich et al., 2011) due to the rise of obesity, sedentary lifestyles, hypertension, and diabetes over the past quarter century (Xiao & Graham, 2019). CVD prevalence varies by age, race, biological sex, and geography (Boykin et al., 2011; Mensah, Mokdad, Ford, Greenlund, & Croft, 2005). In particular, Black men have a substantially higher risk of premature death due to CVD complications than other racial, ethnic, and gender groups in the US. Notably, a stark disparity in premature death rates for White and Black men (9.5 vs. 21.6/100,000) is observed at 25-34 years of age (Heron, 2018). Furthermore, individuals younger than 30 years often present with modifiable lifestyle risk factors associated with CVD (e.g. smoking, unhealthy diet, lack of physical activity, excessive alcohol consumption, overweight and obesity), and racial/ethnic minorities tend to have higher prevalence rates of many of these lifestyle risk factors compared to Whites (G. Graham, 2015). Therefore, reducing young men's CVD risk may be a cost-effective strategy to delay onset of CVD, reduce associated health care costs, and improve health-related quality of life.

In 2010, the American Heart Association (AHA) introduced the concept of cardiovascular health (CVH) to focus on preventing CVD by promoting clinical and lifestyle factors that are important to heart health (Lloyd-Jones et al., 2010). CVH encompasses four clinical (optimal blood pressure, total cholesterol, blood glucose, and normal body mass index) and three lifestyle (healthy diet, physical activity, and not smoking) factors associated with CVD risk. AHA's shift to prioritizing CVH is linked to evidence that young adults with these factors are more likely to reach middle age with higher quality of life and lower CVD risk (Liu et al., 2012; Unger et al., 2014).

One explanation for racial differences in the prevalence of CVD risk factors is racial residential segregation (RRS) (Mujahid et al., 2017; Thorpe, Kennedy-Hendricks, et al., 2015), . defined as the degree to which two or more racial groups live in separate residential contexts Williams and Collins (2001). While RRS can be considered a determinant of racial disparities in health (Williams & Collins, 2001), much of literature does not account for the health impacts of living in segregated environments (LaVeist, Pollack, Thorpe, Fesahazion, & Gaskin, 2011). For racial minorities, living in segregated environments limits educational and employment opportunities, increases exposure to social stressors, and provides differential access to resources that promote healthy opportunities compared to their White peers (Kershaw, Diez Roux, et al., 2015; Williams & Collins, 2001). Acknowledging that individual health is influence by where we live (Schroeder, 2007), there is a need enhance our understanding of whether RRS impacts racial disparities in CVH among men. This relationship is especially under explored among young adult men.

My <u>long-term goal</u> was to understand the health effects of RRS for men across the adult life course. In this study, my overall objective was to examine whether RRS influenced the emergence of race differences in CVH among young Black and White men in the US. Specifically, I examined if the association between RRS and CVH was different for Black and White men during young adulthood beyond individual and neighborhood factors. Using data from the National Longitudinal Study of Adolescent to Adult Health (Add Health) and interviews of young Black men residing in two North Carolina communities, I had three specific aims.

**Specific Aims**

Aim 1: To compare racial differences in the association between RRS and CVH among young men. I hypothesize that after accounting for individual-level factors, a) White men will have better CVH than Black men; b) RRS is **negatively** associated with CVH in young Black men; and c) RRS is **positively** associated with CVH for young White men. I use Add Health Wave IV (2008-2009) data and logistic regression to examine the effect of race and RRS on CVH for young men.

Aim 2: To examine the extent to which RRS during adolescence contributes to racial differences in body mass index, sleep duration, and tobacco use trajectories from adolescence to young adulthood. I hypothesize that after accounting for individual-level factors, a) Black respondents will have **worse** trajectories from adolescence to young adulthood than White respondents; and b) Black respondents who lived in more segregated neighborhoods during adolescence will have **worse** trajectories than White respondents who lived in more segregated neighborhoods during adolescence. I use Add Health data from Waves II (1996), III (2001-2002), & IV (2008-2009) and conditional growth curve modeling to examine the effect of residential segregation during adolescence (Wave II) on the trajectories of select cardiovascular risk factors (body mass index, sleep duration, and tobacco use) by race.

Aim 3: To examine young Black men's conceptualizations of RRS and its contribution to CVH. I use concept mapping, a participatory research method, to conceptualize and identify neighborhood features of predominantly Black communities that young Black men perceive are associated with CVH. Findings will contribute to our understanding of what neighborhood features in communities characterized by RRS can be targeted to improve young Black men's CVH.

**Significance**

Since the turn of this century, RRS has emerged as a reason for persisting racial health disparities in the United States. Because many Americans live in racially segregated environments, observed racial disparities may be confounded by place-based disparities (LaVeist et al., 2011; Williams & Collins, 2001). In general, studies using national data have not considered that racial differences are linked to living in communities with differential exposure to health risks and opportunities. To demonstrate the impact of RRS on health disparities among men, one study used a community survey to explore racial disparities in unhealthy behaviors (drinking, smoking, and physical inactivity) among men living in a racially-integrated neighborhood, and compared these findings to men from a national survey (Thorpe, Kennedy-Hendricks, et al., 2015). That study found that racial disparities in unhealthy behaviors among men were present in the national survey but ameliorated in the community survey, where the sample of men lived in the same social, economic, and environmental conditions. Thus, RRS was identified as a potential determinant of racial health disparities.

RRS produces racial disparities in health through three primary pathways. First, RRS shapes racial disparities in socioeconomic status (SES) because neighborhoods with a significant concentration of Black residents tend to have lower home property values and limited access to high-quality schools and employment opportunities compared to neighborhoods with mostly White residents (Acevedo-Garcia, Osypuk, McArdle, & Williams, 2008; Popescu, Duffy, Mendelsohn, & Escarce, 2018). This disadvantage contributes to concentrated poverty and wealth inequality. Second, RRS increases minorities' exposure to unfavorable neighborhood conditions (e.g., poorer housing quality, elevated crime rates, limited access to recreational facilities and healthy food sources, increased exposure to environmental hazards) compared to Whites. Third, RRS is associated with racial disparities in health care quality, access, and service use. Research on place-based disparities shows that Black individuals tend to receive medical care at lower quality health centers than their White peers (Dimick, Ruhter, Sarrazin, & Birkmeyer, 2013; Popescu et al., 2018). Additionally, the racial composition of communities surrounding health care centers is associated with racial disparities in the utilization of physical and mental health services (Dinwiddie, Gaskin, Chan, Norrington, & McCleary, 2013; Gaskin, Price, Brandon, & LaVeist, 2009). The impact of RRS on racial disparities among men has been confirmed for several health outcomes through the aforementioned pathways (Dinwiddie et al., 2013; Gaskin, Dinwiddie, Chan, & McCleary, 2012; M. S. Goodman et al., 2012; A. Jones, 2013; Thorpe, Kelley, et al., 2015). However, these studies have not examined how RRS effects racial health disparities among men during young adulthood.

Research examining RRS and CVH among young adult men is limited. Most research on RRS and health outcomes focuses on racial and ethnic differences among adults in middle-age or as an aggregate population (Caldwell, Ford, Wallace, Wang, & Takahashi, 2017; Kershaw & Albrecht, 2015). Literature examining the effect of RRS on health at earlier life stages is scant (Kotecki, Gennuso, Givens, & Kindig, 2018; Ryabov, 2015). CVH in today's young adults is threatened because they grew up during the childhood obesity epidemic (Lawrence, Hummer, & Harris, 2017); fewer than one-in-five young adults have CVH in good standing (Gooding et al., 2016). Moreover, there is a dearth of research about CVH in young Black men, a group with the highest risk for developing CVD. While men develop and die from CVD sooner than women, Black men's disproportionate CVD burden relative to other male race/ethnic groups is related to having a higher prevalence of CVD risk factors in young adult and adolescent years (Bruce, Wilder, et al., 2017; Thorpe et al., 2016). Thus, research on the emergence and expansion of CVH disparities by race among young adult men warrants greater attention.

In summary, this research is significant because:

1) It will contribute to the growing body of scientific literature on CVH and racial differences by focusing on RRS as a contextual determinant. Although the AHA has resolved to prevent CVD and stroke by defining, monitoring, and improving CVH, there is a need for more research that investigates the role of RRS in explaining racial differences in CVH among men (Benjamin et al., 2019; Carnethon et al., 2017).
2) It addresses important gaps in the literature on men's health disparities across the life course by examining the relationship between RRS and CVH during young adulthood. The health of Black Americans deteriorates prematurely compared to

White Americans (Thorpe et al., 2016). Accordingly, the interplay of race, health, and place may vary by age. However, much of the scholarship on RRS and CVD disparities among men applies to middle-aged and elderly life stages. Applying a life course approach will expand our understanding of how inequities in men's health emerge and potential solutions to reduce disparities (Gilbert et al., 2016; Griffith, Bruce, & Thorpe, 2019).

3) Understanding the effect of RRS on young Black men's CVH may have significant policy implications. Increasingly, Centers for Medicare and Medicaid Services (CMS) are granting States waivers to use Medicaid funds for non-medical interventions that address select health (e.g. chronic conditions, repeated emergency visits or hospital admissions) and social (e.g. housing, food, intimate partner violence) risks (Hinton, Artiga, Musumeci, & Rudowitz, 2019), for example, North Carolina's innovative Healthy Opportunities Pilot program. This study situates RRS as a contextual, determining factor for health and social risks that may inform such demonstration projects. Study findings can assist state-, county-, and community-level stakeholders in developing strategies to improve population health that focus on residential context and CVD prevention (i.e. CVH).

**Innovation**

CVD is the leading cause of death in the US, with men experiencing higher rates of premature death and lower health care engagement than women (Baker & Shand, 2017; Heron, 2018). A burgeoning body of evidence suggests RRS confounds the relationship among race, socioeconomic status, and health (Kershaw & Albrecht, 2015; LaVeist et al., 2011; Morenoff et al., 2007; Thorpe, Kennedy-Hendricks, et al., 2015). Several studies demonstrate that the impact of RRS on adult CVD diagnoses and risk factors differ by race and gender (Kershaw & Albrecht, 2015); however, the evidence mostly includes cross-sectional studies and community samples. Amid growing interest in the determinants of men's health across the life course (Griffith et al., 2019), there is a need for increased scholarship addressing these determinants in young adulthood.

This study is innovative because it uses longitudinal data from a nationally representative study and community sample to understand the contribution of RRS to young men's health disparities. We use data from a nationally representative cohort of adolescents who were followed into adulthood for approximately 12 years. The longitudinal design enables us to explore the role of adolescent RRS in trajectories of CVD risk from adolescence to adulthood by race in males. Complementing this study, we employed a participatory research method, concept mapping, with a community sample of young Black men residing in majority Black communities to examine how they identify and perceive their CVH is influenced by neighborhood features.

This study is also novel because it positions RRS as a possible pathway through which health disparities may exist or expand for males during young adulthood. Social disadvantages, the unfavorable social, economic, or political conditions that some population groups systematically experience based on their relative position in social hierarchies (P. A. Braveman et al., 2011), are a primary mechanism through which inequities are created and sustained (Thorpe, Duru, & Hill, 2015). Lastly, using CVH as the outcome of interest, instead of CVD, may offer new insights to understanding and attenuating men's CVD risk before they reach middle-age, reducing health care costs and improving quality of life.

## Organization of this Dissertation

This dissertation contains six chapters. Chapter 2 reviews the literature on men's health related to racial residential segregation and CVD and outlines the basis of the conceptual frameworks used in this dissertation. Chapters 3, 4, and 5 contain three manuscripts, one for each specific aim. Chapter 6 summarizes findings across aims, discusses policy implications, and concludes with future directions for research.

# CHAPTER 2: CVD, RACE, AND PLACE: LITERATURE AND FRAMEWORK

## Cardiovascular Disease and Race among Men

CVD is a major health problem for men with persistent racial disparities in the US. In 2017, CVD caused 1in 4 male deaths, and nearly half of men were unaware of their CVD risk (Benjamin et al., 2019). Despite population-level declines in deaths attributable to CVD in recent decades, Black adults are twice as likely to prematurely die from CVD than non-Hispanic Whites adults (Benjamin et al., 2019; Carnethon et al., 2017; Cunningham et al., 2017; Heron, 2019). In fact, CVD became the leading cause of death for Black men a decade sooner than other racial groups (Heron, 2019).

Black men experience a disproportionate burden of CVD (Gadson, 2006; Gilbert et al., 2016; Williams, 2003). CVD prevalence is higher in Black (60%) compared to White (50%) or Hispanic (49%) men (Benjamin et al., 2019). Black men have a higher prevalence of chronic diseases that are risk factors for CVD (e.g., hypertension, type 2 diabetes, and obesity) than White men (Benjamin et al., 2019). Relative to other male groups, Black men with hypertension have low awareness of their status and more issues with treatment and control. Diabetes has more than doubled in the past two decades (Singh et al., 2017), with the incidence of diabetes being greater in Black men. The prevalence of obesity has substantially increased over the past few decades (Griffith, Johnson-Lawrence, Gunter, & Neighbors, 2011; Newton, Griffith, Kearney, & Bennett, 2014; Ogden, Carroll, Kit, & Flegal, 2014); from 1999-2008, Black men experienced the largest (28.1%-37.3%) and White men the smallest (27.3%-31.9%) increase in prevalence (Flegal, Carroll, Ogden, & Curtin, 2010). Altogether, these data illustrate CVD is a critical men's health issue and Black men are at greater risk for CVD and its associated morbidity and mortality.

**Overview of Cardiovascular Health**

Despite advancements in biomedical research and available evidence-based strategies, CVD continues to plague Americans. Individuals who maintain ideal levels of body mass index, smoking, blood pressure, blood glucose, diet, physical activity, and total cholesterol have fewer adverse CVD events and longer life expectancy (Wilkins et al., 2012). Hence, the American Heart Association (AHA) set strategic goals to (1) improve the cardiovascular health (CVH) of all Americans by 20% and (2) reduce national deaths from CVDs and stroke by 20% by the year 2020 (Lloyd-Jones et al., 2010). CVH is comprised of seven health metrics (known as Life's Simple 7): three clinical (blood pressure, total cholesterol, blood glucose) and four lifestyle (diet, physical activity, body mass index, smoking). CVH has three categories: ideal, intermediate, and poor. As seen in Table 2.1, ideal CVH for a health metric denotes both the absence of a relevant clinical condition and achieving the nationally-recommended health standard. The seven CVH metrics can also be examined as a summary score based on the number of individual CVH metrics rated as: ideal (5-7 health metrics) ; intermediate (1-4 health metrics); and poor (no reports of ideal CVH for any health metric) (Benjamin et al., 2019; Mujahid et al., 2017; Rodriguez, 2012).

The AHA's focus on CVH signified a significant shift in priorities toward prevention, rather than treatment. It also provides an opportunity to monitor and eliminate cardiovascular-related inequities across the lifespan. Recent epidemiologic data in the US found that 47.2% of children (aged 2-19) and 18% of adults (aged 20 and older) have ideal CVH; Black children (36.2%) and adults (10.6%) have the lowest ideal CVH prevalence (Benjamin et al., 2019). Moreover, men are less likely to achieve ideal CVH standards than women. Although most children have ideal CVH, few adults do; notably, Black and male populations struggle the most to meet ideal CVH standards. This is cause for great concern because as CVH declines, CVD risk rises (Ford, Greenlund, & Hong, 2012; McClurkin et al., 2015; Q. Yang et al., 2012). To improve men's CVH, we need to identify modifiable factors and pathways that narrow disparities in CVH.

**Racial Residential Segregation**

Much of men's health literature examining CVD risk focuses on proximate- or individual-level causes (e.g., healthcare practices, socioeconomic status, risk-taking behaviors, gender roles) (Courtenay, 2003; Griffith et al., 2019; O'Neil, Scovelle, Milner, & Kavanagh, 2018; Williams, 2003). However, this literature has not investigated factors that affect both individual-level factors and cardiovascular outcomes. Given the increasing focus on population health, there has been a recent emphasis on upstream drivers of health to explain disparities in race and income among men (Gilbert et al., 2016; Griffith et al., 2019; Treadwell & Ro, 2008). These upstream drivers, commonly referred to as social determinants of health, are related to unequal and place-based resources, power, and privileges (P. Braveman, 2008; Puckrein, Egan, & Howard, 2015; Woolf & Braveman, 2011). Such unequal distributions produce health advantages for certain social groups and disadvantages for others. It follows then, the impact of social determinants of health on population health and health inequities depends on who people are (individual characteristics) and where they live (place-based characteristics).

One aspect of place that has received increased attention is racial residential segregation (RRS), defined as the degree in which two or more racial groups live in separate neighborhood environments (Massey & Denton, 1988; Williams, Lawrence, & Davis, 2019). In their seminal article, Massey and Denton (1988) argued RRS is a multidimensional societal phenomenon to be measured along five distinct dimensions: evenness, exposure, concentration, centralization, and clustering. Applying these measures involves matching geospatial data across multiple levels (e.g. census tract, metropolitan statistical area, county, state) with respondent data. Researchers often employ census tract measures of racial composition and racial concentration as a proxy for neighborhood-level RRS (Carreon & Baumeister, 2015; Ryabov, 2015; White & Borrell, 2011).

### *History and Nature of Racial Residential Segregation in the United States*

Although RRS is often neglected in investigations of racial health disparities, it is a fundamental determinant of racial inequalities in the United States (Massey, 1994). Formally supported by federal housing policies, economic institutions, and housing market practices, the core function of RRS is to ensure White and Black Americans live in separate neighborhoods (Massey, 1994; Rothstein, 2017). RRS was institutionalized across America with the New Deal (1933-1939) which sought to rehabilitate the economy, expand workforce opportunities, improve housing conditions, and ensure security for Americans during the Great Depression (Kennedy, 2009). In 1933, the Home Owner’s Loan Corporation (HOLC) was established to purchase risky mortgages and protect defaulting homeowners against foreclosure (Kennedy, 2009; Mitchell & Franco, 2018). The National Housing Act of 1934 created the Federal Housing Authority (FHA) to facilitate capital investments for housing construction and ensure the affordability of long-term housing mortgages (Kennedy, 2009).

Housing legislation benefited the middle-class and left the housing needs of low-income families unaddressed. In response, the United States Housing Act of 1937 was passed to improve slum areas and finance public housing projects for low-income Americans (Kennedy, 2009).

The New Deal is remembered as a series of stabilizing policies aims at ending the Great Depression. However, it is less acknowledged that it codified and expanded racial segregation, known as Jim Crow laws, into housing and homeownership across the United States that persists today (Rothstein, 2017). The Jim Crow era, lasting from the late 19th century until the mid-20th century, established de jure racial segregation within Southern state and local governments. The New Deal resulted in a "state-sponsored system of segregation" by creating housing and home ownership opportunities for White, middle- and lower-class families, but denying people of color these same opportunities (Rothstein, 2017). For example, HOLC created residential security maps to systematically evaluate the mortgage lending risk of neighborhoods in major cities (R. K. Nelson, Winling, Marciano, & Connolly, 2017). On these maps, neighborhoods were graded and color-coded: Best-green; Desirable-blue; Declining-yellow; and Hazardous-red. Hazardous neighborhoods, defined as having a high proportion of African American residents, were redlined by lending institutions and denied capital investments to improve housing (Crossney & Bartelt, 2005). While millions of White families secured housing loans and bought homes in newly constructed neighborhoods, Black families were systematically denied housing loans to leave Hazardous neighborhoods or enter neighborhoods with higher HOLC grades, likely majority White. Additionally, Black families migrating North and West realized that the Jim Crow practices they fled from existed in the national housing market (Black, Sanders, Taylor, & Taylor, 2015; Wilkerson, 2011).

RRS lawfully saturated the United States until the Civil Rights Act (Fair Housing Act) of 1968 made racial discrimination in housing sales and rentals illegal (Kramer & Hogue, 2009). However, the Fair Housing Act's Affirmatively Furthering Fair Housing (AFFH) rule, which enforced the elimination of housing segregation and discrimination, was not implemented (Poverty and Race Research Action Council, 2020). Consequently, RRS remains in contemporary society: "the average White person in metropolitan America lives in a neighborhood that is 75% White", whereas "the average Black person lives in a neighborhood that is  35% White and as much  as 45% Black" (Havekes, Bader, & Krysan, 2016). A recent report from the National Community Reinvestment Coalition examined how the present racial composition of areas compared to the HOLC grade they received in the 1930s (Mitchell & Franco, 2018).  Nationally, nearly 64% of the neighborhoods that the HOLC graded Hazardous areas are majority-minority neighborhoods today.  To address this, President Obama updated the AFFH regulation in 2015 by instituting a "community-centered process to analyze patterns and causes of segregation and well as neighborhood disparities, and set actionable steps to promote greater integration and equity"(Poverty and Race Research Action Council, 2020).  Unfortunately,, the Trump administration suspended the 2015 AFFH rule in 2017 and in July 2020,  the 2015 AFFH rule was repealed and replaced with Preserving Community and Neighborhood Choice, which gives local communities maximum control in designing and implementing policies based on their respective housing needs (HUD, 2020). This new rule is considered a major setback as it adopts a broad definition of fair housing (housing that, among other attributes, is affordable, safe, decent, free of unlawful discrimination, and accessible under civil rights laws) that does not explicitly address RRS or remove rent regulations and environmental protections that may harm vulnerable populations economically and health-wise.

In short, racially segregated neighborhood patterns are not random. RRS among Black and White Americans is connected to policies that promote investment disparities in social and economic development, resulting in limited access to health-promoting resources and increased exposure to health risks for Black individuals living in predominantly Black neighborhoods (LaVeist, Gaskin, & Trujillo, 2011). Accordingly, leading scholars conceptualize RRS as an enduring product of racism in America (Bailey et al., 2017; Williams et al., 2019) initiated through discriminatory and exclusionary policies, persisting overtime, and fundamentally impacting health patterns across social institutions (Bonilla-Silva, 1997). Notably, the social, economic, and health consequences associated with White-Black RRS are distinct from the segregation other racial and ethnic groups experience, which is often protective, especially for immigrant groups (Carreon & Baumeister, 2015; M.-A. Lee & Ferraro, 2007; Pool et al., 2018).

**Racial Residential Segregation and Cardiovascular Disease Risk**

The persistence of racial disparities in CVD warrants greater understanding of root causes to inform evidence-based strategies and policy solutions. Since health is profoundly influenced by where we live (Schroeder, 2007) and most Americans live in racially segregated environments (LaVeist et al., 2011), RRS is critical to understanding health and health inequities. Using National Center for Health Statistics data, Greer and colleagues found that RRS was related to CVD mortality among Blacks ages 35 and older, but this relationship was observed only among Whites 65 and older (Greer, Kramer, Cook-Smith, & Casper, 2014). Unfortunately, much of the literature on CVD risk and racial disparities does not account for the health effects of segregated living patterns in the US (LaVeist, 2013b). Using data from the Multi-ethnic Study of Atherosclerosis (MESA) researchers observed higher RRS resulted in increased CVD risk for Blacks, but a decreased CVD risk for Whites (Kershaw, Osypuk, Do, De Chavez, & Diez Roux, 2015). Furthermore, after adjusting for individual (e.g. demographics, health risk factors, and socioeconomic position) and neighborhood (e.g. poverty, physical and social environment) factors, the association between RRS and CVD risk remained for Blacks, but not Whites. Similarly, studies using data from community surveys with large Black adult samples shows that higher segregation is related to higher CVD risk for Blacks (Kershaw & Albrecht, 2015; Mayne et al., 2019) and specifically Black men (Barber, Hickson, Kawachi, Subramanian, & Earls, 2016).

**Racial Residential Segregation and Cardiovascular Health**

The relationship between RRS and CVH has not been studied extensively. Using data from the National Health and Nutrition Examination Survey, a higher proportion of Blacks in a census tract was positively associated with higher BMI for Black men (Do et al., 2007). Similar findings were observed for Blacks in two national studies (Chang, 2006; Corral et al., 2015). In contrast, researchers found no association between higher segregation and higher BMI for Black men (Kershaw, Albrecht, & Carnethon, 2013). The differences may result from different RRS measures and covariates.

Diet and physical activity are integral to weight status and weight gain. However, the relationship between RRS and these measures is not the same as for obesity. A recent community study found neighborhood poverty, not RRS, was associated with increased physical activity among Black men (Whitaker et al., 2019). Interestingly, a study using national data found that RRS and poverty jointly contributed to fruit and vegetable consumption; segregation alone contributed to obesity; and neighborhood poverty alone contributed to exercise. This study did not consider gender differences (Corral et al., 2012).

Among US adults, 33.9% and 43.0% of White men and Black men have hypertension (Go et al., 2013); the most recent definitions suggest the prevalence of hypertension among Black men may be 59% (Whelton et al., 2018). To date, one study has examined the role of RRS on hypertension among Black men. In a sample of urban Black men with uncontrolled hypertension, aged 50 and older, the authors found that men living in areas with higher concentrations of Black residents were less likely to receive hypertension treatment (Cole, Duncan, Ogedegbe, Bennett, & Ravenell, 2016). To our knowledge, no studies have explored the contribution of RRS to smoking, blood glucose, and cholesterol in men. While research on RRS and CVH in men is limited, evidence highlights observed race disparities may stem from differences in exposure to health risks and access in environments in which Black and White men live.

**Residential Integration and Cardiovascular Health**

Most research on the etiology of racial disparities in health are biased as they do not account for the ways that RRS confounds observed health outcomes (LaVeist, Thorpe, Mance, & Jackson, 2007; LaVeist, 2013a). Moreover, the dynamic nature of RRS influences health outcomes by race, after accounting for the traits and behaviors of individuals (Schroeder, 2007; Williams & Jackson, 2005). As presented above, a growing body of literature illuminates the link between RRS and race-based disparities in CVD risk and CVH, which disadvantages Black men.  While a significant contribution, there remains an evidentiary gap as to whether observed patterns of racial health disparities are evident when racial groups live under similar socio-environmental conditions and have similar socioeconomic status (SES) (LaVeist et al., 2008).

The Exploring Health Disparities in Integrated Communities (EHDIC) study addresses this question. EHDIC is an ongoing, multi-site study of racial disparities where Black and White Americans live in the same social and economic community context (LaVeist et al., 2008). Evidence from EHDIC study demonstrates Black-White disparities among men are attenuated when living in the same community. For example, a series of studies found that Black and White respondents in the integrated community study had more similar rates of obesity, physical inactivity, hypertension, and diabetes than in national studies (Bleich, Thorpe, Sharif-Harris, Fesahazion, & LaVeist, 2010; LaVeist, Thorpe, Galarraga, Bower, & Gary-Webb, 2009; Thorpe, Brandon, & LaVeist, 2008; Wilson-Frederick et al., 2014). In addition, several studies of men found that, in contrast to national studies, racial disparities in obesity, smoking, and physical inactivity were eliminated among Black and White men in EHDIC (Thorpe, Kelley, et al., 2015; Thorpe, Kennedy-Hendricks, et al., 2015). Taken together, these studies provide evidence that racial disparities among Black and White men can be ameliorated when they live under exposure to the same health risks and have similar incomes.

### *Youth and Young Adults*

As previously noted, Black men struggle to achieve optimal CVH, and Black-White disparities in men on salient CVD metrics are eliminated when they live in the same residential and economic contexts. Limitations of the current literature on CVD disparities between Black and White men include being largely cross-sectional and focusing on middle-age and elderly men. Evidence suggests that maintaining CVH is associated with lower CVD incidence and age is a key risk factor for CVD (Benjamin et al., 2019; Djoussé et al., 2015; Yang et al., 2012). This is an important gap because CVH in young adulthood is associated with lower CVD risk in middle-age (Liu et al., 2012). To improve men's CVH, there is a need for increased research that investigates how CVH trajectories develop over the life course along racial lines.

Black men's disproportionate CVD burden and lower CVH attainment is attributable to their high prevalence of CVD risk factors in younger years relative to other male age groups (Bruce, Wilder, et al., 2017). The limited evidence suggests that obesity and hypertension during adolescence and young adulthood may be salient risk factors for Black men's accelerated CVD risk progression (Benjamin et al., 2019; Bruce, Beech, Griffith, & Thorpe, 2015; Bruce, Beech, et al., 2017; Bruce, Wilder, et al., 2017; Cutler et al., 2008). A few studies have explored whether RRS is associated with subsequent racial disparities in CVH longitudinally (Kershaw et al., 2017; Pool et al., 2018; Thorpe et al., 2016; Xiao & Graham, 2019). Bancks and colleagues found that, with age, Black men and women had higher diabetes incidence than their White peers. However, this disparity was no longer significant after adjusting for RRS during young adulthood, among other place-based covariates (Bancks et al., 2017). This suggests that what happens in youth and young adults is important to men's CVH in later years and warrants greater attention in efforts to eliminate health disparities across the life course, in particular for men.

To extend what our knowledge about men's CVH at the intersection of race and place, it is imperative to better understand the role of place-based factors in racial disparities before men reach middle-age This dissertation centers the contribution of RRS to observed race differences in CVH among Black and White men during their young adult life stage.

## Conceptual Frameworks

The guiding conceptual frameworks for this dissertation are adapted from the Williams model for the studying the role of race in health (David R. Williams, 1997), the Healthy Environments Partnership (HEP) Model (Schulz et al., 2005), and weathering hypothesis (Geronimus, 1992; 2006). The models can be used to examine RRS as an upstream factor that impacts health through individual- and neighborhood-level characteristics.

### *Fundamental Cause Models*

Williams presents a fundamental cause model (Figure 2.1) that situates societal and historical factors (e.g. culture, racism, political, legal, and economic factors), not race or SES per se, as the basis of racial health inequities (Williams, 1997). Williams identifies RRS as a primary mechanism of institutional racism that has operated in American society for nearly a century, constraining economic and residential mobility for Blacks. Herein, SES, race, and other demographic factors are conceptualized as social status categories that have social and political consequences. Williams posits that race and its associated health differences reflect the confluence of societal forces, particularly racism, at multiple levels. Additionally, risk behaviors, stress, psychosocial resources, and access to medical care are deemed surface causes that affect biological processes and racial differences in health status. Addressing these health inequities by intervening on surface causes are unlikely to succeed because they do not get at the root causes of racial differences in health.

Inspired by community-based participatory research, the HEP model (Figure 2.2) posits race-based residential segregation and economic inequalities are fundamental factors influencing intermediate and proximate predictors of CVD (Schulz et al., 2005). In this model, RRS and economic inequality are forms of institutional racism that fundamentally influence CVH. The HEP model includes life stressors, health behaviors, and psychosocial factors as proximate factors that have established relationships with CVD in scientific literature. This model highlights the intermediary roles that social context and physical environment (e.g. sociopolitical and neighborhood conditions) play in the relationship among RRS, proximate risk factors, and CVD.

### *Life Course Perspective*

A life course perspective can help explain how race is connected to differential health pathways throughout life (Thorpe & Kelley-Moore, 2013). One way a life course perspective does this is through its ability to determine the timing of biological, behavioral, and social processes that may significantly shape health (George, 2002). Acknowledging that racial disparities in health vary across age groups, a life course perspective suggests that health inequities are susceptible to change at individual and societal levels (Thorpe & Kelley-Moore, 2013). The weathering hypothesis (Geronimus, 1992) states that the health status of Blacks, compared to Whites, begins to deteriorate prematurely in early adulthood as a consequence of their exposure to harmful social-environmental, economic, and psychosocial conditions (Geronimus, Bound, Waidmann, Colen, & Steffick, 2001; Thorpe & Kelley-Moore, 2013; Thorpe et al., 2016). This produces observed Black-White disparities that widen with age. To be clear, the weathering hypothesis does not espouse that there is fundamental difference between Black and White persons. Rather, racial differences in health are the result "of living in a race conscious society"(Geronimus et al., 2006).

### *Integrating Conceptual Frameworks*

The conceptual framework guiding this dissertation study integrates aspects of the Williams and HEP models to conceptualize how racial differences in CVH may be influenced by RRS. Both models identify RRS as a fundamental cause of racial health inequities and identify similar surface or proximate factors along this pathway. The major contribution of the Williams model is its conceptualization of race being influenced by societal forces, rather than being the influential societal force. The HEP model informs this dissertation by articulating how RRS effects on CVH may be mediated by neighborhood social context and physical environment. Drawing on the strengths of these models, my integrated conceptual model (Figure 2.3) presents a pathway to understand the direct and indirect impacts of RRS on young men's CVH profiles when race is jointly considered. Specifically, this dissertation examines: a) racial differences in the relationship between RRS and CVH among young men (Aim 1) and b) young Black men's perspectives on how neighborhood social context and physical environment contributes to their CVH (Aim 3). Evaluating the impact of RRS on CVH across various life stages is needed to identify intervention strategies that are relevant to where men are in their life course.

Few studies have explored race, RRS, and CVH at younger life stages, especially among men. Childhood and adolescence are periods in the life course during which lived experiences have lasting effects on health (Braveman & Barclay, 2009; Foster, Hagan, & Brooks-Gunn, 2008). It follows then that RRS during adolescence may have a lasting effect on CVD risk during the transition to adulthood (Geronimus, 1992; Osypuk, 2013). A life course approach (Figure 2.4) builds on the integrated conceptual model; I explore the extent RRS during adolescence contributes to CVD risk trajectories in young adulthood by race for men (Aim 2).

**Tables & Figures**

Table 2.1 Definitions of Ideal, Intermediate, and Poor Cardiovascular Health based on American Heart Association's 2020 Goals for Adults ≥ 20 years of age.

| Metric | Ideal Cardiovascular Health | Intermediate Cardiovascular Health | Poor Cardiovascular Health |
|---|---|---|---|
| Current Smoking | Never or quit smoking >12 months | Former ≤12 months | Yes |
| Body Mass Index | < 25 $kg/m^2$ | 25-29.9 $kg/m^2$ | ≥ 30 $kg/m^2$ |
| Physical Activity | 150 min/week of moderate intensity or 75 min/week of vigorous intensity | 1-149 min/week of moderate intensity or 1-74 min/week of vigorous intensity | None |
| Healthy Diet [a] | 4-5 components | 2-3 components | 0-1 components |
| Total Cholesterol | <200 mg/dL | 200-239 mg/dL or treated | ≥ 240 mg/dL |
| Blood Pressure | SBP<120 and DBP <80 mmHg | SBP 120-139 or DBP 80-89 mmHg | SBP ≥140 or DBP ≥ 90 mmHg |
| Fasting Blood Glucose | <100 mg/dL | 100-125 mg/Dl | ≥ 126 mg/dL |

[a] Healthy diet components include fruits (≥ 4.5 cups/day), vegetables (≥ 4.5 cups/day), fish (2 or more 3.5 oz. servings/week), fiber-rich whole grains (3 or more 1 oz. servings/day), sodium (≤ 1500 mg/day), and sugar-sweetened beverages (≤ 36 oz./week).

Figure 2.1 Framework for the study of the role of race in health (Williams, 1997).

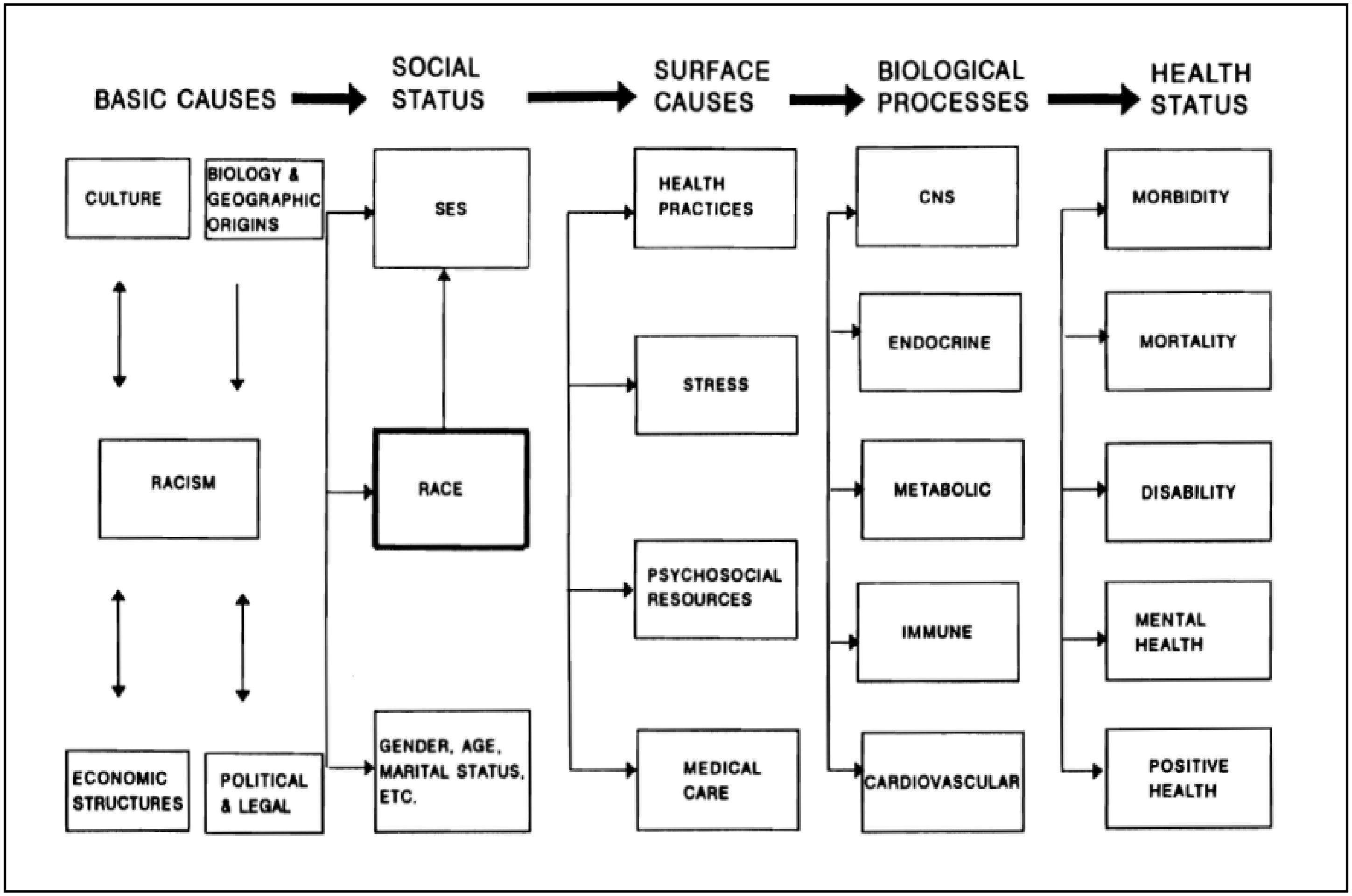


Figure 2.2 Healthy Environments Partnership (HEP) Model (Schulz et al., 2005).

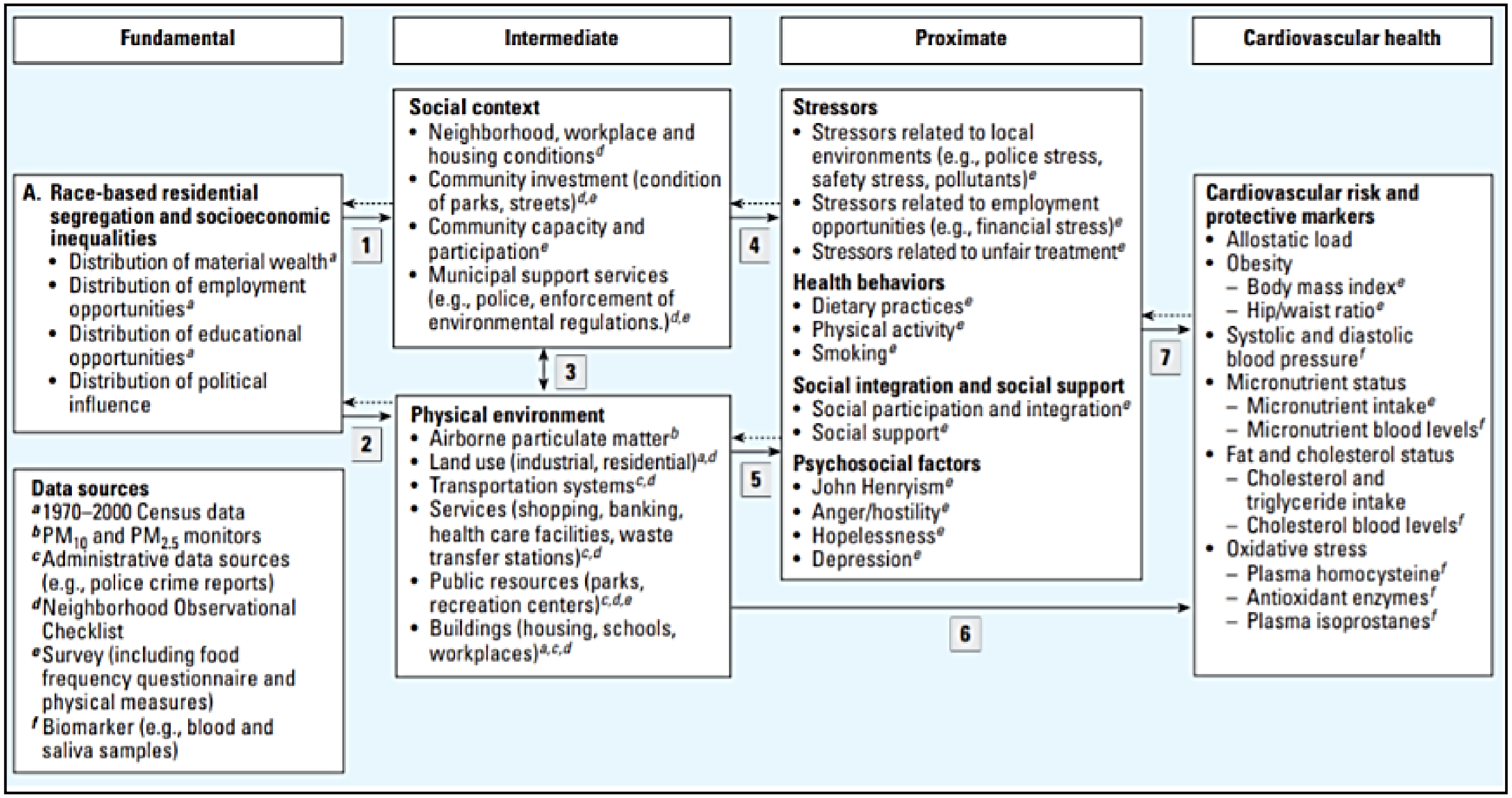


Figure 2.3 Integrated Conceptual Model.

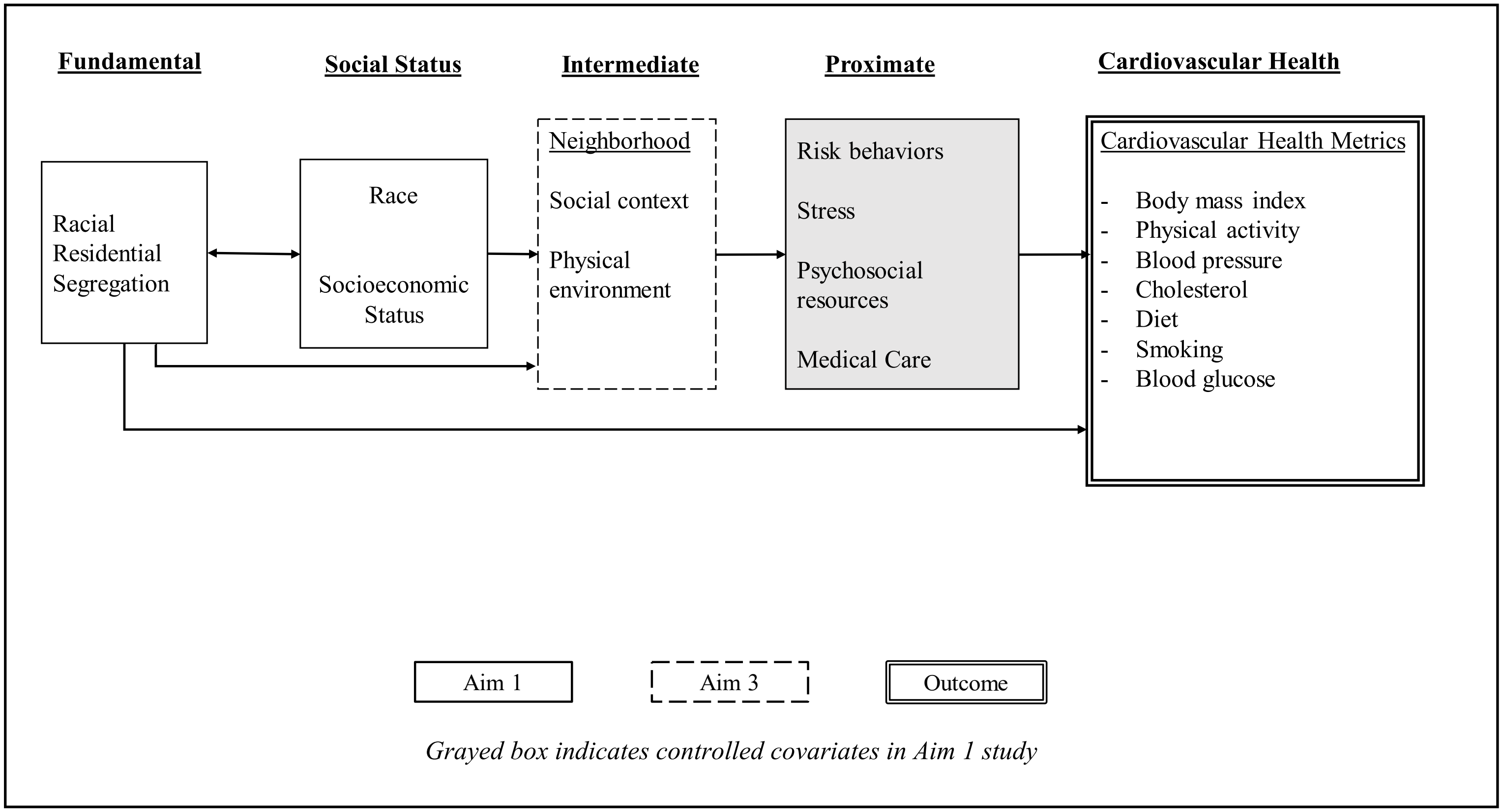
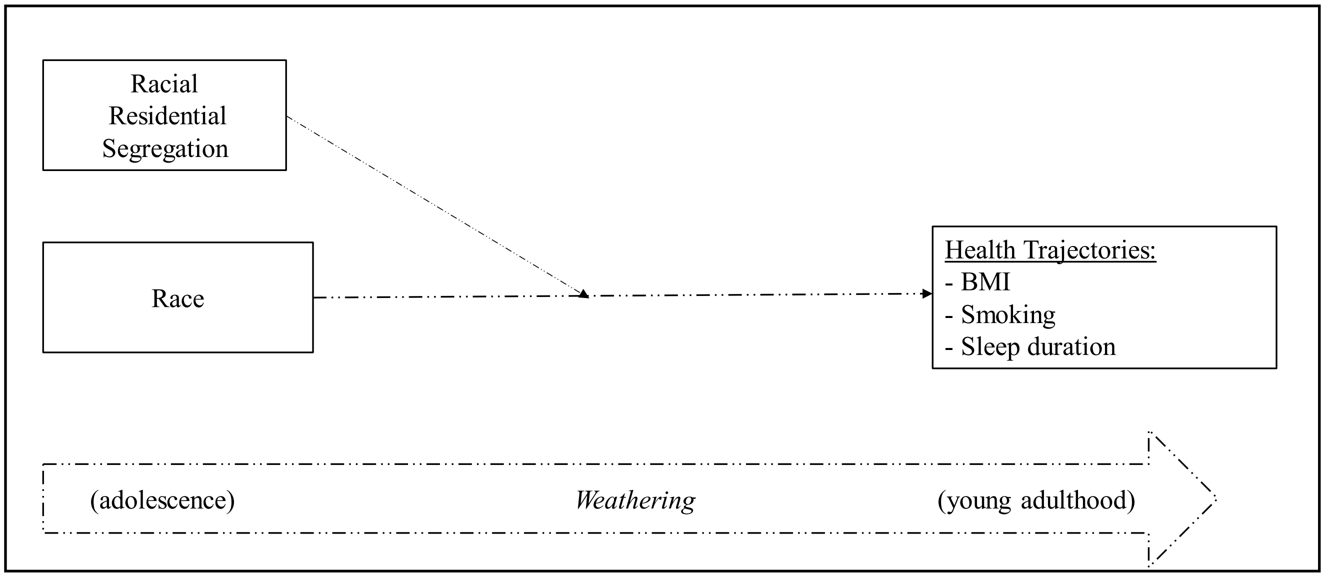


Figure 2.4 Trajectory Conceptual Model (Aim 2).



## CHAPTER 3. RACE DIFFERENCES IN IDEAL CARDIOVASCULAR HEALTH AMONG YOUNG MEN: THE ROLE OF RACIAL RESIDENTIAL SEGREGATION

### Introduction

Cardiovascular disease (CVD) is the leading cause of death for all adults in the US, with the death rate being higher in men than women (Benjamin et al., 2019; Centers for Disease Control and Prevention & National Center for Health Statistics, 2020; Heron, 2019). Men's excess burden is compounded by higher rates of CVD-related morbidity, risk taking, and poor health care engagement compared to women (Baker & Shand, 2017; Heron, 2018). Black men have higher rates of CVD morbidity and mortality than White men (Benjamin et al., 2019). Notably, a stark racial disparity in CVD mortality is observed between Black and White men 25-34 years old (21.6 vs. 9.5 deaths/100,000) (Heron, 2018).

Given the population-level CVD burden in the US and recognition of the importance of early life years in disease trajectories, the American Heart Association (AHA) expanded CVD prevention efforts to focus on maintaining health rather than solely reducing disease prevalence. To that end, the AHA outlined 7 targets, termed Life's Simple 7 (LS7), with the goal of improving the cardiovascular health (CVH) of Americans by 20% (Lloyd-Jones et al., 2010). Ideal CVH refers to the following LS7 targets: healthy diet, moderate to vigorous physical activity, no smoking, normal body mass index (BMI), and blood pressure, total cholesterol, and blood glucose at normal levels without taking prescription medication. CVH has a strong inverse, stepwise association with CVD morbidity (Dong et al., 2012; Ford, Greenlund, & Hong, 2012; McClurkin et al., 2015; Yang et al., 2012). Fewer than 20% of adults have ideal CVH, but this prevalence differs by race and biological sex. White adults are nearly twice as likely to meet the criteria for ideal CVH than Black adults (19.4% versus 10.6%), and women are more likely to achieve ideal CVH than men (22% versus 15%) (Benjamin et al., 2019; Brown et al., 2018). These differences in CVH reflect disparities in CVD risk that are due to factors ranging from biological risk to social and environmental characteristics.

One explanation for racial disparities in the prevalence of CVD risk factors is racial residential segregation (RRS) (Mujahid et al., 2017; Thorpe et al., 2015), defined as the degree to which two or more racial groups live in separate residential environments (Williams & Collins, 2001). Notable scholars on race and health consider RRS an upstream determinant of health that creates and sustains racial disparities in health (Bonilla-Silva, 1997; Gaskin, Price, Brandon, & LaVeist, 2009; LaVeist, Thorpe, Mance, & Jackson, 2007; Riley, 2018; Williams, Lawrence, & Davis, 2019; Williams, 1997). Unfortunately, much of the literature on racial disparities in health fails to acknowledge that most Americans live in segregated environments (LaVeist et al., 2007; LaVeist, Pollack, Thorpe, Fesahazion, & Gaskin, 2011). Minorities living in segregated environments endure structural barriers to educational and employment opportunities, increased exposure to social stressors, and differential access to resources that promote healthy opportunities (Kershaw et al., 2015; Williams & Collins, 2001). A recent literature review suggests that increased segregation has deleterious effects on CVD risk for Black adults (Kershaw & Albrecht, 2015). The interplay of place, race, and health has gained increased attention in men's health disparities literature (Gilbert et al., 2015; Hale, Smith, Bowie, LaVeist, & Thorpe, 2019; Thorpe et al., 2015; Thorpe, Bowie, Wilson-Frederick, Coa, & LaVeist, 2013). Moreover, a community-based study revealed there was no racial disparity in CVD risk factors (obesity, physical inactivity, hypertension, smoking, diabetes) when White and Black men live in the same residential environment (Thorpe et al., 2015; Thorpe et al., 2015).

Most evidence supporting segregation effects on race differences in CVD focuses on middle-age adults and excludes young adults. This is concerning because young adulthood is an important period for establishing health practices that shape health in later adult years (Arnett, 2000; Harris, Gordon-Larsen, Chantala, & Udry, 2006; Stroud, Walker, Davis, & Irwin, 2015). Prior studies demonstrate that being healthy in young adulthood is associated with lower CVD risk in middle-age (Liu et al., 2012; Unger et al., 2014). However, the impact of residential context on young adults' CVD risk is understudied. Furthermore, the CVH trajectories of today's young adults may be affected by growing up during the childhood obesity epidemic, having many modifiable CVD risk factors, and being disproportionately uninsured (Graham, 2015; Lawrence, 2017). Though limited, recent data show that 18% of young adults have ideal CVH, with Blacks and men less likely to have ideal CVH than Whites and women, respectively (Lawrence, Hummer, Domingue, & Harris, 2018). Thus far, Black-White disparities in CVH among young adults have been attributed to differences in educational attainment, insurance status, and neighborhood population density (Lawrence et al., 2018; Lawrence, 2017; McClurkin et al., 2015). The distribution of these factors is unequal across race and the places where people live. To our knowledge, no study has examined the relationship between RRS and CVH disparities in young adult men.

Given these research gaps, the purpose of this study was to understand race (i.e. Black-White comparisons) differences in ideal CVH among young men and the contribution of RRS to these differences. Our interest in the relationship between RRS, race, and ideal

CVH was guided by Williams' (1997) framework for understanding race differences in health. This framework situates societal and historical factors (e.g. culture, biology, geography, racism, economic structures, political and legal factors) as fundamental causes of race differences in health outcomes (Williams, 1997). RRS is a manifestation of structural racism created by federal policies that have functioned in American society for centuries through discriminatory housing market practices and policies at state and local levels (Massey & Denton, 1988; Massey, 1994; Rothstein, 2017; Williams & Collins, 2001). Within this context, many minorities tend to live in majority-minority communities and, on average, face greater economic and social mobility constraints and differential exposure to health risks than Whites (Smedley, 2012; Williams & Collins, 2001). Additionally, the framework posits race as a complex, multidimensional construct that bears the historical consequences of multiple large-scale societal structures and processes that support racism at multiple levels. Race and other social status categories (e.g. socioeconomic status, age, gender) are inscribed with societal power and privilege, and linked to health through surface causes. Surface causes include a range of factors (e.g. neighborhood context, risk behaviors, stressful life events, medical care, psychosocial factors) that may be correlated with each other and race to result in differential health outcomes. Like social status categories, surface causes are shaped by larger structures and processes in society. Although surface causes are the usual intervention mechanisms to address race differences in health, they may be insufficient without intervening on the root causes. Thus, developing effective strategies that produce long-term population health impacts requires attention to both the surface and fundamental causes of race differences in health. RRS reflects many fundamental causes and can serve as an important step to understanding variations in ideal CVH by race.

In this study, we hypothesize that among young men: (1) Whites will be more likely to have ideal CVH than Blacks; (2) those living in neighborhoods with a greater proportion of White residents will be more likely to have ideal CVH; and (3) living in neighborhoods with a greater proportion of White residents will be associated with Black-White differences in ideal CVH.

## Methods

### *Data Source and Sample*

Data came from Wave IV of the National Longitudinal Study of Adolescent to Adult Health (Add Health), a nationally representative cohort study of adolescents (grades 7-12) who were followed into adulthood (Harris et al., 2003). Add Health used a multistage, stratified, clustered sampling design where schools were systematically sampled to reflect the diversity of US adolescents with respect to census region, school type and size, urbanicity, and proportion of White students. Adolescents were sampled from 80 high schools and 52 middle schools to complete home interviews in 1994-1995 (Wave I) and 1996 (Wave II) (Harris & Udry, 2008). As adults, follow-up interviews were conducted in 2001-2002 (Wave III) and 2008-2009 (Wave IV). The most recent wave of data collection was completed in 2016-2018 (Wave V). Add Health oversampled for Black respondents with highly educated parents and paired respondent interview data with contextual data on some aspects of their residential environment at each wave (Harris, 2012).

Our study includes Black and White men at Wave IV who did not simultaneously identify with any other racial or ethnicity categories, had a valid sampling weight, and did not having missing values on the outcome variable or residential location (n=5,080). Wave

IV includes CVD related biomarkers not measured in previous waves. This study was approved by UNC's Institutional Review Board.

### *Measures*

**Dependent Variable.** The dependent variable is ideal CVH, based on the AHA's LS7 targets. First, we categorized respondents as having ideal, intermediate, or poor CVH for each LS7 target based on the definitions and thresholds provided in supplemental materials (see Appendix A). Next, we created and summed binary ideal CVH indicators for each LS7 target. We then created a binary ideal CVH variable representing whether or not respondents achieved ideal CVH for at least four of the LS7 targets. We chose this approach over using a continuous (0-14) or categorical (ideal, intermediate, and poor thresholds) CVH measure because it: (1) best aligned with the AHA's desire to keep populations at the lowest risk of developing CVD by maintaining recommended levels of LS7 targets (Lloyd-Jones et al., 2010; Steinberger et al., 2016); and (2) was consistent with current literature operationalizing the AHA's construct of ideal CVH (Bambs et al., 2011; Lawrence, Hummer, & Harris, 2017; Lawrence et al., 2018; McClurkin et al., 2015; Unger et al., 2014). Add Health trained staff measured height, weight, and blood pressure, obtained blood glucose and total cholesterol from blood spots, and asked respondents about their diet, physical activity, and smoking practices. Additional information on data collection procedures is available at https://www.cpc.unc.edu/projects/addhealth/documentation/guides.

**Independent Variables.** The primary independent variables of interest were race, RRS, and the interaction between these two variables. Race was categorized as White (referent group) or Black. For RRS, we used the percentage of White people in the neighborhood to total census tract population where the participant resided at Wave IV.

Consistent with previous work, neighborhoods were defined using census tract boundaries (Lippert, 2016; Mujahid et al., 2017; White & Borrell, 2011).

**Covariates.** We included two sets of factors informed by existing literature and the study's framework (Figure 3.1): social status, and surface causes (neighborhood context, risk behavior, stressful life event, medical care, and psychosocial factors). Social status categories included two dimensions of socioeconomic status and age at time of interview. Socioeconomic status dimensions were educational attainment (1= less than high school to 4=college degree or more), and income-to-needs ratio (ratio of the self-reported household income at midpoint values in thousands of dollars to poverty threshold for that year and household size based on the US Census). Given the diversity of neighborhood contexts in the US, we included census tract-level population density and urbanicity measured using rural-urban commuting area (RUCA) codes. Because population density was highly skewed, we used natural log transformation. RUCA code categories were arranged as: 1=Metropolitan neighborhood, 2=Micropolitan neighborhood, and 3=Small town/rural neighborhood). For risk behavior, we used a binary indicator of any binge drinking (consuming $\geq$ 5 drinks in a row in the past year). Stressful life events included self-report of ever being arrested, underemployment (working fewer than 10 hours a week), and financial strain (6 questions assessed if respondents were unable to pay for phone service, food, utility bills, had a utility service turned off, full amount of rent or mortgage, or were evicted from their residence during the past year) (Brummett et al., 2011). Medical care included self-reports of being insured, having a routine health checkup in the past two years, and not obtaining medical care in the past year when needed. Finally, psychosocial factors included the 5-item Center for Epidemiological Studies-Depression Scale (CES-D) (scale range 0-15) and Cohen's 4-

item perceived stress scale (scale range 0-16) (Cohen, Kamarck, & Mermelstein, 1983; Perreira, Deeb-Sossa, Harris, & Bollen, 2005).

***Statistical Analysis***

We did not impute missing values for ideal CVH or spatial geocodes. For covariates, we used multiple imputation chained equations for missing values. This allowed continuous and categorical variables to be imputed with their own specified distribution, rather than assuming one common distribution. Less than 7% of sample had missing information: 6% for the income-to-needs ratio and fewer than 1% for self-reported binge drinking, routine checkup, insurance status, unmet healthcare need, unemployment, financial strain, arrest experience, perceived stress, and depressive symptomology. To account for Add Health's complex survey design and ensure representativeness, survey weights were applied when specifying statistical models.

We first calculated weighted descriptive statistics of the sample. In our logistic regression analysis of ideal CVH, we began with a baseline model that only included race. We then added percentage of White people in neighborhood, our neighborhood RRS measure. Next, we adjusted for neighborhood context, social status, risk behavior, stressful life events, medical care, and psychosocial factors. Finally, we included an interaction term between race and percentage of White people in neighborhood to assess whether the effect of RRS on ideal CVH differed by race. All analyses were conducted using STATA version 15 (StataCorp, 2017).

**Results**

Table 3.1 presents weighted descriptive statistics of the sample (n=5,080) by race. The average age of the male respondents was 28.4 years (range 24-34 years), 21% of whom were Black. Approximately 27% of men had ideal CVH for at least four of the LS7 targets. More White men had ideal CVH than Black men (28.0 versus 20.9). On average, White men lived in neighborhoods with a greater proportion of White residents than Black men (81.4 ± 0.8 versus 47.7 ± 2.1, p=0.000). Most of men's neighborhoods were within metropolitan areas. White men were more likely to be college educated, have a higher income-to-needs ratio average, report binge drinking, and be insured. Black men were more likely to report receipt of a routine health checkup, financial strain, an arrest experience, and greater average scores for stress and depressive symptoms.

*$H_1$: White men will be more likely to have ideal CVH than Black men.*

As hypothesized, at baseline (Model 1), Black men had lower odds of ideal CVH (OR=0.67, 95% CI=0.49, 0.92) compared to White men (Table 3.2). When adjusting for covariates (Model 3), race remained significant in the model (OR=0.70, 95% CI=0.50, 0.97).

*$H_2$: Men who live in neighborhoods with a greater proportion of White residents will be more likely to have ideal CVH.*

In model 2, we added percentage of White people in neighborhood to the unadjusted model. RRS was not a significant predictor of ideal CVH (OR=0.99, 95% CI= 0.99, 1.00). When adjusting for covariates (Model 3), the percentage of White people in neighborhood was not (OR=0.99, 95% CI=0.99, 1.00).

*$H_3$: Living in neighborhoods with a greater proportion of White residents will be associated with Black-White differences in ideal CVH among young men.*

When we added an interaction term between race and percentage of White people in neighborhood, race was no longer a significant (Model 4). The interaction between race and percentage of White people in a neighborhood was not statistically significant ($p$=0.098), indicating that a Black-White difference in ideal CVH was not observed at every RRS threshold. Figure 3.2 shows the thresholds where race differences in the effect of RRS on the probability of having ideal CVH were observed. Specifically, Black men in neighborhoods where a percentage of White people was 55% or greater had lower probability of having ideal CVH than their White counterparts; whereas, Black and White men had no difference in probability of having ideal CVH in neighborhoods where the percentage of White people was less than 55%.

**Discussion**

Understanding race differences in CVH among men is an important step in reducing disparities in CVD, the leading cause of death in the US. RRS is a structural determinant of health and should be considered in developing interventions, systems change, and policy approaches addressing cardiovascular inequities. In this study, we investigated if there was a Black-White difference in ideal CVH among young men (ages 24-34) and whether RRS contributed to any observed difference. We found significant race differences in both the proportion of young men with ideal CVH and the percentage of White people in neighborhood by race in our nationally-representative sample. Young Black men had 0.3 lower odds of achieving ideal CVH (at least 4 of the LS7 targets) than White men. On average, young Black and White men lived in neighborhoods where the percentage of White people was 48% and 81% respectively. We also observed the effect of neighborhood RRS on ideal CVH differed by race only when the proportion of White residents was 55% or greater.

Our results are consistent with research documenting CVD disparities among men, suggesting that disparities may begin as young adults (Benjamin et al., 2019; Gilbert et al., 2016; Gilbert et al., 2015). Further, this work fits within a growing body of evidence linking Black men's higher CVD morbidity and mortality in middle-age to their higher prevalence of CVD risk as youth and young adults (Bruce et al., 2017; Everett & Zajacova, 2015). Notably, these prior studies did not account for the role of RRS. To our knowledge, we are the first study to examine the role of neighborhood RRS in any observed differences. We found that Black men were less likely to have ideal CVH than White men when both groups live in mostly White neighborhoods. Additionally, we did not observe race differences in the marginal effect of neighborhood RRS on ideal CVH when the percentage of White residents was below the 60% percent threshold. This cutoff connects with some neighborhood racial integration classifications (Friedman, 2008; Sin & Krysan, 2015). This finding also supports prior research that claims suggests health disparities dissipate when Black and White men live together in the same social and economic conditions (Hale, Smith, Bowie, LaVeist, & Thorpe, 2019; LaVeist, Pollack, Thorpe, Fesahazion, & Gaskin, 2011; Thorpe et al., 2015; Thorpe et al., 2015). Both a reflection and reinforcement of structural racism, RRS may harm the health of young Black men, compared to White, men, through several pathways, such as unfavorable exposure to neighborhood conditions, limited opportunities for quality education and employment, restricted access to quality health care and healthful food sources, and increased exposure to environmental toxins and psychosocial stressors (Bailey et al., 2017; Gaskin, Price, Brandon, & LaVeist, 2009; Gee & Ford, 2011; Williams, 1997).

Study findings must be considered within the context of several limitations. First, our minimum for ideal CVH indicators was 4, rather than 5 that other authors used (Gooding et al., 2016; E. Lawrence, Hummer, & Harris, 2017; E. M. Lawrence, Hummer, Domingue, & Harris, 2018). We selected 4 because detailed dietary data were not available to construct the complete LS7 target for diet and maintaining a healthy diet is difficult for the majority of Americans. Second, measuring RRS as racial composition in neighborhoods, though widely used, has been criticized for not reflecting the relative distribution of racial groups within larger geographic areas (e.g. metropolitan statistical area, county, state) or spatial interaction patterns between racial groups (Friedman, 2008; White & Borrell, 2011(Massey & Denton, 1988). Several formal measures of RRS exist (Massey & Denton, 1988); however Add Health does not include geographic identifiers that can be merged with publicly accessible databases that contain contextual data needed to calculate formal segregation measures. Third, the relationship between segregation and individual health is multilevel in nature. However, Add Health's multistage sampling design did not include neighborhood-level indicators that would support multilevel analyses focused on neighborhood contexts. Lastly, our cross-sectional approach does not support any causal claims about this relationship.

Future studies should apply formal measures of RRS when studying CVH outcomes and compare results of formal and proxy measures. We recommend that future studies examine built, social, and economic characteristics of segregated environments to better understand men's CVH and associated race differences. There is a need for more research studies that employ a multilevel framework to understand the effects of RRS and other neighborhood characteristics on health beyond individual-level factors (Acevedo-Garcia, Lochner, Osypuk, & Subramanian, 2003). Longitudinal and life course research approaches that examine the relationship between place, race, and CVH are needed to enhance understandings of how CVH disparities, and consequently increases in CVD risks, emerge for men and offer insights into causal mechanisms of CVH decline.

**Implications and Conclusion**

Findings from the current study highlight the need to pay attention to the CVH of young adult men and suggest implications for health care and policy. First, health care systems should provide preventive services that can monitor and improve CVH among patients, in particular young Black men. However, there is a gap between men's health care engagement and the capacity that clinicians understand how residential contexts influences their health (Elder et al., 2015; Powell, Adams, Cole-Lewis, Agyemang, & Upton, 2016; Thorpe, Bowie, Wilson-Frederick, Coa, & LaVeist, 2013). The current study shows that young men are not as healthy as they visibly present and RRS plays a significant role in CVH race differences. Young adulthood is the period when individuals begin to assume responsibility for their care and develop relationships with clinicians (Arnett, 2000; Park, Paul Mulye, Adams, Brindis, & Irwin, 2006). Accordingly, this is an opportune time for providers and young adult male patients to have positive health care experiences that will shape health in later adult years. However, young adult men and clinicians are without clear preventive services guidelines that would inspire interactions to monitor health and provide quality engagement around CVH (Lau, Adams, Irwin, & Ozer, 2013; Ozer, Urquhart, Brindis, Park, & Irwin, 2012). The National Adolescent and Young Adult Health Information Center offers a toolkit of clinical preventive services guidelines that clinicians can use to guide their engagement with young adult men (National Adolescent and Young Adult Health Information Center, 2020). Professional health care organizations should endorse these guidelines to facilitate young adult men's transition to adult care and CVH maintenance. Guidelines should be expanded to include social factors that may protect or harm health.

Furthermore, social conditions and lived experiences exert a greater influence on individual health than health care (Schroeder, 2007; Smedley, 2012). Therefore, it important for clinicians have an increased understanding of how residential context shapes CVH differently for Black and White young men. Numerous media have connected the novel coronavirus pandemic to structural racism which disproportionately places Black communities at greater health risk (Egede & Walker, 2020). This crisis has also demonstrated health systems can deliver care and address health inequities without relying on in-person services by expanding telehealth on a federal scale (Nouri, Khoong, Lyles, & Karliner, 2020). The Centers for Medicare and Medicaid Services (CMS) has reimbursed for telehealth to evaluate and care for vulnerable populations— rural residents, older adults, those with low income, and those with chronic disease comorbidities (U.S. Department of Health and Human Services, 2020). It follows then that health systems may have the capacity to adjust how they deliver care to young adult men with greater risks of CVH decline. Most young adults have a keen aptitude for virtual communication and limited varying degrees of health literacy (Sansom-Daly et al., 2016). Initiating telehealth with young adult men can give clinicians important insights about how residential context affects the health of young adult men that may not be achieved during office visits. However, CMS and other payors will need to continue to reimburse telehealth beyond the coronavirus pandemic.

Lastly, there is a need for effective community-level and policy efforts focused on men and boys that meaningfully addresses the ways that RRS creates disparities in health and life chances. Black and White men tend to live in differently resourced residential contexts that can explain differences in exposure to health resources and risks. The recent wave of social unrest and scholarly discussions sparked by police violence have been met with national acknowledgements of racism in America (Fausset, 2020; Oppel Jr. & Taylor, 2020; Stolberg, 2020). With respect to CVD and associated health inequities, solutions to reduce men's risk should expand their scope from individual health behavior change to health-maintenance, while transforming the health-harming aspects of segregated neighborhoods in ways that will not cause displacement (Kershaw & Albrecht, 2015; Thorpe et al., 2015). Policymakers and public health agency leadership should revise their agendas to equitably fund health resources and programming for men and boys (Fadich, Llamas, Giorgianni, Stephenson, & Nwaiwu, 2018).

The results of this study and its focus on young men demonstrate the continued need to examine the role of RRS in race differences in cardiovascular outcomes among men earlier in the life course. Our findings contribute to our understanding of RRS by demonstrating that higher White segregation is associated with lower CVH for Black than White young men. The literature has consistently shown that higher Black segregation is associated with higher CVD risk for Black adults (Kershaw & Albrecht, 2015; Kershaw et al., 2017; Mayne et al., 2019). Our results extend understanding of how segregation impacts CVD by investigating CVH, a positive cardiovascular outcome, and measuring segregation with respect to the concentration of White people. Since race differences were only evident in the sample when Black and White men lived in majority White neighborhoods, these results suggest that residential context is important to young men's CVH. Moreover, this disparity may be associated with higher CVD risk for Black than White young men, as evidence supports an inverse association with CVH and CVD morbidity (Dong et al., 2012; Ford, Greenlund, & Hong, 2012; McClurkin et al., 2015; Yang et al., 2012).

## Tables & Figures

Table 3.1 Weighted descriptive statistics of adult male participants by race, Add Health (Wave IV).

| | Total (N=5,080) | White (n=4,001) | Black (n=1,079) | |
|---|---|---|---|---|
| Variable | % or mean (SD) | % or mean (SD) | % or mean (SD) | p |
| Ideal cardiovascular health | 26.9 | 28.0 | 20.9 | 0.014*** |
| Percent White in neighborhood | 76.1 (± 1.306) | 81.4 (± 0.833) | 47.7 (± 2.154) | 0.000*** |
| **Neighborhood context** | | | | |
| Population density (persons/square km.) | 1,692 (±159) | 1,587 (±146) | 2,259 (±432) | 0.123 |
| Urbanicity | | | | 0.173 |
| Metropolitan area | 84.0 | 85.1 | 78.3 | |
| Micropolitan area | 10.2 | 9.5 | 14.0 | |
| Small town/Rural area | 5.8 | 5.4 | 8.7 | |
| **Social status** | | | | |
| Age | 28.4 (±0.124) | 28.4 (±0.131) | 28.7 (±0.227) | 0.116 |
| Education | | | | 0.007*** |
| Less than high school | 10.1 | 9.4 | 13.9 | |
| High school diploma | 20.9 | 20.0 | 26.1 | |
| Some college | 43.0 | 43.0 | 42.7 | |
| College degree or more | 26.0 | 27.6 | 17.3 | |
| Income-to-needs | 4.5 (±0.093) | 4.7 (±0.097) | 3.5 (±0.138) | 0.000*** |
| **Risk behavior** | | | | |
| Binge drinking | 79.6 | 81.0 | 71.6 | 0.000*** |

| | | | | |
|---|---|---|---|---|
| **Stressful life event** | | | | |
| Financial strain | 22.8 | 21.1 | 32.0 | 0.000*** |
| Arrest experience | 42.9 | 41.5 | 50.6 | 0.006*** |
| Underemployed | 29.5 | 28.6 | 33.9 | 0.077 |
| **Medical care** | | | | |
| Insurance status | 73.1 | 74.5 | 65.2 | 0.000*** |
| Routine checkup | 63.8 | 61.8 | 75.0 | 0.000*** |
| Unmet healthcare need | 25.8 | 25.5 | 27.5 | 0.398 |
| **Psychosocial factors** | | | | |
| Perceived stress | 4.5 (±0.064) | 4.4 (±0.063) | 5.0 (±0.168) | 0.001*** |
| Depressive symptoms | 2.3 (±0.051) | 2.2 (±0.047) | 2.9 (±0.151) | 0.000*** |

* $p<0.05$, ** $p<0.01$, *** $p<0.001$. Subheadings aligned with constructs of the Williams model; $Chi^2$ and t-test were used to compare race differences for categorical and continuous variables, respectively. For continuous variables, means and standard deviations (SD) are displayed. All estimates account for complex sampling design by applying appropriate sampling weights and strata variables.

Table 3.2 Logistic regression of odds of having ideal CVH [a] among 5,080 adult male participants, Add Health (Wave IV).

| | Model 1 | Model 2 | Model 3 [b] | Model 4 [b] |
|---|---|---|---|---|
| Variable | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| Black [c] | 0.67 (0.497, 0.924)* | 0.58 (0.415, 0.820)** | 0.70 (0.502, 0.970)* | 1.10 (0.525, 2.314) |
| Percent White in neighborhood [d] | | 0.99 (0.991, 1.001) | 1.00 (0.995, 1.004) | 1.00 (0.995, 1.008) |
| Black × percent White in neighborhood [e] | | | | 0.99 (0.982, 1.002) |
| Constant | 0.39 (0.353, 0.428)*** | 0.55 (0.370, 0.821)** | 0.21 (0.037, 1.137) | 0.17 (0.028, 1.005) |

*Note*. Ideal CVH= ideal cardiovascular health; OR= odds ratio; CI=confidence interval; * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

[a] Ideal CVH is defined as 4 or more Life's Simple 7 targets categorized as ideal.

[b] Model adjusts for neighborhood population density, neighborhood urbanicity (rural urban commuting area code), age, educational attainment, income-to-needs ratio, binge drinking, financial strain, arrest experience, underemployment, insurance status, routine health checkup, unmet healthcare need, perceived stress, and depressive symptoms.

[c] White men are the referent group.

[d] Racial residential segregation proxy measure

[e] Mean percentage of White people in neighborhood among White men is referent group.

All estimates account for complex sampling design by applying appropriate sampling weights and strata variables.

Figure 3.1 Conceptual framework of the study.

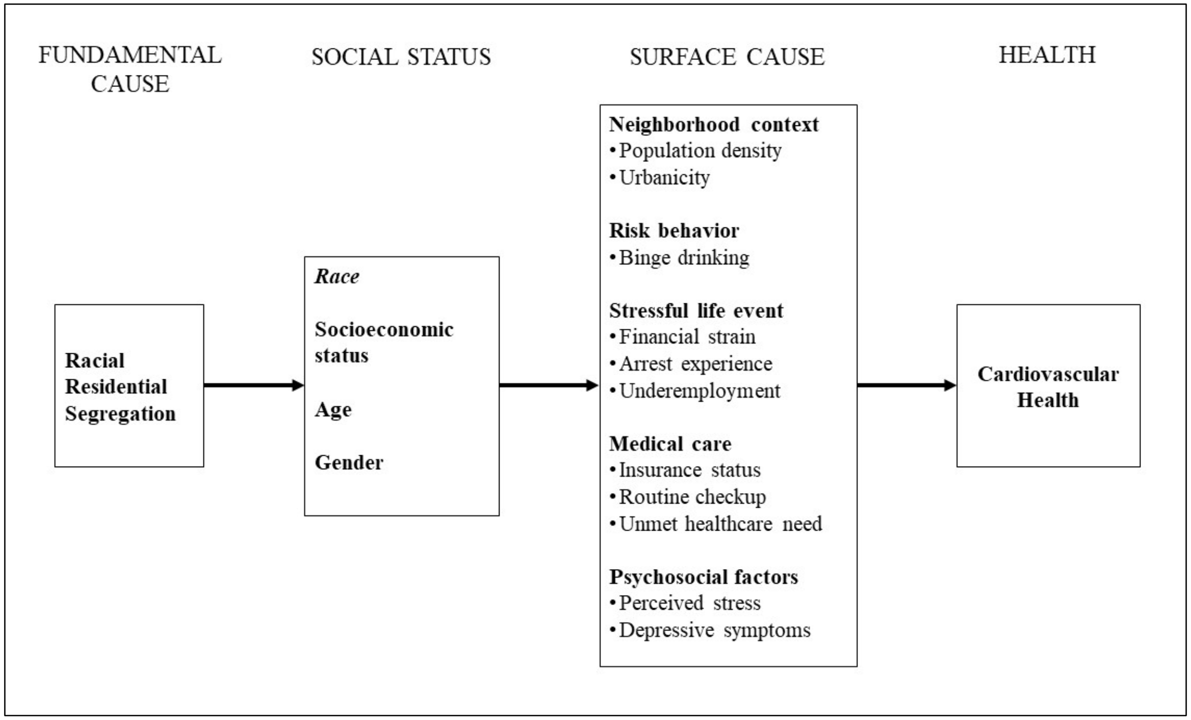
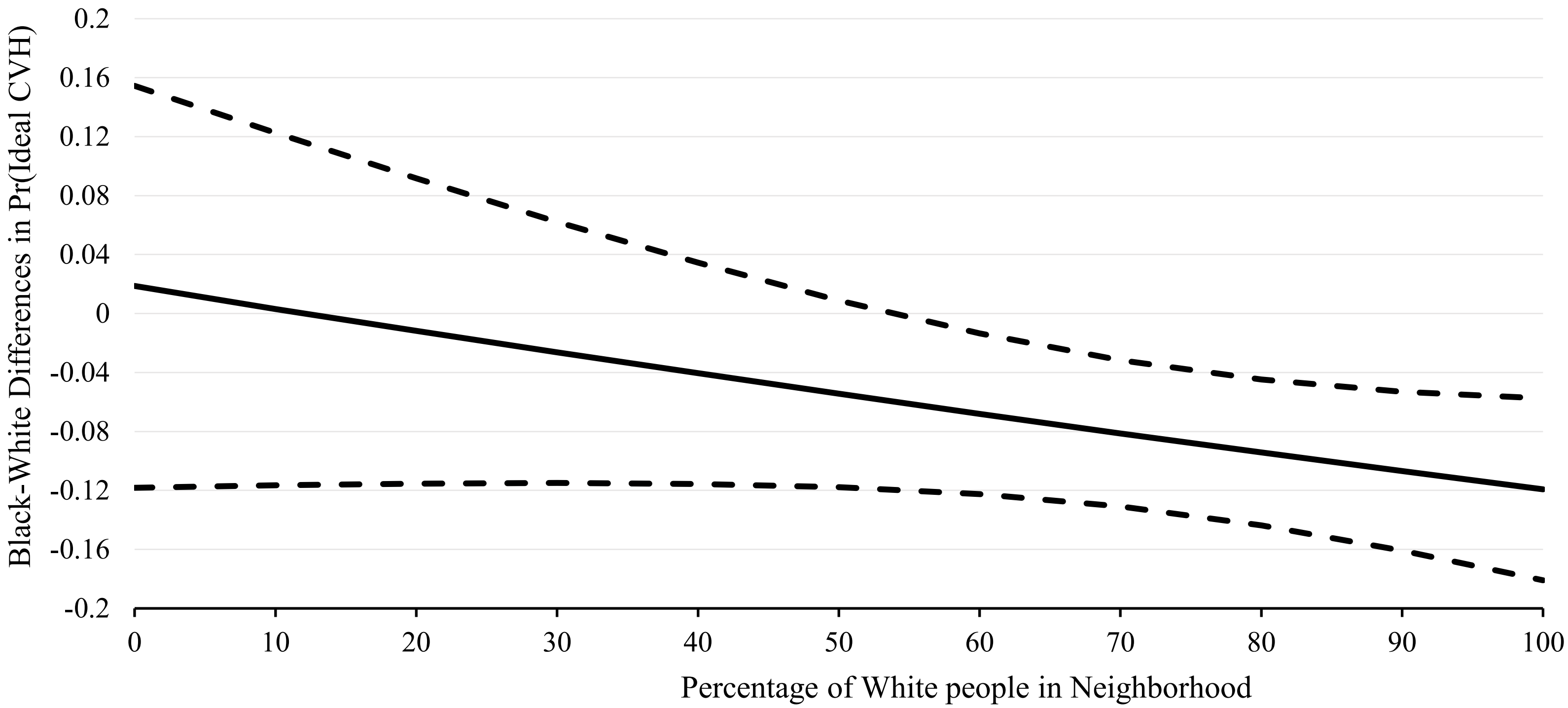


Figure 3.2 Race differences in the marginal effect of percentage of White people in neighborhood on ideal cardiovascular health (CVH) across observed thresholds.




Graph is based on Model 4 of Table 3.2. Dashed lines give 95% confidence interval.

# CHAPTER 4: VARIABILITY IN CARDIOVASCULAR DISEASE RISK TRAJECTORIES BY RACE AND NEIGHBORHOOD RESIDENTIAL SEGREGATION FROM ADOLESCENCE TO YOUNG ADULTHOOD

## Introduction

For many, the transition from adolescence to adulthood is a critical period during which health beliefs and practices that influence subsequent health trajectories are developed (Arnett, 2000; Daw, Margolis, & Wright, 2017; Stroud, Walker, Davis, & Irwin, 2015). During this transition, adolescents often experiment with cigarettes, consume alcohol, gain weight, and sleep far less than recommended (Daw et al., 2017; Kwan, Cairney, Faulkner, & Pullenayegum, 2012; M. C. Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008; Park, Paul Mulye, Adams, Brindis, & Irwin, 2006). While chronic condition diagnoses are rare, young adults engaging in these behaviors increase risk for cardiovascular disease (CVD) as adults, particular for men (Committee on Improving the Health, Safety, and Well-Being of Young Adults, Board on Children, Youth, and Families, Institute of Medicine, & National Research Council, 2015; Neinstein & Irwin, 2013; Park et al., 2006; Stroud et al., 2015). Young men are at greater risk of experiencing health declines as adults because of their risk taking and lower healthcare engagement than young women (Baker & Shand, 2017; Baker et al., 2014; Lau, Adams, Boscardin, & Irwin, 2014; Marcell, Ford, Pleck, & Sonenstein, 2007). Notably, young Black men have shorter life expectancies and higher prevalence of CVD risk factors than young White men (Benjamin et al., 2019; Bruce, Wilder, et al., 2017). Furthermore, CVD latency periods can be long, beginning with the accumulation of risk factors in youth (Bruce, Beech, et al., 2015, 2017; Isong, Richmond, Avendaño, & Kawachi, 2017; Marin, Chen, & Miller, 2008; Strand, Murray, Guralnik, Hardy, & Kuh, 2012).

Health behaviors, health practices, and social factors throughout the life course influence trajectories of CVD risks and diagnoses (Doom, Mason, Suglia, & Clark, 2017; Liu et al., 2012; Pollitt, Rose, & Kaufman, 2005). Although much research has examined trajectories related to weight, sleep, and cigarette use by gender and race (Ames & Leadbeater, 2018; Daw et al., 2017; Goings, Hidalgo, & Howard, 2018; Krueger, Reither, Peppard, Burger, & Hale, 2015; Maslowsky & Ozer, 2014; Sokol, Grummon, & Lytle, 2020; Suglia, Kara, & Robinson, 2014; Wood, Schott, Marshal, & Akers, 2017), few studies focus on how exposure to social factors during adolescent influence CVD risk trajectories by race and gender (Crespi, Wang, Seto, Mare, & Gee, 2015; Krueger & Reither, 2015; T. K. Lee, Wickrama, & O'Neal, 2019; Li, Mustillo, & Anderson, 2018; Liao & Lin, 2018; Ruel, Reither, Robert, & Lantz, 2010; Ryabov, 2015; Wickrama, Kwon, Oshri, & Lee, 2014). Growing evidence suggests social aspects of neighborhoods may contribute to health disparities. In particular, racial residential segregation (RRS) (Bell, Thorpe, & LaVeist, 2017; Kershaw et al., 2013; Kershaw & Albrecht, 2015; Kershaw, Osypuk, et al., 2015; Mujahid et al., 2017), socioeconomic position and adversity (Bell, Thorpe, Bowie, & LaVeist, 2018; Bleich et al., 2010; Subramanian, Kim, & Kawachi, 2005), and built and social neighborhood environments (Bower, Thorpe, Rohde, & Gaskin, 2014; Kelli et al., 2017; Kim, Hawes, & Smith, 2014; Niu, Hoyt, & Pachucki, 2019; Papas et al., 2007; Unger et al., 2014) have been identified as neighborhood attributes that influence CVD disparities. Some longitudinal research demonstrate neighborhood-level disadvantage and socioeconomic status differently influence CVD trajectories by race (Li et al., 2018; Ruel et al., 2010; Wickrama et al., 2014). A study by Ryabov (2015) found that neighborhood RRS explained up to 20% differences in obesity between minority and White youth. While important, this evidence did not follow youth into adulthood and were not stratified by biological sex.

A growing body of evidence observes RRS is associated with worse CVD outcomes for Black compared to White men (Griffith et al., 2019; Kershaw & Albrecht, 2015; LaVeist et al., 2011; Thorpe, Kennedy-Hendricks, et al., 2015). However, much of the literature is cross-sectional and centers on middle-age men; these studies ignore their transition from adolescence to young adulthood. Given the dearth of studies examining the role of RRS in CVD disparities among young men, this research explores race differences in CVD risk factor trajectories and whether RRS during adolescence contributes to different male trajectories from adolescence to young adulthood. Specifically, we focus on three CVD risk factors—body mass index (BMI), sleep duration, and cigarette use. We hypothesized that: (1) Black males will have worse outcome trajectories than White males and (2) increased RRS during adolescence will result in (a) worse outcome trajectories for Black males and (b) better outcome trajectories for White males.

**Methods**

Data come from the National Study of Adolescent to Adult health (Add Health). Add Health participants were selected from a stratified sample of 12 schools to reflect the diversity of US adolescents with respect to census region, school type and size, urbanicity, and proportion of White students (Harris & Udry, 2008; Harris, 2012). This produced a nationally representative sample of 20,745 adolescents followed into adulthood. Baseline data were collected in 1994-1995 (Wave I) and follow-up in-home interviews occurred in

1996 (Wave II), 2001-2002 (Wave III), and 2008 (Wave IV). The 14-year study period provides data as they transition from adolescence (11-18 years old) to young adulthood (24-34 years old). For this study, we used in-home interview data from adolescent respondents who participated in Waves II, III, and IV and their parent/guardian at baseline. Respondents were linked to neighborhood level data obtained from the US Census (Harris & Udry, 2008). We used data from these waves because they contain objective BMI measurements. This study was approved by UNC's Institutional Review Board.

Our analytic sample (n=2,981) was restricted to male respondents who: participated in Waves II-IV; had valid survey weights to ensure representativeness; self-identified as Black or White; and had complete data for the outcomes, independent variables of interest, and model covariates.

***Measures***

**Dependent Variables.** Our three outcomes, BMI, sleep duration, and cigarette use, were measured at all three waves. BMI was calculated from height and weight ($kg/m^2$) measurements conducted by trained staff. Self-reported measures of sleep duration were measured differently at Wave II than waves III and IV. In wave II, adolescent respondents were asked how many hours of sleep do you usually get? At waves III and IV, adult respondents were asked to report the hour and minute they go to bed and wake up on (a) days when they go to work, school, or do similar activates ("weekdays") and (b) days they do not have to go to wake up at a certain time ("weekends"). Sleep hours multiplied by 5/7 for weekdays and 2/7 for weekends and then added to create a weighted average of usual hours of sleep. Cigarette use was measured using the following question: "during the past 30 days, on how many days did you smoke cigarettes?" Because most responses were near 0 or 30 days, we dichotomized their responses so that ≥15 days was coded as 1 and 0 otherwise. Answers reveal the probability of respondents smoking frequently as they age (Goings et al., 2018).

**Independent Variables.** The independent variables of interest were respondent race, neighborhood RRS during adolescence, and the interaction between these two variables. Race was categorized Black or White (the referent group). Respondents who self-identified as multi-racial were not included. Neighborhood RRS during adolescence was measured as the percentage of White people in the census tract to total census tract population where the participant resided at Wave II. Consistent with previous work, we used census tract boundaries to define neighborhoods (Barr, 2018; Lippert, 2016; Mujahid et al., 2017; White & Borrell, 2011). We categorized neighborhood RRS during adolescence as: (1) integrated neighborhood (40-80% White); (2) predominantly White neighborhood (>80% White); and (3) predominantly nonwhite (<40% White) (Friedman, 2008; Spader & Rieger, 2017).

**Covariates.** We controlled for select time-invariant covariates measured at Wave II that have been associated with BMI, sleep duration, and cigarette use trajectories. These factors include general health, pubertal status, physical activity, sleep satisfaction, peer cigarette use, depressive symptoms, socioeconomic adversity, recent change of residence, and parental health (Bakour et al., 2017; Barr, 2018; Daw et al., 2017; Hoyt, Niu, Pachucki, & Chaku, 2020; Jacobs, 2019; Lippert, 2016; Wickrama et al., 2014; Y. C. Yang, Gerken, Schorpp, Boen, & Harris, 2017). A single item assessed adolescent's general health (1=excellent to 4=fair/poor). Male pubertal status was constructed from four questions (i.e. hair under arms, hair on face, deepness of voice, and physical development) based on Tanner scores (Petersen, Crockett, Richards, & Boxer, 1988). Items ranged from low (1=I look younger than most boys my age) to high (5=I look older than most boys my age) (α=0.69). Physical activity was based on the number of times respondents engaged in a moderate (e.g. jogging, skateboarding) to vigorous (e.g. basketball, bicycling) physical activity during the past week (ranging 0= not at all to 3=5 or more times). Sleep satisfaction was coded as 1 (yes) or 0 (no) response to the question "do you usually get enough sleep?" Respondents were asked about the number of close friends who smoked regularly (0=none, to 3= $\geq$3 of my best friends). We used the five-item Center for Epidemiological Studies of Depression Scale (CES-D) to assess depressive symptoms in the past week (α=0.75). This version of CES-D was selected for its comparability across racial and ethnic groups (Perreira, Deeb-Sossa, Harris, & Bollen, 2005; Wickrama et al., 2014).

Socioeconomic adversity during adolescence was operationalized using four family indicators at baseline: parental education, parental financial strain, family receipt of public assistance, and family structure. Parental education ranged from 1 (less than high school diploma) to 6 (graduate degree) for the parent or guardian that provided baseline data. Parental financial strain (1=did not have enough money to pay bills in past year, 0=otherwise), family receipt of public assistance (1=someone in household received a social service benefit, 0=otherwise), and family structure (1=lives with both biological parents, 0=otherwise) were binary indicators.

We accounted for respondents that changed their residential address once or more in the past year (1=moved at least once; 0=did not move). Lastly, we accounted for two measures of parental health: obesity (1=either biological parent is obese, 0=otherwise) and presence of cigarette smoker in household (1=yes, 0=no).

***Statistical Analysis***

We used a cohort-sequential design where the data have been restructured so that age, rather than wave, is the unit of time (Bollen & Curran, 2005). This allowed us to model a 19-year trajectory as males transitioned from adolescence to young adulthood. We fit two-level mixed-effects latent growth models (MLGM) where observations were nested within individuals. The model fitting process involved determining the functional form that best fit age dependent trajectories for each outcome. First, we created unconditional MLGM to determine appropriate functional forms for each outcome. We sequentially included linear, quadratic, and cubic terms to the models and examined improvements in overall fit. Improvement in model fit was assessed with Bayesian Information Criterion (BIC) values. If a higher ordered term increased the BIC, it leads to a decrement in model fit and no additional higher ordered terms were included (Curran, Obeidat, & Losardo, 2010). Second, we determined the appropriate structure of the random effects components. The random portion of MLGM demonstrates variability among individuals. We started with random intercept and then sequentially added latent slope factors and variance constraints to the random components part of the nested model. Improvement in model fit was determined by examining residual variances and BIC. For both, lower values indicate a better model fit. The BMI unconditional MLGM followed a quadratic growth trajectory with latent age slope factor and correlated variances. The sleep duration unconditional MLGM followed a cubic growth trajectory with latent age slope factor and correlated variances. The cigarette use unconditional MLGM followed a cubic growth trajectory with latent intercept. To evaluate our research questions, conditional MLGM included the effects of race and percentage of White people in neighborhood on both initial status and change over time. We then adjusted for covariates. Models included Add Health longitudinal survey weights and analyses were conducted using STATA 15 (StataCorp, 2017).

**Results**

Table 4.1 presents weighted descriptive statistics of the sample (n=2981) broken down by race. Significant race differences were observed for sleep duration and cigarette use at Wave II. No race differences were observed for BMI across waves. During adolescence (Wave II), most White males lived in predominantly White neighborhoods (82%) and most Black males lived in predominantly nonwhite (50%) and integrated (32%) neighborhoods. White males were more likely to be further along in pubertal development, have close friends who smoke cigarettes, and live with both biological parents than Black males as adolescents.

*$H_1$: Black males will have worse outcome trajectories than White males.*

Table 4.2 presents results for the effects of race and RRS during adolescence on BMI, sleep, and cigarette use trajectories. To begin, we observed BMI over time (as it increased with age). In the BMI unadjusted model, there was no difference in initial BMI status by race; however, Black males (b= -0.331; 95% CI= -0.598, -0.064) had less steep linear slopes for BMI than White males over time when we accounted for neighborhood RRS during adolescence. In the adjusted model for BMI, race differences in initial BMI statuses became significant and were higher, on average, for Black (b=1.133; 95% CI= 0.100, 2.166) than White males, after adjusting for parent and adolescent covariates. Race differences in BMI slopes remained significant. In the sleep duration unadjusted model, sleep duration slopes where higher for Black males (b=0.283, 95% CI=0.077, 0.489) than White males over time and did not change in the adjusted model. Lastly, we observed the outcome of cigarette use. In its unadjusted model, Black males had substantially lower odds (OR=0.103; 95%

CI=0.036, 0.294) of cigarette use during adolescence than White males; however, this difference was no longer significant in the adjusted model.

To test our second hypotheses, Figures 1.1-1.6 present population averages and predicted probabilities for BMI, sleep duration, and cigarette use based on the fully adjusted models in Table 4.2. Results are presented across categories of neighborhood RRS during adolescence within race groups.

*$H_{2a}$: Increased RRS during adolescence results in worse outcome trajectories for Black males.*

Among Black males, significant differences in BMI by neighborhood RRS during adolescence were only observed at initial values between those from integrated and predominantly nonwhite neighborhoods (Figure 4.2). Patterns of sleep duration from adolescence to young adulthood appear to be different between Black and White males by RRS.  Among Black males, sleep duration patterns were highly varied and did not significantly differ across neighborhood RRS categories (Figure 4.4). Lastly, cigarette use patterns uniformly increased and decreased across neighborhood RRS categories and thus did not exert significantly different effects (Figure 4.6).

*$H_{2b}$: Increased RRS during adolescence results in better outcome trajectories for White males.*

Among White males, those from predominantly White neighborhoods saw a drop in BMI that began at age 25 and continued onward, compared to those from integrated neighborhoods (Figure 4.1). Similarly, the pattern of increases in BMI for White males from predominantly nonwhite neighborhoods was different than those from integrated neighborhoods beginning at age 19; however, this was no longer significant by age 28.

White adolescent males from predominantly White neighborhoods appeared to get more sleep than those from integrated neighborhoods until age 27 (Figure 4.3). Lastly, the effect of RRS on cigarette use patterns differed among White males (Figure 4.5). Specifically, White males from predominantly White neighborhoods had greater probabilities of cigarette use than White males from integrated neighborhoods from ages 19 to 25.

**Discussion**

We sought to better understand whether CVD risk trajectories differed as Black and White males transitioning from adolescence to young adulthood and whether neighborhood RRS during their adolescence played a role. At baseline, Black and White males lived in different neighborhood contexts. We did not find sufficient evidence to support our first hypothesis. While Black males had higher initial BMI as adolescents, they had less steep increases in BMI over time than White males. Sleep duration trajectories were better (i.e. getting more sleep) over time for Black males relative to White males; this did not support our hypothesis because population averages for recommended hours of sleep fell short in adolescence for both groups, but were within range for young adults (Consensus Conference Panel et al., 2015). We did not observe significant cigarette use trajectory differences by race.

We also hypothesized that living in segregated neighborhoods as adolescents would result in outcome trajectories that were adverse for Black males, but beneficial for White males. For Black males, we found that living in predominantly White and predominantly nonwhite neighborhoods during adolescence did not resulted in worse BMI, sleep duration, or cigarette use trajectories when compared to Black males who lived in integrated neighborhoods. Additionally, there was mixed support for the hypothesized benefit of living in segregated neighborhoods during adolescence for White male trajectories. Compared to

White males who lived in integrated neighborhoods as adolescents, White males from predominantly nonwhite neighborhoods started out with higher average BMI.  BMI trajectories became more beneficial by decreased at age 25 for White males that lived in predominantly White neighborhoods during adolescence. For most of the transition to young adulthood, living in predominantly White neighborhoods during adolescence was associated with beneficial sleep trajectories for White males. Lastly, we found that for White males, those who lived in predominantly White neighborhoods during adolescence had steeper increases in cigarette use trajectories than those who were from  integrated neighborhoods. The effects of RRS on cigarette use trajectories did not support our hypothesis that neighborhood RRS during adolescence would benefit CVD risk outcome trajectories for White males. In short, adolescent RRS did not impact BMI, sleep duration, and cigarette use trajectories for Black males, but resulted in beneficial (e.g. lower BMI, longer sleep duration) and adverse (e.g. greater cigarette use) trajectories for White males.

Our findings were not consistent with other studies examining the relationship between race, RRS, and CVD risk (Kershaw & Albrecht, 2015; Osypuk, 2013). One possible explanation is that we focused on a healthier period in the life course (adolescence to young adulthood) and only studied males. We purposefully chose adolescent males because this is a group that is developing health behaviors and practices that could improve CVH as adults. Some research posits gender is an important modifier of the relationship between segregation and health among youth. Therefore, greater attention is warranted to understand gendered-specific effects of neighborhoods on health in this population (Leventhal & Brooks-Gunn, 2000; Osypuk, 2013).  Since young adults are the most likely to be uninsured, proactively preventing health risks is essential (Callahan & Cooper, 2005; Fortuna, Robbins, & Halterman, 2009; Lau et al., 2014).

Despite the insights gained, this study is subject to several limitations. Respondents' self-reported hours of sleep and the number of days they smoked cigarettes in the past month may be subject to recall error or social desirability. We operationalized RRS using racial composition of neighborhood (percentage of White people); although widely-used, it is not a formal measure (Friedman, 2008; White & Borrell, 2011; Massey & Denton, 1988). While several formal measures of RRS exist (Massey & Denton, 1988), Add Health contextual data does not include geographic identifiers that can be linked with publicly-accessible databases with the contextual data needed to calculate formal segregation measures. Given our limited access, neighborhood RRS categories were based on the proportion of White people because neighborhoods with greater shares of Whites have been shown to have greater access to and protections for health promotion and social mobility (Friedman, 2008; Massey, 1994).

The study also had strengths. We used longitudinal data derived from a nationally representative sample of adolescents who were approaching middle age. We focused on an important, yet understudied period of the male life course which presents an opportunity to better understand race differences in CVD risk factor development. We conducted MLGM to understand the characteristics of growth for Black and White males, while allowing variation within individuals.

**Conclusion**

Our results suggest that segregation impacted the CVD risk trajectories of White males, more than Black males during the transition from adolescence to young adulthood. The visualizations of results illustrate that early exposure to different RRS contexts for Black and White males may have different effects on BMI, sleep duration, and cigarette use during the transition from adolescence to young adulthood. Thus, it is important to look within same-race groups to enhance understanding of how pathways linking segregation to CVD risk change over time.  Additional research is needed to understand whether CVD risk factors trajectories differ by race for as males move to different neighborhoods over time.  Future studies may consider examining how RRS effects CVD risk differently across gender within same-race groups.

## Tables & Figures

Table 4.1 Sample-weighted descriptive statistics for Black and White males in Add Health.

| | White (n=2,324) | Black (n=657) | |
|---|---|---|---|
| | % / mean (SD) | % / mean (SD) | *p* |
| W2: BMI | 22.97(0.13) | 23.65(0.33) | 0.062 |
| W3: BMI | 26.21(0.16) | 26.20(0.38) | 0.978 |
| W4: BMI | 28.67(0.20) | 28.75(0.45) | 0.884 |
| W2: Sleep duration | 7.74(0.03) | 7.49(0.087) | 0.007 |
| W3: Sleep duration | 7.67(0.03) | 7.89(0.10) | 0.061 |
| W4: Sleep duration | 7.55 | 7.51 | 0.750 |
| W2: Cigarette use | 21.26 | 5.57 | 0.000 |
| W3: Cigarette use | 33.52 | 26.99 | 0.068 |
| W4: Cigarette use | 32.53 | 28.77 | 0.284 |
| W2: Age | 16.01(0.04) | 15.89(0.09) | 0.263 |
| W3: Age | 21.45(0.05) | 21.38(0.10) | 0.513 |
| W4: Age | 27.95(0.04) | 27.82(0.09) | 0.234 |
| % White in neighborhood | | | 0.000 |
| 40-80% (integrated: referent group) | 14.85 | 31.94 | |
| >80% (predominantly White) | 82.49 | 18.04 | |
| <40% (predominantly nonwhite) | 02.66 | 50.02 | |
| | | | |
| Covariates | | | |
| General health | | | 0.151 |
| Excellent | 32.69 | 39.27 | |
| Very good | 41.16 | 35.26 | |
| Good | 20.51 | 21.23 | |
| Poor/fair | 5.64 | 4.21 | |
| Pubertal status | 3.01(0.02) | 2.56(0.04) | 0.000 |
| Physical activity | 4.05(0.06) | 4.18(0.11) | 0.309 |
| Sleep satisfaction | | | 0.188 |
| Yes | 75.21 | 71.16 | |
| No | 24.79 | 28.84 | |
| Peer cigarette use | | | 0.002 |
| No friends smoke regularly | 46.72 | 57.64 | |
| 1 close friend smokes regularly | 22.43 | 23.46 | |
| 2 close friends smoke regularly | 13.85 | 9.03 | |
| 3 close friends smoke regularly | 17.00 | 9.86 | |
| Depressive symptoms | 2.58(0.68) | 2.73(0.13) | 0.330 |
| Socioeconomic adversity | | | |
| Parent education | | | 0.283 |
| Less than high school diploma | 12.56 | 16.62 | |
| High school diploma/GED | 31.05 | 28.96 | |
| Completed trade school | 12.47 | 10.38 | |
| Some college | 18.92 | 21.55 | |
| College degree | 15.48 | 15.57 | |
| Graduate degree | 9.53 | 6.92 | |
| Parent financial strain | | | 0.000 |
| Yes | 13.32 | 27.13 | |
| No | 86.68 | 72.87 | |
| Family receives public assistance | 0.32(0.02) | 0.90(0.08) | 0.000 |
| Family structure | | | 0.000 |

| | | | |
|---|---|---|---|
| Lives with both biological parents | 62.13 | 34.37 | |
| Other family structure | 37.87 | 65.53 | |
| Recent change of residence | | | 0.777 |
| Moved at least once | 6.98 | 7.46 | |
| Did not move | 93.02 | 92.54 | |
| Parent obese | | | 0.846 |
| Yes | 24.06 | 24.64 | |
| No | 75.94 | 75.36 | |
| Smoker in household | | | 0.650 |
| Yes | 46.60 | 48.19 | |
| No | 53.40 | 51.81 | |

W2= Wave II; W3= Wave III; W4=Wave IV. All covariates come from W2, except parent obese, smoker in household, family structure, and socioeconomic adversity characteristics. Difference in proportion (%)/mean across race is significant $p < 0.05$ based on Chi-square test/T-test.

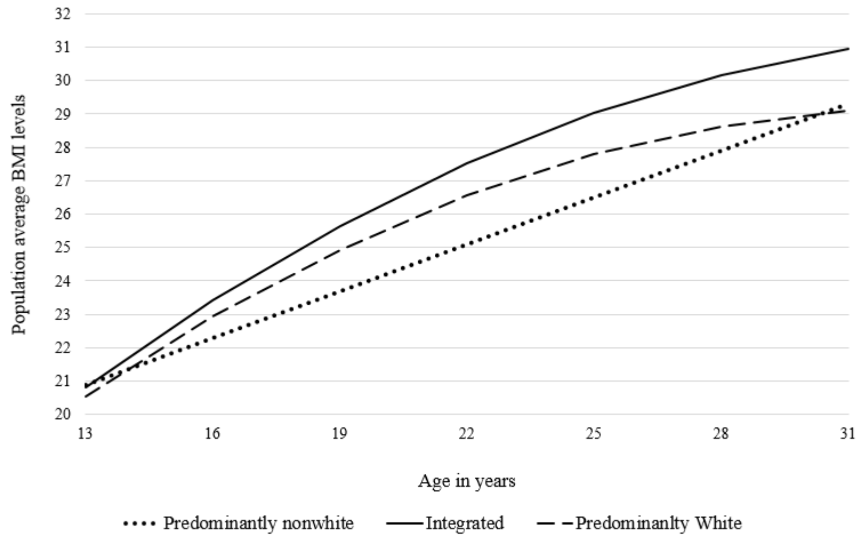
Table 4.2 Linear and logistic regression mixed effects models for the effects of race and percentage of White people in neighborhood during adolescence on changes in body mass index, sleep duration, and cigarette use.

| | | Unadjusted models | | | Adjusted models | | |
|---|---|---|---|---|---|---|---|
| | | b/OR | 95% CI | | b/OR | 95% CI | |
| BMI | | | | | | | |
| Age | I | **23.532** | **22.854** | **24.210** | **19.032** | **17.492** | **20.571** |
| | S | **0.80** | **0.643** | **0.966** | **0.804** | **0.642** | **0.965** |
| | Q | **-0.02** | **-0.0320** | **-0.008** | **-0.020** | **-0.032** | **-0.008** |
| Black | I | 0.542 | -0.505 | 1.590 | **1.133** | **0.100** | **2.166** |
| | S | **-0.331** | **-0.598** | **-0.064** | **-0.330** | **-0.596** | **-0.063** |
| | Q | **0.022** | **0.001** | **0.041** | **0.021** | **0.001** | **0.041** |
| %White in neighborhood | | | | | | | |
| >80% | I | -0.548 | -1.311 | 0.215 | -0.486 | -1.206 | 0.233 |
| | S | -0.071 | -0.242 | 0.101 | -0.070 | -0.243 | 0.101 |
| | Q | -0.001 | -0.013 | 0.011 | -0.001 | -0.013 | 0.0110 |
| <40% | I | -0.623 | -2.203 | 0.958 | -1.152 | -2.758 | 0.453 |
| | S | -0.337 | -0.777 | 0.102 | -0.336 | -0.776 | 0.103 |
| | Q | -0.020 | -0.015 | 0.056 | 0.020 | -0.015 | 0.056 |
| Black * %White in neighborhood | | | | | | | |
| >80% | I | -0.201 | -1.766 | 1.364 | -0.367 | -1.924 | 1.188 |
| | S | 0.173 | -0.214 | 0.560 | 0.171 | -0.215 | 0.558 |
| | Q | -0.004 | -0.0351 | 0.262 | -0.004 | -0.034 | 0.026 |
| <40% | I | -0.203 | -2.116 | 1.710 | 0.020 | -1.525 | 2.374 |
| | S | **0.596** | **0.073** | **1.117** | **0.593** | **0.071** | **1.115** |
| | Q | **-0.043** | **-0.085** | **-0.001** | **-0.043** | **-0.085** | **-0.001** |
| Sleep duration | | | | | | | |
| Age | I | **7.552** | **7.365** | **7.7439** | **7.919** | **7.595** | **8.242** |
| | S | -0.055 | -0.158 | 0.048 | -0.054 | -0.158 | 0.048 |
| | Q | 0.010 | -0.011 | 0.033 | 0.010 | -0.011 | 0.032 |
| | C | -0.000 | -0.001 | 0.001 | -0.000 | -0.001 | 0.001 |
| Black | I | -0.207 | -0.577 | 0.161 | -0.222 | -0.576 | 0.131 |
| | S | **0.284** | **0.078** | **0.491** | **0.283** | **0.077** | **0.489** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Q | -0.036 | -0.084 | 0.011 | -0.036 | -0.084 | 0.011 |
| | C | 0.000 | -0.001 | 0.003 | 0.001 | -0.001 | 0.003 |
| %White in neighborhood | | | | | | | |
| >80% | I | 0.195 | -0.015 | 0.406 | **0.211** | **0.009** | **0.412** |
| | S | -0.018 | -0.131 | 0.094 | -0.018 | -0.130 | 0.094 |
| | Q | 0.006 | -0.017 | 0.030 | 0.006 | -0.017 | 0.030 |
| | C | -0.001 | -0.001 | 0.001 | -0.001 | -0.001 | 0.001 |
| <40% | I | 0.166 | -0.284 | 0.617 | 0.136 | -0.289 | 0.562 |
| | S | -0.060 | -0.343 | 0.222 | -0.061 | -0.343 | 0.221 |
| | Q | 0.011 | -0.043 | 0.066 | 0.011 | -0.043 | 0.066 |
| | C | -0.001 | -0.003 | 0.002 | -0.001 | -0.003 | 0.002 |
| Black*%White in neighborhood | | | | | | | |
| >80% | I | 0.069 | -0.495 | 0.634 | 0.086 | -0.449 | 0.621 |
| | S | 0.015 | -0.335 | 0.367 | 0.016 | -0.333 | 0.367 |
| | Q | -0.035 | -0.115 | 0.044 | -0.035 | -0.115 | 0.044 |
| | C | 0.002 | -0.001 | 0.007 | 0.002 | -0.001 | 0.007 |
| <40% | I | 0.182 | -0.427 | 0.792 | 0.169 | -0.409 | 0.748 |
| | S | -0.101 | -0.484 | 0.281 | -0.101 | -0.483 | 0.281 |
| | Q | 0.001 | -0.076 | 0.078 | 0.001 | -0.076 | 0.078 |
| | C | 0.001 | -0.003 | 0.005 | 0.001 | -0.003 | 0.005 |
| Cigarette use | | | | | | | |
| Age | I | **0.054** | **0.034** | **0.087** | **0.002** | **0.001** | **0.005** |
| | S | **1.425** | **1.174** | **1.729** | **1.371** | **1.135** | **1.656** |
| | Q | **0.958** | **0.921** | **0.996** | 0.965 | 0.929 | 1.003 |
| | C | 1.001 | 0.999 | 1.003 | 1.001 | 0.999 | 1.003 |
| Black | I | **0.103** | **0.036** | **0.294** | 0.174 | 0.064 | 0.471 |
| | S | 1.477 | 0.906 | 2.406 | 1.425 | 0.883 | 2.300 |
| | Q | 0.991 | 0.907 | 1.083 | 0.996 | 0.913 | 1.087 |
| | C | 0.999 | 0.994 | 1.003 | 0.998 | 0.994 | 1.003 |
| %White in neighborhood | | | | | | | |
| >80% | I | 1.165 | 0.711 | 1.909 | 1.171 | 0.730 | 1.880 |
| | S | **1.305** | **1.051** | **1.621** | **1.268** | **1.026** | **1.568** |
| | Q | 0.964 | 0.922 | 1.007 | 0.971 | 0.930 | 1.014 |
| | C | 1.001 | 0.999 | 1.003 | 1.001 | 0.998 | 1.003 |
| <40% | I | 0.958 | 0.312 | 2.941 | 0.921 | 0.316 | 2.682 |
| | S | 1.050 | 0.636 | 1.732 | 1.007 | 0.615 | 1.650 |
| | Q | 1.002 | 0.902 | 1.113 | 1.013 | 0.912 | 1.125 |
| | C | 0.999 | 0.993 | 1.005 | 0.998 | 0.993 | 1.004 |
| Black*%White in neighborhood | | | | | | | |
| >80% | I | 1.408 | 0.294 | 6.730 | 1.404 | 0.322 | 6.126 |
| | S | 0.713 | 0.349 | 1.456 | 0.727 | 0.360 | 1.465 |
| | Q | 1.028 | 0.900 | 1.175 | 1.020 | 0.895 | 1.163 |
| | C | 0.999 | 0.993 | 1.006 | 1.000 | 0.993 | 1.006 |
| <40% | I | 0.204 | 0.029 | 1.414 | 0.291 | 0.046 | 1.848 |
| | S | 1.643 | 0.670 | 4.023 | 1.741 | 0.722 | 4.194 |
| | Q | 0.920 | 0.784 | 1.080 | 0.904 | 0.772 | 1.059 |
| | C | 1.004 | 0.996 | 1.012 | 1.005 | 0.997 | 1.013 |

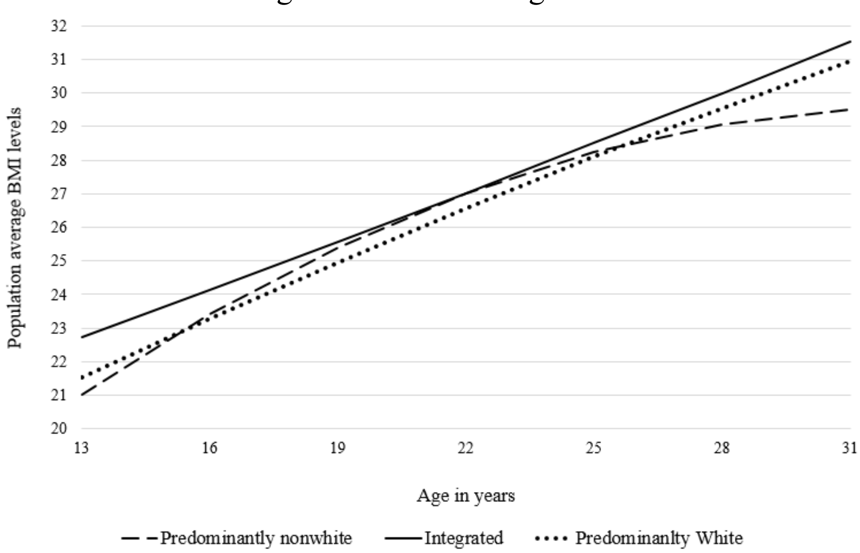
Estimates reflect odds ratios (OR) for cigarette use and beta coefficients (b) for body mass index and sleep duration. Adjusted models control for covariates related to respondent health, family socioeconomic adversity, and parental health during adolescence (Wave II). Bolded b/OR= $p < 0.05$.
I=intercept; S=linear slope; Q=quadratic slope; C=cubic slope. Age is centered at 16. Age intercept is model constant.
For all models N=2,981; Observations=8,612

Figure 4.1 BMI among White males.



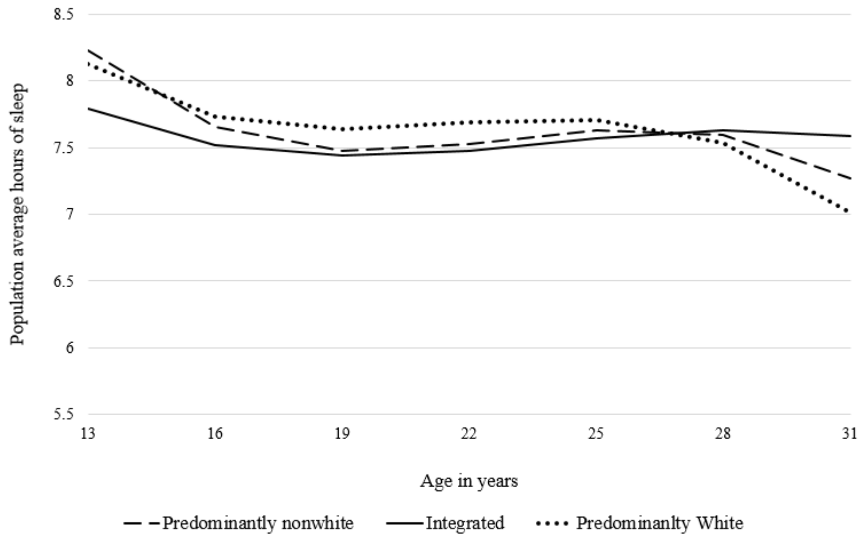

Note: This figure predicts the population averages for sleep duration from best fitting models across age. Neighborhood racial residential segregation (RRS) categories during adolescence include predominantly nonwhite, integrated, and predominantly White. All covariates were fixed at mean or representative values. Statistically significant differences were determined by examining differential effects within race and across age (Appendix B table 1) where integrated neighborhoods were the referent group.

Figure 4.2 BMI among Black males.



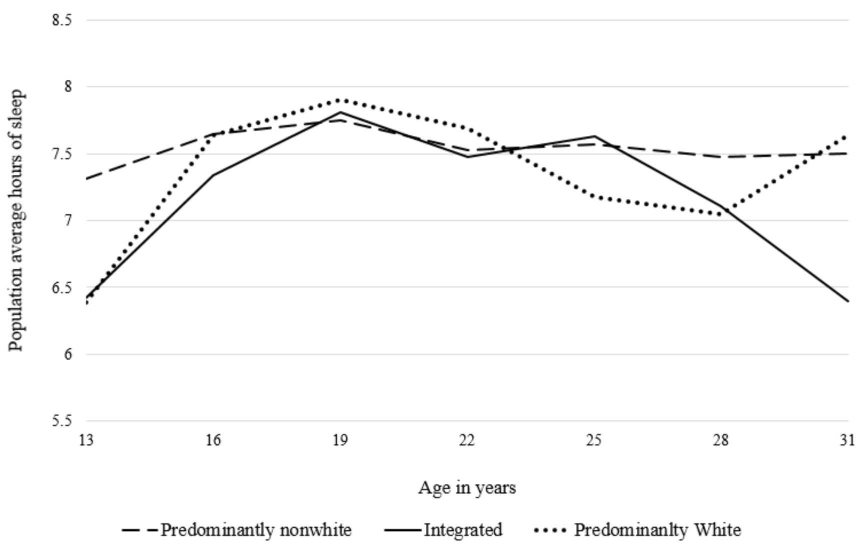

Note: This figure predicts the population averages for sleep duration from best fitting models across age. Neighborhood racial residential segregation (RRS) categories during adolescence include predominantly nonwhite, integrated, and predominantly White. All covariates were fixed at mean or representative values. Statistically significant differences were determined by examining differential effects within race and across age (Appendix B table 1) where integrated neighborhoods were the referent group.

Figure 4.3 Sleep duration among White males.



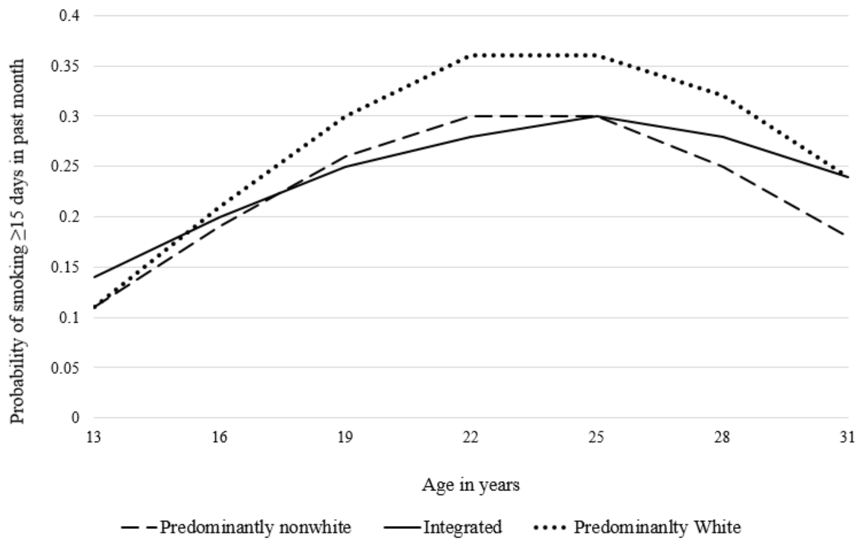

Note: This figure predicts the population averages for sleep duration from best fitting models across age. Neighborhood racial residential segregation (RRS) categories during adolescence include predominantly nonwhite, integrated, and predominantly White. All covariates were fixed at mean or representative values. Statistically significant differences were determined by examining differential effects within race and across age (Appendix B table 2) where integrated neighborhoods were the referent group.

Figure 4.4 Sleep duration among Black males.



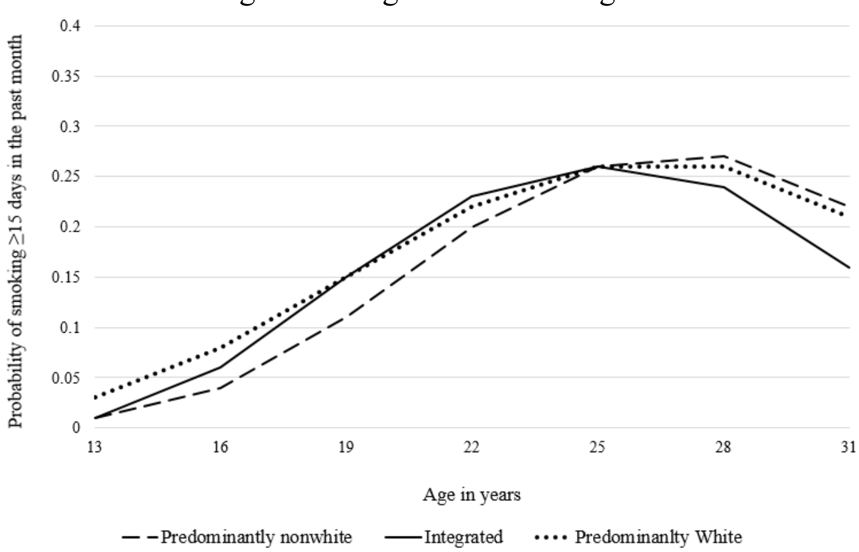

Note: This figure predicts the population averages for sleep duration from best fitting models across age. Neighborhood racial residential segregation (RRS) categories during adolescence include predominantly nonwhite, integrated, and predominantly White. All covariates were fixed at mean or representative values. Statistically significant differences were determined by examining differential effects within race and across age (Appendix B table 2) where integrated neighborhoods were the referent group.

Figure 4.5 Cigarette use among White males.




This figure predicts the predicted probabilities for cigarette use from best fitting models across age. Neighborhood racial residential segregation (RRS) categories during adolescence include predominantly nonwhite, integrated, and predominantly White. All covariates were fixed at mean or representative values. Statistically significant differences were determined by examining differential effects within race and across age (Appendix B table 3) where integrated neighborhoods were the base outcome category.

Figure 4.6 Cigarette use among Black males.




This figure predicts the predicted probabilities for cigarette use from best fitting models across age. Neighborhood racial residential segregation (RRS) categories during adolescence include predominantly nonwhite, integrated, and predominantly White. All covariates were fixed at mean or representative values. Statistically significant differences were determined by examining differential effects within race and across age (Appendix B table 3) where integrated neighborhoods were the base outcome category.

# CHAPTER 5: CONCEPTUALIZING RESIDENTIAL CONTEXT INFLUENCES ON CARDIOVASCULAR HEALTH

## Introduction

Cardiovascular disease (CVD) remains the leading cause of death in the US, with an estimated 121.5 million Americans experiencing CVD complications (Benjamin et al., 2019; Heron, 2019). Black individuals comprise approximately 13% of the population, but have a nearly three-fold greater risk of developing and dying from CVD than their White peers (Carnethon et al., 2017; Der Ananian, Winham, Thompson, & Tisue, 2018; US Census Bureau, 2020). In particular, Black men are among the most at-risk for prematurely developing and dying from CVD compared to their race and gender peers (Benjamin et al., 2019). Notably, a stark racial disparity in CVD mortality is observed between Black and White men 25-34 years old (21.6 vs. 9.5 deaths/100,000, respectively) (Heron, 2018). The American Heart Association expanded CVD prevention efforts to focus on cardiovascular health (CVH) to reduce CVD risk and promote population health (Lloyd-Jones et al., 2010). However, disparities among racial/ethnic groups and other populations are a major barrier to advancing CVH for all.

The reasons for racial disparities in CVD risk and mortality are multifactorial. Health behaviors (e.g. diet, physical activity, and smoking), differential health care access and quality, persistent racial discrimination, genetic variation, socioeconomic status, and neighborhood influences contribute to the excess CVD risk in minorities (Bell et al., 2017;

Der Ananian et al., 2018; Williams & Mohammed, 2013; Winham & Jones, 2011). Among males , beliefs about masculinity and manhood, socioeconomic status, stressors, unequal neighborhood environments, and cumulative adversity over the life course have been hypothesized as determinants of Black men's excess CVD risk relative to their White peers (Bruce, Griffith, & Thorpe, 2015; D. J. Jones, Crump, & Lloyd, 2012; Thorpe, Duru, & Hill, 2015; Williams, 2003). Many of these factors can be considered social determinants of health— the conditions in which people are born, grow, live, work and age (World Health Organization, 2010). Social determinants of health exist because resources, power, and privileges are unequally distributed among population subgroups (P. Braveman, 2008; Puckrein et al., 2015; Woolf & Braveman, 2011). These unequal distributions shape the environments we live in, producing health advantages for certain social groups and health disadvantages for others.

Racial residential segregation (RRS), defined as the extent to which racial groups live in separate residential environments, is a social determinant of health disparities (Williams & Collins, 2001). RRS is a form of structural racism created by federal and local housing laws that structured the racial composition of neighborhoods to protect White individuals from interacting with Black individuals (Kennedy, 2009; Mitchell & Franco, 2018; Rothstein, 2017; Williams & Collins, 2001). Today, most of the US population live in segregated environments (LaVeist et al., 2011). For example, 88.1% of White people live in majority White neighborhoods, and 40.6% of Black people live in majority Black neighborhoods (Spader & Rieger, 2017; US Census Bureau, 2020). RRS is more harmful to the cardiovascular health of Black people, relative to White people (Kershaw & Albrecht, 2015; Riley, 2018) through direct and indirect pathways including inadequate housing conditions, limited access to resources promoting physical activity and healthy food choices, community-level safety concerns, financial stress, concentrated poverty, restricted access to quality health care services, and limited opportunities for quality education an employment (Bailey et al., 2017; Carnethon et al., 2017; Goff & Lloyd-Jones, 2016; Kershaw & Albrecht, 2015; Kershaw, Osypuk, et al., 2015; Lewis, Cogburn, & Williams, 2015; Sampson et al., 2016; Thorpe et al., 2016; Williams & Collins, 2001). Social class is considered a confounder of the relationship between RRS and health (LaVeist et al., 2007; Thorpe et al., 2016, 2008; Thorpe, Kelley, et al., 2015). However, some evidence suggests health outcomes are worse for Black than White individuals even when social class is comparable (Bell et al., 2018, 2017; Frierson, Howard, DeFina, Powell-Wiley, & Willis, 2013).

A recent literature review found that increased RRS has deleterious effects on CVD risk for Black adults (Kershaw & Albrecht, 2015). Likewise, a growing body of evidence suggests RRS is an important contributor to race differences in CVD risk factors among men (Griffith et al., 2019; Kershaw & Albrecht, 2015; LaVeist et al., 2011; Thorpe, Kennedy-Hendricks, et al., 2015). However, this evidence base largely focuses on middle-age men, excluding young adult men. This is concerning because young adulthood is an important period for establishing health practices that shape health in later adult years (Arnett, 2000; Harris, Gordon-Larsen, Chantala, & Udry, 2006; Stroud, Walker, Davis, & Irwin, 2015). Much of the prior research shows that Black men's disproportionate risk of CVD and stroke can be attributed to obesity and hypertension developed during adolescence and young adulthood (Benjamin et al., 2019; Bruce, Beech, et al., 2017, 2015; Bruce, Wilder, et al., 2017; Cutler et al., 2008).

There remains a need to articulate why and how RRS influences the CVH of young Black men if we are to develop place-based interventions that advance their CVH and reduce CVD risk.  More than half of Black men in the US live in the southeastern region of the country, which has been called the 'Stroke Belt' because of the high CVD and stroke rates (Carnethon et al., 2017; Der Ananian et al., 2018; Voeks et al., 2008). Thus, young adult Black men living in the South may be at greatest risk of developing CVD. Understanding their lived experiences and perspectives is critical to improving and protecting their CVH. To conceptualize this understanding, we used concept mapping (CM), a participatory research method, and partnered with young Black men living in two majority black communities in one southeastern US state. The goal of this study was to better understand young Black men's conceptualizations of their residential context and how it is related to their health. We also aimed to understand which aspects of their residential contexts are most important to their CVH.

## Methods

### *Concept Mapping Overview*

This study used CM, a structured participatory research methodology, to identify constructs related to neighborhood features that influence CVH among young Black men living in majority Black communities in a southeastern state. CM applies statistical analysis procedures to qualitative input from participants (Burke et al., 2005; Kane & Trochim, 2007; Trochim, 1989).  Participant input was obtained during brainstorming and sorting and rating sessions.  During brainstorming, participants generated a list of statements. At a later time, these statements were sorted and rated by participants. Sorting and rating data were aggregated to generate a "concept map" that visually represents how constructs related to neighborhood influences on CVH are interrelated. CM applies nonmetric multidimensional scaling (MDS) and hierarchical cluster analysis (HCA) to produce a concept map, a pictorial of results that was shared with participants for input at a separate interpretation session (Kane & Trochim, 2007). We expound on these procedures later in this section. The University of North Carolina at Chapel Hill's Institutional Review Board (19-2337) approved this study.

***Setting***

We selected Durham and Rocky Mount, North Carolina (NC) as the community sites for this research for several reasons. First, both communities have higher Black population (Durham- 39%; Rocky Mount- 63%) than the state average (22%) (World Population Review, 2019), which increases the likelihood that participants live in RRS contexts. Second, these majority Black communities have different geographic contexts, adding nuance to the relationship between race and place. Durham is located in central NC, while Rocky Mount is in the eastern region. Durham is urban (5.6% of its county lives in rural areas), while Rocky Mount is rural (~46% of the county lives in rural areas) (County Health Rankings, 2020). Durham is more populous than Rocky Mount (population size 278,993 vs. 53,922) (U.S. Census Bureau, 2018). Third, the counties of both communities have a major CVD concern. Age-adjusted rates of CVD deaths per 100,000 people were 130.7 and 192, respectively for the counties in which Durham and Rocky Mount are located (North Carolina Institute of Medicine, n.d.). Further, countywide community health assessments listed chronic disease prevention as a top priority in each county (Edgecombe County, 2019; Nash County, 2019; Partnership for a Healthy Durham, 2019).

***Community Advisory Board***

While CM is well-suited to engage diverse communities to explore complex health issues, it does not overcome barriers associated with "hard-to-reach" populations (Vaughn, Jones, Booth, & Burke, 2017). Barriers to successfully recruiting Black men in health research include: distrust of mainstream institutions (e.g. hospitals, universities), the potential to negatively portray communities, lack of diversity within research team, narrow cultural and gender-sensitivity among research team, and failure to build rapport and trust with participants (Dean, Griffith, McKissic, Cornish, & Johnson-Lawrence, 2018; Graham et al., 2018; Randolph, Coakley, & Shears, 2018).

To address these barriers, the lead author (S.K.L.B.) convened a six-member community advisory board (CAB) (Newman et al., 2011; Vaughn et al., 2017). The CAB added value to the project and participant recruitment process by informing S.K.L.B. of important community-specific cultural, social, and environmental factors that would impact the research process, and holding S.K.L.B. accountable throughout the research process (Randolph et al., 2018; Vaughn et al., 2017). The CAB was comprised of one Black woman and five Black men (see Appendix C); two were Durham residents and the four were Rocky Mount residents. CAB members were identified by respected community leaders involved in research and county-level leaders in public health. Most CAB members were under the age of 35 and half worked in the health sector. They were selected based on their knowledge and experience engaging communities in health promotion efforts and availability to attend meetings periodically. The CAB: (1) provided insight on community priorities and perspectives during the CM research process, (2) advised and assisted in recruitment, and (3) disseminated information to community, public health, and local policy stakeholder audiences.  CAB members were offered independent contractor status to invoice for study-related efforts.

### *Recruitment of Participants*

We used purposive and snowball sampling to identify potential participants (Donnelly, 2017). The purposive sample used the following inclusion criteria: (1) self-identify as an African American/Black man; (2) between the ages of 18 and 34; and (3) currently reside in Durham or Rocky Mount. Potential participants were invited to complete an online survey to confirm eligibility.  Eligible individuals were informed they could participate and were also asked to invite men in their network to complete the online eligibility survey.  We also posted flyers in publicly accessible locations where young Black men coalesce; made announcements at health organization meetings; and posted flyers on Facebook, Instagram, and Twitter.  Recruitment materials described opportunities to participate in research activities to understand how neighborhoods impact Black men's health.

Of the individuals that met inclusion criteria, 30 participated in CM sessions. Among the 30 study participants, 10 participated in brainstorming, 24 participated in sorting and rating, and 5 participated in interpretation sessions. CM procedures state that can be involved in one session and not others as long as they represent the same population pool (Kane & Trochim, 2007).  Upon entering the study, participants were provided.  After providing informed consent, participants answered questions assessing demographics, residential context, and health characteristics (see Appendix C). CM sessions were completed in-person (February 2020) and at remotely using an encrypted video conference platform (March to

July of 2020). Participants selected either mail or online delivery of gift cards of $25 for brainstorming, $50 for sorting and rating, and $25 for interpretation sessions.

### *Data Collection*

**Brainstorming.** The purpose of the brainstorming session was to generate participants' perspectives on neighborhood features that may impact Black men's health and well-being. Participants in the brainstorming session suggested or free listed statements in response to a focal question developed by S.L.K.B. and piloted by CAB members: "What are some features of your neighborhood that could relate in any way to Black men's health and well-being?" The phrase "your neighborhood" was included rather than "Black neighborhoods" to contextualize this study within the selected geographic contexts and counter dominant narratives about majority Black neighborhoods. Both "health and well-being" were included to invite holistic conceptualizations of health among participants. S.L.K.B. facilitated three brainstorming sessions conducted as group discussions, each lasting about 1.5 hours. Two sessions took place in-person (Durham and Rocky Mount respectively). The third session was a video conference. To ensure participants across brainstorming sessions had a similar understanding of the focal question, S.L.K.B. and the CAB developed lay definitions of neighborhood, health, and well-being before engaging in group discussions (see Appendix C). Participants entering subsequent brainstorming session were not provided the list of statements generated from a past session. Ten participants completed brainstorming and each received a $25 gift card.

**Sorting and Rating.** The purpose of the sorting and rating session was to have participants conceptually structure the statements generated during the brainstorming session. For the sorting activity, each participant independently organized brainstormed statements into conceptually-similar piles that made sense to them. During pile construction, participants used the following rules: (1) a pile must contain at least 2 statements, (2) no fewer than 3 piles are allowed, and (3) a miscellaneous/unrelated pile is not allowed. Participants were encouraged to label each pile using a short phrase or summative term. Immediately following sorting, each participant was asked to independently "rate the relative importance of each statement item to Black men having a healthy diet, healthy weight, engaging in physical activity, and no tobacco use" on a Likert scale ranging from 1 (not at all important) to 5 (absolutely essential). Participants were encouraged to use the full range of the scale. Participants completed both activities in Concept Systems Inc.'s GroupWisdom™ web-based platform. The research team debriefed with participants after each activity to understand the viewpoints participants relied on to complete each activity and confirm instruction adherence. Twenty-four participants completed sorting and rating and received a $50 gift card.

### Statistical Analysis

**Statistical analysis of sorting and rating data**. We used nonmetric MDS to visually represent the sorting data. First, a similarity matrix was created to identify the number of times each statement was sorted into the same pile by all participants (Kane & Trochim, 2007). Next, nonmetric MDS of the similarity matrix assigned spatial coordinates (x, y) to form a two-dimensional "point map" (Figure 5.1) where each statement from brainstorming is a point. Points that are closer were sorted together by more participants. Thus, points that are farther apart were sorted together by fewer participants and may contain less similar content. To determine how well the point map represents the similarity matrix, we assessed the stress value-a fit statistic in CM (Kane & Trochim, 2007). Optimal stress values range between 0.205 and 0.365, with an average stress value of 0.285 (Rosas & Kane, 2012). The point map's stress value was 0.222, indicating good fit. We then applied hierarchical cluster analysis (HCA) using Ward's algorithm (Hair, Tatham, Anderson, & Black, 1998) to partition points on the map into distinct groups, yielding a two-dimensional cluster map. Each non-overlapping cluster generated in HCA represents a conceptually-distinct construct that addresses the focal question. The research team began with a maximum number of clusters, which were consolidated into a meaningful cluster map solution (Figure 5.2), the initial concept map, which was presented to participants and CAB for interpretation.

Additional analyses were performed on participants' rating data to obtain average ratings for statements and clusters and produce a cluster rating map. This allowed us to understand the importance of each statement and cluster to participants' CVH. Cluster ratings maps add layers beneath each cluster to denote the average rating of importance to CVH. Clusters with one layer had the lowest, and clusters with five layers had the highest, average ratings. We used pattern matching, a CM analytic tool, to compare how cluster ratings differed by subgroups (defined by demographics, residential context, and health characteristics). A Pearson's correlation (r) was calculated to measure the consensus between how subgroups rated each cluster; values range from -1.0 (complete disagreement) to 1.0 (complete agreement).

**Map interpretation by participants.** Interpretation of the cluster map involved participants and CAB members naming clusters on the initial concept map, identifying relationships across statements within- and between-clusters, and suggesting items that could be moved from one cluster to another to enhance conceptual clarity. Interpretation session participants included a small group of CAB members and participants selected based on responsiveness in past concept mapping sessions. S.L.K.B. facilitated two interpretation sessions on an encrypted video conference platform. During these sessions, participants collaboratively labeled each cluster on the eight-cluster map solution. We then had short deliberations about why statements within clusters indicated a shared conceptual domain and how statements in some clusters may be conceptually relevant to statements in other adjacent clusters. Two modified maps (Figure 5.3) resulted from these interpretation sessions.

The research team created a third map (Figure 5.4) after the interpretation sessions. Through an iterative process, the consolidated cluster map was created by comparing the cluster content and discussion notes on the relationships of statement items within clusters and perceived conceptual similarities across neighboring clusters. Conceptual consistency was high for most clusters, with participants feeling that most clusters represented wholly distinct conceptual domains. When there was a lack of consensus about distinctions among clusters, we focused on preserving conceptual consistency across statements within a given cluster.

## Results

### *Participant Characteristics*

Of the ten participants in brainstorming sessions, four returned for sorting and rating activities. An additional 20 young Black men were recruited to participate in sorting and rating activity sessions. Of these, five participants were selected to take part in interpretation sessions. Table 5.1 displays demographic, residential context, and health characteristics for the entire sample (n=30). Their mean age was 25.8 years, and 43% completed college. The overall employment status breakdown was as follows: 63% employed, 16% unemployed, and

20% students. Most participants (60%) resided in their respective community for five years or more.  On self-reported health behaviors, most participants had not used any tobacco products in the past 30 days (63%) and were not overweight or obese (63%).

***Concept Map Results***

**Brainstormed Statements.** The free list of statements from all brainstorming sessions produced 91 statements To ensure the number of statements were manageable for the sorting and rating activities, the CAB assisted remove statements that lacked clarity or were redundant. This process resulted in a master list of 45 unique statement (see Table 5.2). Below, each cluster of the finalized eight-cluster rating concept map (Figure 5.5 and Table 5.3) is described and presented from highest to lowest mean cluster rating as it relates to participants' diet, weight, physical activity, and tobacco use.

**Cluster Rating Map.** The *economic opportunity* cluster (mean rating=4.24) included seven statements that were suggested as advantageous to health and well-being (e.g. "access to healthcare", "free time"), but only attainable to Black men who are middle-class or financial stable. The *health choices* cluster (mean rating=4.21) included three statements that described health decision Black men make on a daily basis (e.g. "smoking cigarettes").  The *health threats* cluster (mean rating=3.98) included four statements that described obstacles to health care utilization (e.g. "clinics only cater to women, children, and elderly") and adverse individual health behaviors (e.g. "young Black men self-medicating"). The *constraints to wellness* cluster (mean rating=3.81) included five statements about factors that limit Black men's ability to thrive, namely the proximity of food retail establishments (e.g. "distance to grocery stores") and mental health (e.g. "suffering from daily traumas"). The *community dynamics* cluster (mean rating=3.55) included eight statements that suggested positive interactions with social institutions (e.g. "Black churches"), civic engagement (e.g. "paying attention to social issues") and social cohesion (e.g. "sense of community"). The *sense of safety* cluster (mean rating=3.54) included just two statements: desire for a shared bond, trust, and mutual respect with others in their community (e.g. "Black police officer living in neighborhood"). The *environmental stressors* cluster (mean rating=3.13) included 13 statements that described neighborhood features beyond their control that may cause anxiety (e.g. "law enforcement presence"), social stigma (e.g. "living on the other side of the tracks"), or present obstacles to daily living (e.g. "living near few bus stops"). The *economic stressors* cluster (mean rating=3.13) included three statements about financial circumstances that inhibit social mobility (e.g. "living paycheck to paycheck").

Participants and the research team observed a large amount of white space that seemed to divide the cluster map into two regions, illustrated as a dotted line in Figures 5.5 and 5.6, where the clusters were classified into two large groups. Specifically, clusters above the dotted line (*economic opportunity, community dynamics, sense of safety*) represented conceptual domains that, if achieved or maintained, may prove protective of Black men's health, well-being, and ultimately CVH. Clusters below the dotted line (*health threats, health choices, constraints to wellness, environmental stressors, economic stressors*) represented conceptual domains that are harmful to Black men's health and warrant intervention.

**Cluster Rating Comparisons.** The correlation between subgroups by age, geographic location, and neighborhood RRS ranged from 0.93 to 0.97, suggesting no subgroup differences in conceptualizations of the relative importance of neighborhood features to Black men's CVH (see Table 5.4). The correlation between subgroups by receipt of routine checkup in the past year and years lived in neighborhood was 0.88, which suggests a slight difference in conceptualization among subgroups.

**Discussion**

RRS is a determinant of health disparities that uniformly disadvantages predominantly minority communities, beyond individual risks and characteristics. RRS is also a significant contributor to CVD disparities between Black and White men. However, there remains a need to understand the effects of RRS on CVD risk among men, specifically as young adults. This study is the first to articulate how RRS influences cardiovascular health (i.e. diet, weight, physical activity, and tobacco use) from a community-based, male-centered perspective. We used concept mapping and an involved CAB to understand the perspectives of young Black men from two majority Black southern communities about features of their neighborhood that influence Black men's health and well-being. Our central goal was prioritizing the domains of neighborhood features the men felt were most important to their diet, weight, physical activity, and tobacco use. Appealing to the lived experiences and perspectives of young Black men around this topic makes an important contribution as the target population is underrepresented in CVD literature.

The final eight clusters were identified and rated based on their perceived importance to Black men's CVH. Each domain conceptually mirrored the social, economic, and health contexts of living in predominantly Black, racially segregated neighborhoods (Gee & Ford, 2011; Kershaw & Albrecht, 2015; Unger et al., 2014). For example, the health choices cluster represented living in a food desert that limits access to health-promoting food and may be a result of concentrated poverty (Bower et al., 2014; Goodman, Lyons, Dean, Arroyo, & Hipp, 2018). The community dynamics cluster highlighted potential health-protective effects of RRS that include enhanced social support, social capital, and diminished discrimination experiences (Borrell, Menendez, & Joseph, 2011). Much of the literature is clear that these health-protective effects are not enough to overcome the damaging effects RRS on health in Black communities (Borrell et al., 2011; Kershaw & Albrecht, 2015; Kramer & Hogue, 2009). However, LaVeist (1993) suggests that concentrating Black political power may counter the negative effects of segregation on health outcomes. On the other hand, the economic opportunity cluster might have reflected how segregation limits social mobility opportunities. Economic opportunity statements alluded to access to healthcare and other health-promoting resources, notable negative health effects of RRS. However, participants may not have been able to make this connection because poverty is concentrated in majority Black communities (LaVeist et al., 2011; Thorpe, Kennedy-Hendricks, et al., 2015).

The visual organization of the eight cluster domains depicts the interrelatedness among clusters, which were aggregated into two distinct regions labeled protective and harmful. During the interpretation session, participants conceptualized the relationship among several clusters in the harmful region of the map. *Environmental stressors, economic stressors,* and *constraints to wellness* formed one large cluster (Figures 3.1 and 3.2). Participants conceptualized that economic stressors followed environmental stressors and their combined exposure imposes constraints on wellness to negatively influence Black men's cardiovascular health. Consistent with evidence, Black individuals may experience accelerated health declines and consequently elevated CVD risk that result from greater exposure to environmental and social stressors (Geronimus et al., 2001; Thorpe et al., 2016). Figure 5.4 does not combine these clusters to illustrate they are conceptually distinct but intertwined.   Participants did not provide much dialogue about the interrelatedness of cluster domains in the protective region of the map. Similarly, the amount of space between these clusters reflected their distinctiveness.

On the other hand, there was healthy discussion among participants in all sessions about one statement in the *sense of safety* cluster— “Black police officer living in neighborhood” (Table 5.2, statement 20). The historical legacy and contemporary consequences of organized policing in the US triggered varied reactions to this statement (Alexander, 2016; Gilbert & Ray, 2016; Gordon, 2020; Ray, 2019).  Some participants resounded Black communities are over-policed and do not need police officers living in them.  Other participants perceived both Black resident neighbors and on duty officers may benefit from a Black police officer living next to them. A minority opinion was that health or community benefits should not depend on an officer’s race, officers should protect and serve everyone equally. According to expert opinion, diversifying the police force will not equate to improved relations between police and Black people because diverse police officers have been trained the same way as other officers (King & Ray, 2020).  In turn, relations with Black communities can be improved when police officers invest in the communities they serve, through activities and interactions when off duty.   The dotted line dividing the concept map into two, protective and harmful, regions sits just below the statement “Black police officer living in neighborhood” to reflect these diverse perspectives.

*Economic opportunity, health choices*, and *health threats* received the highest average cluster ratings with respect to Black men’s cardiovascular health.  We found uniform consistency across subgroups of age, community site, and neighborhood racial composition in terms of how neighborhood features were conceptualized as important to Black men’s cardiovascular health. On the other hand, we observed some qualitative differences in how neighborhood features were rated in terms of importance to Black men's cardiovascular health by receipt of routine checkup and years lived in neighborhood. Specifically, young men without a routine checkup in the past year rated the *economic opportunity, health threats,* and *economic stressors* cluster domains as more important to cardiovascular health than those with a routine checkup in the past year. Those who lived in their current neighborhood for at least three years rated *constraints to wellness* and *community dynamics* as more important to cardiovascular health than those who lived at their current residence for less than three years. These dissimilarities highlight differences in lived experiences that may influence the perceived relevance of neighborhood features to cardiovascular health.

This study had several limitations. First, we had a purposive sample of 30 young Black men living in two majority Black southern communities, which limit generalizability. Second, the concept mapping process was completed during two major national events that may have affected response: coronavirus-related lockdowns and recent wave national unrest resulting from police violence.

It has been well documented that social determinants of health structurally shape health outcomes and health inequities through complex, interrelated mechanisms (Davis et al., 2016; Schroeder, 2007; Smedley, 2012). Our findings suggest the need for structural improvements in the racially segregated environments in which young Black men live to improve their CVH. Interventions primarily focused on individual and interpersonal factors have a limited ability to produce sustainable improvements (Brown et al., 2019). Thus, addressing health inequities concerning young Black men's CVH requires a structural approach (Carnethon et al., 2017). The American Heart Association's Guide for Improving

Cardiovascular Health at the Community Level states the greatest population impacts will be realized when contexts change in such a way that makes healthy decisions the easiest decision for individuals (Pearson et al., 2013). However, inequities in CVH cannot be tackled without understanding the social, economic, political, and environmental contexts experienced in majority Black communities.

Engaging community stakeholders at the beginning and throughout the processes of structural intervention development, implementation, and evaluation is essential (Brown et al., 2019; Newman et al., 2011; Sampson et al., 2016). Agencies and organizations committed to population health may be well-suited to implement structural initiatives, interventions, and services. For example, states can apply for waivers to use Medicaid funds to conduct non-medical interventions that address community health and social risks (Hinton et al., 2019), which could focus on the health vulnerabilities segregated communities endure. Through a public-private partnership, North Carolina created a technology platform designed to address immediate and long-term needs (e.g. housing, employment, food insecurity, interpersonal safety) that are drivers of health across all counties (NCDHHS, 2019). Additionally, the Robert Wood Johnson Foundation's vision to ensure that every person in the US has the opportunity to achieve health and well-being is aligned with funding opportunities focused on making more equitable, health community and collaborations across sectors that produce systemic change (Chandra et al., 2017). These examples demonstrate available initiatives, services, and funding mechanisms to implement structural interventions that advance health equity.

In sum, young Black men are among the most at-risk for CVH declines because they largely live in communities that endure structural disadvantages. To change their outcomes, their residential contexts must be understood and changes in such a way that transforms the health-harming aspects of their neighborhoods without causing displacement.

## Tables & Figures

Table 5.1 Sample demographic, residential context, and health characteristics (N=30).

| Characteristics | N | % |
|---|---|---|
| Age (mean, SD) | (25.8, 4.6) | |
| Education | | |
| High school diploma/GED | 9 | 36.7 |
| Some college | 7 | 23.3 |
| Associates degree | 1 | 3.3 |
| College degree | 11 | 36.7 |
| Advanced degree | 2 | 6.7 |
| Employment status | | |
| Employed | 19 | 63.3 |
| Unemployed | 5 | 16.7 |
| Student | 6 | 20.0 |
| Resident City | | |
| Durham | 19 | 63.3 |
| Rocky Mount | 11 | 36.7 |
| Years lived in city | | |
| Less than 1 year | 3 | 10.0 |
| 1-2 years | 4 | 13.3 |
| 3-4 years | 5 | 16.7 |
| 5 or more years | 18 | 60.0 |
| Neighborhood racial composition | | |
| Mostly Black residents | 17 | 56.7 |
| A good mixture of Black and White residents | 10 | 33.3 |
| Mostly White residents | 3 | 10.0 |
| Years lived in neighborhood | | |
| Less than 1 year | 9 | 30.0 |
| 1-2 years | 7 | 23.3 |
| 3-4 years | 6 | 20.0 |
| 5 or more years | 8 | 26.7 |
| Routine checkup in past year | | |
| Yes | 16 | 53.3 |
| No | 14 | 46.7 |
| Tobacco use in past 30 days* | | |
| Yes | 11 | 36.7 |
| No | 19 | 63.3 |
| Weight status | | |
| About the right weight | 19 | 63.3 |
| Overweight or obese | 11 | 36.7 |
| Hypertension | | |
| Yes | 8 | 26.7 |
| No | 22 | 73.3 |

Note: Tobacco use was described as smoking a cigarette, e-cigarette, cigar, vaping, or chewing tobacco.

Table 5.2 Master list of brainstormed statements.

1. Living paycheck to paycheck
2. Living on the other side of the train tracks
3. Run down homes
4. Neighbors getting evicted
5. Utility companies taking advantage of people
6. Damaged streets and sidewalks (e.g. potholes in road, cracked sidewalks)
7. Living near few bus stops
8. Owning your house
9. Gun violence
10. Living in a safe neighborhood
11. Perceived danger in community
12. Hearing sirens (e.g. Ambulance, fire truck, police)
13. Fights in public
14. Racial profiling
15. Being able to walk around
16. Lack of reentry programs
17. Crime rate in area
18. Parks are not places to play
19. Law enforcement presence
20. Black police officer living in neighborhood
21. Suffering from daily traumas
22. Paying attention to social issues
23. Caring about our families
24. Conversations at barbershops
25. Feeling comfortable around mostly black people
26. Black churches
27. Sense of community
28. Practicing good health habits
29. Having community gardens
30. Access to healthcare
31. Recreation centers
32. Clinics only cater to women, children, and elderly
33. Black men are uninsured in our community
34. Not getting enough sleep
35. Free time (e.g. playing basketball)
36. Corner stores selling alcohol and cigarettes
37. Corner stores on every block
38. Improvements in downtown area
39. More white people moving into neighborhood
40. Smoking cigarettes
41. Young black men self-medicating (using drugs, sex, or violence to deal with stress)
42. Distance to grocery stores
43. Distance to affordable healthy food
44. Access to healthy food options
45. Having lots of fast-food spots

Table 5.3 Identified clusters and statements average rating of importance to cardiovascular health.

| Cluster Name | Statement | Average Rating |
|---|---|---|
| **Economic Opportunity** | | **4.24** |
| | 8. Owning your house | 2.71 |
| | 29. Having community gardens | 3.50 |
| | 31. Recreation centers | 4.42 |
| | 35. Free time | 4.46 |
| | 30. Access to healthcare | 4.88 |
| | 28. Practicing good health habits | 4.88 |
| | 44. Access to healthy food options | 4.83 |
| **Health Choices** | | **4.21** |
| | 40. Smoking cigarettes | 4.54 |
| | 43. Distance to affordable healthy food | 4.21 |
| | 45. Having lots of fast-food spots | 3.88 |
| **Health Threats** | | **3.98** |
| | 32. Clinics only cater to women, children, and elderly | 3.33 |
| | 33. Black men are uninsured in our community | 4.21 |
| | 34. Not getting enough sleep | 4.22 |
| | 41. Young Black men self-medicating (i.e. using drugs, sex, or violence to deal with stress) | 4.17 |
| **Constraints to Wellness** | | **3.81** |
| | 16. Lack of reentry programs | 3.33 |
| | 21. Suffering from daily trauma | 4.21 |
| | 36. Corner stores selling alcohol and cigarettes | 3.92 |
| | 37. Corner stores on every block | 3.38 |
| | 42. Distance to grocery stores | 4.21 |
| **Community Dynamics** | | **3.55** |
| | 22. Paying attention to social issues | 3.58 |
| | 23. Caring about our families | 4.21 |
| | 24. Conversations at barbershops | 3.00 |
| | 26. Black churches | 2.96 |
| | 38. Improvements in downtown areas | 3.13 |
| | 25. Feeling comfortable around mostly Black people | 3.17 |
| | 27. Sense of community | 3.92 |
| | 10. Living in a safe neighborhood | 4.46 |
| **Sense of Safety** | | **3.54** |
| | 15. Being able to walk around | 4.54 |
| | 20. Black police officer living in neighborhood | 2.54 |
| **Environmental Stressors** | | **3.13** |
| | 2. Living on the other side of the train tracks | 2.58 |
| | 9. Gun violence | 3.67 |
| | 11. Perceived danger in community | 3.75 |
| | 13. Fights in public | 2.46 |
| | 14. Racial profiling | 3.79 |
| | 17. Crime rate in area | 4.17 |
| | 19. Law enforcement presence | 2.75 |
| | 39. More White people moving into neighborhoods | 2.21 |
| | 12. Hearing sirens (e.g. ambulances, police, fire trucks) | 2.46 |
| | 18. Parks are not places to play | 4.04 |
| | 3. Run down homes | 2.21 |
| | 6. Damaged streets and sidewalks | 3.46 |
| | 7. Living near few bus stops | 3.08 |
| **Economic stressors** | | **3.13** |
| | 1. Living paycheck to paycheck | 4.38 |
| | 4. Neighbors getting evicted | 2.08 |
| | 5. Utility companies taking advantage of people | 2.92 |

Table 5.4 Pearson's correlation coefficients (r) for relative importance to cardiovascular health[1] ratings by subgroups of select variables.

| **Variable** | **Subgroup(n)[2]** | **Subgroup(n)[2]** | **r-values** |
|---|---|---|---|
| Resident city | Durham (15) | Rocky Mount (9) | 0.93 |
| Age in years | 18-25 (13) | 26-34 (11) | 0.97 |
| Neighborhood racial composition[3] | Mostly black residents (11) | A good mixture of black and white residents (10) | 0.94 |
| Years lived in neighborhood | Less than 3 years (11) | At least 3 years (13) | 0.88 |
| Routine checkup in the past year | Had a routine checkup (13) | Did not have a routine checkup (11) | 0.88 |

[1] Cardiovascular health was operationalized as diet, weight, physical activity, and tobacco use.
[2] Items do not amount to full sample size (n=30) but do apply to those who completing sorting and rating activities (n=24).
[3] There are three neighborhood racial composition categories, we omit the "mostly White residents" category because few participants (n=3) are represented in that category.

Figure 5.1 Point map.


Figure 5.2 Initial Cluster Map.

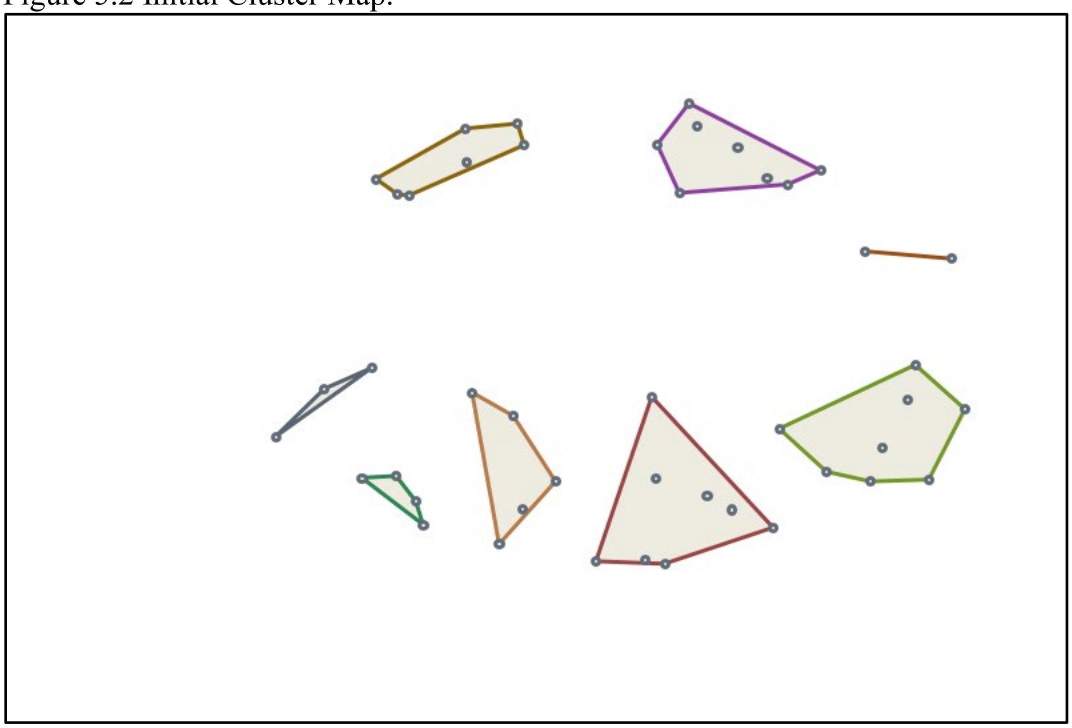


Figure 5.3 Cluster Map from Interpretation Session 1.

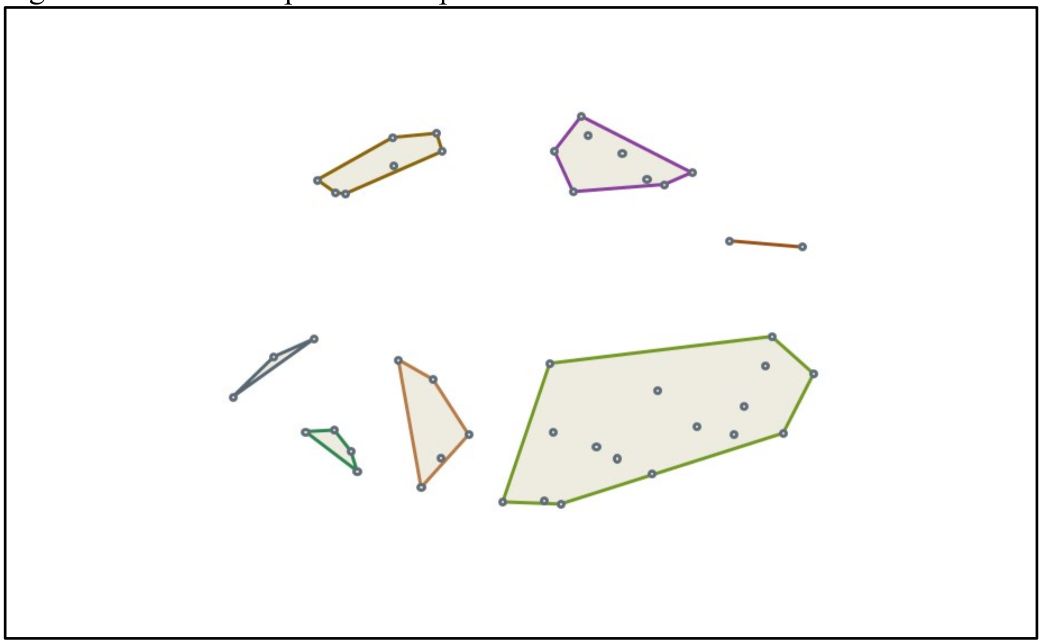


Figure 5.4 Cluster Map from Interpretation Session 2.

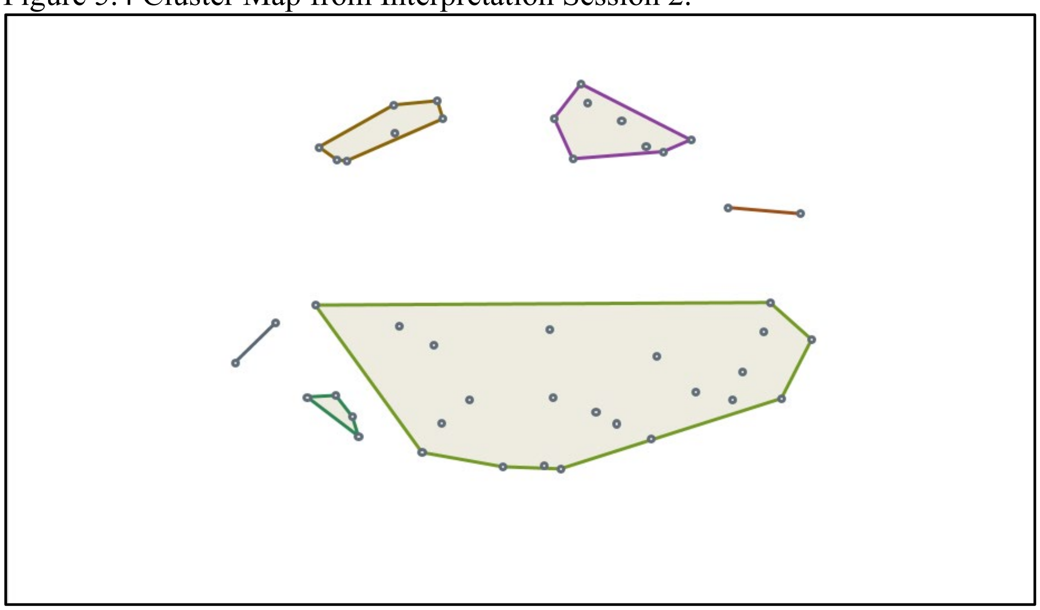


Figure 5.5 Final Cluster Map.

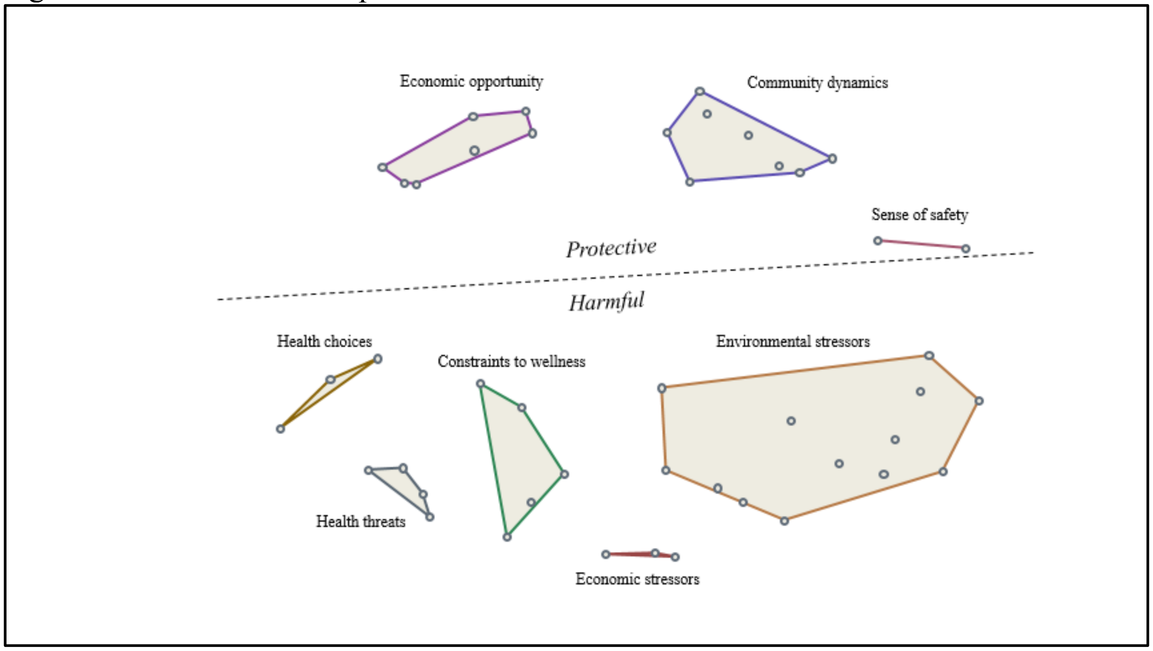
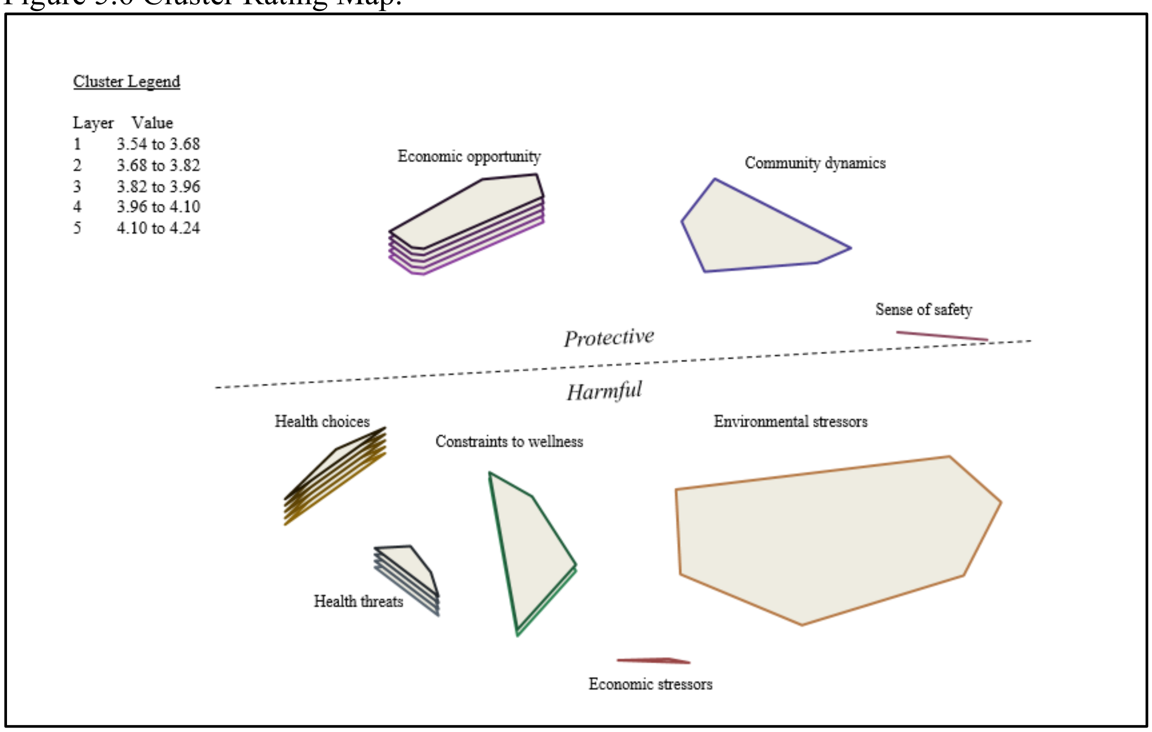



Figure 5.6 Cluster Rating Map.



# CHAPTER 6. SUMMARY OF FINDINGS AND IMPLICATIONS

The goal of this dissertation was to examine race differences in CVH among young Black and White men and determine whether RRS influenced these differences. The effects of RRS on racial disparities in CVD have been documented (Kershaw & Albrecht, 2015), but evidence on the effect of RRS on racial disparities related to CVH among men is limited (Gilbert et al., 2015; Thorpe, Kennedy-Hendricks, et al., 2015). This work is motivated by the limited inclusion of young men in research on CVH despite their increased CVD risk. Additionally, our focus on the CVH of young men is motivated by the inverse relationship between ideal CVH and CVD risk (Dong et al., 2012; Q. Yang et al., 2012), and the notion that health practices and behaviors during young adulthood influence health and disease trajectories in later adult years (Benjamin et al., 2019; Wilkins et al., 2012; Q. Yang et al., 2012).

This dissertation study developed three aims as manuscripts. Manuscripts 1 and 2 used data from Add Health. In manuscript 1 (Chapter 3), we used logistic regression analysis to compare racial differences in the association between RRS and CVH among young men (ages 24-34). We hypothesized that (1) White young men would be more likely to have ideal CVH than Black young men; (2) ideal CVH would be positively associated with increasing the proportion of White residents in neighborhoods; and (3) a greater proportion of White residents in neighborhoods would be associated with Black-White differences in ideal CVH. In manuscript 2 (Chapter 4), we used linear and logistic regression mixed effects modeling to examine whether neighborhood RRS during adolescence contributed to trajectories of three important CVD risk factors (BMI, sleep duration, and cigarette use) differently for Black and White males as they transition from adolescence to young adulthood. Here, we categorized RRS as: predominantly White neighborhood (>80% White), integrated neighborhood (40-80% White), and predominantly nonwhite neighborhood (<40% White). We tested two hypotheses: (1) Black males would have worse trajectories than White males, when accounting for adolescent RRS, and (2) increased RRS during adolescence would result in adverse outcome trajectories for Black men, but beneficial outcome trajectories for White men over time. In manuscript 3 (Chapter 5) we used concept mapping to engage a community sample of young Black men (ages 18-34) residing in two majority Black North Carolina communities to identify and prioritize neighborhood features that were relevant to Black men's diet, weight, physical activity, and tobacco use.

**Summary of Findings**

Findings from these manuscripts suggest the effect of RRS on CVH may be different for young Black and White men. In manuscript 1 evidence supported hypotheses 1 and 3. Black men had lower odds of ideal CVH (OR=0.67, 95% CI=0.49, 0.92) than White men after adjusting for RRS. Moreover, we observed significant racial disparities in ideal CVH when both racial groups reside in neighborhoods comprised of 60% or more White residents.

Manuscript 2 found that the impact of RRS experienced during adolescent years on young Black and White men's CVD risk developmental trajectories was not as expected. Contrary to hypothesis 1, BMI trajectories were more beneficial for Black than White males, after adjusting for adolescent RRS. Regarding hypothesis 2, Black males whose adolescence was spent in predominantly nonwhite neighborhoods experienced a different rate of change in BMI compared to those from racially integrated and predominantly White neighborhoods. RRS did not affect sleep or cigarette use trajectories among Black males. In contrast, neighborhood RRS during adolescence affected BMI, sleep, and cigarette use into young adulthood for White males. Specifically, those from predominantly White adolescent neighborhoods experienced beneficial rates of change in BMI and sleep, but adverse rates of change in cigarette use than White males from racially integrated adolescent neighborhoods.

In manuscript 3, young Black men living in segregated communities conceptualized eight distinct conceptual clusters that identified neighborhood features that were important their diet, weight, physical activity, and tobacco use. The visual representation of these participant-generated domains mirrored aspects of RRS that influence CVD risk in contemporary literature (Gee & Ford, 2011; Kershaw & Albrecht, 2015; Unger et al., 2014). Comparative analysis revealed that cluster ratings of importance were similar across participants' residential context (urban vs. rural and mostly Black vs. integrated neighborhood). Conversely, ratings of clusters' importance differed by the number of years lived in neighborhood (≥3 years vs. < 3 years) and recent healthcare engagement (had a checkup vs. did not have a check in the past year).

**Strengths and Limitations**

First, in Aims 1 and 2, we operationalized RRS using racial composition of neighborhood (percentage of White people) which is not a formal measure of segregation, though widely used (Friedman, 2008; Spader & Rieger, 2017; White & Borrell, 2011). Add Health data cannot be merged with publicly accessible datasets to calculate formal segregation measures. Second, Indigenous, Asian, and Latino American populations were omitted from analysis because their representation in the data was not sufficient to facilitate disaggregation. Lastly, primary data collection for Aim 3 occurred during the novel coronavirus pandemic and national unrest in response to police state violence. Thus, participant's awareness of the health challenges imposed on Black communities beyond individual health behaviors and traits may be different than before these events occurred.

Despite these limitations, findings from this dissertation are strengthened by its triangulated approach. To my knowledge, this is the first study to examine whether RRS has a moderating effect on race differences in CVH among young men. This was accomplished using a nationally representative cohort of adolescent boys that were followed into adulthood (Harris & Udry, 2008). Longitudinal analysis offered a novel perspective on how adolescent RRS influenced the emergence of racial disparities with respect to BMI, sleep, and cigarette use, as adolescent boys transitioned to young adulthood. Moreover, findings from Aim 3 reflected the lived experiences of young Black men residing in majority Black communities. These findings were strengthened by the involvement of the community advisory board (CAB), comprised of young Black men and public health professionals. The CAB was instrumental in recruiting participants and offering dissemination strategies that extend beyond academia.

**Implications for Practice and Policy**

This dissertation contributes to evidence linking RRS to racial disparities in CVH among men in important ways. First, to my knowledge, this is the first to focus on young men and examine race differences in CVH and CVD risk factors as they transition from adolescence to young adulthood. Much of the evidence how RRS contributes to racial disparities in CVD risk among men is centered on those in middle-age, when CVD diagnoses are most prevalent. By examining the how RRS impacts CVD-related racial disparities in the male life course can inform interventions designed to prevent CVD and improve CVH in an at-risk population. Second, this study is the first to identify which features of racially segregated neighborhoods are most salient to CVH from the perspective of young, southern Black men—a gravely underrepresented population in research and interventions. Third, while healthcare systems provide preventive services to monitor CVH, men often have limited preventive healthcare engagement (Ravenell, Whitaker, & Johnson, 2008). Moreover, young men and other marginalized male groups are among the least likely to interact with healthcare systems (Hammond, Matthews, & Corbie-Smith, 2010; Lau, Adams, Irwin, & Ozer, 2013; Powell et al., 2019; Thorpe & Halkitis, 2016). Specifically, young men could benefit from young adult-specific guidelines for preventive service use that may facilitate their transition to adult care through guided interactions with clinicians. The results of this research may enhance clinicians' awareness of how place, race, and gender interact to influence CVH and CVD risk. The insights gained from this work may cause clinicians to meaningfully consider how residential context differently impacts young men's health choices and behaviors by race.

Public health systems may be a key, underutilized player in connecting this research to policy change and practice. While federal agencies provide funding and leadership to state and local public health organizations, states have a considerable authority to determine the breadth and depth of services delivered to the public (Fadich, Llamas, Giorgianni, Stephenson, & Nwaiwu, 2018). At the federal level, the Office of Women's Health was established in 1991 to inform policies, educate health professionals, and support innovative programs that improve the health of women and girls (Office of Women's Health, 2018). There is no Office of Men's Health in the federal government. At the State level, 71% have an office of women's health, while 21% have an office of men's health (Fadich et al., 2018). Establishing a national Office of Men's Health modeled after the Office of Women's Health may be a vehicle to implement interventions that address structural barriers, like RRS, that disproportionately affect men's diverse health issues. Further, this work can inform existing state offices of men's health of the need to understand and address residential context as a significant contributor to men's cardiovascular health.

**Future Research**

This dissertation study contributes to our understanding of RRS and racial disparities in CVH among young men; however, more research is needed. The inclusion of multiple formal measures of RRS in research may illuminate under examined links between segregation and health among men. A more concerted effort to integrate a life course approach in research is needed to comprehensively understand men's CVH disparities. Longitudinal studies can increase confidence in temporality and projecting health in the future. Moreover, immense heterogeneity exists within male populations (e.g. nativity, sexual orientation, gender norms, spirituality, political perspective). Thus, the pathway between RRS and CVH among men may benefit from within-group analyses. Lastly, engaging men of all ages in the research process can ensure evidence-informed interventions are salient to their life stage and tailored to the unique social, cultural, and geographic contexts men live in.

In closing, Black and White males live in different residential contexts and experience life differently in the United States. Overall, study findings advance knowledge of the extent that RRS influences Black-White differences in CVH among young men. The insights gained in this work highlight nuances in young adult men's CVH development. It is important to continue examinations of how RRS influences CVH among men across the life course. Taken together, findings from my dissertation have the potential to inform research, healthcare delivery, and policy solutions to better serve young men within their residential contexts and attenuate racial disparities in CVD that disproportionately burden Black men.

# APPENDIX A: CHAPTER 2 SUPPLEMENTAL TABLE

Table 1. Cardiovascular health: Ideal, intermediate, and poor thresholds of the Life's Simple 7 targets.

| | Data source: Add Health (Wave IV) | | |
|---|---|---|---|
| | *Ideal* | *Intermediate* | *Poor* |
| Diet | <4 sugary beverages/week | 5-7 sugary beverages per week | 8+ sugary beverages per week |
| Physical activity | 5+ activities weekly | 1-4 activities weekly | 0 activities |
| Smoking | Never smoked regularly | Smoked in the past year | Current smoker |
| Body mass index | $<25$ kg/m$^2$ | 25 - 29.9 kg/m$^2$ | 30+ kg/m$^2$ |
| Blood pressure | <120 SBP and <80 DBP (no medication use/no prior diagnosis) | SBP 120-139 or DBP 80-89 or treated to ideal level | > 140 SBP or > 90 DBP or treated to less than ideal |
| Total cholesterol | Bottom seven deciles (no medication use/no prior diagnosis) | 8th and 9th deciles or treated to ideal | Top decile |
| Glucose | HbA1c<5.7% and fasting glucose <100 mg/dL or nonfasting glucose<200 mg/dL and no medication use/no prior diagnosis | 5.7 - 6.4% HbA1c or 100-125 mg/dL fasting glucose | 6.5+ HbA1c or 126+ fasting glucose or 200+ non-fasting glucose or diabetic medications |

# APPENDIX B: CHAPTER 4 SUPPLEMENTAL TABLES AND FIGURES

Table 1. Differential effects of adolescent racial residential segregation neighborhood designation on body mass index by race and age.

| | Effect | Delta-method Std. Err. | z | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| **Integrated adolescent neighborhood** (referent group) | | | | | | |
| **Predominantly White adolescent neighborhood** | | | | | | |
| Age 13, #NH-White | -.2857187 | .492128 | -0.58 | 0.562 | -1.250272 | .6788343 |
| Age 13, NH-Black | -1.20746 | .9592773 | -1.26 | 0.208 | -3.087608 | .6726894 |
| Age 16, NH-White | -.4867995 | .3674481 | -1.32 | 0.185 | -1.206985 | .2333855 |
| Age 16, NH-Black | -.8547826 | .7045406 | -1.21 | 0.225 | -2.235657 | .5260915 |
| Age 19, NH-White | -.7116551 | .4247441 | -1.68 | 0.094 | -1.544138 | .1208281 |
| Age 19, NH-Black | -.6028702 | .8452725 | -0.71 | 0.476 | -2.259574 | 1.053833 |
| Age 22, NH-White | -.9602856 | .5149784 | -1.86 | 0.062 | -1.969625 | .0490535 |
| Age 22, NH-Black | -.4517223 | 1.010612 | -0.45 | 0.655 | -2.432485 | 1.52904 |
| Age 25, NH-White | -1.232691 | .5967863 | -2.07 | 0.039 | -2.40237 | -.0630111 |
| Age 25, NH-Black | -.4013389 | 1.122369 | -0.36 | 0.721 | -2.601141 | 1.798463 |
| Age 28, NH-White | -1.528871 | .7070483 | -2.16 | 0.031 | -2.91466 | -.1430816 |
| Age 28, NH-Black | -.4517199 | 1.291659 | -0.35 | 0.727 | -2.983324 | 2.079884 |
| Age 31, NH-White | -1.848826 | .9072239 | -2.04 | 0.042 | -3.626952 | -.0706996 |
| Age 31, NH-Black | -.6028655 | 1.697675 | -0.36 | 0.723 | -3.930248 | 2.724517 |
| **Predominantly nonwhite adolescent neighborhood** | | | | | | |
| Age 13, NH-White | .0407758 | 1.38597 | 0.03 | 0.977 | -2.675675 | 2.757227 |
| Age 13,NH-Black | -1.703982 | .821061 | -2.08 | 0.038 | -3.313232 | -.0947316 |
| Age 16,NH-White | -1.152648 | .8192981 | -1.41 | 0.159 | -2.758443 | .4531465 |
| Age 16,NH-Black | -.7278584 | .5590491 | -1.30 | 0.193 | -1.823575 | .3678577 |
| Age 19,NH-White | -1.979139 | .7714971 | -2.57 | 0.010 | -3.491246 | -.4670328 |
| Age 19,NH-Black | -.1633021 | .6228421 | -0.26 | 0.793 | -1.38405 | 1.057446 |
| Age 22,NH-White | -2.438698 | .8600395 | -2.84 | 0.005 | -4.124344 | -.7530514 |
| Age 22,NH-Black | -.0103127 | .7373614 | -0.01 | 0.989 | -1.455514 | 1.434889 |
| Age 25,NH-White | -2.531323 | .8930806 | -2.83 | 0.005 | -4.281729 | -.7809174 |
| Age 25,NH-Black | -.2688901 | .8214225 | -0.33 | 0.743 | -1.878849 | 1.341068 |
| Age 28,NH-White | -2.257016 | 1.05263 | -2.14 | 0.032 | -4.320133 | -.1938991 |
| Age 28,NH-Black | -.9390343 | .9630371 | -0.98 | 0.330 | -2.826552 | .9484838 |
| Age 31,NH-White | -1.615776 | 1.629757 | -0.99 | 0.321 | -4.81004 | 1.578489 |
| Age 31,NH-Black | -2.020745 | 1.303743 | -1.55 | 0.121 | -4.576035 | .5345441 |

Note: Adolescent racial residential segregation designations include three categories corresponding to the percentage of White residents in neighborhoods at Wave II: (1) integrated adolescent neighborhood (40-80% white in neighborhood) is the referent group; (2) predominantly White adolescent neighborhood (>80% White in neighborhood); and (3) predominantly nonwhite adolescent neighborhood (<40% White in neighborhood). Effect estimates reflect differences in average BMI within each age and race category compared to the referent group. Effects are based on adjusted models (Chapter 4. Table 4.2) that control for respondent health, family socioeconomic adversity, and parental health during adolescence (Wave II). P<0.05 indicated statistical significance. For all models N=2,981; observations=8,612.

Table 2. Differential effects of adolescent racial residential segregation neighborhood designation on sleep duration by race and age.

| | Effect | Delta-method Std. Err. | z | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| **Integrated adolescent neighborhood** (referent group) | | | | | | |
| **Predominantly White adolescent neighborhood** | | | | | | |
| Age 13, NH-White | .3381435 | .3026276 | 1.12 | 0.264 | -.2549958 | .9312827 |
| Age 13, NH-Black | -.021885 | .8606064 | -0.03 | 0.980 | -1.708643 | 1.664873 |
| Age 16, NH-White | .2110894 | .1027797 | 2.05 | 0.040 | .0096449 | .4125339 |
| Age 16, NH-Black | .2971868 | .2537561 | 1.17 | 0.242 | -.2001661 | .7945397 |
| Age 19, NH-White | .1987887 | .1134605 | 1.75 | 0.080 | -.0235899 | .4211672 |
| Age 19, NH-Black | .0905334 | .3084087 | 0.29 | 0.769 | -.5139366 | .6950034 |
| Age 22,NH-White | .2071286 | .0916438 | 2.26 | 0.024 | .0275101 | .3867471 |
| Age 22,NH-Black | -.2800808 | .2478441 | -1.13 | 0.258 | -.7658462 | .2056847 |
| Age 25,NH-White | .1419965 | .1044217 | 1.36 | 0.174 | -.0626662 | .3466593 |
| Age 25,NH-Black | -.4528911 | .3203434 | -1.41 | 0.157 | -1.080753 | .1749703 |
| Age 28,NH-White | -.0907202 | .1177475 | -0.77 | 0.441 | -.321501 | .1400606 |
| Age 28,NH-Black | -.0661331 | .3204972 | -0.21 | 0.837 | -.6942961 | .5620298 |
| Age 31,NH-White | -.5851344 | .2792912 | -2.10 | 0.036 | -1.132535 | -.0377336 |
| Age 31,NH-Black | 1.241958 | .943809 | 1.32 | 0.188 | -.6078738 | 3.091789 |
| **Predominantly nonwhite adolescent neighborhood** | | | | | | |
| Age 13,NH-White | .4386267 | .7487634 | 0.59 | 0.558 | -1.028923 | 1.906176 |
| Age 13,NH-Black | .8972504 | .6885518 | 1.30 | 0.193 | -.4522863 | 2.246787 |
| Age 16,NH-White | .1364501 | .217211 | 0.63 | 0.530 | -.2892756 | .5621758 |
| Age 16,NH-Black | .3058385 | .2005276 | 1.53 | 0.127 | -.0871884 | .6988654 |
| Age 19,NH-White | .0394054 | .2294412 | 0.17 | 0.864 | -.410291 | .4891019 |
| Age 19,NH-Black | -.0651416 | .2153113 | -0.30 | 0.762 | -.487144 | .3568608 |
| Age 22,NH-White | .0463167 | .2413843 | 0.19 | 0.848 | -.4267878 | .5194213 |
| Age 22,NH-Black | -.1933541 | .224767 | -0.86 | 0.390 | -.6338893 | .2471811 |
| Age 25,NH-White | .0560081 | .252236 | 0.22 | 0.824 | -.4383653 | .5503816 |
| Age 25,NH-Black | -.0564633 | .265199 | -0.21 | 0.831 | -.5762438 | .4633172 |
| Age 28,NH-White | -.0326962 | .2438079 | -0.13 | 0.893 | -.5105509 | .4451586 |
| Age 28,NH-Black | .3678666 | .2192046 | 1.68 | 0.093 | -.0617666 | .7974997 |
| Age 31,NH-White | -.320972 | .8280753 | -0.39 | 0.698 | -1.94397 | 1.302026 |
| Age 31,NH-Black | 1.101971 | .7940216 | 1.39 | 0.165 | -.4542824 | 2.658225 |

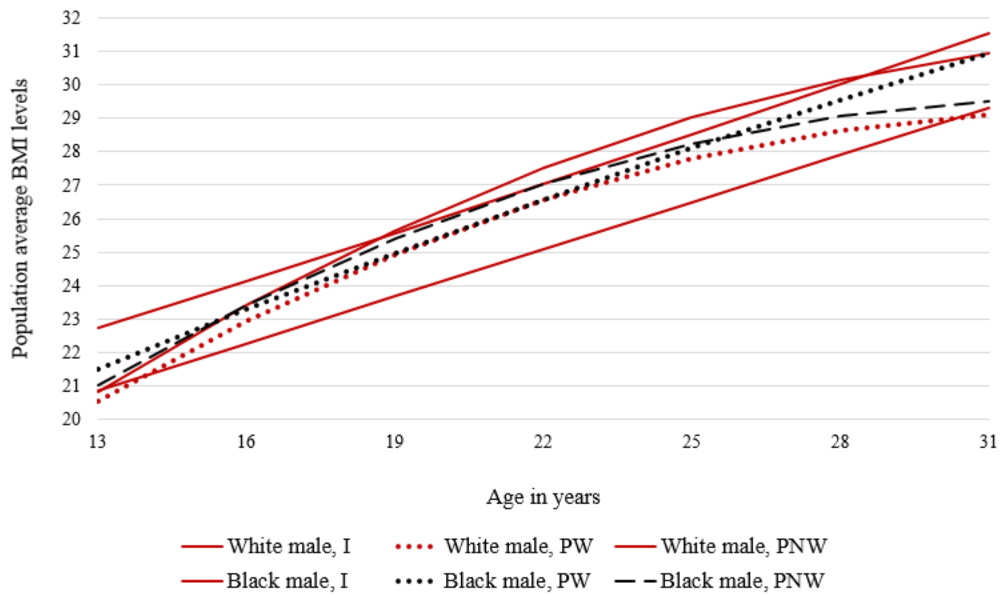
Note: Adolescent racial residential segregation designations include three categories corresponding to the percentage of White residents in neighborhoods at Wave II: (1) integrated adolescent neighborhood (40-80% white in neighborhood) is the referent group; (2) predominantly White adolescent neighborhood (>80% White in neighborhood); and (3) predominantly nonwhite adolescent neighborhood (<40% White in neighborhood). Effect estimates reflect differences in average hours of sleep within each age and race category compared to the referent group. Effects are based on adjusted models (Chapter 4. Table 4.2) that control for respondent health, family socioeconomic adversity, and parental health during adolescence (Wave II). P<0.05 indicated statistical significance. For all models N=2,981; observations=8,612.

Table 3. Differential effects of adolescent racial residential segregation neighborhood designation on cigarette use by race and age.

| | Effect | Delta-method Std. Err. | z | P>\|z\| | [95% Conf. Interval] | |
|---|---|---|---|---|---|---|
| **Integrated adolescent neighborhood** (referent group) | | | | | | |
| **Predominantly White adolescent neighborhood** | | | | | | |
| Age 13, #NH-White | -.0393291 | .0325185 | -1.21 | 0.226 | -.1030641 | .0244059 |
| Age 16, NH-Black | .0071507 | .0241912 | 0.30 | 0.768 | -.0402631 | .0545645 |
| Age 16, NH-White | .0134327 | .0201573 | 0.67 | 0.505 | -.026075 | .0529403 |
| Age 19, NH-Black | .0199123 | .0293076 | 0.68 | 0.497 | -.0375296 | .0773542 |
| Age 19, NH-White | .0651391 | .0223318 | 2.92 | 0.004 | .0213695 | .1089087 |
| Age 22, NH-Black | .0151592 | .0419455 | 0.36 | 0.718 | -.0670525 | .0973709 |
| Age 22, NH-White | .0784548 | .0214869 | 3.65 | 0.000 | .0363411 | .1205684 |
| Age 22, NH-Black | -.0061146 | .0459263 | -0.13 | 0.894 | -.0961285 | .0838993 |
| Age 25, NH-White | .0631582 | .0240728 | 2.62 | 0.009 | .0159764 | .1103399 |
| Age 25, NH-Black | -.0141962 | .0533769 | -0.27 | 0.790 | -.1188131 | .0904206 |
| Age 28, NH-White | .0382597 | .0225676 | 1.70 | 0.090 | -.0059719 | .0824913 |
| Age 28, NH-Black | .0151656 | .050019 | 0.30 | 0.762 | -.0828698 | .1132011 |
| Age 31, NH-White | .0208252 | .0471085 | 0.44 | 0.658 | -.0715058 | .1131561 |
| Age 31, NH-Black | .0873239 | .1122055 | 0.78 | 0.436 | -.1325949 | .3072427 |
| **Predominantly nonwhite adolescent neighborhood** | | | | | | |
| Age 13, NH-White | .0028198 | .0816568 | 0.03 | 0.972 | -.1572246 | .1628641 |
| Age 13, NH-Black | -.0118137 | .0122681 | -0.96 | 0.336 | -.0358588 | .0122313 |
| Age 16, NH-White | -.0067002 | .0443633 | -0.15 | 0.880 | -.0936508 | .0802503 |
| Age 16, NH-Black | -.0340189 | .0194901 | -1.75 | 0.081 | -.0722188 | .0041809 |
| Age 19, NH-White | .0029474 | .0496239 | 0.06 | 0.953 | -.0943136 | .1002085 |
| Age 19, NH-Black | -.0197773 | .0315461 | -0.63 | 0.531 | -.0816065 | .042052 |
| Age 22, NH-White | .0190977 | .0499084 | 0.38 | 0.702 | -.0787209 | .1169164 |
| Age 22, NH-Black | -.0152151 | .0370739 | -0.41 | 0.682 | -.0878785 | .0574483 |
| Age 25, NH-White | .0188366 | .0577116 | 0.33 | 0.744 | -.0942761 | .1319494 |
| Age 25, NH-Black | -.0248284 | .0418982 | -0.59 | 0.553 | -.1069475 | .0572907 |
| Age 28, NH-White | -.0172364 | .0491449 | -0.35 | 0.726 | -.1135586 | .0790857 |
| Age 28, NH-Black | .0115246 | .0395757 | 0.29 | 0.771 | -.0660422 | .0890915 |
| Age 31, NH-White | -.097943 | .1013737 | -0.97 | 0.334 | -.2966318 | .1007459 |
| Age 31, NH-Black | .1510691 | .0803495 | 1.88 | 0.060 | -.006413 | .3085513 |

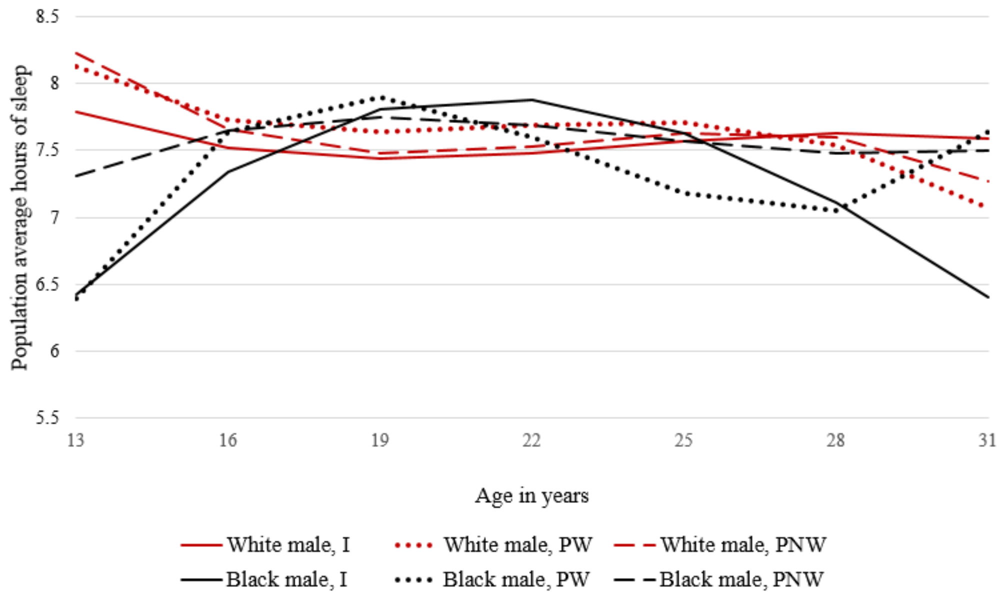
Note: Adolescent racial residential segregation designations include three categories corresponding to the percentage of White residents in neighborhoods at Wave II: (1) integrated adolescent neighborhood (40-80% white in neighborhood) is the referent group; (2) predominantly White adolescent neighborhood (>80% White in neighborhood); and (3) predominantly nonwhite adolescent neighborhood (<40% White in neighborhood). Effect estimates reflect differences in predicted probability of smoking a cigarette for at least 15 days in the past 30 days within each age and race category compared to the referent group. Effects are based on adjusted models (Chapter 4. Table 4.2) that control for respondent health, family socioeconomic adversity, and parental health during adolescence (Wave II). P<0.05 indicated statistical significance. For all models N=2,981; observations=8,612.

Figure 1. BMI male trajectories by race and adolescent racial residential segregation designation



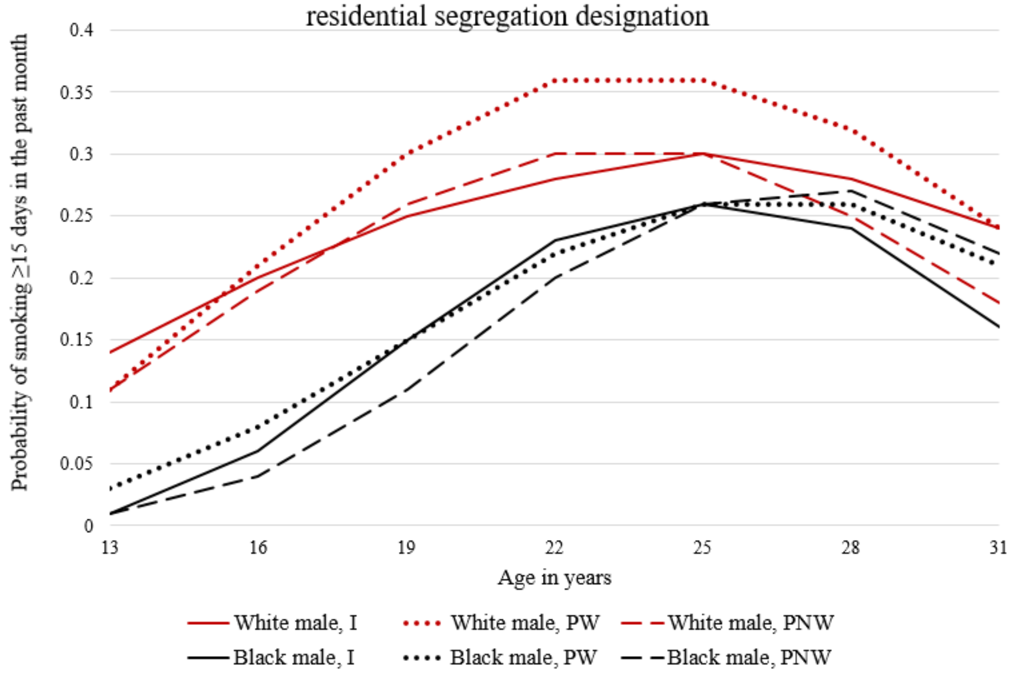

Note: This figure depicts the population averages for male body mass index (BMI) trajectories across age by race and Adolescent racial residential segregation(RRS) designations, which include three categories corresponding to the percentage of White residents in neighborhoods at Wave II: (1) integrated adolescent neighborhood (40-80% white in neighborhood) is the referent group; (2) predominantly White adolescent neighborhood (>80% White in neighborhood); and (3) predominantly nonwhite adolescent neighborhood (<40% White in neighborhood). All covariates were fixed at mean or representative values. Statistically significant differences were determined by examining differential effects (Appendix B table 1) of adolescent RRS on the outcome within race and across age.

Figure 2. Sleep duration male trajectories by race and adolescent racial residential segregation designation




Note: This figure depicts the population averages for male sleep duration trajectories across age by race and Adolescent racial residential segregation(RRS) designations, which include three categories corresponding to the percentage of White residents in neighborhoods at Wave II: (1) integrated adolescent neighborhood (40-80% white in neighborhood) is the referent group; (2) predominantly White adolescent neighborhood (>80% White in neighborhood); and (3) predominantly nonwhite adolescent neighborhood (<40% White in neighborhood). All covariates were fixed at mean or representative values. Statistically significant differences were determined by examining differential effects (Appendix B table 2) of adolescent RRS on the outcome within race and across age.

Figure 3. Cigarette use male trajectories by race and adolescent racial residential segregation designation




Note: This figure depicts the predicted probabilities of cigarette use for males across age by race and Adolescent racial residential segregation(RRS) designations, which include three categories corresponding to the percentage of White residents in neighborhoods at Wave II: (1) integrated adolescent neighborhood (40-80% white in neighborhood) is the referent group; (2) predominantly White adolescent neighborhood (>80% White in neighborhood); and (3) predominantly nonwhite adolescent neighborhood (<40% White in neighborhood). All covariates were fixed at mean or representative values. Statistically significant differences were determined by examining differential effects (Appendix B table 3) of adolescent RRS on the outcome within race and across age.

# APPENDIX C: CHAPTER 5 SUPPLEMENTAL MATERIALS

## Community advisory board roster

Durham Residents

Georgina Dukes, MHA: Network Director, NCCARE360 at Unite Us

Recardo Kersey: Student, Department of Public Health Education at North Carolina Central University

Rocky Mount Residents

Moe Deloach: Owner of Moe and D's Restaurant Grill

Robert Gonzalez: Student, Health Promotion Program at North Carolina Wesleyan College

Cooper Blackwell: Resource Development Coordinator at OIC Rocky Mount

Kirby Slade: Director of Community Relations at UNC Nash Health Care

**Concept mapping participant eligibility survey**

Thank you for expressing interest in the Neighborhood Heart Health (N2H) study, a research project about the ways that neighborhoods influence the health and well-being of young Black men. Please complete this short survey to determine your eligibility. A member of the research team will contact you soon to inform you of your eligibility status.

- Samuel Baxter, Principle Investigator IRB Study#19-2337

- sbaxter@unc.edu

- (919)-391-0005

1. Please provide your age in years.
2. First and Last Name
3. Which of the following describes your race/ethnicity? (check all that apply)
    a. African American/Black
    b. Caribbean
    c. Continental African
    d. Afro-Latino
    e. Latino/Hispanic
    f. Multiracial
    g. None of the above
4. What is the highest level of education you have completed?
5. What is your current employment status?
    a. Employed
    b. Unemployed
    c. Student
6. If you are a student, what type of institution are you enrolled in?
7. High school or GED program
8. 4-year college/university
9. Technical or community college
10. I currently live in a neighborhood that can be described as:
    a. Mostly Black residents
    b. Mostly White residents
    c. A good mixture of Black and White residents
11. How long have you lived in this neighborhood?
    a. Less than a year
    b. 1-2 years
    c. 3-4 years
    d. 5 or more years
12. What street do you live on?
13. What city do you live in?
14. How long have you lived in this city?
    a. Less than a year

    b. 1-2 years
    c. 3-4 years
    d. 5 or more years
15. What is your current residential zip code?
16. Have you smoked a cigarette in the past 30 days?
    a. Yes
    b. No
17. Have you used any of the following tobacco products in the past 30 days: cigarette, vape or e-cigarette, cigar, chewing tobacco?
    a. Yes
    b. No
18. How do you think of yourself in terms of weight?
    a. Underweight
    b. About the right weight
    c. Overweight or obese
19. During the past 7 days, how many hours and minutes were you physically active? (ex. 2 hours and 30 minutes)
20. In the past 12 months, have you had a routine checkup or physical exam?
    a. Yes
    b. No
21. Has a health professional ever told you that you have high blood pressure?
    a. Yes
    b. No
22. Email address you check often:
23. Telephone number (please include area code)
24. How did you hear about this?
    a. Word of mouth
    b. Passed by the flyer
    c. Someone gave you the flyer (email or in person)
    d. Social media

SURVEY COMPLETED! A research team member will contact you shortly about your responses and eligibility to participate in this study. In the meantime, please contact Samuel Baxter (sbaxter@unc.edu or 919-391-0005) if you have any questions. Thank you for your time and we hope to connect soon.

**Working definitions, focal questions, and rating prompt used in concept mapping study**

| | |
|---|---|
| Neighborhood | A local community that is different from other areas of a city or town because of the people who live there and the things that surround them. Some of these things could be homes, hospitals, social conditions, buildings, and other establishments. |
| Health | The states of physical and mental illness that exist on a spectrum of having no diseases to having a disease. |
| Well-being | Overall satisfaction with life that includes the absence of negative emotions, feeling healthy, and being full of energy. |
| Focal question for brainstorming | What are some features of your neighborhood that could relate in any way to young Black men's health and well-being? |
| Rating prompt about cardiovascular health | Compared to other items on this list, please rate on a scale of 1-5 the relative importance of each item to adults having a healthy diet, healthy weight, physically active life, and no tobacco use.<br><br>1= not at all important 2= of little importance<br>3= average importance 4= very important<br>5=absolutely essential |

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