ABSTRACT

Title of Dissertation:	STATE-LEVEL STRUCTURAL RACISM AND ALCOHOL AND TOBACCO USE BEHAVIORS IN A NATIONAL PROBABILITY SAMPLE OF AFRICAN AMERICANS
	Nathaniel Woodard, Doctor of Philosophy, 2023
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Structural racism is how society maintains and promotes racial discrimination through established and interconnected systems. Structural racism is a historical driver of health disparities, including those in the area of cancer. One pathway posited for this effect is through the promotion of maladaptive coping behaviors, such as alcohol and tobacco use. This dissertation empirically assessed the association between state-level structural racism and alcohol and tobacco use behaviors among African Americans, including within various subgroups of African Americans based on age, gender, and household income. This project analyzed secondary self-report data collected from a national probability sample of 1,946 African Americans in the Religion and Health in African Americans (RHIAA) Study. Existing measures of state level structural racism were merged into the RHIAA dataset including a

composite index of structural racism assessed using five dimensions (i.e., residential segregation, and economic, employment, education, and incarceration disparities). Analyses were performed in SPSS Version 28 using hierarchical linear and logistic regression models. In the first study, two models (Model A and Model B) were constructed for each of four outcomes, frequency of alcohol consumption (measured in days per month), frequency of binge drinking (measured in the number of occurrences per month), smoking status (current smoker or not a current smoker), and smoking frequency (never smoked, former smoker, currently smoke on some days, and currently smoke every day). Model A used the composite structural racism index measure to model the four alcohol and tobacco use measures and Model B analyzed the disaggregated dimensions of structural racism rather than the composite measure. All hierarchical analyses controlled for confounding variables (i.e., participant gender, age, education, income, and employment status). In the second study, analyses using the dimension-level approach in Model B from study one were repeated in subgroups stratified by participant age, gender, and income for the frequency of binge drinking and smoking status behaviors. Statistical comparisons of the slope estimates between corresponding subgroups (e.g., younger and older age) were used to test the moderation effects of age, gender, and income on the association between structural racism and alcohol and tobacco use behaviors. Results from these studies generally indicated a positive association between state level structural racism, especially in the incarceration dimension, and binge drinking and tobacco use behaviors. Stratified analyses generally did not support age, gender, or income as moderating variables of the association between structural racism and binge drinking

and tobacco use behaviors. Current findings demonstrate a need for further research on structural racism and health and progress in structural racism measurement, including further emphasis of dimension-level measurement and analysis. Findings from the current dissertation highlight the importance of addressing structural racism, especially in incarceration, to reduce alcohol and tobacco use behaviors among African Americans and help address existing health disparities.

STATE-LEVEL STRUCTURAL RACISM AND ALCOHOL AND TOBACCO USE BEHAVIORS IN A NATIONAL PROBABILITY SAMPLE OF AFRICAN AMERICANS

by

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Chapter 1: Introduction

Problem statement

Structural racism

Structural inequities have critical implications for nations and populations. Structural inequities are multilevel drivers (e.g., racism, sexism, able-ism, and homophobia) that limit opportunities and outcomes, including those that are health-related, for certain groups of people as compared to others (National Academies of Sciences, Engineering, and Medicine, 2017). Not only do structural inequities contribute to considerable economic loss (e.g., it is estimated that disparities by gender and race in the labor market cost the U.S. over 2.5 trillion dollars in GDP in 2019 (Buckman et al., 2021), but these inequities contribute to existing health disparities (Bailey et al., 2017; Homan, 2019; Homan et al., 2021; Lee et al., 2022; McAllister et al., 2018).

Structural racism is one of many structural inequities that helps drive health inequities across groups. Structural racism encompasses how society maintains and promotes racial discrimination through established and interconnected systems (e.g., housing, education, employment, earnings, benefits, credit, media, health care, and criminal justice) (Brown & Homan, 2022; Krieger, 2014). These systems support patterns and practices that encourage discriminatory thought and action, inequitable distribution of resources, and fewer health-supporting opportunities. This

discrimination and inequity ultimately result in health inequities observed across racial groups.

Structural racism and cancer

Cancer is the second most common cause of death in the U.S. and it is estimated that 2 of every 5 people in the U.S. will develop cancer in their lifetimes (American Cancer Society, 2022). There were an estimated 2 million new cases of cancer and over 600,000 deaths caused by cancer in the U.S. in 2022, nearly 1,700 deaths due to cancer each day (American Cancer Society, 2022). However, the burden of cancer is not shared equitably among groups with Black individuals continuing to have worse cancer survival rates when compared to White individuals, though this gap has decreased in recent decades (American Cancer Society, 2023). Structural racism has been linked to cancer incidence, treatment, and mortality (Blanco et al., 2021; Collin et al., 2021; Eldridge & Berrigan, 2022; Goel et al., 2022; Poulson, Beaulieu-Jones, et al., 2021; Poulson, Blanco, et al., 2021; Poulson, Cornell, et al., 2021; Poulson, Helrich, et al., 2021; Zhou et al., 2017). and is one contributor to persistent disparities in cancer survival among Black populations.

Alcohol, tobacco, cancer, and structural racism

Hundreds of studies have assessed the association between alcohol and tobacco use and cancer outcomes. This vast body of research presents strong evidence to support alcohol consumption as a risk factor for cancer outcomes across a variety of cancer sites (Bagnardi et al., 2001, 2015; Longnecker, 1994), as well as tobacco use as a risk factor for various cancers, including, but not limited to respiratory cancers

(Botteri et al., 2008; Gandini et al., 2008; Macacu et al., 2015; Phua et al., 2022). Recent theory posits that structural racism promotes maladaptive coping behaviors (e.g., drinking and smoking), which in turn contribute to the health disparities observed between racial and ethnic groups, including cancer health disparities (Bailey et al., 2017). The availability of alcohol and tobacco products has been linked to structural racism in recent studies (Kong et al., 2022; Schwartz et al., 2021; Scott et al., 2020), however, there is a need for further empirical research assessing the association between structural racism and enacted drinking and smoking behaviors.

Problem justification

When assessing structural racism and its association with health behaviors and outcomes, there is a need to employ more rigorous measures of structural racism in future research (Adkins-Jackson, Chantarat, et al., 2021; Adkins-Jackson, Legha, et al., 2021; Gee & Ford, 2011). Structural racism has traditionally been measured using indicators of residential segregation (Massey & Denton, 1988; White, 1986). However, recent progress in structural racism research suggests the importance of measuring multiple dimensions of structural racism beyond residential segregation (Adkins-Jackson, Chantarat, et al., 2021; Chantarat et al., 2021; Dougherty et al., 2020; Gee & Ford, 2011; Hardeman et al., 2022; Homan & Brown, 2022). Proposed dimensions of structural racism include residential segregation, housing discrimination, systemic differences in policing and incarceration, employment discrimination, opportunities for education, income, healthcare, and structural inequities limiting political participation, among others.

Structural racism has been associated with a variety of health issues and contributes to health disparities that disproportionately burden Black populations. While structural racism has been associated with health outcomes such as cancer incidence (Eldridge & Berrigan, 2022) and cancer survival (Blanco et al., 2021; Collin et al., 2021; Goel et al., 2022; Poulson, Beaulieu-Jones, et al., 2021; Poulson, Blanco, et al., 2021; Poulson, Cornell, et al., 2021; Poulson, Helrich, et al., 2021; Zhou et al., 2017), there is a gap in empirical research on intermediary outcomes (e.g., health behaviors) and mechanisms of how structural racism affects health outcomes. Currently, there is a lack of empirical research assessing the association between structural racism and cancer risk behaviors, including alcohol and tobacco use.

Research question and hypotheses

The current study aims to employ a multidimensional measure of state-level structural racism to assess: 1) the association between structural racism and alcohol use behaviors among African Americans; 2) the association between structural racism and tobacco use behaviors among African Americans; and 3) differences in these associations between various subgroups of African Americans. Based on prior research and theory regarding the association between structural racism and health determinants, behaviors, and outcomes, we hypothesized that structural racism (the independent variable) is positively associated with alcohol and tobacco use (the dependent variables) among African Americans. We further hypothesized that these associations are differentially present among various subgroups of African Americans and that certain participant demographic characteristics (i.e., age, gender, and

income) moderate these associations. The current study has implications for population health. It may be possible to reduce health disparities, specifically in cancer outcomes, by addressing structural racism through multilevel policy and intervention to curtail cancer-causing alcohol and tobacco use behaviors that structural racism is posited to promote.

Definition of terms

Table 1: Definition of key terms

Term	Definition
Discrimination	An unjustified action that harms an individual or group predicated on socially constructed grounds (Abramson et al., 2015; Dovidio et al., 2008)
Health equity	When every person has the opportunity to reach their highest level of potential health (Centers for Disease Control and Prevention, 2022; U.S. Department of Health and Human Services, 2021)
Health inequity	Unfair and avoidable differences in health outcomes across groups, as generated by systematic differences in opportunities to achieve optimum health across those groups (Braveman, 2006; World Health Organization, 2018)
Redlining	The intentional denial of reasonable home loans and the restriction of insurance services within particular communities, often on the basis of racial characteristics of that community (Encyclopaedia Britannica, 2023), a practice especially prevalent in the United States prior to the Fair Housing Act of 1968 (U.S. Department of Housing and Urban Development, 2021)
Structural inequity	Multilevel drivers (e.g., racism, sexism, able-ism, and homophobia) that limit (health) opportunities and outcomes for certain groups, as compared to others (National Academies of Sciences, Engineering, and Medicine, 2017)
Structural racism	How society maintains and promotes racial discrimination through established and interconnected systems (e.g., housing, education, employment, earnings, benefits, credit, media, health care, criminal justice) (Krieger, 2014)

Chapter 2: Literature Review

Defining structural racism

Most empirical research on racial discrimination and health has centered around interpersonal racism and stress associated with unfair treatment among individuals at the personal level (Bailey et al., 2017; Gee & Ford, 2011; Krieger, 2014; Paradies et al., 2015; Reskin, 2012; Williams & Mohammed, 2013). Research at the intersection of racism and health that goes beyond the level of interpersonal experience has comparatively received far less attention. Although understanding the structural roots underlying racial inequalities in the U.S. is critical to addressing these inequalities (Bonilla-Silva, 1997; Feagin & Bennefield, 2014; Ray, 2019; Reskin, 2012), there is a dearth of empirical research on how structural racism influences health and how best to combat it (Bailey et al., 2017; Hardeman et al., 2022). In the late 2010's less than one percent of empirical research studying race and health assessed structural racism as a health determinant (Bailey et al., 2017). While interpersonal racism occurs between individuals, structural racism occurs at a societal level with population-level implications. Still, structural racism has only recently begun to garner more attention in health research.

Structural racism theory posits that structural racism is a ubiquitous compilation of connected systems embedded into the fabric of societal structures and institutions that develops a racial hierarchy causing racial inequalities (Brown & Homan, 2022). Modern thinking also identifies structural racism as a key driver of health inequities

across populations (Gee & Ford, 2011; Hardeman et al., 2016, 2022; Krieger, 2014; Ramaswamy & Kelly, 2015; Reskin, 2012; Yearby & Mohapatra, 2020). Some scientists argue that structural racism has generated and supported segregation, disparities in health care access and quality, unjust inequity in the social determinants of health, and mental, emotional, and even physical injury to minoritized communities that have shaped the health inequities observed today (Alang et al., 2017; Auger et al., 2020; Krieger & Sidney, 1996; Kwate & Goodman, 2015; Laster Pirtle, 2020; Phelan & Link, 2015; Yearby & Mohapatra, 2020).

Structural racism and institutional racism have often been used interchangeably in research and practice; however, these terms have different meanings. While institutional racism is characterized by discriminatory practice and policy through institutions on the basis of race, structural racism supersedes institutional racism and constitutes all the ways society fosters racial discrimination through inequitable and mutually reinforcing systems (Krieger, 2014). This includes discrimination in housing, education, employment, media, health care, criminal justice, and so on (Bailey et al., 2017). Systems of structural racism support patterns and practices of discriminatory thought and action, that promote the inequitable distribution of resources, and that inhibit opportunities for health among minoritized populations. As such, addressing structural racism is a feasible and auspicious method to improve health equity and population health. Indeed, some experts argue that without addressing structural racism, health inequities will persist and gains in population health will be stunted (Bailey et al., 2017).

Beyond defining the construct, operationalizing structural racism in research has proven challenging for researchers due to the deep integration of structural racism into the fabric of society (Bailey et al., 2017; Groos et al., 2018). Structural racism is often operationalized using the observable racial inequalities (e.g., economic, social, political, judicial) that it generates (Brown & Homan, 2022; Lukachko et al., 2014; Merolla & Jackson, 2019; Ray & Seamster, 2016; Wallace et al., 2017). Despite challenges in quantifying structural racism, the body of research on structural racism and health is growing (Bailey et al., 2017).

Measuring structural racism

Measures of racial residential segregation

A systematic review (Groos et al., 2018) identified only 20 quantitative studies that explicitly examined relationships between health and indicators of structural racism between 2007 and 2017. This review also revealed that prior studies on structural racism and health most often employed racial residential segregation (a measure of the spatial distribution of racial groups) as the sole indicator of structural racism. While racial residential segregation has frequently been applied as a measure of structural racism (Bailey et al., 2017; Groos et al., 2018), there are multiple ways in which racial residential segregation has been measured. Some scientists distinguished measures of racial residential segregation from one another based on those that measure diversity within a geographic area (e.g., entropy index and interaction or Simpson index) as compared to those that measure segregation in a region (e.g., index of dissimilarity, Gini Index, Bell's index of isolation, Atkinson

index, and White's spatial proximity measure) (White, 1986). Others instead categorized measures of racial residential segregation based on specific dimensions of measurement. Massey and Denton (1988) described five types of racial residential segregation measurement including evenness – how differently racial groups are distributed in an area (e.g., index of dissimilarity, Gini index, entropy index, and Atkinson index), exposure – how likely different racial groups are to interact in an area (e.g., interaction index and isolation index), concentration – how much space one group occupies in an area as compared to another group (delta index, absolute concentration index, relative concentration index, index of concentration at the extremes), centralization – to what extent a racial group is located near the urban center of an area (e.g., proportion in the central city, relative centralization index, and absolute Centralization index), and clustering – to what extent groupings of a racial group cluster together into a larger overall area (e.g., absolute clustering measures, contiguity index, index of spatial proximity, relative clustering index, distance-based index of dissimilarity, and the distance-decay P-index) (Massey & Denton, 1988). Recently, scientists have argued the need for more comprehensive measures of structural racism beyond measures of residential segregation.

Pathways and dimensions of structural racism

While other single dimension indicators have been applied to measure structural racism in addition to measures of racial residential segregation (e.g., measures of police violence), with the growth in structural racism research in recent years, there has been a push for the development and use of more rigorous, multidimensional measures of structural racism in health research (Adkins-Jackson, Chantarat, et al.,

2021; Brown & Homan, 2022; Chantarat et al., 2021; Dougherty et al., 2020; Gee & Ford, 2011; Groos et al., 2018; Hardeman et al., 2022). Bailey and colleagues (2017), describe several pathways by which structural racism functions. These pathways include economic injustice and social deprivation, environmental and occupational health inequities, psychosocial trauma, targeted marketing of harmful substances, inadequate health care, state-sanctioned violence and alienation from property, political exclusion, maladaptive coping behaviors, and stereotype threats. Within these pathways are underlying dimensions of structural racism (e.g., racial residential segregation under social deprivation and housing discrimination under alienation from property).

Economic injustice and social deprivation are one way in which structural racism is believed to influence health (Acevedo-Garcia et al., 2003; Bailey et al., 2017; Gee & Ford, 2011; Krieger, 2014; Pager & Shepherd, 2008; Williams & Collins, 2001). Examples of economic injustice and social deprivation include segregation (e.g., residential, educational, and occupational) of minoritized populations to lower-quality homes, neighborhoods, schools, and jobs. Other examples include lower pay for the same job and reduced likelihood of promotion despite comparable performance. Environmental and occupational health inequities, for example, the placement of hazardous sites or toxic plants in communities of minoritized populations, unsafe water sources (e.g., Flint, Michigan, which gained mass media attention in 2015), and greater exposure to unsafe or hazardous working conditions among minoritized populations also promote health inequities via structural racism (Adkins-Jackson,

Chantarat, et al., 2021; Bailey et al., 2017; Bravo et al., 2016; Krieger, 2014; Mohai et al., 2009).

Psychosocial trauma such as interpersonal racial discrimination, micro-aggressions, racist media coverage, and racist social media content are other ways for structural racism to influence the health of minoritized populations (Bailey et al., 2017; Berger & Sarnyai, 2015; Krieger, 2014; Paradies et al., 2015; Williams & Mohammed, 2013). Targeted marketing of harmful substances to minoritized groups, such as the prevalence of sugary beverage ads and cigarette ads in minoritized communities also influences health via enacted structural racism (Bailey et al., 2017; Grier & Kumanyika, 2010; Hinton, 2017; Krieger, 2014). Structural racism in the form of inadequate health care, including inadequate health insurance access, inadequate healthcare facilities, and poor medical treatment (e.g., due to racial bias) contribute to poorer health outcomes among minoritized populations as well (Bailey et al., 2017; Blair et al., 2013; Flores & The Committee on Pediatric Research, 2010; Krieger, 2014; Paradies et al., 2015; Shavers et al., 2012; White et al., 2012).

State-sanctioned violence (e.g., police violence) and alienation from property and traditional lands (e.g., gentrification) serve as another path for structural racism to alter health trajectories among populations (Bailey et al., 2017; Chaney & Robertson, 2013; Hinton, 2017; Krieger, 2014). Political exclusion can include a lack of political representation and the promotion of voter restrictions that limit the ability of minoritized populations to obtain political voice and representation that could help address structural failures in health access and opportunities (Bailey et al., 2017; Blessett, 2015; Purtle, 2013). Structural racism can spur maladaptive coping

behaviors such as tobacco use and alcohol consumption, which have been notoriously associated with poor health outcomes (Bailey et al., 2017; Krieger, 2014; Paradies et al., 2015; Williams & Mohammed, 2013). Additionally, stereotype threats promoted through structural racism can promote a stigma of inferiority among minoritized populations (Bailey et al., 2017; Berger & Sarnyai, 2015; Paradies et al., 2015; Williams & Mohammed, 2013). This promotes a fear that the actions of the individual can support negative stereotypes about their group, imposing undue burden and psychological stress with regard to how they believe they are perceived by society.

Multidimensional measurement of structural racism

Recently, research employing measures of multiple dimensions of structural racism has emerged. Recent multidimensional measurement of structural racism often captures three or more domains of structural racism. These applications most often include measures of structural racism enacted through residential segregation, education systems, economic resources or employment, and political participation, home ownership, or judicial treatment. For example, Brown and Homan (2022) measured five dimensions of state-level structural racism including residential segregation, education, economic resources, political participation, and judicial treatment using a scale developed from structural racism indicators present in publicly available data (e.g., Census data). Similarly, Chantarat and colleagues (2021) employed measures of residential segregation and education, employment, economic, and homeownership inequity. Dougherty and team (2020) included measures of education, employment, housing, health care, and judicial treatment to measure

structural racism across various dimensions. Mesic and colleagues (2018) characterized structural racism using five dimensions of structural racism at the state level, including residential segregation, gaps in incarceration rates, educational attainment, economic indicators, and employment status. When examining structural racism it is also important to recall it is built on interconnected systems (Hardeman et al., 2022). That is to go beyond assessing the influence of individual dimensions of structural racism in isolation, but rather, to analyze these dimensions collectively to better capture the nature of structural racism as a network of related systems.

Theory conceptualizing the influence of structural racism on health

Structural racism theory and research posit that structural racism causes racial inequalities (Brown & Homan, 2022; Merolla & Jackson, 2019; Phelan & Link, 2015; Ray & Seamster, 2016) and health inequities across populations (Gee & Ford, 2011; Hardeman et al., 2016, 2022; Krieger, 2014; Ramaswamy & Kelly, 2015; Reskin, 2012; Yearby & Mohapatra, 2020). Structural racism theory in the context of health holds that structural racism generates and supports systems that influence health by way of altering the environment (exposures and opportunities), behaviors, and resources available to racialized populations (Alang et al., 2017; Auger et al., 2020; Krieger & Sidney, 1996; Kwate & Goodman, 2015; Laster Pirtle, 2020; Phelan & Link, 2015; Purtle, 2013; Yearby & Mohapatra, 2020). This notion is supported by ecosocial theory which similarly posits that oppression perpetuated by structural racism presents as political, social, and economic processes that create unequal and unjust life opportunities that then harm the health of the racialized group(s) (Krieger, 2014; Lukachko et al., 2014). Ecosocial theory names these processes “pathways of

embodiment," which include manifestations such as social deprivation, poor living conditions, political exclusion, poor health care, and poorer psychosocial states (Krieger, 2014). These perspectives are also echoed in critical race theory, which emphasizes the deleterious influence of structural conditions at the societal level on the risks, opportunities, and resources presented (or not presented) to minority populations that in turn influence well-being (Gee & Ford, 2011; Sewell, 2016; Williams & Mohammed, 2013).

Bailey and colleagues (2017) summarize the theoretical underpinnings explaining the influence of structural racism on health. There are theorized pathways by which structural racism influences health as described above, including adverse exposures (e.g., physical, social, and economic), promotion of maladaptive coping behaviors (e.g., smoking and alcohol consumption), and stereotype threats (e.g., anxiety associated with a fear of corroborating negative stereotypes about one's racial group through one's own actions or shortcomings). These pathways of influence occur simultaneously and can accumulate over the lifespan. It is even argued that these exposures can be transmitted between generations (Bailey et al., 2017). In the specific case of the maladaptive coping behaviors pathway, it is posited that structural racism perpetuates political, social, and economic systems that worsen conditions and reduce resources available to racialized populations, causing poorer health behaviors (e.g., alcohol and tobacco use). These poor or maladaptive health behaviors in turn contribute to poorer health outcomes among the populations subjected to structural racism. Theory conceptualizing the influence of structural racism on health in context of the current work is summarized in the Figure 1 conceptual model.

Structural racism and health

Structural racism remains present in American culture and is believed to contribute to disparities in health outcomes observed between different racial groups. Though the existing body of research is smaller and more novel, as compared to research on interpersonal racism and health, structural racism has been associated with poorer health outcomes in areas ranging from hypertension (Gao et al., 2022), heart attack (Lukachko et al., 2014), and heart disease (Basile Ibrahim et al., 2021), to COVID-19 (Cai et al., 2021; Tan et al., 2022), depression (Das et al., 2021; Hankerson et al., 2022; Homan & Brown, 2022), and cancer (Blanco et al., 2021; Collin et al., 2021; Eldridge & Berrigan, 2022; Goel et al., 2022; Poulson, Beaulieu-Jones, et al., 2021; Poulson, Blanco, et al., 2021; Poulson, Cornell, et al., 2021; Poulson, Helrich, et al., 2021; Zhou et al., 2017).

Lukachko and colleagues (2014) used a nationally representative survey of non-institutionalized U.S. adults to assess the association between state-level structural racism (i.e., political participation, employment and job status, educational attainment, and judicial treatment) and heart attack. This study found that Black residents from states high in structural racism were more likely to report a heart attack than Black residents living in low-structural racism states. These results controlled for individual age, sex, education, household income, health insurance, and state-level disparities in poverty. Moreover, data suggested that increases in state-level structural racism did not affect, or may have even been beneficial to, White residents in terms of heart attack risk. These findings support the claim that structural racism may not only harm minoritized populations, but benefit populations in power.

Bell and colleagues (Bell et al., 2019) had similar findings in their study linking county-level structural racism with county-level obesity rates. In this study, greater racial inequalities in income, employment, and homeownership were associated with higher rates of obesity in the county. Racial inequalities in income, education, and employment were also associated with reduced presence of grocery stores and greater presence of fast-food restaurants. A more recent study found that neighborhood structural racism (percentage of poverty, percentage of unemployment, percentage of residents >25 years old without a high school diploma, and percentage of residents without access to a vehicle) was associated with high blood pressure and obesity (Basile Ibrahim et al., 2021). In the same study, psychological stress was found to moderate the associations between structural racism and cardiovascular risk.

Dougherty and their team (2020) assessed the association between county-level structural racism (operationalized in factors of housing, education, employment, health care, and criminal justice) and individual BMI (body mass index). This study included 324,572 adults in the U.S. and demonstrated a positive association between structural racism and BMI among Black residents and an inverse association between structural racism and BMI among White residents, controlling for county-level demographics (i.e., age, percentage of the population that was Black, percentage of the population that was female, percentage of the population that lived in rural locations, median income, and geographic region). These findings support the claim that structural racism may not only harm minoritized populations, but benefit populations in power, as a high BMI is generally associated with poorer health outcomes.

Cai and colleagues (2021) determined that nursing homes and communities serving racial minority populations demonstrated greater COVID-19 cases and deaths in nursing home settings, controlling for the COVID-19 infection rate. Tan and colleagues (2022) add to this body of research with a study to empirically test the association between COVID-19 disparities and indicators of structural racism, including county-level residential segregation data, racial disparities in socioeconomic status, and racial disparities in incarceration. They found that indicators of structural racism were associated with greater COVID-19 infection and death due to COVID-19 among Black residents, controlling for county-level demographics, population health, healthcare access, population density, and outbreak duration.

Structural racism has been linked to other health concerns as well. The incidence of HIV has been (human immunodeficiency virus) has been associated with structural racism (Buot et al., 2014). Al Hazzouri and their team (2022) assessed the influence of cumulative exposure to structural racism, as characterized by racial residential segregation experienced in 25 years, on brain size. They found that cumulative exposure to high levels of structural racism was associated with smaller brain volumes, which is believed to indicate worse brain aging. Jacoby and colleagues (2018) have even demonstrated an association between housing discrimination dating back to the 1930s and firearm injury in Philadelphia during 2013-2014, which was found to be most heavily concentrated in ‘redzoned’ sectors from the 1930s that were predominantly Black and low-income. Structural racism has been associated with lower birthweight (Wallace et al., 2015) and greater rates of infant mortality as well

(Bishop-Royse et al., 2021; Wallace et al., 2017). Alvarez (2022) analyzed over 65,000 census tracts and found that states with greater levels of structural racism in housing and employment also had increased outdoor air pollution exposure that contributes to the risk of cancer and respiratory diseases. This work suggests that disparities in air toxin exposure may be linked to systematic inequalities such as those in environmental and housing regulation and design (Alvarez, 2022).

Burden of cancer

Cancer is the second most common cause of death in the U.S., including among African Americans (American Cancer Society, 2022), and similarly has been linked to structural racism. It is estimated that 2 out of 5 people in the U.S. will develop cancer in their lifetimes. There were an estimated 2 million new cases of cancer and over 600,000 deaths due to cancer in the U.S. in 2022. This equates to nearly 1,700 deaths each day due to cancer (American Cancer Society, 2022). Economic costs of cancer are estimated to be nearly 350 billion dollars in the U.S. annually due to healthcare costs, productivity loss, and premature mortality (American Cancer Society, 2019b). However, the burden of cancer is not shared equitably among racial groups. African Americans continue to have worse cancer outcomes when compared to White individuals. African Americans have the highest mortality rate, shortest survival time, and African American men have the highest cancer incidence when compared with any other racial or ethnic group in the U.S. (American Cancer Society, 2019a, 2022). Structural racism has been linked to cancer incidence, treatment, and mortality (Blanco et al., 2021; Collin et al., 2021; Eldridge & Berrigan, 2022; Goel et al., 2022; Poulson, Beaulieu-Jones, et al., 2021; Poulson, Blanco, et al., 2021;

Poulson, Cornell, et al., 2021; Poulson, Helrich, et al., 2021; Zhou et al., 2017) and is believed to be one contributor to persistent disparities in cancer survival between majority and minoritized populations.

Structural racism and cancer

Research empirically examining the relationship between structural racism and cancer has emerged in recent years. Eldridge and Berrigan (2022) sought to examine the association between structural racism and triple-negative breast cancer incidence. They assessed state-level structural racism using the Black to White rate ratios in educational attainment, political participation, incarceration, and unemployment. They found that states with high levels of structural racism had a greater incidence of triple-negative breast cancer among Black and White women, but that odds of triple-negative breast cancer were greater still for Black women when compared to White women when controlling for age and marital status.

Multiple studies have assessed structural racism in the context of breast cancer survival and mortality. Beyer and their team (2016) used a 'redlining' index (a measure of home loan bias based on property location) to assess the association between structural racism and breast cancer survival among women. Redlining is the intentional denial of reasonable home loans and the restriction of insurance services within particular communities, often on the basis of the racial characteristics of that community (Encyclopaedia Britannica, 2023). Redlining was particularly prevalent in the United States prior to the Fair Housing Act of 1968 (U.S. Department of Housing and Urban Development, 2021) Women living in redlined locations were more often Black or Hispanic than White. Greater scores on the redlining index (indicating

greater bias) were associated with all-cause mortality and breast cancer mortality in this study. Similarly, another study sought to examine the role of redlining and lending bias on breast cancer mortality and explored differences by race (Collin et al., 2021). Collin and colleagues (2021) used Georgia Cancer Registry data from 4,943 White and 3,580 Black women with invasive breast cancer diagnoses from 2010–2014. The Home Mortgage Disclosure Act database (Bhutta et al., 2015; Canner et al., 1991) was used for redlining and lending bias data. Four times as many Black women in the study lived in redlined sectors, as compared to White women, and over twice as many White women lived in sectors with high lending bias. Women living in redlined sectors were more than 1.5 times as likely to die from breast cancer while women living in high lending bias sectors demonstrated a lower risk of mortality when controlling for stage of breast cancer and age of the patient.

Another study assessed the role of racial residential segregation in breast cancer-specific survival in Florida (Goel et al., 2022). This retrospective cohort study of breast cancer patients from 2005 to 2017 used the index of concentration at the extremes to demonstrate that patients living in low-income neighborhoods had higher mortality when compared to patients in high-income neighborhoods, controlling for patient demographic characteristics, including age, comorbidities (hypertension, diabetes, and coronary artery disease), tumor type, and treatment type. These results were magnified for those living in low-income minority (Black or Hispanic) neighborhoods, demonstrating that racial/ethnic and economic segregation are associated with poorer breast cancer survival, independent of age, comorbidities, and tumor and treatment types. Poulson has studied structural racism in the context of

various cancers, including breast cancer, using Surveillance, Epidemiology, and End Results program data. Poulson and their collaborators have found that residential racial segregation is positively associated with increased racial disparities in: 1) breast cancer stage at diagnosis and chance of death between Black and White patients (Poulson, Beaulieu-Jones, et al., 2021), 2) liver cancer stage at diagnosis and chance of death between Black and White patients (Poulson, Blanco, et al., 2021), 3) racial disparities in pancreatic cancer outcomes (Blanco et al., 2021), 4) chance of death due to prostate cancer between Black and White patients (Poulson, Helrich, et al., 2021), and 5) racial disparities in colorectal cancer stage at diagnosis and chance of death between Black and White patients (Poulson, Cornell, et al., 2021).

Zhou and colleagues (2017) also studied the association between racial bias in mortgage lending (housing discrimination), segregation, and colorectal cancer survival in Wisconsin. They found that racial bias in mortgage lending was associated with poorer colorectal cancer survival in areas with greater racial bias in mortgage lending. Black women, especially, had poorer colorectal cancer survival in this analysis. These analyses controlled for individual-level demographics (e.g., age, sex, and cancer stage at diagnosis) and neighborhood level variables (i.e., local population density and socioeconomic status) Abraham and colleagues (2022) performed a survival analysis study among leukemia patients and found poorer chances of survival up to two years among Black patients when compared to non-Hispanic White patients, controlling for age, sex, and study site from which the participant was recruited. They then performed mediation analyses and found that structural racism,

as characterized by census tract disadvantage, explained most of the observed racial disparities in leukemia death.

Recently, Annesi and their team (2022) assessed the association between residential segregation and disparities in non-small cell lung cancer treatment and mortality. The study included 193,369 White and 35,649 Black patients. Similar to other studies, in areas with greater residential segregation, Black patients were more likely to be diagnosed with advanced-stage cancer, less likely to receive adequate treatment, and more likely to die, as compared to White patients. Disparities between Black and White patients were not observed for communities with less residential segregation (Annesi et al., 2022). While some existing research, as described, has investigated associations between indicators of structural racism and cancer-related outcomes (e.g., incidence and mortality), there is limited empirical research investigating the pathways explaining this relationship and how to mitigate this relationship. As per theory described above, one pathway likely contributing to the association observed between structural racism and cancer health outcomes is the promotion of maladaptive health behaviors such as alcohol and tobacco use, which have consistently been associated with cancer outcomes including incidence and mortality.

Alcohol consumption and cancer

There is strong evidence to support alcohol consumption as a risk factor for cancer outcomes across a variety of cancer sites (Bagnardi et al., 2001, 2015; Longnecker, 1994). A meta-analysis of 38 studies demonstrated a highly significant positive dose-response relationship between alcohol use and breast cancer

(Longnecker, 1994). In this study, women consuming one alcoholic drink per day had an 11% increased breast cancer risk when compared with women that abstained from drinking. A later meta-analysis of 235 studies assessed the association between alcohol consumption and the risk of various types of cancer (Bagnardi et al., 2001). Results suggested a positive association between drinking behaviors and oral, pharyngeal, esophageal, laryngeal, stomach, colorectal, liver, breast, and ovarian cancers. A more recent meta-analysis of 572 studies amounting to 486,538 cases, assessed the association between alcohol and risk for 23 types of cancer (Bagnardi et al., 2015). This study supported previous findings, demonstrating associations between drinking behavior and cancer of the oral cavity, pharynx, esophagus, colorectal and rectum, larynx, breast, stomach, and liver. However, this study also identified a greater risk of gallbladder, pancreatic, and lung cancers among heavy drinkers. Data trends in this analysis also suggest a potential positive association between drinking and melanoma and prostate cancer risk.

Structural racism and alcohol availability and consumption

Limited research has empirically investigated the relationship between structural racism and alcohol consumption. However, recent work has demonstrated a positive association between structural racism and the availability of alcohol. One study assessed the association between the index of isolation (a measure of residential segregation) and the presence of alcohol retailers. This study found higher concentrations of alcohol outlets in the Black neighborhoods of more highly segregated counties of Alabama and Louisiana (Scott et al., 2020). Another recent study employed the Index of Concentration at the Extremes (ICE; a measure of racial

and economic segregation) to assess the association between structural racism and the presence of alcohol and tobacco retailers (Kong et al., 2022). As expected, neighborhoods with the highest segregation had the greatest number of alcohol retailers. Regarding alcohol consumption, a recent qualitative study of 24 Latinx participants with a history of depression and anxiety symptoms sought to understand participant experiences of structural racism. Participants of this study raised concerns regarding structural barriers impeding their lives such as limited educational support and inaccessibility of needed aid/assistance programs (Lee et al., 2021). Participants identified exclusion (e.g., social and political) and discriminatory practices as contributors to their mental health concerns and drinking as a way to cope with these mental health concerns. While some evidence exists to suggest an association between structural racism and alcohol availability and use, research examining the association between structural racism and alcohol consumption behaviors is limited.

Tobacco use and cancer

As with alcohol, there is strong evidence to support tobacco use as a risk factor for various cancers, including, but not limited to respiratory cancers (Botteri et al., 2008; Gandini et al., 2008; Macacu et al., 2015; Phua et al., 2022). A meta-analysis of 106 studies assessing the association between cigarette smoking and colorectal cancer demonstrated positive dose-response relationships between the variables when tobacco use was measured in terms of pack-year smoking history and when smoking was measured as cigarettes per day (Botteri et al., 2008). These findings suggest that as cigarette use increases, the odds of being diagnosed with colorectal cancer increase as well. The same study identified 17 studies for inclusion in a separate analysis of

colorectal cancer mortality. Similarly, the pooled analyses yielded a positive association between smoking behaviors and colorectal cancer mortality, suggesting that those who smoke are at greater risk of death due to colorectal cancer.

A meta-analysis of smoking and breast cancer demonstrated positive associations between smoking behavior and breast cancer risk, suggesting a greater risk of breast cancer among people who have smoked. This work even demonstrated a greater risk of breast cancer among women who had been exposed to second-hand smoke throughout their life (Macacu et al., 2015). Another meta-analysis assessed the association between smoking and risk for 13 different types of cancer. This analysis included 216 studies and concluded that tobacco smoking was positively associated with all 13 cancer types included, except for myeloid leukemia. Tobacco smoking was associated with the risk of lung, laryngeal, pharyngeal, digestive tract, oral, nasal, esophageal, stomach, liver, pancreatic, cervical, and kidney cancers (Gandini et al., 2008). Second primary cancers (SPCs) are new cancers that develop in people who have had cancer before (National Cancer Institute, 2011). An SPC can be diagnosed shortly after the original cancer or could take years to develop. In line with prior research, a recent meta-analysis of the association between cigarette use and SPCs found that current and former smokers are at an increased risk of SPCs, as compared to people who have never smoked (Phua et al., 2022).

Structural racism and tobacco availability and use

As with alcohol, limited empirical research has investigated the relationship between structural racism and tobacco use. However, following alcohol outlet distribution, research suggests tobacco outlets are similarly more highly concentrated

among more racially disadvantaged Black neighborhoods. It is estimated that disadvantaged Black neighborhoods have as much as three times the number of tobacco retailers when compared to neighborhoods with the least disadvantage (Kong et al., 2022). Similar findings were presented in a study of 13 Ohio cities that demonstrated a greater presence of tobacco outlets in neighborhoods historically subjected to the discriminatory practice of systematic redlining (Schwartz et al., 2021). The current existence of health disparities based on intentional practices from before the 1970s demonstrates the long-term impact of structural racism in communities that have been perpetually subjected to it. It is posited that tobacco policy (such as policies regarding tobacco outlets) and the differential enforcement of policies contribute to structural racism and specifically to observed race-based differences in tobacco use behaviors (Breland et al., 2022). While some research suggests an association between structural racism and tobacco availability, there is an existing need for empirical research examining association between structural racism and tobacco use behaviors.

Chapter 3: Study 1 – The association between state-level structural racism and alcohol and tobacco use behaviors among a national probability sample of African Americans

Abstract

Structural racism is how society maintains and promotes racial discrimination through established and interconnected systems. Structural racism is believed to influence maladaptive coping behaviors, such as alcohol and tobacco use, that in turn contribute to observed health inequities, such as those in cancer-health outcomes. However, there is limited empirical research investigating the association between structural racism and alcohol and tobacco use behaviors. The current study assesses the association between measures of structural racism and alcohol and tobacco use among African Americans. This study is a secondary analysis of self-report data from a national sample of 1,946 African Americans in the Religion and Health in African Americans (RHIAA) Study. Existing state-level measures of structural racism were merged into the RHIAA dataset including a composite index of structural racism and five dimensional measures (subscales) of structural racism (i.e., residential segregation, and employment, economic, incarceration, and educational inequities). Hierarchical linear and logistic regression models accounting for participant clustering at the state level assessed the associations between structural racism and frequency of alcohol use, frequency of binge drinking, smoking status, and smoking frequency. Two statistical models were constructed for each behavioral outcome, one using the composite structural racism index and one modeling measured dimensions

of structural racism in lieu of the composite measure, each controlling for individual-level covariates. Results indicated statistically significant positive associations between the composite structural racism index and binge drinking behaviors, an inverse association between the education dimension and current smoking status, and positive association between the incarceration dimension and binge drinking frequency, smoking status, and smoking frequency. Results suggest that state-level structural racism, particularly that expressed in the incarceration dimension, is positively associated with alcohol and tobacco use behaviors among African Americans. Future research should carefully consider dimension-level measurement and analysis when seeking to quantify the influence of structural racism on health outcomes. Addressing structural racism through multilevel policy and intervention may be auspicious methods to reduce population-level alcohol and tobacco use behaviors and improve health outcomes among African Americans.

Introduction

Background

Structural racism

Structural inequities have critical population-wide implications. Structural inequities are multilevel drivers (e.g., racism, sexism, able-ism, and homophobia) that inhibit opportunities and outcomes among a group or groups (National Academies of Sciences, Engineering, and Medicine, 2017). These structural inequities contribute considerably to economic loss. For example, gender and race disparities in the labor market cost the U.S. an estimated 2.5 trillion dollars in 2019 (Buckman et al., 2021).

But these inequities also widen gaps between the health of majority and minoritized populations (Bailey et al., 2017; Homan, 2019; Homan et al., 2021; Lee et al., 2022; McAllister et al., 2018).

Structural racism is one type of structural inequity that serves as a driver of health inequities across populations. Structural racism is how society maintains and promotes racial hierarchy and discrimination through established and interconnected systems (e.g., housing, education, employment, earnings, benefits, credit, media, health care, and criminal justice) (Brown & Homan, 2022; Krieger, 2014). These systems of society encourage discriminatory thoughts and action, inequitable distribution of resources, and limit opportunities that could improve the health of racialized populations by establishing and maintaining patterns and practices that disadvantage those populations. These discriminatory and inequitable practices repeated for centuries ultimately affect the health of different groups differently and contribute to the persistent inequities present between racial groups today (Gee & Ford, 2011; Hardeman et al., 2016, 2022; Krieger, 2014; Ramaswamy & Kelly, 2015; Reskin, 2012; Yearby & Mohapatra, 2020). As such, opposing, eliminating, and aiding populations to recover from structural racism can promote health equity and improve population health. If structural racism is not addressed, health inequities will continue to persist, and progress toward improving the overall health of the population will continue to be hindered (Bailey et al., 2017).

Theories of structural racism and health

Structural racism theory and research suggest that structural racism causes racial inequalities (Brown & Homan, 2022; Merolla & Jackson, 2019; Phelan & Link, 2015;

Ray & Seamster, 2016) and in turn generates health inequities across groups of people (Gee & Ford, 2011; Hardeman et al., 2016, 2022; Krieger, 2014; Ramaswamy & Kelly, 2015; Reskin, 2012; Yearby & Mohapatra, 2020). Structural racism theory asserts that structural racism creates and maintains systems of health determinants by altering environmental conditions, exposures, opportunities, behaviors, psychosocial conditions, and resources in a way that contributes to poorer health outcomes among racialized populations (Alang et al., 2017; Auger et al., 2020; Krieger & Sidney, 1996; Kwate & Goodman, 2015; Laster Pirtle, 2020; Phelan & Link, 2015; Purtle, 2013; Yearby & Mohapatra, 2020). Similarly, ecosocial theory posits that structural racism perpetuates oppression in the forms of political, social, and economic systems that create unequal and unjust life opportunities, harming racialized groups and impeding their health (Krieger, 2014; Lukachko et al., 2014). Ecosocial theory describes these systems and their resulting patterns as "pathways of embodiment." Social deprivation, poor living conditions, political exclusion, poor health care, and poorer psychosocial states are some examples of how these pathways of embodiment manifest in discernable differences between groups (Krieger, 2014). Critical race theory also emphasizes the harmful effects of racially driven structural conditions, asserting that these conditions are responsible for the risks, opportunities, and resources presented (or not presented) to racialized populations that in turn affect the well-being of those populations (Gee & Ford, 2011; Sewell, 2016; Williams & Mohammed, 2013).

Theory seeking to explain the association between structural racism and health can be summarized in the pathways by which structural racism influences health,

including adverse exposures (e.g., physical, social, and economic), promotion of maladaptive coping behaviors (e.g., smoking and alcohol consumption), and stereotype threats (e.g., anxiety associated with a fear of corroborating negative stereotypes about one's racial group through one's actions or shortcomings) (Bailey et al., 2017). Each pathway can occur simultaneously, accumulate over the lifespan, and may be transferred to subsequent generations. With regard to maladaptive coping behaviors, structural racism creates and maintains political, social, and economic systems that subvert the environmental and psychosocial conditions, exposures, opportunities, and resources available to racialized groups and promote poorer health behaviors (e.g., alcohol and tobacco use). These poorer health behaviors then cause poorer health outcomes among populations afflicted by structural racism.

To appropriately apply theory, there is a need to employ sound measures of structural racism to promote rigorous empirical study as the structural racism and health research area continues to grow (Adkins-Jackson, Legha, et al., 2021; Gee & Ford, 2011). Structural racism has frequently been measured using indicators of residential segregation (Massey & Denton, 1988; White, 1986). However, current thinking emphasizes the importance of measuring multiple aspects or dimensions of structural racism, including, but not limited to residential segregation (Adkins-Jackson, Legha, et al., 2021; Chantarat et al., 2021; Dougherty et al., 2020; Gee & Ford, 2011; Hardeman et al., 2022; Homan & Brown, 2022). Measuring structural racism using multiple dimensions often incorporates three or more domains, but there is considerable variability in how multidimensional measurement of structural racism occurs, including which dimensions are assessed and how they are assessed.

Structural racism and health research

Empirical research at the intersection of racial discrimination and health has frequently emphasized personal experiences of racism and discrimination (interpersonal racism) and resulting stress for the individual (Bailey et al., 2017; Gee & Ford, 2011; Krieger, 2014; Paradies et al., 2015; Reskin, 2012; Williams & Mohammed, 2013). Structural racism and health has generated far less research by comparison. Understanding the structural mechanisms perpetuating racial disparities is imperative to addressing racial inequity (Bonilla-Silva, 1997; Feagin & Bennefield, 2014; Ray, 2019; Reskin, 2012), yet there is a paucity of research empirically assessing the role of structural racism in health outcomes and how best to mitigate it (Bailey et al., 2017; Hardeman et al., 2022). In the late 2010s, less than one percent of empirical race and health research measured structural racism as a determinant of health (Bailey et al., 2017). Structural racism is a societal-level outcome with population-level health implications, yet, the empirical study of structural racism and health is a young area of research, only recently receiving greater attention. While the structural racism literature is less developed when compared to interpersonal racism and health research, research has demonstrated associations between structural racism and poorer health outcomes including hypertension (Gao et al., 2022), heart attack (Lukachko et al., 2014), and heart disease (Basile Ibrahim et al., 2021), to COVID-19 (Cai et al., 2021; Tan et al., 2022), depression (Das et al., 2021; Hankerson et al., 2022; P. A. Homan & Brown, 2022; Moise & Hankerson, 2021), and cancer (Blanco et al., 2021; Collin et al., 2021; Eldridge & Berrigan, 2022; Goel et al., 2022;

Poulson, Beaulieu-Jones, et al., 2021; Poulson, Blanco, et al., 2021; Poulson, Cornell, et al., 2021; Poulson, Helrich, et al., 2021; Zhou et al., 2017).

Structural racism and cancer

Cancer is the second most common cause of death in the U.S. (American Cancer Society, 2022). It is estimated that 2 out of every 5 Americans develop cancer within their lifetime. There were roughly 2 million new cancer cases and more than 600,000 deaths due to cancer in the U.S. in 2022 alone (American Cancer Society, 2022). However, the burden of cancer does not affect all people equally. For example, Black individuals in the U.S. continue to have worse cancer survival rates when compared to White individuals (American Cancer Society, 2023). Research has linked structural racism to cancer incidence, cancer treatment, and cancer mortality (Blanco et al., 2021; Collin et al., 2021; Eldridge & Berrigan, 2022; Goel et al., 2022; Poulson, Beaulieu-Jones, et al., 2021; Poulson, Blanco, et al., 2021; Poulson, Cornell, et al., 2021; Poulson, Helrich, et al., 2021; Zhou et al., 2017). Structural racism is now recognized for its role in persistent disparities in cancer survival among Black populations. However, there is a shortage of empirical research investigating associations between structural racism and cancer risk and prevention behaviors that influence cancer health outcomes. One opportunity for research is in assessing the relationship between structural racism and common cancer risk behaviors such as alcohol and tobacco use.

Alcohol, tobacco, and structural racism

Meta-analyses have identified alcohol consumption as a risk factor for various types of cancer (Bagnardi et al., 2001, 2015; Longnecker, 1994), and similar findings have been observed for tobacco and cancer, including but not limited to those of the respiratory system (Botteri et al., 2008; Gandini et al., 2008; Macacu et al., 2015; Phua et al., 2022). While theory posits that structural racism promotes maladaptive coping behaviors such as alcohol and tobacco use that contribute to poor health outcomes like cancer (Bailey et al., 2017), empirical investigation of the association between structural racism and alcohol and tobacco use is lacking. However, existing research does imply that a significant association between structural racism and alcohol and tobacco use may exist.

Prior study has demonstrated associations between structural racism and the availability of alcohol and tobacco with a higher concentration of alcohol and tobacco retailers in more highly segregated and otherwise disadvantaged communities (Kong et al., 2022; Schwartz et al., 2021; Scott et al., 2020). The increased availability of alcohol and tobacco in more racialized communities may suggest, and even promote, increased usage of these products in those communities. Additionally, Latinx participants have cited the impact of structurally racist and discriminatory practices (e.g., social and political exclusion) on their mental health, while identifying alcohol consumption as a coping method for these mental health concerns in a recent qualitative study (Lee et al., 2021). While some existing research suggests a link between structural racism and alcohol and tobacco use behaviors, there is a need for

empirical research examining the associations between structural racism and alcohol and tobacco use behaviors.

The current study

The current study employs a multidimensional measure of state-level structural racism to assess the relationship between structural racism and alcohol and tobacco use behaviors among a national probability sample of African Americans. Based on existing research and theory regarding structural racism and health, we hypothesized that structural racism would be positively associated with alcohol and tobacco use behaviors among African Americans. This work has implications for future health policy and intervention intended to address health disparities.

Methods

Sampling procedures

The current study is a secondary analysis of self-report data collected from a national probability sample of African Americans in the Religion and Health in African Americans (RHIAA) Study (Clark et al., 2018; Holt, Le, et al., 2015; Roth et al., 2012). Eligible participants were African Americans living in the U.S., who spoke English, and who were age 21 or older at the time of data collection. A professional sampling firm generated a call list of households from the 50 States in the U.S. using probability-based methods in 2010 to collect the data. Home phone numbers for these households were obtained from publicly available data (e.g., motor vehicle records). The response rate (i.e., number of individuals responding/number of individuals contacted) was 22% (Debnam et al., 2012). Data reflecting a racism index at the state

level (Mesic et al., 2018) were merged into the RHIAA dataset based on participants' state of residence.

Measures

State-level structural racism index

Structural racism was captured using an existing state-level structural racism index (Mesic et al., 2018) assessing five dimensions of structural racism, captured using nine state-level indicators that were merged into the RHIAA dataset. With the exception of the residential segregation measures, each indicator was measured using each state's ratio of Black to White resident values. These ratios are rescaled from 0 to 100 assigning the maximum ratio a score of 100, the minimum ratio a score of 0, and each value in between a corresponding score between 0 and 100. The score within each dimension is calculated as the average of the scores for each component within that dimension. The structural racism dimensions include: (1) residential segregation; and gaps in (2) incarceration rates; (3) educational attainment; (4) economic indicators; and (5) employment status (Mesic et al., 2018). The overall state racism index score is calculated by averaging scores from the five dimensions of the index. This index was developed by adapting previous state-level measures of structural racism (Lukachko et al., 2014; WalletHub, 2017) to include measures of residential segregation, in consideration of the conceptual validity of the previous measures, and considering the availability of state-level data. The five dimensions of the structural racism index and the state-level measures constituting them are further described below and in Supplemental Table 1.

Residential segregation

Residential segregation is measured using the average of the index of dissimilarity (Iceland et al., 2002; Krieger et al., 2017; Mesic et al., 2018) and the isolation index (Iceland et al., 2002; Mesic et al., 2018). The index of dissimilarity measures the differential distribution of two groups. In the context of Black and White populations, the index of dissimilarity translates to the percentage of Black people that would have to move to achieve an equal distribution of Blacks and Whites across all blocks within a state (Mesic et al., 2018). Possible values on this measure range from 0 to 100, with higher values indicating greater spatial segregation by race. The dissimilarity index for Black vs. White populations in each state is calculated using 2010 U.S. Census data (U.S. Census Bureau, 2010).

The isolation index measures the spatial isolation of one group from another. In the context of Black populations, the isolation index measures the extent to which Black residents are exposed to other Black residents (Mesic et al., 2018). Possible values on this measure range from 0 to 100, with higher values indicating greater spatial isolation among Black residents. The isolation index for the Black vs. White populations in each state is calculated using 2010 U.S. Census data (U.S. Census Bureau, 2010).

Employment Disparity Index

The employment disparity index is the average of two parts including non-labor force participation and unemployment (Mesic et al., 2018). Possible values on this measure range from 0 to 100, with higher values indicating greater disparities in employment between Black residents and White residents. Non-labor force

participation is the ratio of the proportion of Black residents not participating in the labor force as compared to the proportion of White residents not participating in the labor force rescaled to a range of 0-100, as described above. Unemployment is characterized as the ratio of the proportion of unemployed Blacks compared to the proportion of unemployed Whites for each state, again, rescaled to a range of 0-100. Non-labor force participation and unemployment were calculated using 2010 U.S. Census data (U.S. Census Bureau, 2010).

Economic Disparity Index

The economic disparity index is the average of three parts, the poverty status gap ratio, the median annual household income gap, and the rental housing percent gap (Mesic et al., 2018). Possible values on this measure range from 0 to 100, with higher values indicating greater economic disparities between Black and White residents. The poverty status gap ratio is characterized by the Black-White gap in the proportion of people living under the poverty level rescaled to a range of 0-100. The median annual household income gap represents the Black-White gap in median household income, as defined by White income divided by Black income and rescaled to a range of 0-100. Finally, the rental housing percent gap represents the Black-White gap in the proportion of the population that rents housing as opposed to owning their home, which was then rescaled to a range of 0-100. The poverty status gap ratio, median annual household income gap, and rental housing percent gap were calculated using 2010 U.S. Census data (U.S. Census Bureau, 2010).

Incarceration rate gap

The incarceration rate gap represents the ratio of the incarceration rates among Blacks as compared to those among Whites in a state rescaled to a range of 0-100 (Mesic et al., 2018). Higher values indicate greater rates of incarceration among Black residents as compared to White residents. The incarceration rate gap is calculated using 2010 U.S. Census (U.S. Census Bureau, 2010) and U.S. Bureau of Justice Statistics data (Bureau of Justice Statistics, 2013).

Educational attainment gap

The educational attainment gap is characterized by the ratio of the proportion of Black residents with no college degree as compared to the proportion of White residents with no college degree within a state rescaled to a range of 0-100 (Mesic et al., 2018). Higher values indicate greater gaps in educational attainment between Black and White residents. This measure was calculated using 2010 census data (U.S. Census Bureau, 2010).

Alcohol and tobacco use behaviors

Established items based on the Behavioral Risk Factor Surveillance System (BRFSS) were used to assess alcohol use (Holt, Roth, et al., 2015). Previous study has demonstrated sound test–retest reliability of the BRFSSS among African American respondents (Stein et al., 1993). Alcohol use data were collected as dichotomous use in the last 30 days (yes, have used and no, have not used) with subsequent items for respondents that indicated use in the previous 30 days. Participants that had consumed alcohol in the previous 30 days then responded to

items assessing the frequency of alcohol consumption ("During the past 30 days, how many days per month did you have at least one drink of any alcoholic beverage?") and frequency of binge drinking ("Considering all types of alcoholic beverages, how many times during the past 30 days did you have X [X=4 drinks for women; 5 drinks for men] or more drinks on an occasion?") behaviors. Similarly, tobacco smoking behaviors were assessed dichotomously ("Have you smoked at least 100 cigarettes in your entire life?") with a subsequent item for participants that reported a history of smoking to assess how often they smoked at the time of their response ("Do you now smoke cigarettes every day, some days, or not at all?"). Two new variables were constructed from these two smoking items to reflect whether the participant currently smoked (current smoking status; yes or no) and a four-category smoking frequency variable (never smoked, former smoker, currently smoke some days, and currently smoke every day).

Demographics

A standard demographic module assessed participant characteristics including gender, age, relationship status, educational attainment, work status, and household income before taxes.

Data analysis

Of the 2,370 participants in the RHIAA-I project, 1,946 that responded to items about alcohol and tobacco use behaviors and provided residential information for geocoding were included in the current study assessing the association between state-level structural racism and alcohol and tobacco use behaviors. Descriptive statistics

were calculated to summarize the demographic composition of the sample (e.g., means and standard deviations or frequency and percentages) and distributions of study measures (i.e., state racism indices and alcohol and tobacco use behaviors). Pearson's bivariate correlations were performed between all study variables to form an initial understanding of how these variables relate to one another in the current dataset. All descriptive and bivariate analyses were performed in SPSS version 28 with a statistical significance threshold of $p < .05$.

Multilevel modeling

Multilevel analyses accounting for state-level clustering were performed in SPSS Version 28 via multilevel linear (for the continuous outcomes of drinking days per month and binge drinking events per month), binomial (for the dichotomous outcome of current smoking status), and multinomial (for the four-category smoking frequency outcome) regression analyses, controlling for participant age, education, income, gender, and employment status with a statistical significance threshold of $p < .05$. Two models were estimated for each of the four outcomes, one using the structural racism index composite measure as the independent variable, and another including four of the five dimensions of the structural racism index (segregation, economic, incarceration, and education; the employment dimension was removed from this model due to multicollinearity concerns between the employment and other dimensions) as the independent variables.

Results

Per the eligibility criteria of the RHIAA project, all participants in the current study self-identified as African American. The mean age of participants was 53.08 (SD =14.48) and 1199 (61.6%) participants were women (see Table 1). Just over half (50.7%) of the participants had a gross household income of over $30,000 and over half (56.5%) had attended a college or technical school. A sizable portion of the sample was retired (24.5%) and less than half of participants were working full-time (40.5%). The mean number of reported drinking days per month was 3.01 (SD=5.98) and the mean number of binge drinking events per month was .59 (SD=2.58). Over half (56.3%) of the current sample had never smoked cigarettes, 20.9% were former smokers who had quit, and the remaining 22.8% were current smokers at the time of data collection. Sample representation by state and state racism index and dimensional scores by state are presented in Table 2 and Table 3, respectively.

Table 4 presents the correlation matrix for variables included in the current analysis. Correlations between the structural racism index and its dimensions were all significant with varying magnitudes of association ranging from -.06 to .90. Additionally, each measure of structural racism demonstrated statistically significant positive correlations with at least one alcohol or tobacco use outcome, with the exception of the segregation index. Each of the alcohol and tobacco use outcomes was also positively associated with one another to varying magnitudes of association.

Multilevel modeling

Drinking days per month

Neither multilevel linear model estimating the number of participant drinking days per month demonstrated any significant associations between structural racism and drinking days per month ($p>.05$; controlling for the covariates age, gender, employment, income, and education; see Table 5 and Table 6). The lack of significant findings in these multilevel models mirror those in the bivariate analyses. These results suggest that no significant relationship exists between state-level structural racism assessed via the composite measure or the four dimensions (segregation, economic, incarceration, and education) and drinking days per month among participants in the current sample of African Americans.

Binge drinking events per month

The multilevel linear model using the state-level structural racism composite measure to estimate the number of binge drinking events per month demonstrated a statistically significant association between the two variables ($p=.04$; controlling for the covariates age, gender, employment, income, and education; see Table 7). The estimate indicates that for a 10-point increase in the state-level structural racism composite measure, the expected number of binge drinking events per month increases by .20 occasions. This suggests an estimated difference of .74 more binge drinking events per month or 8.88 more binge drinking events per year between participants in the states with the highest and lowest scores on the structural racism

index (scores on the state-level structural racism index ranged from 34.34 to 71.34 among states represented in the current analysis).

The second model of binge drinking events demonstrated statistical significance for the incarceration dimension of structural racism ($p<.01$) and did not demonstrate significance for any of the remaining structural racism dimensions. These results indicate that for every 10-point increase in the incarceration dimension of the state-level structural racism index, the expected number of binge drinking events per month increases by .10 occasions, controlling for the other dimensions of structural racism and the individual-level covariates (see Table 8). This suggests an estimated difference of .78 more binge drinking events per month or 9.34 more binge drinking events per year between participants in the states with the highest and lowest scores on the incarceration dimension of the structural racism index (scores on the incarceration dimension ranged from .08 to 77.92 among states represented in the current analysis).

Current smoking status

The first multilevel binomial logistic model using the state-level structural racism composite measure to estimate participant smoking status did not demonstrate a statistically significant association between the composite index and smoking status ($p=.20$; controlling for the covariates age, gender, employment, income, and education, see Table 9). The incarceration and education dimensions of structural racism both demonstrated statistical significance in the second model including the four dimensional measures of structural racism. The results for this model suggest that for every 10-point increase in structural racism measured via the incarceration

dimension, the odds of being a current smoker as compared to being a non-smoker are multiplied by 1.10, (p=.03; see Table 10), and for every 10-point increase in structural racism measured via the education dimension, the odds of being a current smoker as compared to being a non-smoker are multiplied by .90 (p=.03; see Table 10). This equates to an estimated 2.17 times the odds of being a current smoker for participants in the state with the highest levels of structural racism in incarceration as compared to states with the lowest levels (scores on the incarceration dimension of structural racism ranged from .08 to 77.92 among states represented in the current analysis) and an estimated .37 times the odds of being a current smoker for participants in the state with the highest levels of structural racism in education as compared to states with the lowest levels (scores on the education dimension of structural racism ranged from 0 to 100 among states represented in the current analysis).

Smoking frequency categorization

The first multinomial logistic regression model for the smoking frequency categorization outcome (never smoked, former smoker, currently smoke some days, and currently smoke every day) did not demonstrate a statistically significant association between the composite structural racism measure and smoking frequency categorization (see Table 11). The incarceration dimension was the only dimension of the four to demonstrate statistical significance in the second model. This model demonstrated statistically significant associations when comparing never-smokers to former smokers (p=.03) and current everyday smokers (p=.01). Results suggest that for every 10-point increase in structural racism in incarceration, the odds of being a

former smoker are multiplied by 1.10 and the odds of being an everyday smoker are multiplied by 1.22, when compared to the reference group of never-smokers (see Table 12). This equates to 2.17 times the odds of being a former smoker and 4.67 times the odds of being an everyday smoker for participants in the state with the highest levels of structural racism in incarceration as compared to states with the lowest levels (scores on the incarceration dimension of structural racism ranged from .08 to 77.92 among states represented in the current analysis).

Discussion

The current study used multilevel regression modeling to test the associations between state-level indicators of structural racism and alcohol and tobacco use behaviors among African Americans, which, to the author's current knowledge, has not been empirically studied prior. Bivariate analyses detected statistically significant positive correlations between structural racism measures (structural racism index score, employment index score, economic index score, and incarceration gap score) and maladaptive coping behavior outcomes of interest (drinking days per month, binge drinking events per month, current smoking status, and smoking frequency). These bivariate analyses generally suggest that as state-level structural racism increases, so too do alcohol and tobacco use among African Americans. Multilevel modeling permits a more rigorous investigation of these bivariate associations, accounting for state-level clustering of participants and controlling for individual-level covariates (age, gender, employment status, household income, and educational attainment).

In the current multilevel models, no indicators of structural racism were significantly associated with participant drinking days per month. While the composite index of state-level structural racism was positively associated with participant binge drinking, smoking status, and smoking frequency in the bivariate analyses, the association between the composite measure and binge drinking was the only one to maintain statistical significance in the multilevel models. In isolation, these findings would suggest that state-level structural racism may not be associated with tobacco use behaviors. However, subsequent multilevel analyses replacing the composite measure of structural racism with four of its dimensions (segregation, economic, incarceration and education), suggest that different indicators of structural racism may be significantly associated with different alcohol and tobacco use behaviors.

The education dimension of state-level structural racism was inversely associated with participant smoking status in the bivariate and multilevel analyses, suggesting that participants in states with greater structural racism in education would be less likely to be current smokers than participants in states with less structural racism in education. This finding is counter to our hypothesis and what previous research and theory would suggest. Additionally, there was no significant association between the education dimension and smoking frequency. Interestingly, the education dimension was also the only measure of structural racism to demonstrate inverse associations with any of the other structural racism measures and was the only structural racism measure inversely associated with any of the alcohol and tobacco use measures in the bivariate or multilevel analyses. Given the lack of existing research and theory to

support this finding and inverse associations between the education dimension and other measures of structural racism in the current study, careful scrutiny ought to be given to this particular finding.

The incarceration dimension was positively associated with participant binge drinking, smoking status, and smoking frequency, even after controlling for three other dimensions of structural racism and the individual level covariates (i.e., individual age, gender, employment, income, and education) included in the multilevel models. This makes the incarceration dimension the measure of structural racism most frequently associated with alcohol and tobacco use behaviors in the current analysis. This may suggest that structural racism in incarceration is a particularly salient construct contributing to racial disparities in alcohol and tobacco use and resulting health outcomes. Existing theory suggests that mass incarceration, especially of Black individuals, has deteriorated and continues to undermine Black communities (Sampson & Wilson, 1995). Many African Americans may use alcohol and tobacco as ways to cope with their everyday experiences of structural racism, including that expressed in incarceration and criminal justice practices in the U.S. (Bailey et al., 2017).

Mass incarceration contributes to the deterioration of social capital and support in Black communities by removing community members from the neighborhood, breaking up families, and otherwise limiting the human resources, capital, and support available in Black communities (Sampson & Wilson, 1995). Structural racism, in the form of inequitable federal and state policies (e.g., Jim Crow Laws), over-policing in Black communities, over-sentencing of Black offenders as compared

to Whites, etc., have contributed to Black men having the highest rates of incarceration in the United States (Hinton et al., 2018). The imprisonment of Black Americans also contributes further to reductions in social resources available in Black communities by limiting political participation and promoting systemic joblessness by automatically disqualifying many Black Americans from voting and employment opportunities due to prior conviction (Gilbert et al., 2016, 2022; Pettit, 2012). This incarceration, joblessness, lack of social and other resources, and existing structural discrimination encourage a continuous cycle of poor living conditions, adverse life experiences, and maladaptive coping behaviors among minoritized populations in America.

Interestingly, the residential segregation dimension of structural racism did not reach statistical significance in any of the analyses conducted. This is of particular note because structural racism has most often been characterized by measures of residential segregation (Bailey et al., 2017; Groos et al., 2018). However, other aspects or dimensions of structural racism (e.g., structural racism in incarceration) may influence populations independent of residential segregation. Given the lack of significant findings in both the bivariate and multilevel analyses for the segregation dimension, current findings suggest the critical importance of considering new and alternative measures of structural racism.

Findings from the current study support existing theory regarding structural racism and health positing that structural racism is linked to maladaptive coping behaviors among minoritized populations (Bailey et al., 2017). Structural racism theory provides a plausible rationale for the existence of these associations. That is,

structural racism perpetuates unjust systems that disadvantage minoritized populations, limiting their desirable opportunities and resources and promoting undesirable conditions that facilitate maladaptive behaviors. Prior research supports this theoretical notion of structural racism and undesirable conditions and presents some evidence to support and explain, at least in part, the findings from the current study. Latinx individuals have cited structural racism and discrimination as sources of mental health concern, adding that alcohol consumption can serve as a method for coping with those experiences (Lee et al., 2021). The promotion of maladaptive coping behaviors by way of structural racism is exacerbated by the availability of products to enact these behaviors within highly racialized neighborhoods. Previous work has demonstrated positive associations between structural racism and greater alcohol and tobacco retailer density, an undesirable environmental condition (Kong et al., 2022; Schwartz et al., 2021; Scott et al., 2020). Greater retailer density suggests greater availability of alcohol and tobacco products, suggesting, and perhaps generating, greater utilization of these products. The promotion of maladaptive coping and the availability of substances to engage in maladaptive coping are plausible explanations for associations detected between structural racism and alcohol and tobacco use behaviors in the current study. These behaviors can contribute to negative outcomes including poorer health, job absenteeism and loss, incarceration, etc., and further perpetuate an intergenerational cycle.

Structural racism characterized at the state level is not as proximal to the individual as the structural racism they might experience in their county, city, or neighborhood community; nonetheless, differences in alcohol use and tobacco

smoking behaviors were detected between states with high and low scores on structural racism measures. One might expect stronger associations between neighborhood-level measures of structural racism and maladaptive coping behaviors than those detected using the state-level measures applied here. However, structural racism within a state affects a greater number of people than structural racism present within a single neighborhood within that state. The current findings generally support a positive association between state-level structural racism (e.g., in incarceration) and individual behaviors (e.g., alcohol and tobacco use). The current findings suggest the plausibility for multilevel policy and intervention including structural discrimination and determinants among the target constructs to help address population-level alcohol and tobacco use behaviors and health disparities among African Americans, rather than solely employing individual-level interventions.

Limitations

This study should be interpreted in context of its limitations. First, data analyzed for this study reflect those captured in 2010, which could present concerns about the relevance of these findings today. However, structural racism has endured for hundreds of years (Braveman et al., 2022) and the resulting inequities are not likely to change considerably within a decade, as is suggested by studies on the longstanding impacts of redlining practices prominent before the 1970s (Beyer et al., 2016; Collin et al., 2021; Gabriel et al., 2021; Gonzalez et al., 2022; Lee et al., 2022; Lynch et al., 2021; Schwartz et al., 2021). As such, conclusions about the influences of structural racism on health in 2010 are likely still relevant today. Second, there could be other characteristics of the state confounding the current results. For instance, the price of

alcohol and tobacco may vary from state to state and could influence engagement in alcohol and tobacco use behaviors.

The dataset utilized does not include other racial groups. It would be valuable to examine the influence of structural racism on maladaptive coping behaviors among other racial minorities. Though the current dataset is national, it is not representative of the nation or African Americans in the U.S. As such, the results of the current study may not be generalizable beyond the sample. Self-report and recall bias are additional limitations, and reports of maladaptive coping behaviors could likely have been underestimated (e.g., a participant reports 3 drinking days in the last 30, but actually consumed alcohol on 5 days of the last 30).

Exposure to structural racism is characterized at the level of the state in this study. While statewide policies and practices are likely to influence experiences within their borders, the experiences of individuals from one part of a state may not reflect the experiences of individuals from another part of that same state. As such, characterizing exposure to structural racism based on smaller areas (e.g., neighborhood) could more accurately depict actual exposure to structural racism among community members. However, state-level structural racism is expected to affect a greater percentage of the U.S. population when compared with structural racism at the neighborhood level, for instance. Additionally, as this study suggests, there is considerable value in multidimensional measurement of structural racism, however, multidimensional measurement of structural racism at geographic units smaller than the state level is generally underdeveloped. Measurement at the county

or neighborhood levels, for instance, has most often focused solely on measures of segregation, as compared to other dimensions (Hardeman et al., 2022).

Conclusions

The current study demonstrates positive associations between structural racism (especially in incarceration) characterized at the state level and alcohol use and tobacco smoking behaviors among African Americans in the U.S. Future research at the intersection of structural racism and health should carefully consider which aspects or dimensions of structural racism to assess (e.g., incarceration, economic, education, employment, and segregation) and how to assess them (e.g., to characterize structural racism at the state level or at the community/neighborhood-level). Subsequent research is not only required to better understand structural racism, but also to develop methods and inform policy and health behavior change interventions to address enduring structural racism. Addressing structural racism is a pivotal step in addressing health disparities and achieving health equity.

Tables

Table 1: Participant demographics and behavioral outcomes (n=1946)

Age	Mean	SD
	53.08	14.48
Gender	Frequency	Percentage
Man	747	38.4
Woman	1199	61.6
Household income	Frequency	Percentage
Less than $5,000	164	8.4
$5,001 - $10,000	244	12.5
$10,001 - $20,000	296	15.2
$20,001 - $30,000	257	13.2
$30,001 - $40,000	229	11.8
$40,001 - 50,000	184	9.5
$50,001 - $60,000	162	8.3
More than $60,000	410	21.1
Education	Frequency	Percentage
Grades 1 through 8 (Elementary)	43	2.2
Grades 9 through 11 (Some high school)	175	9.0
Grade 12 or GED (High school graduate)	629	32.3
College 1 year to 3 years (Some college or technical school)	591	30.4
College 4 years or more (College graduate)	508	26.1
Employment	Frequency	Percentage
Receiving disability	215	11.0
Retired	477	24.5
Not currently employed	233	12.0
Part-time employed	233	12.0
Full-time employed	788	40.5
Drinking days per month	Mean	SD
	3.01	5.98
Binge drinking events per month	Mean	SD
	.59	2.58
Current smoking status	Frequency	Percentage
Not a current smoker	1499	77.2
Yes, a current smoker	443	22.8
Smoking frequency	Frequency	Percentage
Never smoked	1093	56.3
Former smoker	406	20.9
Currently smoke some days	135	7.0
Currently smoke every day	308	15.9
Eligible participants self-identified as African American		

Table 2: Sample representation by state (n = 1946)

State (2-letter code)	Frequency	Percentage
Alabama (AL)	108	5.5
Arizona (AZ)	6	.3
Arkansas (AR)	19	1.0
California (CA)	44	2.3
Colorado (CO)	2	.1
Connecticut (CT)	15	.8
Delaware (DE)	8	.4
Florida (FL)	63	3.2
Georgia (GA)	169	8.7
Illinois (IL)	131	6.7
Indiana (IN)	14	.7
Kansas (KS)	4	.2
Kentucky (KY)	18	.9
Louisiana (LA)	132	6.8
Maryland (MD)	147	7.6
Massachusetts (MA)	17	.9
Michigan (MI)	128	6.6
Minnesota (MN)	3	.2
Mississippi (MS)	63	3.2
Missouri (MO)	51	2.6
Nebraska (NE)	2	.1
Nevada (NV)	5	.3
New Hampshire (NH)	1	.1
New Jersey (NJ)	52	2.7
New York (NY)	152	7.8
North Carolina (NC)	87	4.5
Ohio (OH)	90	4.6
Oklahoma (OK)	18	.9
Oregon (OR)	2	.1
Pennsylvania (PA)	124	6.4
South Carolina (SC)	53	2.7
Tennessee (TN)	39	2.05
Texas (TX)	74	3.85
Utah (UT)	1	.15
Vermont (VT)	1	.1
Virginia (VA)	69	3.5
Washington (WA)	1	.1
Wisconsin (WI)	33	1.7

States not represented in the current sample include Alaska (AK), Hawaii (HI), Idaho (ID), Iowa (IA), Maine (ME), Montana (MT), New Mexico (NM), North Dakota (ND), Rhode Island (RI), South Dakota (SD), West Virginia (WV), Wyoming (WY)

Table 3: State Structural Racism Index and Dimension Scores by State

State (2-letter code)	State Racism Index Score	Segregation Index Score	Employment Index Score	Economic Index Score	Incarceration Gap Score	Education Gap Score
Alabama (AL)	42.52	72.79	47.30	42.47	12.03	38.02
Alaska (AK)	22.52	40.77	10.55	17.31	4.41	39.56
Arizona (AZ)	34.62	44.48	36.34	34.42	14.51	43.37
Arkansas (AR)	41.18	72.56	44.19	39.43	15.45	34.27
California (CA)	47.07	60.57	44.85	31.27	25.49	73.19
Colorado (CO)	57.15	53.00	61.32	39.89	31.57	100.00
Connecticut (CT)	64.35	63.47	43.71	64.77	57.25	92.56
Delaware (DE)	43.47	59.52	39.92	48.30	26.97	42.66
Florida (FL)	40.82	66.42	30.36	35.74	20.98	50.58
Georgia (GA)	40.91	70.26	40.90	39.61	5.24	48.52
Hawaii (HI)	25.94	38.29	4.35	7.05	0.00	80.00
Idaho (ID)	34.56	44.67	35.38	42.67	23.91	26.19
Illinois (IL)	64.37	77.85	68.04	61.45	50.81	63.72
Indiana (IN)	48.12	68.30	54.66	44.77	37.20	35.66
Iowa (IO)	62.45	52.67	64.57	85.36	72.12	37.55
Kansas (KS)	53.25	56.13	62.45	48.63	49.06	50.00
Kentucky (KY)	39.23	58.92	35.45	37.04	37.09	27.66
Louisiana (LA)	47.16	74.19	52.47	51.48	13.78	43.89
Maine (ME)	46.65	49.85	46.31	69.62	23.43	44.05
Maryland (MD)	49.88	73.20	39.81	35.89	32.27	68.26
Massachusetts (MA)	50.70	59.57	43.02	49.33	19.41	82.21
Michigan (MI)	53.68	75.14	58.27	54.42	38.72	41.83
Minnesota (MN)	68.95	57.54	61.21	99.61	68.95	57.42
Mississippi (MS)	42.19	74.75	51.28	47.54	0.08	37.30
Missouri (MO)	45.72	71.90	53.45	41.40	20.65	41.19
Montana (MT)	32.92	46.82	31.15	29.48	51.61	5.54
Nebraska (NE)	62.84	61.29	79.78	66.70	47.56	58.88
Nevada (NV)	34.34	45.81	39.65	38.96	10.29	37.00
New Hampshire (NH)	34.97	40.91	40.57	43.70	36.06	13.61
New Jersey (NJ)	58.97	70.84	42.40	55.66	49.21	76.76
New Mexico (NM)	30.95	43.93	33.09	26.18	3.89	47.65
New York (NY)	55.99	79.08	48.56	36.63	41.37	74.30
North Carolina (NC)	42.86	64.27	42.17	38.22	19.32	50.34
North Dakota (ND)	46.88	46.68	54.96	63.86	47.73	21.15
Ohio (OH)	50.04	68.64	54.65	52.02	30.92	43.98
Oklahoma (OK)	37.59	58.97	39.59	37.85	21.34	30.20
Oregon (OR)	37.05	45.58	40.35	40.81	32.27	26.22
Pennsylvania (PA)	57.76	72.59	60.22	47.54	57.59	50.88
Rhode Island (RI)	57.42	54.25	49.11	66.06	46.94	70.75

South Carolina (SC)	46.59	66.85	45.68	43.14	19.78	57.48
South Dakota (SD)	52.55	50.01	67.03	47.72	64.59	33.38
Tennessee (TN)	37.84	71.12	38.32	30.50	16.13	33.16
Texas (TX)	44.72	64.97	45.18	40.06	14.50	58.87
Utah (UT)	48.56	40.41	51.63	52.31	50.87	47.61
Vermont (VT)	36.05	41.75	44.45	34.39	59.68	0.00
Virginia (VA)	48.55	60.53	43.96	35.99	30.62	71.64
Washington (WA)	40.24	46.14	36.17	38.62	29.22	51.04
West Virginia (WV)	48.59	54.71	47.40	28.04	100.00	12.79
Wisconsin (WI)	71.34	74.24	77.53	73.89	77.92	53.12
Wyoming (WY)	41.36	46.93	64.10	59.17	21.28	15.30
Mean (SD) state score	46.49 (10.78)	59.08 (12.03)	46.95 (13.98)	45.93 (16.28)	33.64 (21.72)	46.82 (21.50)

There is no representation of Alaska (AK), Hawaii (HI), Idaho (ID), Iowa (IA), Maine (ME), Montana (MT), New Mexico (NM), North Dakota (ND), Rhode Island (RI), South Dakota (SD), West Virginia (WV), or Wyoming (WY) in the current study sample. The range of possible scores for each measure range from 0 to 100. Mean (SD) state score computations reflect all states, including those not represented in the current analysis.

Table 4: Correlation matrix of structural racism measures, drinking and smoking behaviors, and demographic variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Structural racism index													
2. Segregation dimension	.48***												
3. Employment dimension	.75***	.47***											
4. Economic dimension	.68***	.31***	.79***										
5. Incarceration dimension	.90***	.26***	.60***	.50***									
6. Education dimension	.52***	.06*	-.06**	-.07**	.42***								
7. Drinking days per month	.03	.04	.05*	.01	.02	.01							
8. Binge drinking events per month	.05*	.02	.05*	.03	.06*	-.00	.50***						
9. Current smoking status	.06**	.03	.11***	.08***	.07**	-.06**	.18***	.14***					
10. Smoking frequency	.07**	.02	.11***	.07**	.08***	-.04	.19***	.13***	.92***				
11. Age	.01	-.04	.01	.01	.02	-.01	-.07**	-.08**	-.08***	.01			
12. Gender	-.02	.01	-.03	-.02	-.05*	.03	-.19***	-.07**	-.07**	-.09***	.06*		
13. Household income	.01	-.02	-.10***	-.11***	.03	.14***	.07**	.00	-.13***	-.13***	-.11***	-.12***	
14. Education	-.01	-.01	-.07**	-.08***	-.00	.08***	.05*	-.01	-.14***	-.15***	-.11***	-.02	.48***

N ranged from 1905 to 1946 participants
*** Correlation is significant at the .001 level (2-tailed).
** Correlation is significant at the .01 level (2-tailed).
* Correlation is significant at the .05 level (2-tailed).

Table 5: Hierarchical linear regression for the structural racism index predicting number of drinking days per month (N=1920)

	Estimate	SE	95% Confidence Interval		p-value
			Lower bound	Upper bound	
Structural racism index	.02	.02	-.02	.06	.39
Age	.00	.01	-.03	.02	.88
Gender (male compared to female reference group)	2.33***	.28	1.78	2.88	<.001
[W]Work status: disability	-.93	.51	-1.93	.08	.07
[W]Work status: retired	-1.26**	.44	-2.12	-.39	<.01
[W]Work status: unemployed	.23	.47	-.70	1.15	.63
[W]Work status: part-time	-1.08*	.46	-1.98	-.18	.02
[I]Income: less than $5,000	-.42	.62	-1.64	.80	.50
[I]Income: $5,001-$10,000	-.20	.56	-1.29	.90	.73
[I]Income: $10,001-$20,000	-.06	.51	-1.05	.94	.91
[I]Income: $20,001-$30,000	-.68	.50	-1.66	.29	.17
[I]Income: $30,001-$40,000	-.13	.51	-1.12	.86	.80
[I]Income: $40,001-$50,000	.27	.53	-.77	1.31	.61
[I]Income: $50,001-$60,000	-.46	.55	-1.54	.63	.41
[E]Education: Elementary	-.82	.97	-2.72	1.08	.40
[E]Education: Some high school	.29	.57	-.82	1.40	.61
[E]Education: High school graduate	-.46	.39	-1.22	.30	.24
[E]Education: Some college	.26	.37	-.47	.99	.48

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** Estimate is significant at the .001 level.
** Estimate is significant at the .01 level.
* Estimate is significant at the .05 level.

Table 6: Hierarchical linear regression for four dimensions of the structural racism index predicting number of drinking days per month (N=1920)

	Estimate	SE	95% Confidence Interval		p-value
			Lower bound	Upper bound	
Segregation dimension	.04	.03	-.02	.09	.21
Economic dimension	-.01	.02	-.05	.04	.71
Incarceration dimension	.00	.01	-.03	.03	.79
Education dimension	-.00	.01	-.03	.02	.82
Age	-.00	.01	-.02	.02	.91
Gender (male compared to female reference group)	2.33***	.28	1.78	2.88	<.001
[W]Work status: disability	-.93	.51	-1.93	.08	.07
[W]Work status: retired	-1.26**	.44	-2.12	-.39	<.01
[W]Work status: unemployed	.22	.47	-.70	1.15	.64
[W]Work status: part-time	-1.09*	.46	-1.99	-.19	.02
[I]Income: less than $5,000	-.43	.63	-1.65	.80	.49
[I]Income: $5,001-$10,000	-.21	.56	-1.31	.89	.71
[I]Income: $10,001-$20,000	-.07	.51	-1.08	.93	.88
[I]Income: $20,001-$30,000	-.70	.50	-1.68	.29	.17
[I]Income: $30,001-$40,000	-.12	.51	-1.12	.88	.81
[I]Income: $40,001-$50,000	.28	.53	-.77	1.32	.61
[I]Income: $50,001-$60,000	-.47	.55	-1.55	.62	.40
[E]Education: Elementary	-.79	.97	-2.70	1.11	.41
[E]Education: Some high school	.31	.57	-.80	1.42	.59
[E]Education: High school graduate	-.45	.39	-1.21	.31	.25
[E]Education: Some college	.28	.37	-.45	1.02	.45

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** Estimate is significant at the .001 level.
** Estimate is significant at the .01 level.
* Estimate is significant at the .05 level.

Table 7: Hierarchical linear regression for the structural racism index predicting number of binge drinking events per month (N=1909)

	Estimate	SE	95% Confidence Interval		p-value
			Lower bound	Upper bound	
Structural racism index	.02*	.01	.00	.03	.04
Age	-.01**	.01	-.02	.00	<.01
Gender (male compared to female reference group)	.37**	.12	.13	.61	<.01
[W]Work status: disability	-.05	.23	-.49	.40	.83
[W]Work status: retired	.05	.19	-.33	.43	.78
[W]Work status: unemployed	-.02	.21	-.43	.39	.92
[W]Work status: part-time	.05	.20	-.35	.44	.81
[I]Income: less than $5,000	.20	.27	-.33	.73	.46
[I]Income: $5,001-$10,000	.20	.25	-.29	.68	.42
[I]Income: $10,001-$20,000	-.05	.22	-.49	.39	.82
[I]Income: $20,001-$30,000	.39	.22	-.04	.82	.08
[I]Income: $30,001-$40,000	.12	.22	-.32	.56	.59
[I]Income: $40,001-$50,000	.11	.23	-.35	.56	.65
[I]Income: $50,001-$60,000	.42	.24	-.06	.89	.09
[E]Education: Elementary	-.23	.43	-1.07	.61	.60
[E]Education: Some high school	.47	.25	-.02	.96	.06
[E]Education: High school graduate	-.10	.17	-.44	.23	.54
[E]Education: Some college	-.06	.16	-.38	.26	.71

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** Estimate is significant at the .001 level.
** Estimate is significant at the .01 level.
* Estimate is significant at the .05 level.

Table 8: Hierarchical linear regression for four dimensions of the structural racism index predicting number of binge drinking events per month (N=1909)

	Estimate	SE	95% Confidence Interval		p-value
			Lower bound	Upper bound	
Segregation dimension	.00	.01	-.02	.02	.79
Economic dimension	-.01	.01	-.02	.01	.48
Incarceration dimension	.01**	.00	.00	.02	<.01
Education dimension	-.01	.01	-.02	.00	.18
Age	-.01**	.01	-.02	.00	<.01
Gender (male compared to female reference group)	.35**	.12	.11	.59	<.01
[W]Work status: disability	-.04	.23	-.48	.40	.87
[W]Work status: retired	.04	.19	-.34	.42	.83
[W]Work status: unemployed	-.02	.21	-.43	.38	.91
[W]Work status: part-time	.04	.20	-.36	.44	.84
[I]Income: less than $5,000	.21	.27	-.33	.74	.45
[I]Income: $5,001-$10,000	.19	.25	-.30	.67	.45
[I]Income: $10,001-$20,000	-.07	.22	-.50	.37	.77
[I]Income: $20,001-$30,000	.39	.22	-.04	.82	.07
[I]Income: $30,001-$40,000	.12	.22	-.32	.55	.60
[I]Income: $40,001-$50,000	.11	.23	-.35	.57	.64
[I]Income: $50,001-$60,000	.43	.24	-.05	.91	.08
[E]Education: Elementary	-.16	.43	-1.01	.68	.71
[E]Education: Some high school	.47	.25	-.02	.96	.06
[E]Education: High school graduate	-.12	.17	-.46	.21	.48
[E]Education: Some college	-.07	.16	-.39	.25	.67

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** Estimate is significant at the .001 level.
** Estimate is significant at the .01 level.
* Estimate is significant at the .05 level.

Table 9: Hierarchical binary logistic regression for the structural racism index predicting current smoking status (N=1942)

	Odds Ratio (OR)	95% Confidence Interval		p-value
		Lower bound	Upper bound	
Structural racism index	1.01	.99	1.03	.20
Age	.99	.98	1.00	.08
Gender (male compared to female reference group)	1.50***	1.19	1.88	<.001
[W]Work status: disability	1.36	.92	2.03	.13
[W]Work status: retired	.70	.48	1.03	.07
[W]Work status: unemployed	1.59*	1.11	2.28	.01
[W]Work status: part-time	1.09	.75	1.57	.65
[I]Income: less than $5,000	1.23	.73	2.09	.44
[I]Income: $5,001-$10,000	1.87**	1.18	2.99	<.01
[I]Income: $10,001-$20,000	1.76*	1.13	2.72	.01
[I]Income: $20,001-$30,000	2.37***	1.56	3.59	<.001
[I]Income: $30,001-$40,000	1.48	.94	2.31	.09
[I]Income: $40,001-$50,000	1.33	.82	2.14	.25
[I]Income: $50,001-$60,000	1.05	.62	1.79	.86
[E]Education: Elementary	1.45	.64	3.30	.38
[E]Education: Some high school	2.95***	1.88	4.64	<.001
[E]Education: High school graduate	1.68**	1.18	2.37	<.01
[E]Education: Some college	1.63**	1.16	2.29	<.01

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** OR is significant at the .001 level.
** OR is significant at the .01 level.
* OR is significant at the .05 level.

Table 10: Hierarchical binary logistic regression for four dimensions of the structural racism index predicting current smoking status (N=1942)

	Odds Ratio (OR)	95% Confidence Interval		p-value
		Lower bound	Upper bound	
Segregation dimension	1.00	.98	1.03	.89
Economic dimension	1.00	.98	1.02	.99
Incarceration dimension	1.01*	1.00	1.02	.03
Education dimension	.99*	.98	1.00	.02
Age	.99	.98	1.00	.09
Gender (male compared to female reference group)	1.47***	1.17	1.85	<.001
[W]Work status: disability	1.36	.92	2.03	.12
[W]Work status: retired	.69	.47	1.02	.06
[W]Work status: unemployed	1.59*	1.11	2.29	.01
[W]Work status: part-time	1.08	.75	1.56	.69
[I]Income: less than $5,000	1.21	.72	2.05	.48
[I]Income: $5,001-$10,000	1.83*	1.15	2.92	.01
[I]Income: $10,001-$20,000	1.69*	1.09	2.62	.02
[I]Income: $20,001-$30,000	2.35***	1.55	3.57	<.001
[I]Income: $30,001-$40,000	1.45	.93	2.27	.11
[I]Income: $40,001-$50,000	1.31	.81	2.11	.28
[I]Income: $50,001-$60,000	1.04	.61	1.77	.88
[E]Education: Elementary	1.53	.67	3.48	.32
[E]Education: Some high school	2.91***	1.85	4.57	<.001
[E]Education: High school graduate	1.65**	1.16	2.33	<.01
[E]Education: Some college	1.62**	1.15	2.28	<.01

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** OR is significant at the .001 level.
** OR is significant at the .01 level.
* OR is significant at the .05 level.

Table 11: Hierarchical multinomial logistic regression for the structural racism index predicting smoking frequency (N=1942)

		Odds Ratio (OR)	95% Confidence Interval		p-value
			Lower bound	Upper bound	
Former smokers (as compared to the reference group of participants that had never smoked)	Structural racism index	1.02	1.00	1.03	.09
	Age	1.05***	1.04	1.06	<.001
	Gender (male compared to female reference group)	1.82***	1.41	2.33	<.001
	[W]Work status: disability	1.86**	1.17	2.96	<0.01
	[W]Work status: retired	1.36	.93	1.99	.12
	[W]Work status: unemployed	1.51	.95	2.42	.08
	[W]Work status: part-time	1.32	.85	2.04	.21
	[I]Income: less than $5,000	.65	.37	1.16	.15
	[I]Income: $5,001-$10,000	.95	.57	1.57	.83
	[I]Income: $10,001-$20,000	1.06	.68	1.66	.80
	[I]Income: $20,001-$30,000	.69	.43	1.12	.14
	[I]Income: $30,001-$40,000	1.14	.73	1.79	.57
	[I]Income: $40,001-$50,000	1.42	.90	2.26	.13
	[I]Income: $50,001-$60,000	.99	.61	1.61	.96
	[E]Education: Elementary	2.52*	1.16	5.50	.02
	[E]Education: Some high school	1.66	.99	2.79	.05
	[E]Education: High school graduate	1.15	.81	1.62	.45
	[E]Education: Some college	1.50*	1.08	2.10	.02
Some day smokers (as compared to the reference group of participants that had never smoked)	Structural racism index	1.02	1.00	1.05	.08
	Age	1.01	1.00	1.03	.19
	Gender (male compared to female reference group)	1.99***	1.36	2.91	<.001
	[W]Work status: disability	1.91*	1.01	3.62	.05
	[W]Work status: retired	.93	.49	1.76	.82
	[W]Work status: unemployed	1.89*	1.04	3.45	.04
	[W]Work status: part-time	1.17	.62	2.21	.62
	[I]Income: less than $5,000	1.14	.46	2.83	.77

	[I]Income: $5,001-$10,000	2.03	.91	4.54	.08
	[I]Income: $10,001-$20,000	1.44	.65	3.20	.37
	[I]Income: $20,001-$30,000	3.20***	1.58	6.45	<.001
	[I]Income: $30,001-$40,000	1.20	.51	2.82	.68
	[I]Income: $40,001-$50,000	1.78	.77	4.14	.18
	[I]Income: $50,001-$60,000	.98	.36	2.67	.97
	[E]Education: Elementary	2.61	.64	10.56	.18
	[E]Education: Some high school	5.06***	2.32	11.05	<.001
	[E]Education: High school graduate	2.73**	1.45	5.13	<.01
	[E]Education: Some college	2.04*	1.07	3.90	.03
Everyday smokers (as compared to the reference group of participants that had never smoked)	Structural racism index	1.02	1.00	1.04	.15
	Age	1.00	.99	1.01	.82
	Gender (male compared to female reference group)	1.68***	1.28	2.20	<.001
	[W]Work status: disability	1.44	.90	2.32	.13
	[W]Work status: retired	.74	.47	1.18	.21
	[W]Work status: unemployed	1.70*	1.12	2.58	.01
	[W]Work status: part-time	1.17	.76	1.79	.47
	[I]Income: less than $5,000	1.12	.61	2.07	.71
	[I]Income: $5,001-$10,000	1.83*	1.06	3.17	.03
	[I]Income: $10,001-$20,000	2.01**	1.21	3.33	<.01
	[I]Income: $20,001-$30,000	1.80*	1.10	2.94	.02
	[I]Income: $30,001-$40,000	1.71*	1.03	2.84	.04
	[I]Income: $40,001-$50,000	1.37	.78	2.41	.28
	[I]Income: $50,001-$60,000	1.08	.59	1.98	.82
	[E]Education: Elementary	2.00	.71	5.64	.19
	[E]Education: Some high school	2.93***	1.71	5.01	<.001
	[E]Education: High school graduate	1.42	.95	2.14	.09
	[E]Education: Some college	1.73**	1.17	2.55	<.01

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** OR is significant at the .001 level.
** OR is significant at the .01 level.
* OR is significant at the .05 level.

Table 12: Hierarchical multinomial logistic regression for four dimensions of the structural racism index predicting smoking frequency (N=1942)

		Odds Ratio (OR)	95% Confidence Interval		p-value
			Lower bound	Upper bound	
Former smokers (as compared to the reference group of participants that had never smoked)	Segregation dimension	1.00	.97	1.02	.74
	Economic dimension	.99	.97	1.01	.27
	Incarceration dimension	1.01*	1.00	1.02	.03
	Education dimension	1.00	.99	1.01	.74
	Age	1.05***	1.03	1.06	<.001
	Gender (male compared to female reference group)	1.81***	1.40	2.32	<.001
	[W]Work status: disability	1.86**	1.17	2.96	<0.01
	[W]Work status: retired	1.35	.92	1.98	.13
	[W]Work status: unemployed	1.50	.94	2.41	.09
	[W]Work status: part-time	1.32	.85	2.04	.22
	[I]Income: less than $5,000	.68	.38	1.22	.20
	[I]Income: $5,001-$10,000	.97	.58	1.61	.90
	[I]Income: $10,001-$20,000	1.09	.70	1.71	.70
	[I]Income: $20,001-$30,000	.72	.44	1.17	.18
	[I]Income: $30,001-$40,000	1.16	.74	1.83	.51
	[I]Income: $40,001-$50,000	1.46	.92	2.31	.11
	[I]Income: $50,001-$60,000	1.01	.62	1.64	.98
	[E]Education: Elementary	2.63*	1.20	5.75	.02
	[E]Education: Some high school	1.66	.99	2.78	.05
	[E]Education: High school graduate	1.14	.80	1.61	.47
	[E]Education: Some college	1.49*	1.07	2.08	.02
Some day smokers (as compared to the reference group of participants that had never smoked)	Segregation dimension	1.02	.98	1.06	.37
	Economic dimension	1.00	.98	1.03	.76
	Incarceration dimension	1.01	1.00	1.03	.12
	Education dimension	.98	.97	1.00	.08
	Age	1.01	1.00	1.03	.17
	Gender (male compared to female reference group)	1.96***	1.34	2.87	<.001
	[W]Work status: disability	1.91*	1.01	3.63	.05

	[W]Work status: retired	.92	.49	1.74	.80
	[W]Work status: unemployed	1.91*	1.05	3.49	.03
	[W]Work status: part-time	1.16	.61	2.20	.65
	[I]Income: less than $5,000	1.09	.44	2.71	.85
	[I]Income: $5,001-$10,000	1.94	.87	4.35	.11
	[I]Income: $10,001-$20,000	1.35	.61	3.01	.46
	[I]Income: $20,001-$30,000	3.11**	1.54	6.29	<.01
	[I]Income: $30,001-$40,000	1.16	.49	2.74	.73
	[I]Income: $40,001-$50,000	1.72	.74	4.01	.21
	[I]Income: $50,001-$60,000	.97	.35	2.64	.95
	[E]Education: Elementary	2.70	.66	11.00	.17
	[E]Education: Some high school	4.94***	2.26	10.78	<.001
	[E]Education: High school graduate	2.65**	1.41	4.99	<.01
	[E]Education: Some college	2.03*	1.06	3.88	.03
Everyday smokers (as compared to the reference group of participants that had never smoked)	Segregation dimension	.99	.97	1.02	.64
	Economic dimension	.99	.97	1.02	.61
	Incarceration dimension	1.02*	1.00	1.03	.01
	Education dimension	.99	.98	1.00	.08
	Age	1.00	.99	1.01	.80
	Gender (male compared to female reference group)	1.65***	1.26	2.16	<.001
	[W]Work status: disability	1.45	.90	2.34	.13
	[W]Work status: retired	.73	.46	1.17	.19
	[W]Work status: unemployed	1.71*	1.13	2.60	.01
	[W]Work status: part-time	1.16	.76	1.77	.50
	[I]Income: less than $5,000	1.12	.61	2.08	.72
	[I]Income: $5,001-$10,000	1.82*	1.05	3.15	.03
	[I]Income: $10,001-$20,000	1.97**	1.18	3.27	<.01
	[I]Income: $20,001-$30,000	1.82*	1.11	2.99	.02
	[I]Income: $30,001-$40,000	1.68*	1.01	2.80	.05
	[I]Income: $40,001-$50,000	1.37	.78	2.42	.27
	[I]Income: $50,001-$60,000	1.08	.59	1.99	.80
	[E]Education: Elementary	2.14	.76	6.04	.15
	[E]Education: Some high school	2.90***	1.70	4.96	<.001

	[E]Education: High school graduate	1.40	.93	2.10	.10
	[E]Education: Some college	1.71**	1.16	2.52	<.01

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** OR is significant at the .001 level.
** OR is significant at the .01 level.
* OR is significant at the .05 level.

Chapter 4: Study 2 – A stratified analysis of the association between state-level structural racism and alcohol and tobacco use behaviors among a national probability sample of African Americans

Abstract

Structural racism is how society maintains and promotes racial discrimination through established and interconnected systems. Theory suggests structural racism is associated with maladaptive coping behaviors among African Americans, such as alcohol and tobacco use. However, there is a need to understand how this relationship differs within different groups of African Americans. The current study assessed the associations between measures of state-level structural racism and alcohol and tobacco use behaviors among six subgroups of African Americans (i.e., dichotomized by age, gender, and income) and tests the associations for the moderating effects of age, gender, and income on the association between structural racism and frequency of alcohol consumption and smoking status. State-level measures of structural racism were merged into an existing dataset from a national probability sample of 1,946 African Americans in the Religion and Health in African Americans (RHIAA) Study. Hierarchical linear and logistic regression models were used to account for state-level clustering and test associations between structural racism (measured by residential segregation, and economic, incarceration, and educational inequities) and frequency of binge alcohol use and smoking status. Results generally indicated statistically significant positive associations between structural racism, particularly in incarceration, and binge drinking frequency and smoking status for one

subgroup of each categorization but not the other, though moderation testing in large part suggested that these differences between subgroups were not significant. Results suggest that state-level structural racism, especially in incarceration, may play a similar role in the alcohol and tobacco use behaviors of African Americans regardless of their intersecting identities. However, further research is required to determine if various African Americans may require different levels or types of support to combat their experiences of structural racism based on their intersecting identities.

Introduction

Background

Structural racism

Structural inequities can significantly impact population health. These discriminatory systems (e.g., racism, sexism, ableism, and homophobia) result in restricted opportunities and outcomes for specific groups of people as compared to others (National Academies of Sciences, Engineering, and Medicine, 2017). Structural inequities generate nationwide economic loss (Buckman et al., 2021) and contribute to existing health disparities (Bailey et al., 2017; Homan, 2019; Homan et al., 2021; Lee et al., 2022; McAllister et al., 2018). Structural racism is a specific type of structural inequity that promotes the health disparities observed between racial groups. Structural racism constitutes how racial discrimination and hierarchy are promoted through networks of societal systems (e.g., housing, education, employment, and criminal justice) (Brown & Homan, 2022; Krieger, 2014). Structural racism promotes behaviors and

beliefs that foster discrimination, inequitable distribution of resources, and reductions in the ability of racialized populations to access opportunities to improve their health, resulting in the health disparities evident among different racial groups. (Gee & Ford, 2011; Hardeman et al., 2016, 2022; Krieger, 2014; Ramaswamy & Kelly, 2015; Reskin, 2012; Yearby & Mohapatra, 2020).

Theories of structural racism and health

Per structural racism theory and research, structural racism is believed to cause racial inequalities (Brown & Homan, 2022; Merolla & Jackson, 2019; Phelan & Link, 2015; Ray & Seamster, 2016) and health inequities (Gee & Ford, 2011; Hardeman et al., 2016, 2022; Krieger, 2014; Ramaswamy & Kelly, 2015; Reskin, 2012; Yearby & Mohapatra, 2020). Environmental and psychosocial conditions, adverse exposures, health opportunities, behaviors, and resources are all influenced by the societal systems developed and maintained through structural racism (Alang et al., 2017; Auger et al., 2020; Krieger & Sidney, 1996; Kwate & Goodman, 2015; Laster Pirtle, 2020; Phelan & Link, 2015; Purtle, 2013; Yearby & Mohapatra, 2020). The structurally racist nature of these systems disadvantages racial minorities, hindering positive health behaviors and outcomes, and supporting poorer health behaviors and outcomes among them. Ecosocial theory identifies "pathways of embodiment," by which structural racism perpetuates oppression and disparate health outcomes through political, social, and economic systems (Krieger, 2014; Lukachko et al., 2014). Pathways of embodiment such as social deprivation, poor living conditions, and poor psychosocial conditions breed poorer health (Krieger, 2014) Critical Race Theory presents similar thinking suggesting that society and

circumstances generated by society determine which risks, opportunities, and resources are available to which populations, with minoritized populations often bearing the undesirable conditions (Gee & Ford, 2011; Sewell, 2016; Williams & Mohammed, 2013).

Researchers have summarized the pathways of structural racism's influence on health (Bailey et al., 2017) including adverse exposures, maladaptive coping behaviors, and stereotype threats. These pathways may occur at once, may influence each other and expand throughout the lifespan, and may branch across generations. According to theory, maladaptive coping behaviors such as alcohol and tobacco use are promoted through poor environmental conditions, adverse exposures, limited positive opportunities and available adverse opportunities, poor psychosocial conditions, and limited resources among racialized populations, which are all perpetuated through structural racist political, social, and economic systems. Of course, these maladaptive health behaviors in turn increase the risk and occurrence of poorer health outcomes among these racialized groups.

Prior study suggests that intersecting identities interact and affect experiences of structural racism, discrimination, and resultant health outcomes within racialized groups. While the literature conflicts on which intersecting identities are at greatest risk, current thinking suggests that experiences of structural racism and health outcomes may differ on the bases of age (Carreon & Noymer, 2011; Chatters et al., 2020; Farrell et al., 2022; Geronimus, 1992; Geronimus et al., 2006), sex (Baiden et al., 2022; Crenshaw, 1989; Laster Pirtle & Wright, 2021; Perry et al., 2013), and income (Homan et al., 2021; Wallace et al., 2015), with traditionally neglected, minoritized, or less powerful groups (e.g., older individuals, women, and individuals

of lower income) being at greater risk for poorer health due to the compounding effects of structural racism and other forms of discrimination.

Structural racism and health research

Racism and health research has traditionally focused on interpersonal racism and stress (Bailey et al., 2017; Gee & Ford, 2011; Krieger, 2014; Paradies et al., 2015; Reskin, 2012; Williams & Mohammed, 2013). Structural racism and health is much less studied by comparison. It is imperative to understand structural racism to effectively address health disparities (Bonilla-Silva, 1997; Feagin & Bennefield, 2014; Ray, 2019; Reskin, 2012), but research on structural racism and health and how to address the influence of structural racism on health is limited (Bailey et al., 2017; Hardeman et al., 2022). The health research lens has focused more on structural racism in recent years than it has in the past, but the population-level implications of structural racism and our limited understanding of the construct call for further study still.

While structural racism and health research is limited when compared to interpersonal racism and health research, recent studies of structural racism have demonstrated associations with poorer hypertension (Gao et al., 2022), heart attack (Lukachko et al., 2014), heart disease (Basile Ibrahim et al., 2021), COVID-19 (Cai et al., 2021; Tan et al., 2022), depression (Das et al., 2021; Hankerson et al., 2022; Homan & Brown, 2022; Moise & Hankerson, 2021), and cancer (Blanco et al., 2021; Collin et al., 2021; Eldridge & Berrigan, 2022; Goel et al., 2022; Poulson, Beaulieu-Jones, et al., 2021; Poulson, Blanco, et al., 2021; Poulson, Cornell, et al., 2021; Poulson, Helrich, et al., 2021; Zhou et al., 2017) outcomes.

When translating from theory to empirical study, rigorous methods of measurement should be applied. Currently, there is no identified "best" way to measure structural racism. However, as the field is rapidly evolving, the measurement of structural racism is too. Measures of residential segregation have often been the primary and frequently the only measures of structural racism applied in structural racism research (Massey & Denton, 1988; White, 1986). However, recent evolutions in this area of research have raised the importance of measuring many dimensions of structural racism, beyond residential segregation alone (Adkins-Jackson, Legha, et al., 2021; Chantarat et al., 2021; Dougherty et al., 2020; Gee & Ford, 2011; Hardeman et al., 2022; Homan & Brown, 2022). Examples of frequently measured dimensions include residential segregation, education systems, economic resources and/or employment, political participation, and judicial treatment.

Structural racism and cancer

With nearly 2 million new cases of cancer each year, roughly 2 out of every 5 people in the U.S. will develop cancer in their lifetimes, (American Cancer Society, 2022). Additionally, cancer is the second most common cause of death in the U.S., claiming over 600,000 lives each year, or nearly 1,700 deaths due to cancer each day (American Cancer Society, 2022). The immense burden of cancer is not shared equitably among groups. Cancer survival rates are significantly lower among Black individuals when compared with White counterparts (American Cancer Society, 2023). One potential contributor to these disparities is structural racism. Research suggests that structural racism is associated with cancer incidence, treatment, and mortality (Blanco et al., 2021; Collin et al., 2021; Eldridge & Berrigan, 2022; Goel et al., 2022;

Poulson, Beaulieu-Jones, et al., 2021; Poulson, Blanco, et al., 2021; Poulson, Cornell, et al., 2021; Poulson, Helrich, et al., 2021; Zhou et al., 2017). While limited research has demonstrated associations between structural racism and cancer, the research is novel and has not investigated mechanisms of how structural racism affects cancer outcomes, including structurally driven cancer risk and/or prevention behaviors that contribute to cancer outcomes.

Alcohol, tobacco, cancer, and structural racism

Strong evidence in the form of various meta-analyses identifies alcohol consumption as a risk factor for cancer outcomes across a variety of cancer sites (Bagnardi et al., 2001, 2015; Longnecker, 1994). Similarly, meta-analyses have consistently provided evidence to support tobacco as a cancer risk factor, including respiratory and non-respiratory cancers (Botteri et al., 2008; Gandini et al., 2008; Macacu et al., 2015; Phua et al., 2022). While cancer has been associated with structural racism empirical research to support mechanisms of this association is lacking. One potential way for structural racism to influence cancer risk is through the promotion of alcohol and tobacco. Latinx community members have identified structural and systemic barriers as adverse exposure affecting their mental health in a recent qualitative study, while proposing alcohol consumption as a coping method to deal with the mental health strain (Lee et al., 2021). Other studies suggest a greater concentration of alcohol and tobacco retailers in communities experiencing greater structural racism (Kong et al., 2022; Schwartz et al., 2021; Scott et al., 2020). Study 1 from this dissertation demonstrated an association between structural racism and alcohol use, however, it is unknown how this association applies to different groups of African Americans, if at all.

The current study

This study assesses the association between state-level structural racism and alcohol and tobacco use behaviors among subgroups of African Americans dichotomized based on age, gender, and income. We hypothesized that while structural racism may be positively associated with binge drinking and tobacco use behaviors among African Americans, this association would not present the same way among all African Americans. That is, we hypothesized that statistical significance and magnitudes of association between structural racism and binge drinking and tobacco use behaviors would be greater among groups with intersecting traditionally neglected/minoritized identities (i.e., older African Americans, African American women, and lower-income African Americans) than their counterparts (i.e., younger African Americans, African American men, and higher-income African Americans). The influence of structural racism on alcohol and tobacco use behaviors of specific groups of African Americans has implications for public health promotion and chronic disease prevention (e.g., cancer prevention) research, practice, and policy tailored to, or at least cognizant of and responsive to, experiential and behavioral differences between different groups of African Americans.

Methods

Sampling procedures

This study is a secondary analysis of self-report data collected from a national probability sample of African Americans in the Religion and Health in African Americans (RHIAA) Study (Clark et al., 2018; Holt, Le, et al., 2015; Roth et al., 2012) and builds on the work from Study 1 described above. Participants were 21 years or older, English-speaking, and African Americans.

To support data collection, a sampling firm used home phone numbers from public data (e.g., motor vehicle records) to create a probability-based list of U.S. households in 2010. Households from this list were invited to participate in the study. The study achieved a response rate of 22% (Debnam et al., 2012). State-level structural racism data used in prior study (Mesic et al., 2018) was merged into the existing RHIAA dataset using participants' state of residence. The structural racism measures are described in detail in the measures section below.

Measures

Structural racism

State-level structural racism was assessed using five different dimensions of structural racism, captured via nine state-level measures (Mesic et al., 2018). With the exception of the residential segregation measures, each indicator was measured using each state's ratio of Black to White resident values. These ratios are rescaled from 0 to 100 assigning the maximum ratio a score of 100, the minimum ratio a score of 0, and each value in between a corresponding score between 0 and 100. The score within each dimension is calculated as the average of the scores for each component within that dimension. The measured dimensions of structural racism included: (1) residential segregation; and Black-White gaps in (2) incarceration rates; (3) educational attainment; (4) economic indicators; and (5) employment status (Mesic et al., 2018). The current structural racism measures were adapted from previously existing ones (Lukachko et al., 2014; WalletHub, 2017) to include residential segregation, in consideration of the conceptual validity of the existing measures, and considering state-level data availability. Further description of the five dimensional measures of structural racism are provided below.

Residential segregation

Residential segregation is measured using the average if the index of dissimilarity (Iceland et al., 2002; Krieger et al., 2017; Mesic et al., 2018) and the isolation index (Iceland et al., 2002; Mesic et al., 2018). The index of dissimilarity measures the differential distribution of two groups. In the context of Black and White populations, the index of dissimilarity translates to the percentage of Black people that would have to move to achieve an equal distribution of Blacks and Whites across all blocks within a state (Mesic et al., 2018). Possible values on this measure range from 0 to 100, with higher values indicating greater spatial segregation by race. The dissimilarity index for Black vs. White populations in each state is calculated using 2010 U.S. Census data (U.S. Census Bureau, 2010).

The isolation index measures the spatial isolation of one group from another. In the context of Black populations, the isolation index measures the extent to which Black residents are exposed to other Black residents (Mesic et al., 2018). Possible values on this measure range from 0 to 100, with higher values indicating greater spatial isolation among Black residents. The isolation index for the Black vs. White populations in each state is calculated using 2010 U.S. Census data (U.S. Census Bureau, 2010).

Employment Disparity Index

The employment disparity index is the average of two parts, including non-labor force participation and unemployment (Mesic et al., 2018). Possible values on this measure range from 0 to 100, with higher values indicating greater disparities in employment between Black and White residents. Non-labor force participation is the ratio of the proportion of Black residents not

participating in the labor force as compared to the proportion of White residents not participating in the labor force rescaled to a range of 0-100, as described above. Unemployment is characterized as the ratio of the proportion of unemployed Blacks compared to the proportion of unemployed Whites for each state rescaled to a range of 0-100. Non-labor force participation and unemployment were calculated using 2010 U.S. Census data (U.S. Census Bureau, 2010).

Economic Disparity Index

The economic disparity index is the average of three parts, the poverty status gap ratio, the median annual household income gap, and the rental housing percent gap (Mesic et al., 2018). Possible values on this measure range from 0 to 100, with higher values indicating greater economic disparities between Black and White residents. The poverty status gap ratio is characterized by the Black-White gap in the proportion of people living under the poverty level, rescaled to a range of 0-100, as described above. The median annual household income gap represents the Black-White gap in median household income, as defined by White income divided by Black income, rescaled to a range of 0-100. Finally, the rental housing percent gap represents the Black-White gap in the proportion of the population that rents housing as opposed to owning their home, rescaled to a range of 0-100. The poverty status gap ratio, median annual household income gap, and rental housing percent gap were calculated using 2010 U.S. Census data (U.S. Census Bureau, 2010).

Incarceration rate gap

The incarceration rate gap represents the ratio of the incarceration rates among Blacks as compared to those among Whites in a state, which is then rescaled to a range of 0-100 across

states (Mesic et al., 2018). Higher values indicate greater rates of incarceration among Black, as compared to White residents. The incarceration rate gap is calculated using 2010 U.S. Census (U.S. Census Bureau, 2010) and U.S. Bureau of Justice Statistics data (Bureau of Justice Statistics, 2013).

Educational attainment gap

The educational attainment gap is characterized by the ratio of the proportion of Black residents with no college degree as compared to the proportion of White residents with no college degree within a state, then rescaled to a range of 0-100 across states (Mesic et al., 2018). Higher values indicate greater educational disparities between Black and White residents. This measure was calculated using 2010 census data (U.S. Census Bureau, 2010).

Alcohol and tobacco use behaviors

Established items based on the Behavioral Risk Factor Surveillance System (BRFSS) were used to assess alcohol use (Holt, Roth, et al., 2015). Previous study has demonstrated sound test–retest reliability of the BRFSSS among African American respondents (Stein et al., 1993). Alcohol use data were collected as dichotomous use in the last 30 days (yes, have used and no, have not used) with subsequent items for respondents that indicated use in the previous 30 days. Alcohol use behavior was assessed in the current study using the frequency of alcohol consumption in the last 30 days ("During the past 30 days, how many days per month did you have at least one drink of any alcoholic beverage?"). Similarly, tobacco smoking behaviors were assessed dichotomously ("Have you smoked at least 100 cigarettes in your entire life?") with a subsequent item for participants that reported a history of smoking to assess how often they

smoked at the time of their response ("Do you now smoke cigarettes every day, some days, or not at all?"). A variable reflecting whether the participant currently smoked was constructed based on participant responses to the smoking items for the current analysis (current smoking status: yes or no).

Demographics

A standard demographic module assessed participant characteristics including gender, age, relationship status, educational attainment, work status, and household income before taxes. Dichotomous age (below 65 years old and 65 or older) and income ($30,000 or less and more than $30,000) variables were created for the current analysis using participant data. These variables were dichotomized based on senior vs. younger age populations and using a data driven approach, respectively.

Data analysis

Of the 2,370 participants in the RHIAA-I project, 1,946 that responded to items about alcohol and tobacco use behaviors and provided residential information for geocoding were included in the current study assessing the association between state-level structural racism and alcohol and tobacco use behaviors within subgroups of African Americans. The current analysis builds on Study 1, assessing the association between dimensions of structural racism and binge drinking events per month and current smoking status among select subgroups of African Americans. Existing structural racism literature informed the selection of dichotomized subgroups of African Americans stratified by age (Carreon & Noymer, 2011; Chatters et al., 2020; Farrell et al., 2022; Geronimus, 1992; Geronimus et al., 2006), gender (Baiden et al., 2022;

Crenshaw, 1989; Laster Pirtle & Wright, 2021), and income (Homan et al., 2021; Wallace et al., 2015) for the current analysis. Descriptive statistics were calculated to summarize the alcohol and tobacco use behaviors among these subgroups of African Americans.

Multilevel modeling

Multilevel analyses accounting for state-level clustering were performed in SPSS Version 28 via multilevel linear (for the continuous outcome of binge drinking events per month) and binomial (for the dichotomous outcome of current smoking status) regression analyses, controlling for participant age, education, income, gender, and employment status with a statistical significance threshold of $p < .05$. A single model including four dimensions of the structural racism index (segregation, economic, incarceration, and education; the employment dimension was removed from this model due to multicollinearity concerns between the employment and other dimensions) was estimated for each behavioral outcome (binge drinking events per month and current smoking status) in each of the six subgroups (below age 65, age 65 and above, men, women, household income of $30,000 or less, and household income greater than $30,000). Moderation effects of age, gender, and income were tested by comparing the slope estimates between each group within categories, for example, men and women (Robinson et al., 2013).

Results

The sample included in the current analysis is identical to the sample from Study 1. Once again, all participants in the study self-identified as African American, the mean participant age was 53.08 (SD =14.48), and 1199 (61.6%) participants were women. Roughly half of the sample

(50.7%) had a gross household income over $30,000 and a slight majority (56.5%) had attended a college or technical school. Participants were most often employed full-time (40.5%), and a fair share of participants were retired (24.5%). The mean number of reported binge drinking events per month was.59 (SD=2.58). in the full sample and most participants (77.2%) were not current smokers. Summary statistics for binge drinking events per month and smoking status within each subgroup (participants below and above age 65, men and women, and those with household incomes below and above $30,000 per year) included in the current analysis are presented in Table 13.

Multilevel modeling

Analyses by age group

The multilevel linear model estimating the number of binge drinking events per month among those below the age of 65 demonstrated significant associations between the incarceration dimension of structural racism and the number of binge drinking events per month ($p<.01$; controlling for the individual-level covariates and three other dimensions of structural racism; see Table 14). The incarceration dimension was positively associated with binge drinking events per month among African Americans below age 65, with results suggesting a .10 increase in the number of binge drinking events per month for every 10-point increase in the structural racism in incarceration measure (scores on the incarceration dimension of structural racism ranged from 0.08 to 77.92 among states represented in the current analysis). The four dimensions of structural racism demonstrated no statistically significant associations in the binge drinking analyses for the group of participants age 65 and older.

Similarly, the incarceration dimension was positively associated with binge drinking behaviors among those below the age of 65 (p=.03; see Table 15). The odds of participant smoking are multiplied by 1.10 for each 10-point increase in the incarceration dimension, per the current analyses. Current analyses suggest that the odds of being a smoker are multiplied by .90 for every 10-point increase in the incarceration dimension (p=.03; scores on the education dimension of structural racism ranged from 0 to 100 among states represented in the current analysis). No statistically significant associations were detected between the structural racism measures and participant smoking status among those above the age of 65. Analyses for the moderating effect of age did not reach statistical significance for either the binge drinking or smoking status outcomes.

Analyses by gender

The model for the number of binge drinking events per month among men demonstrated a positive association between the structural racism in incarceration and the number of binge drinking events per month (p=.02; see Table 16). The results suggest a .20 increase in the number of binge drinking events per month among African American men for every 10-point increase in the incarceration dimension (scores on the incarceration dimension of structural racism ranged from .08 to 77.92 among states represented in the current analysis). No statistically significant associations were detected between structural racism and binge drinking behaviors among African American women. Moderation testing suggested a statistically significant difference in the slopes of the association between the economic dimension and binge drinking behavior for men and women (p=.03; results not shown), however, the association

between the economic dimension and binge drinking behavior was not significant in the full sample, among men, nor among women (p=48, p=.62, and p=.09 respectively). Testing for gender as a moderator of associations between structural racism and binge drinking did not reach statistical significance for any of the other dimensions of structural racism. No significant associations were detected between structural racism and smoking status in the analyses stratified by gender, nor were any significant moderating roles of gender detected (see Table 17).

Analyses by income

Modeling for participants with a gross household income at or below $30,000 demonstrated a positive association between structural racism in incarceration and the number of binge drinking events per month (p=.03; see Table 18). Results suggest a .10 increase in the number of binge drinking events per month among African Americans with an income less than or equal to $30,000 for every 10-point increase in the structural racism in incarceration measure (scores on the incarceration dimension of structural racism ranged from .08 to 77.92 among states represented in the current analysis). The were no significant associations between the structural racism dimensions and binge drinking behaviors among participants with a household income above $30,000.

Models stratified by income showed no significant association between structural racism and smoking status among those with an income of $30,000 or less, however, structural racism in education was inversely associated with smoking status among those with an income of greater than $30,000 per year ($p$=.03; see Table 19). The current results indicate .82 times the odds of being a current smoker for every 10-point increase in structural racism in education among the

subgroup with an income above $30,000. Moderation analyses by income were not significant for binge drinking, nor for smoking status.

Discussion

This study tested the associations between state-level indicators of structural racism and alcohol and tobacco use behaviors among particular subgroups of African Americans, which has not been studied prior. This work builds on Study 1 which demonstrated associations between structural racism and alcohol and tobacco use behaviors among African Americans. As in Study 1, the incarceration dimension of structural racism consistently demonstrated a significant positive association with participant binge drinking and smoking behaviors and the education dimension demonstrated an inverse association with smoking status. While these findings mirror those from Study 1, these significant associations tended to present among one subgroup of African Americans from each pairing in the current study. Statistical significance for the incarceration dimension in predicting binge drinking and smoking behaviors was concentrated among those below the age of 65, men, and those with household incomes below $30,000 per year, while the inverse association between the education dimension and smoking status was only present in the group representing those with an income greater than $30,000 per year and those below the age of 65.

While the current stratified analyses often demonstrated statistical significance among only one group from each categorization, the directions of association often aligned and magnitudes of association were often similar between groups. Given this, it is perhaps unsurprising that the moderation analyses generally did not yield significant findings. The only significant moderation

test suggested a statistically significant difference in the slopes of the association between the economic dimension and binge drinking behavior by gender. This would suggest that being a woman is protective of this association, however, the association between the economic dimension and binge drinking behavior was not statistically significant, so this practical significance of this moderating role comes into question. The general lack of significant moderation testing, accompanied by the alignment in patterns of association represented in the full sample and the stratified analyses provide preliminary evidence that age, gender, and income do not moderate the association between structural racism and binge drinking or smoking status among African Americans. That is, age, gender, and income, do not seem to affect the direction or strength of the associations between state-level structural racism (e.g., in incarceration) and binge drinking and smoking behaviors among the current sample of African Americans. Moderation findings, or lack thereof, may suggest the widespread influence of structural racism on alcohol and tobacco use among African Americans, independent of age, gender, and income.

Positive associations between state-level structural racism and individual-level binge drinking and smoking behaviors suggest the plausibility of large-scale population gains in addressing health disparities via multilevel policy and interventions targeting structural determinants and discrimination to improve conditions for African Americans and reduce alcohol and tobacco use behaviors, rather than employing interventions solely focused on the individual and their behavior. Theory holds that structural racism promotes unjust systems and the inequitable distribution of more undesirable conditions to more racialized populations (Bailey et al., 2017). One example of this is in the concentration of alcohol and tobacco retailers in locations experiencing greater exposure to structural racism (Kong et al., 2022; Schwartz et

al., 2021; Scott et al., 2020). The inequitable presence of alcohol and tobacco products is a key contributor to alcohol and tobacco use among African Americans.

The current work may suggest the particular salience of the incarceration dimension of structural racism, as it relates to alcohol and tobacco use. After accounting for state-level clustering, individual-level covariates, and other dimensions of structural racism, the incarceration dimension was the measure of structural racism most consistently associated with alcohol and tobacco use in the full sample and across subgroups. The significance of structural racism in incarceration in the lives of African Americans is captured in existing theory. Black men have the highest incarceration rates in the U.S., which has been supported by structurally racist systems and actions, such as structurally racist policy (e.g., Jim Crow Laws), over-policing of Black communities, and harsher judicial sentencing of Black offenders. Mass incarceration of African Americans continues to undermine Black communities by extracting community members, splitting families, and reducing social, economic, and political resources and opportunities (Sampson & Wilson, 1995). While limiting social resources by extracting community members, mass incarceration also reduces political power and promotes joblessness through exclusion on the grounds of prior conviction (Gilbert et al., 2016, 2022; Pettit, 2012). Existing structural discrimination encourages a cycle of poor living conditions, limited social resources, incarceration, joblessness, adverse life experiences, and alcohol and tobacco use that many may use in attempts to cope with their situation (Bailey et al., 2017), as suggested by recent research with Latinx participants (Lee et al., 2021).

Though residential segregation has often been used as the main or sole indicator of structural racism (Bailey et al., 2017; Groos et al., 2018), this dimension did not demonstrate statistical

significance in any of the analyses conducted. The current analyses suggest that structural racism in incarceration may influence populations independent of residential segregation. Given the lack of significant findings for the segregation dimension and significance of the incarceration dimension, current findings suggest the critical importance of considering various aspects of structural racism that impact populations beyond residential segregation. This finding supports the importance of multidimensional measurement of structural racism. Analyzing structural racism using a single dimension or using solely a composite measure of all dimensions limits the ability to assess the unique contribution of distinct systems of structural racism on health behaviors and outcomes.

Limitations

The current study should be interpreted in context of its limitations. Data analyzed in this study reflect responses and conditions more than a decade before the analysis. Still, structural racism is a persistent force that has existed for centuries (Braveman et al., 2022). As such, structural racism and the resulting inequities are not expected to have changed within the time between the data collection and the current analysis. In fact, redlining research demonstrates the long-term impact of structural racism, as disparities in health outcomes and conditions can be detected in today's population based on data reflecting redlining practices from over 50 years ago (Beyer et al., 2016; Collin et al., 2021; Gabriel et al., 2021; Gonzalez et al., 2022; Lee et al., 2022; Lynch et al., 2021; Schwartz et al., 2021). Other state-level characteristics have the potential to confound the current results. The price of alcohol and tobacco products and state

associated taxation is likely to influence engagement in smoking and drinking behaviors within a state, for instance.

The current analysis does not include other minoritized groups, though future research should consider these populations. Investigating differential influences of structural racism on maladaptive coping behaviors by race and ethnicity could provide insight into the implications of structural racism for other groups beyond African Americans. As suggested in this study, two groups of people may not have the same experiences and may not cope with structural racism in the same way, if at all. Associations between structural racism and maladaptive coping behaviors may be stronger among certain minoritized populations than others, different dimensions of structural racism could be more salient, or, especially in the case of White individuals, the association may inverse to suggest a benefit of structural racism to White populations, as is suggested in theory (Bailey et al., 2017; Krieger, 2014). Additionally, while national, probability-based sampling methods were employed, this data, and thus the results are not representative of African Americans, and study findings may not be generalizable outside of the current sample. Participant self-report and their ability to recall their health behaviors over a 30-day period influenced this study as well. One might expect that alcohol and tobacco use behaviors were underreported in the current sample.

Finally, exposure to structural racism is a state-level variable in the current analysis. The practices, policies, and experiences of residents in a state can vary widely across that state, and yet each participant within a state is assigned the same structural racism score. A more proximal measure of structural racism, for example, neighborhood-level measurement, might more closely align with each individual's true exposure or experience when compared to state-level exposures.

As such, a stronger association might be found between these more proximal measures of structural racism when compared to the more distal measures used in this analysis.

Conclusions

The current study contributes evidence of a positive association between structural racism, particularly in incarceration, and binge drinking and smoking behaviors among African Americans. The current study suggests that age, gender, and income do not moderate the relationships between structural racism and binge drinking and smoking behaviors among African Americans. While the current study presented null moderation findings, further research is warranted to replicate these findings and disentangle the influence of structural racism (including various types of structural racism, such as that in incarceration and education) on minoritized populations and the intersecting identities within those populations. Understanding the connection between structural racism and health is the first step in developing effective practice and policy to mitigate the influence of structural racism on health and help address health disparities. To develop the most effective practices and interventions, it is critical to consider how these practices and policies could differentially affect different populations of people, and different subgroups within those populations.

Tables

Table 13: Participant drinking and smoking behaviors by age, gender, and household income group (n=1946)

	Full sample		Age				Gender				Household income			
			<65 (n=1504)		≥65 (n=442)		Men (n=747)		Women (n=1199)		≤30,000 (n=961)		>30,000 (n=985)	
Binge drinking events per month	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
	.59	2.58	.65	2.63	.39	2.40	.82	2.91	.44	2.34	.59	2.72	.58	2.43
Current smoking status	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Not a current smoker	1499	77.2	1116	74.4	383	86.7	549	73.6	950	79.4	685	71.3	814	83.0
Yes, a current smoker	443	22.8	384	25.6	59	13.3	197	26.4	246	20.6	276	28.7	167	17.0
Eligible participants self-identified as African American														

Table 14: Hierarchical linear regression for four dimensions of the structural racism index predicting number of binge drinking events per month by age

	Full sample (n=1909)			Age < 65 (n=1475)			Age ≥ 65 (n=434)		
	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
Segregation dimension	.00	.01	.79	-.01	.01	.66	.03	.02	.15
Economic dimension	-.01	.01	.48	-.01	.01	.51	.00	.02	.76
Incarceration dimension	.01**	.00	<.01	.01**	.01	<.01	.01	.01	.43
Education dimension	-.01	.01	.18	-.01	.01	.17	.00	.01	.80
Age	-.01**	.01	<.01	-.01*	.01	.04	-.05*	.02	.01
Gender (male compared to female reference group)	.35**	.12	<.01	.41**	.14	<.01	.16	.26	.53
[W]Work status: disability	-.04	.23	.87	-.02	.25	.93	-.80	.68	.24
[W]Work status: retired	.04	.19	.83	-.06	.26	.81	-.31	.50	.54
[W]Work status: unemployed	-.02	.21	.91	.00	.22	.99	-.64	.77	.41
[W]Work status: part-time	.04	.20	.84	.00	.23	.99	-.51	.60	.40
[I]Income: less than $5,000	.21	.27	.45	.13	.31	.68	.34	.61	.57
[I]Income: $5,001-$10,000	.19	.25	.45	.30	.29	.29	-.19	.52	.71
[I]Income: $10,001-$20,000	-.07	.22	.77	-.06	.26	.81	-.28	.48	.57
[I]Income: $20,001-$30,000	.39	.22	.07	.35	.25	.17	.22	.50	.66
[I]Income: $30,001-$40,000	.12	.22	.60	.17	.25	.51	-.37	.51	.47
[I]Income: $40,001-$50,000	.11	.23	.64	.05	.26	.86	.15	.55	.79
[I]Income: $50,001-$60,000	.43	.24	.08	.54*	.27	.05	-.25	.58	.67
[E]Education: Elementary	-.16	.43	.71	-.25	.68	.71	-.45	.58	.44

[E]Education: Some high school	.47	.25	.06	.86**	.30	<.01	-.56	.46	.22
[E]Education: High school graduate	-.12	.17	.48	-.08	.20	.68	-.35	.34	.31
[E]Education: Some college	-.07	.16	.67	.04	.19	.81	-.62	.35	.07

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** Estimate is significant at the .001 level.
** Estimate is significant at the .01 level.
* Estimate is significant at the .05 level.

Table 15: Hierarchical binary logistic regression for four dimensions of the structural racism index predicting current smoking status by age

	Full sample (n=1942)				Age < 65 (n=1500)				Age ≥ 65 (n=442)			
	Odds Ratio (OR)	95% Confidence Interval		p-value	Odds Ratio (OR)	95% Confidence Interval		p-value	Odds Ratio (OR)	95% Confidence Interval		p-value
		Lower bound	Upper bound			Lower bound	Upper bound			Lower bound	Upper bound	
Segregation dimension	1.00	.98	1.03	.89	1.00	.97	1.03	.95	1.02	.96	1.08	.54
Economic dimension	1.00	.98	1.02	.99	1.00	.98	1.02	.92	.98	.94	1.02	.26
Incarceration dimension	1.01*	1.00	1.02	.03	1.01*	1.00	1.03	.03	1.01	.98	1.03	.70
Education dimension	.99*	.98	1.00	.02	.99*	.97	1.00	.03	.99	.97	1.02	.56
Age	.99	.98	1.00	.09	1.01	.99	1.02	.39	.94	.89	1.00	.06
Gender (male compared to female reference group)	1.47***	1.17	1.85	<.001	1.41**	1.09	1.81	<.01	1.82	.99	3.34	.05
[W]Work status: disability	1.36	.92	2.03	.12	1.36	.89	2.08	.15	.61	.14	2.57	.50
[W]Work status: retired	.69	.47	1.02	.06	1.00	.63	1.58	.99	.45	.16	1.26	.13
[W]Work status: unemployed	1.59*	1.11	2.29	.01	1.73	1.19	2.53	<.01	.78	.15	4.03	.76
[W]Work status: part-time	1.08	.75	1.56	.69	1.20	.81	1.79	.36	.50	.14	1.77	.28
[I]Income: less than $5,000	1.21	.72	2.05	.48	1.14	.65	2.01	.64	1.49	.23	9.64	.68
[I]Income: $5,001-$10,000	1.83*	1.15	2.92	.01	1.83	1.10	3.05	.02	3.19	.76	13.42	.11
[I]Income: $10,001-$20,000	1.69*	1.09	2.62	.02	1.49	.92	2.42	.10	3.57	.93	13.64	.06
[I]Income: $20,001-$30,000	2.35***	1.55	3.57	<.001	2.22	1.42	3.49	<.001	4.93*	1.31	18.57	.02
[I]Income: $30,001-$40,000	1.45	.93	2.27	.11	1.51	.94	2.44	.09	1.52	.34	6.79	.59
[I]Income: $40,001-$50,000	1.31	.81	2.11	.28	1.39	.84	2.31	.20	1.19	.23	6.06	.84
[I]Income: $50,001-$60,000	1.04	.61	1.77	.88	1.09	.63	1.90	.76	.81	.11	5.98	.83
[E]Education: Elementary	1.53	.67	3.48	.32	4.02	1.37	11.81	.01	.33	.05	2.24	.26
[E]Education: Some high school	2.91***	1.85	4.57	<.001	3.77	2.26	6.29	<.001	1.08	.35	3.32	.89
[E]Education: High school graduate	1.65**	1.16	2.33	<.01	1.69	1.16	2.48	.01	1.26	.53	3.04	.60
[E]Education: Some college	1.62**	1.15	2.28	<.01	1.60	1.10	2.31	.01	1.51	.63	3.64	.36

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** OR is significant at the .001 level.
** OR is significant at the .01 level.
* OR is significant at the .05 level.

Table 16: Hierarchical linear regression for four dimensions of the structural racism index predicting number of binge drinking events per month by gender

	Full sample (n=1909)			Men (n=735)			Women (n=1174)		
	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
Segregation dimension	.00	.01	.79	.00	.02	.86	.00	.01	.83
Economic dimension	-.01	.01	.48	.01	.01	.62	-.02	.01	.09
Incarceration dimension	.01**	.00	<.01	.02*	.01	.02	.01	.01	.19
Education dimension	-.01	.01	.18	-.01	.01	.44	-.01	.01	.36
Age	-.01**	.01	<.01	-.01	.01	.57	-.02**	.01	<.01
[W]Work status: disability	-.04	.23	.87	-.78	.43	.07	.38	.26	.14
[W]Work status: retired	.04	.19	.83	-.35	.35	.32	.34	.23	.14
[W]Work status: unemployed	-.02	.21	.91	-.48	.42	.26	.18	.23	.43
[W]Work status: part-time	.04	.20	.84	.02	.37	.96	.02	.23	.95
[I]Income: less than $5,000	.21	.27	.45	1.28*	.55	.02	-.26	.31	.39
[I]Income: $5,001-$10,000	.19	.25	.45	.47	.46	.31	.06	.28	.85
[I]Income: $10,001-$20,000	-.07	.22	.77	.03	.42	.95	-.10	.26	.71
[I]Income: $20,001-$30,000	.39	.22	.07	.71	.38	.06	.24	.26	.36
[I]Income: $30,001-$40,000	.12	.22	.60	.31	.39	.42	-.04	.26	.88
[I]Income: $40,001-$50,000	.11	.23	.64	.44	.40	.27	-.16	.28	.57
[I]Income: $50,001-$60,000	.43	.24	.08	.45	.42	.29	.44	.29	.13
[E]Education: Elementary	-.16	.43	.71	-.07	.75	.92	-.22	.52	.67
[E]Education: Some high school	.47	.25	.06	.51	.50	.31	.39	.28	.17

[E]Education: High school graduate	-.12	.17	.48	.07	.30	.81	-.32	.20	.12
[E]Education: Some college	-.07	.16	.67	.23	.30	.46	-.30	.19	.12

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** Estimate is significant at the .001 level.
** Estimate is significant at the .01 level.
* Estimate is significant at the .05 level.

Table 17: Hierarchical binary logistic regression for four dimensions of the structural racism index predicting current smoking status by gender

	Full sample (n=1942)				Men (n = 746)				Women (n = 1196)			
	Odds Ratio (OR)	95% Confidence Interval		p-value	Odds Ratio (OR)	95% Confidence Interval		p-value	Odds Ratio (OR)	95% Confidence Interval		p-value
		Lower bound	Upper bound			Lower bound	Upper bound			Lower bound	Upper bound	
Segregation dimension	1.00	.98	1.03	.89	1.01	.98	1.04	.69	1.00	.96	1.03	.82
Economic dimension	1.00	.98	1.02	.99	1.01	.99	1.03	.49	.99	.97	1.02	.67
Incarceration dimension	1.01*	1.00	1.02	.03	1.01	1.00	1.02	.14	1.02	1.00	1.03	.08
Education dimension	.99*	.98	1.00	.02	.99	.97	1.00	.06	.99	.97	1.00	.08
Age	.99	.98	1.00	.09	.99	.98	1.01	.29	.99	.98	1.00	.20
[W]Work status: disability	1.36	.92	2.03	.12	1.64	.87	3.08	.12	1.15	.69	1.95	.59
[W]Work status: retired	.69	.47	1.02	.06	.82	.46	1.46	.50	.60	.35	1.02	.06
[W]Work status: unemployed	1.59*	1.11	2.29	.01	1.53	.83	2.84	.17	1.51	.96	2.38	.08
[W]Work status: part-time	1.08	.75	1.56	.69	1.04	.58	1.86	.90	1.08	.67	1.75	.75
[I]Income: less than $5,000	1.21	.72	2.05	.48	1.33	.56	3.18	.52	1.18	.60	2.31	.64
[I]Income: $5,001-$10,000	1.83*	1.15	2.92	.01	2.52*	1.22	5.18	.01	1.53	.82	2.87	.18
[I]Income: $10,001-$20,000	1.69*	1.09	2.62	.02	1.41	.70	2.83	.33	1.80*	1.01	3.20	.05
[I]Income: $20,001-$30,000	2.35***	1.55	3.57	<.001	2.85***	1.55	5.24	<.001	1.98*	1.11	3.54	.02
[I]Income: $30,001-$40,000	1.45	.93	2.27	.11	1.89	.99	3.60	.06	1.13	.61	2.13	.69
[I]Income: $40,001-$50,000	1.31	.81	2.11	.28	1.18	.58	2.40	.65	1.36	.71	2.62	.36
[I]Income: $50,001-$60,000	1.04	.61	1.77	.88	1.14	.53	2.45	.74	.90	.43	1.88	.77
[E]Education: Elementary	1.53	.67	3.48	.32	1.08	.27	4.32	.92	1.99	.69	5.76	.21

[E]Education: Some high school	2.91***	1.85	4.57	<.001	3.34**	1.59	7.04	<.01	2.78***	1.54	5.02	<.001
[E]Education: High school graduate	1.65**	1.16	2.33	<.01	1.75*	1.04	2.95	.04	1.61	1.00	2.59	.05
[E]Education: Some college	1.62**	1.15	2.28	<.01	1.53	.90	2.60	.12	1.67*	1.06	2.62	.03

[W]Compared to full-time work status reference group
[I]Compared to more than $60,000 reference group
[E]Compared to college graduate education reference group
*** OR is significant at the .001 level.
** OR is significant at the .01 level.
* OR is significant at the .05 level.

Table 18: Hierarchical linear regression for four dimensions of the structural racism index predicting number of binge drinking events per month by income

	Full sample (n=1909)			Household income ≤ $30,000 (n=940)			Household income > $30,000 (n=969)		
	Estimate	SE	p-value	Estimate	SE	p-value	Estimate	SE	p-value
Segregation dimension	.00	.01	.79	.02	.02	.17	-.01	.01	.43
Economic dimension	-.01	.01	.48	-.01	.01	.27	.00	.01	.95
Incarceration dimension	.01**	.00	<.01	.01*	.01	.03	.01	.01	.07
Education dimension	-.01	.01	.18	.00	.01	.66	-.01	.01	.17
Age	-.01**	.01	<.01	-.01	.01	.19	-.02*	.01	.01
Gender (male compared to female reference group)	-.04	.23	.87	.46*	.19	.02	.29	.16	.07
[W]Work status: disability	.04	.19	.83	-.22	.30	.47	-.30	.46	.51
[W]Work status: retired	-.02	.21	.91	-.36	.32	.26	.34	.25	.18
[W]Work status: unemployed	.04	.20	.84	-.46	.30	.13	.53	.31	.09
[W]Work status: part-time	.21	.27	.45	-.12	.30	.68	.03	.29	.91
[R]Income: less than $5,000	.19	.25	.45	-.10	.29	.73	-	-	-
[R]Income: $5,001-$10,000	-.07	.22	.77	-.18	.26	.49	-	-	-
[R]Income: $10,001-$20,000	.39	.22	.07	-.44	.24	.07	-	-	-
[I]Income: $30,001-$40,000	.12	.22	.60	-	-	-	.13	.22	.55
[I]Income: $40,001-$50,000	.11	.23	.64	-	-	-	.11	.22	.64
[I]Income: $50,001-$60,000	.43	.24	.08	-	-	-	.44	.23	.06
[E]Education: Elementary	-.16	.43	.71	-.07	.53	.89	-.24	1.24	.85
[E]Education: Some high school	.47	.25	.06	.67	.36	.06	-.14	.50	.77

[E]Education: High school graduate	-.12	.17	.48	.05	.31	.88	-.30	.21	.15
[E]Education: Some college	-.07	.16	.67	-.10	.32	.75	.01	.19	.96

[W]Compared to full-time work status reference group
[R]Compared to more than $20,001-$30,000 reference group
[I]Compared to more than $60,000 reference group
- Covariate is not included in the analysis due to stratification
[E]Compared to college graduate education reference group
*** Estimate is significant at the .001 level.
** Estimate is significant at the .01 level.
* Estimate is significant at the .05 level.

Table 19: Hierarchical binary logistic regression for four dimensions of the structural racism index predicting current smoking status by income

	Full sample (n=1942)				Household income ≤ $30,000 (n = 961)				Household income > $30,000 (n = 981)			
	Odds Ratio (OR)	95% Confidence Interval		p-value	Odds Ratio (OR)	95% Confidence Interval		p-value	Odds Ratio (OR)	95% Confidence Interval		p-value
		Lower bound	Upper bound			Lower bound	Upper bound			Lower bound	Upper bound	
Segregation dimension	1.00	.98	1.03	.89	1.00	.97	1.04	.97	1.00	.97	1.03	.89
Economic dimension	1.00	.98	1.02	.99	1.00	.97	1.02	.75	1.01	.98	1.03	.60
Incarceration dimension	1.01*	1.00	1.02	.03	1.01	1.00	1.03	.07	1.01	1.00	1.02	.13
Education dimension	.99*	.98	1.00	.02	.99	.98	1.01	.19	.98*	.97	1.00	.03
Age	.99	.98	1.00	.09	.99	.98	1.00	.20	.99	.98	1.01	.29
Gender (male compared to female reference group)	1.36	.92	2.03	.12	1.58**	1.17	2.15	<.01	1.31	.92	1.86	.13
[W]Work status: disability	.69	.47	1.02	.06	1.65*	1.01	2.69	.05	.80	.30	2.09	.64
[W]Work status: retired	1.59*	1.11	2.29	.01	.72	.42	1.24	.23	.71	.40	1.25	.23
[W]Work status: unemployed	1.08	.75	1.56	.69	1.76*	1.08	2.85	.02	1.45	.79	2.65	.23
[W]Work status: part-time	1.21	.72	2.05	.48	1.41	.87	2.29	.16	.64	.32	1.28	.21
[R]Income: less than $5,000	1.83*	1.15	2.92	.01	.51**	.31	.84	<.01	-	-	-	-
[R]Income: $5,001-$10,000	1.69*	1.09	2.62	.02	.78	.51	1.19	.25	-	-	-	-
[R]Income: $10,001-$20,000	2.35***	1.55	3.57	<.001	.73	.49	1.08	.12	-	-	-	-
[I]Income: $30,001-$40,000	1.45	.93	2.27	.11	-	-	-	-	1.39	.88	2.20	.16
[I]Income: $40,001-$50,000	1.31	.81	2.11	.28	-	-	-	-	1.26	.77	2.04	.36
[I]Income: $50,001-$60,000	1.04	.61	1.77	.88	-	-	-	-	1.01	.59	1.72	.97
[E]Education: Elementary	1.53	.67	3.48	.32	1.25	.48	3.25	.65	2.34	.24	22.64	.46
[E]Education: Some high school	2.91***	1.85	4.57	<.001	2.33**	1.26	4.33	<.01	4.39***	1.84	10.51	<.001
[E]Education: High school graduate	1.65**	1.16	2.33	<.01	1.37	.80	2.37	.25	1.81*	1.13	2.92	.01

[E]Education: Some college	1.62**	1.15	2.28	<.01	1.34	.76	2.36	.31	1.81**	1.18	2.79	<.01

[W]Compared to full-time work status reference group
[R]Compared to more than $20,001-$30,000 reference group
[I]Compared to more than $60,000 reference group
- Covariate is not included in the analysis due to stratification
[E]Compared to college graduate education reference group
*** OR is significant at the .001 level.
** OR is significant at the .01 level.
* OR is significant at the .05 level.

Chapter 5: Discussion

Study summary

This dissertation project, informed by theories of structural racism and health (Bailey et al., 2017; Krieger, 2014), tested associations between measures of state-level structural racism (i.e., a composite index of structural racism and measures of residential segregation, employment disparities, economic disparities, education gaps, and gaps in incarceration) and alcohol and tobacco use behaviors among African Americans. These associations were subsequently tested among younger and older, men and women, and lower- and higher-income subgroups of African Americans. The dataset utilized consisted of self-report data from a subsample of 1,946 African American participants from the Religion and Health in African Americans (RHIAA) national probability-based study (Clark et al., 2018; Holt, Le, et al., 2015; Roth et al., 2012) alongside state-level structural racism data (Mesic et al., 2018) derived from U.S. Census (U.S. Census Bureau, 2010) and U.S. Bureau of Justice Statistics (Bureau of Justice Statistics, 2013) datasets. Descriptive, bivariate, and multivariate multilevel analyses accounting for state-level clustering were performed to describe the study sample and assess associations between measures of structural racism and alcohol and tobacco use behaviors. Moderation testing was performed to test the moderating effects of age, gender, and income on the associations between state-level structural racism and participant drinking and smoking behaviors.

Bivariate analysis of primary variables demonstrated positive correlations between state-level structural racism, and the employment, economic, and incarceration dimensions of structural racism with maladaptive coping behaviors (alcohol and/or tobacco use). Weak negative correlations were detected between the education dimension of structural racism and participant smoking behaviors, while no significant associations were detected between the segregation dimension and any included alcohol or tobacco use behaviors. Multilevel modeling of the 1,946-participant sample accounting for state-level clustering and controlling for individual-level covariates (i.e., age, gender, employment status, household income, and educational attainment) indicated statistically significant positive associations between the composite state-level structural racism index and binge drinking, the incarceration dimension and binge drinking events per month, smoking status, and smoking frequency, and a negative association between the education dimension and participant smoking status (smoker vs non-smoker). Stratifying this multilevel analysis by age, gender, and income and testing the moderating effects of each of these three variables did not support age, gender, or income as moderators of the association between structural racism and alcohol and tobacco use.

Discussion

This project demonstrated significant positive associations between structural racism, especially in incarceration, and alcohol and tobacco use behaviors among African Americans. Bivariate analyses detected positive correlations between structural racism measures (structural racism index score, employment index score, economic index score, and incarceration gap score) and alcohol and tobacco use,

generally suggesting that as state-level structural racism increases, so too do binge drinking and tobacco use behaviors among African Americans. Multilevel modeling accounting for participant state-level clustering and controlling for individual-level covariates (age, gender, employment status, household income, and educational attainment) allowed a more rigorous investigation of these associations. While no measures of structural racism were associated with participant drinking days per month in the multilevel analyses, the composite index of state-level structural racism was positively associated with participant binge drinking, the education dimension of state-level structural racism was inversely associated with participant smoking status, and the incarceration dimension was positively associated with participant binge drinking, smoking status, and smoking frequency, even after controlling for three other dimensions of structural racism and the individual level covariates (i.e., individual age, gender, employment, income, and education) included in the multilevel models.

As theory posits that structural racism promotes alcohol and tobacco use among minoritized populations (Bailey et al., 2017), the findings of positive associations between structural racism (especially in incarceration) and alcohol and tobacco use are not necessarily unexpected, though the inverse association between the education dimension and smoking status was unanticipated and may warrant additional scrutiny. The incarceration dimension was most frequently associated with alcohol and tobacco use behaviors of the structural racism measures in this analysis. The contribution of structural racism in incarceration may be particularly salient in racial disparities in alcohol and tobacco use and health outcomes. As supported by theory, mass

incarceration is believed to weaken Black communities by removing community members, splitting families, and limiting the human resources, capital, and support within Black communities (Sampson & Wilson, 1995). Mass incarceration also limits political and economic opportunity by disqualifying many from voting and employment opportunities due to prior conviction (Gilbert et al., 2016, 2022; Pettit, 2012). The cycle of structural discrimination, incarceration, joblessness, and lack of resources and strong social networks, encourages poor living conditions, adverse life experiences, and maladaptive coping through things like alcohol and tobacco use that further perpetuate this cycle for many minoritized communities in America. Addressing structural racism in incarceration may be a particular area to intervene and disrupt this cycle.

Implications

The current project presents considerations for the future of structural racism measurement. Structural racism in incarceration was most often associated with alcohol and tobacco use in the current work, above and beyond the other dimensions of structural racism, which may suggest the particular salience of this dimension, at least in the case of alcohol and tobacco use behaviors. Although residential segregation is the most frequently used measure of structural racism (Bailey et al., 2017; Groos et al., 2018), none of the analyses performed in this project demonstrated a significant association between residential segregation and alcohol or tobacco use. This suggests the importance of including measures of structural racism that go beyond residential segregation in future research. Additionally, future research should consider the level at which structural racism is characterized. The current work

demonstrated associations between alcohol and tobacco use behaviors and state-level structural racism, but a more proximal measure of structural racism (e.g., at the neighborhood level) could demonstrate stronger associations than were detected in the current work.

The current work is intended to inform future public health research, intervention, practice, and policy. While this work cannot prove causality, the findings from the current study do indicate a significant association between structural racism and maladaptive coping behaviors among African Americans. If structural racism does affect maladaptive coping behaviors, as is suggested by theory, then addressing structural racism may be one way to reduce maladaptive coping behaviors and resultant health disparities among minoritized populations. There is a need for further research to better understand structural racism and identify methods to combat and eliminate it. Based on findings reflecting state-level structural racism in the current study, multilevel intervention, including state-level policy and practice advancements to address structural racism could be effective methods to help address population-level adverse health behaviors in alcohol and tobacco use and improve health outcomes among minoritized populations.

Limitations

The findings in this project should be interpreted in context of study limitations. While data analyzed in this work were captured in 2010, structural racism is a construct that has, unfortunately, demonstrated stability with time (Braveman et al., 2022). As a result, findings from the current work are likely still relevant at the time of this reporting. Other state-level characteristics may also confound the findings

presented within the current work. While the current study provides a critical view of structural racism and maladaptive coping behaviors among African Americans, this work does not include other minoritized nor White populations. Future research may investigate the association between structural racism and maladaptive coping behaviors among other minoritized groups and White groups and compare the associations of structural racism between them. The current dataset was collected using nationwide probability-based methods; however, these data are not representative of the U.S., nor of African Americans and the current findings may not be generalizable beyond the sample. Sources of bias, such as self-report and recall bias, may have influenced reporting of maladaptive coping behaviors and we might suspect that alcohol and tobacco use behaviors were underreported in this study.

Conclusions

This dissertation project demonstrated positive associations between state-level structural racism, especially in incarceration, and binge drinking and tobacco use among African Americans. Future structural racism and health research should carefully consider measurement, including which dimensions of structural racism to assess and analyze and at what level (e.g., state, city, neighborhood) to characterize structural racism. Addressing structural racism, especially that in incarceration, through multilevel methods may be one way, and arguably a necessity, to effectively address racial disparities in health behaviors and outcomes.

Appendices

Supplemental Figures and Tables

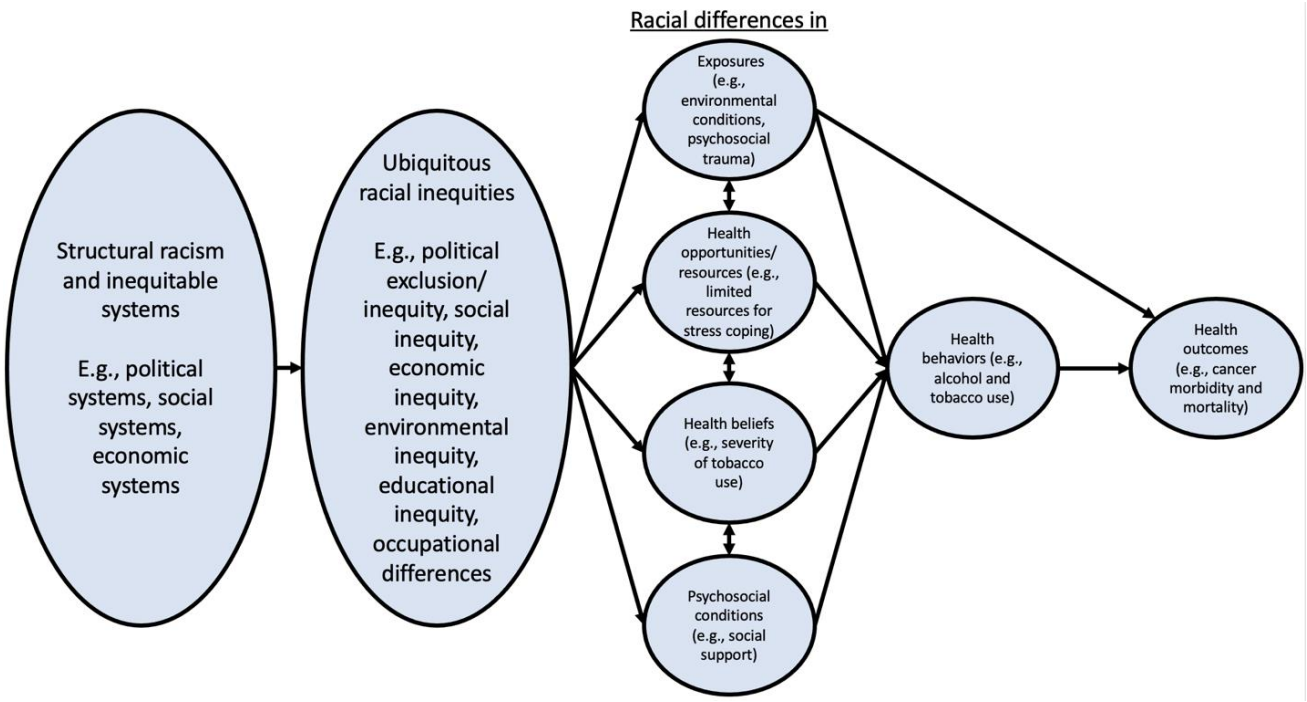

Figure 1: Conceptual model for the current study.

Supplemental Table 1: Dimensions and measures used in the state racism index		
Dimension	Measure	Description
Segregation	Dissimilarity Index	D = 1/2(SUM[blackpct - whitepct])*100, where blackpct is the proportion of the state's black population living in each block and whitepct is the proportion of the state's white population living in that block. Values are on a scale from 0-100 with 100 being the most spacially segregated by race. It represents the percentage of blacks that would have to move in order to achieve an equal distribution of whites and blacks across all blocks within a state.
	Isolation Index	I = 100 - (SUM((blackpct)*(proportionblack))*100), where blackpct is the proportion of the state's black population living in each block and proportionblack is the proportion of people in that block who are black. Values are on a scale from 0-100 with higher values representing higher levels of segregation. It can be interpreted as the probability a black person does not share a block area with a white person or as the extent to which black members of a block are exposed only to one another.
Education	Educational Attainment Gap (No bachelor's degree)	Ratio of proportion of blacks without a college degree to the proportion of whites without a college degree for each state.
Economic	Poverty Status Gap Ratio	Ratio of proportion of blacks living under the poverty level to the proportion of whites living under the poverty level for each state.
	Median Annual Household Income Gap	Ratio of white median annual household income to black median annual household income for each state.
	Rental Housing Percent Gap	Ratio of proportion of blacks in rental housing to proportion of whites in rental housing for each state.
Employment	Non-Labor Force Participation	Ratio of proportion of blacks not participating in the labor force to proportion of whites not participating in the labor force for each state.
	Unemployment	Ratio of proportion of unemployed blacks to proportion of unemployed whites for each state.
Incarceration	Incarceration Rate Gap	Ratio of black incarceration rate to white incarceration rate for each state.
Table adapted from existing research (Mesic et al., 2018). Each measure is constructed using 2010 U.S. Census data (U.S. Census Bureau, 2010). The incarceration rate gap is constructed with data from both the U.S. Bureau of Justice Statistics data (Bureau of Justice Statistics, 2013) and U.S. Census data (U.S. Census Bureau, 2010).		

Select RHIAA (Religion and Health in African Americans Study) survey items

These next few questions ask about alcoholic beverages.

During the past 30 days, have you had at least one drink of any alcoholic beverage such as beer, wine, a malt beverage, or liquor?

____ Yes
____ No
____ Don't know / Not sure

During the past 30 days, how many days per week or per month did you have at least one drink of any alcoholic beverage?

____ Days per week
____ Days in the past 30 days
____ Don't know / Not sure

Considering all types of alcoholic beverages, how many times during the past 30 days did you have X [X = 5 for men, X = 4 for women] or more drinks on an occasion?

____ Number of times
____ Don't know / Not sure

These next questions ask about smoking.

Have you smoked at least 100 cigarettes in your entire life?
(NOTE: 5 packs = 100 cigarettes)

____ Yes
____ No
____ Don't know / Not sure

Do you now smoke cigarettes every day, some days, or not at all?

____ Every day
____ Some days
____ Not at all
____ Don't know / Not sure

Institutional Review Board approval letter

UNIVERSITY OF MARYLAND
INSTITUTIONAL REVIEW BOARD

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DATE:	March 15, 2023
TO:	Nathaniel Woodard
FROM:	University of Maryland College Park (UMCP) IRB
PROJECT TITLE:	[1991778-1] Structural racism and alcohol and tobacco use behaviors in a national sample of African Americans
SUBMISSION TYPE:	New Project
ACTION:	DETERMINATION OF NOT RESEARCH
DECISION DATE:	November 30, 2022

Thank you for your submission of New Project materials for this project. The University of Maryland College Park (UMCP) IRB has determined this project does not meet the definition of human subject research under the purview of the IRB according to federal regulations.

We will retain a copy of this correspondence within our records.

If you have any questions, please contact the IRB Office at 301-405-4212 or irb@umd.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Maryland College Park (UMCP) IRB's records.

U.S. State-level Structural Racism and Structural Racism Dimensions Map Charts

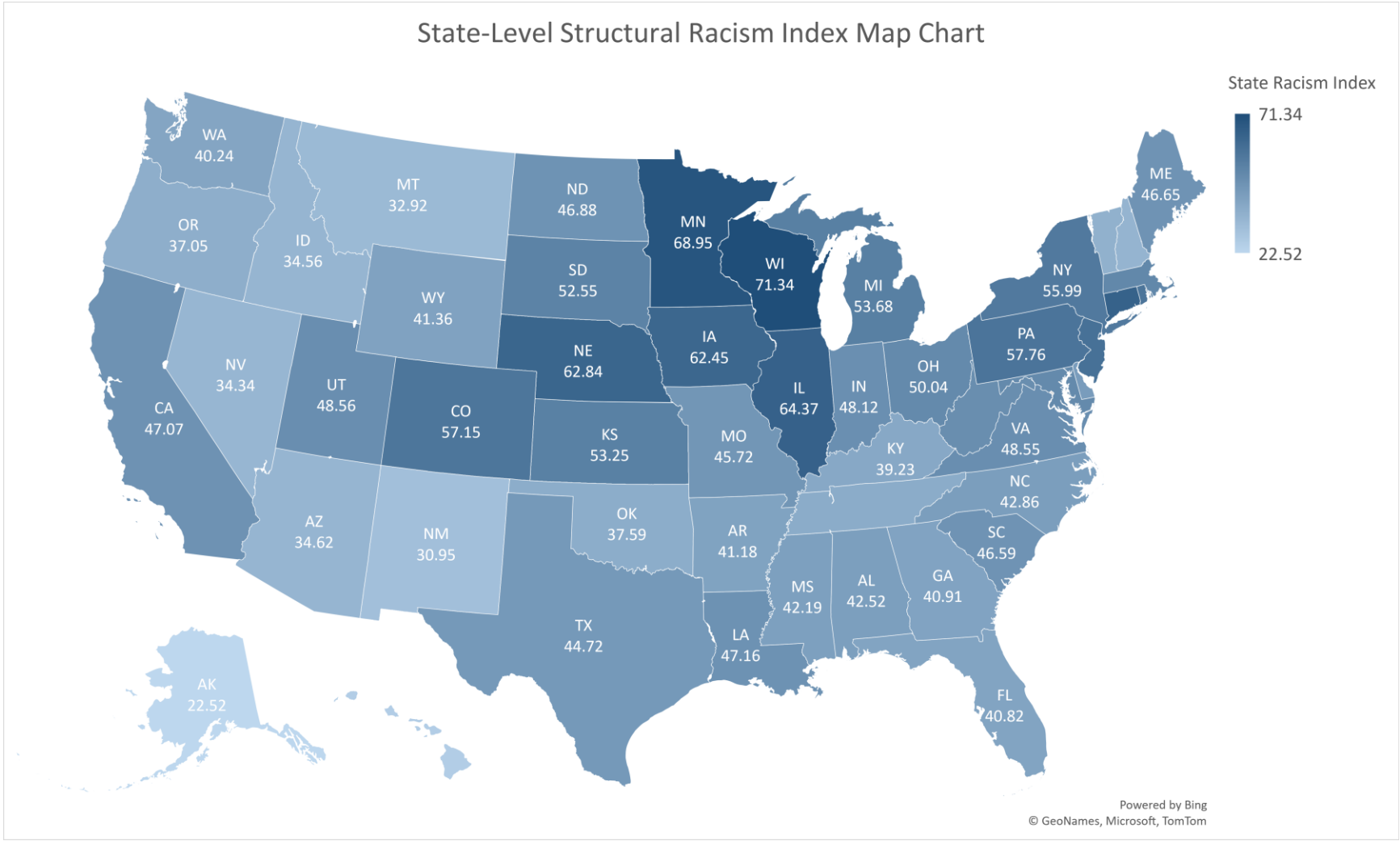

Figure 2: Values for states too small to include labels are available in Table 3.

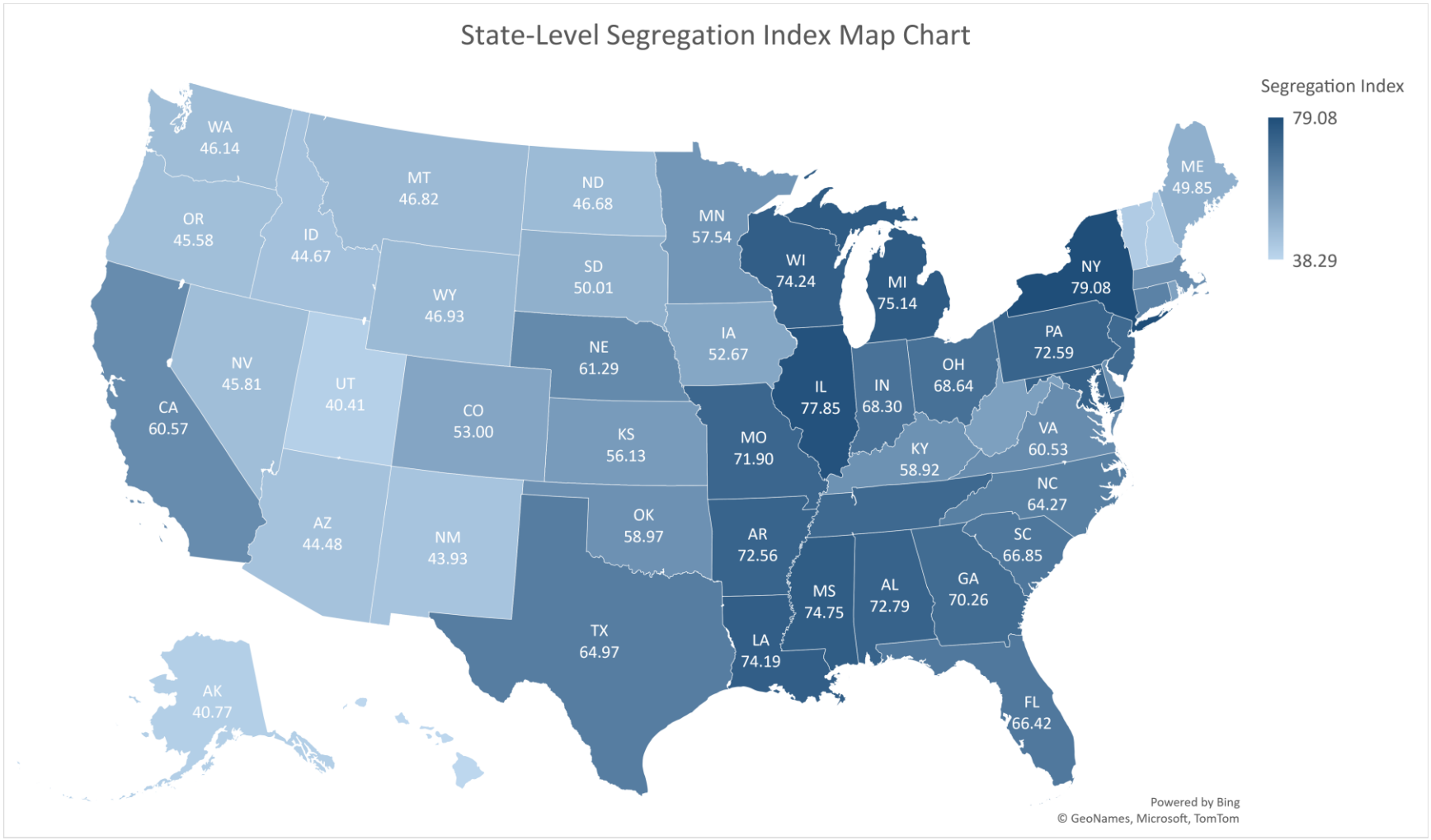

Figure 3: Values for states too small to include labels are available in Table 3.

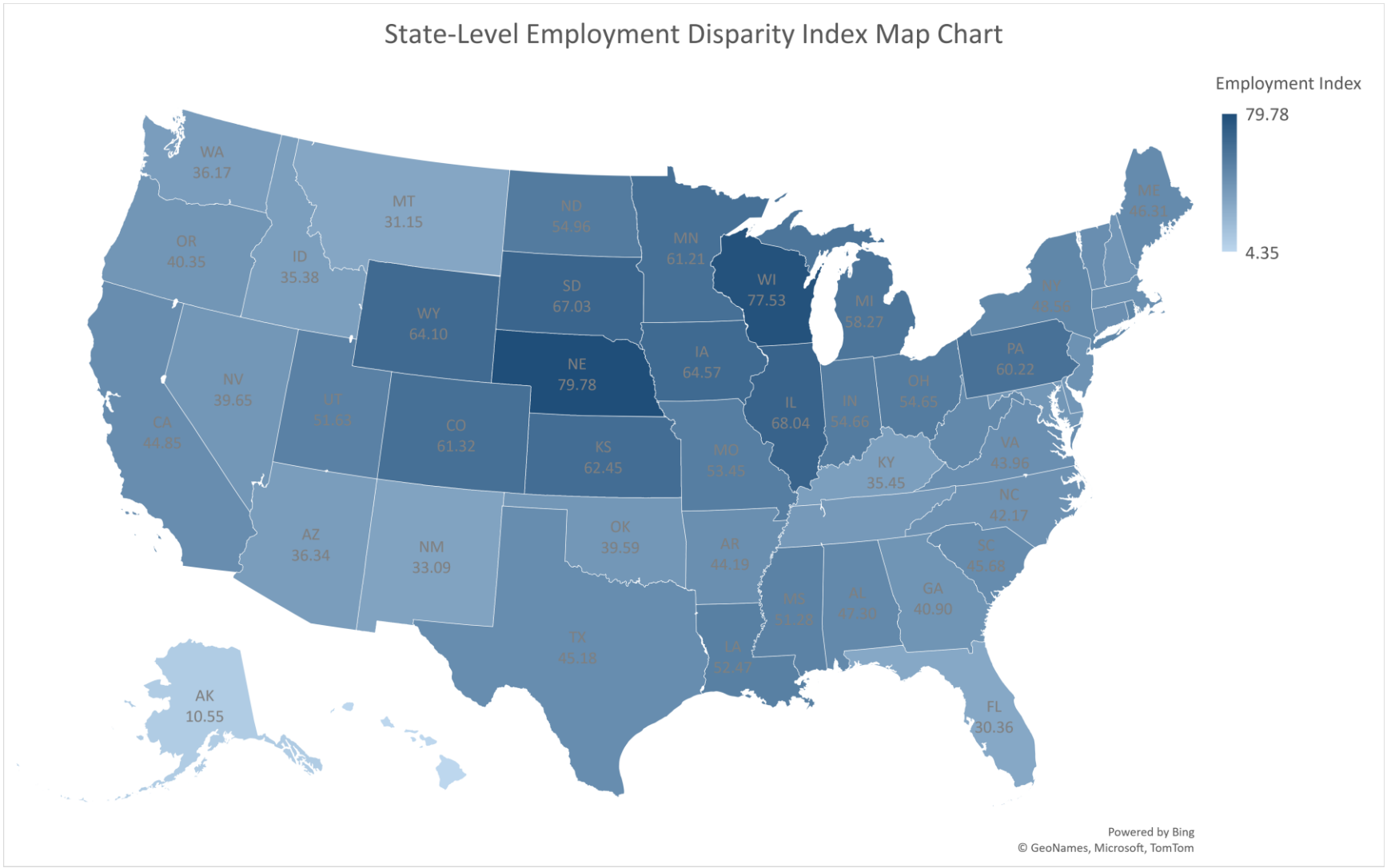

Figure 4: Values for states too small to include labels are available in Table 3.

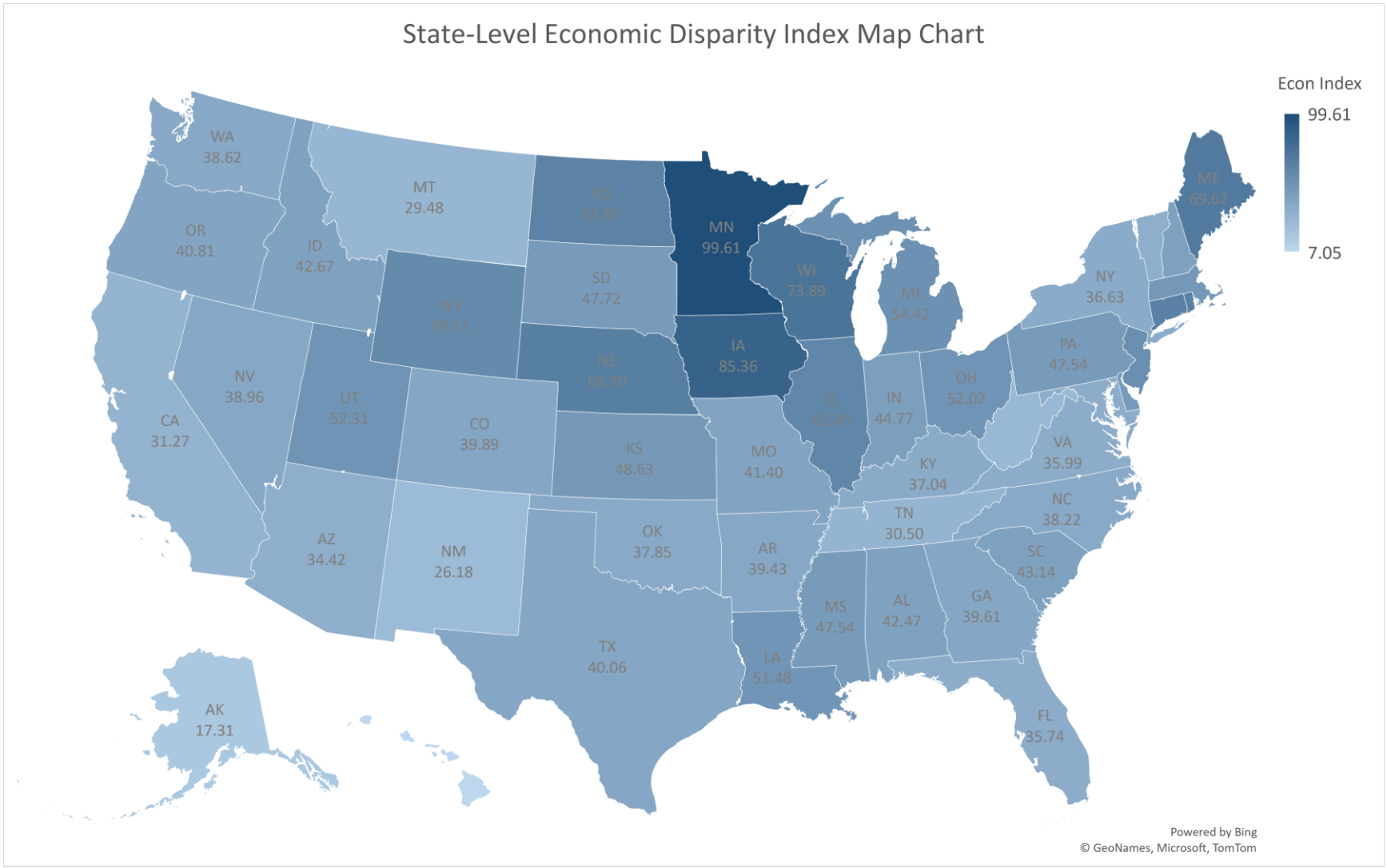

Figure 5: Values for states too small to include labels are available in Table 3.

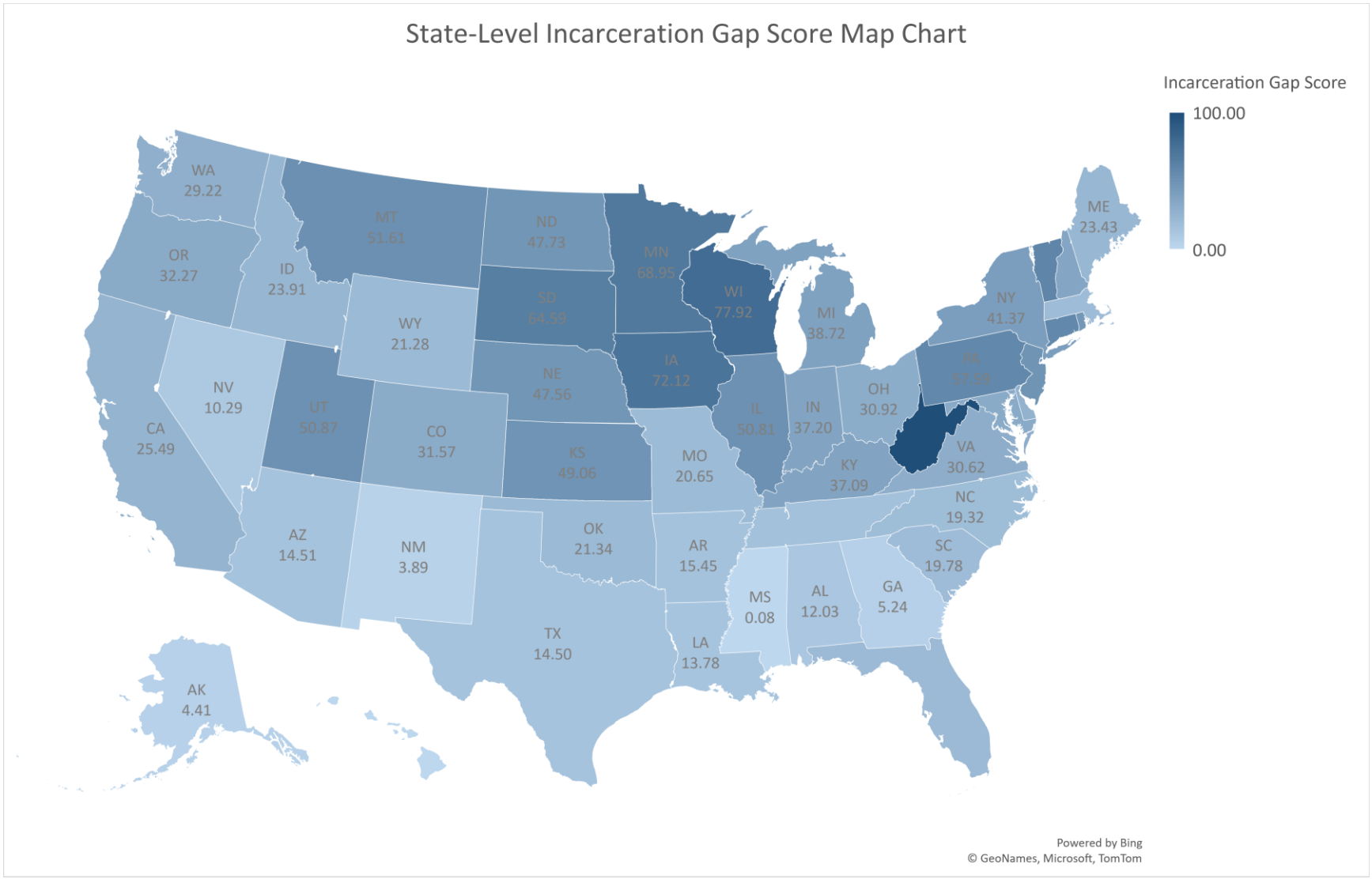

Figure 6: Values for states too small to include labels are available in Table 3.

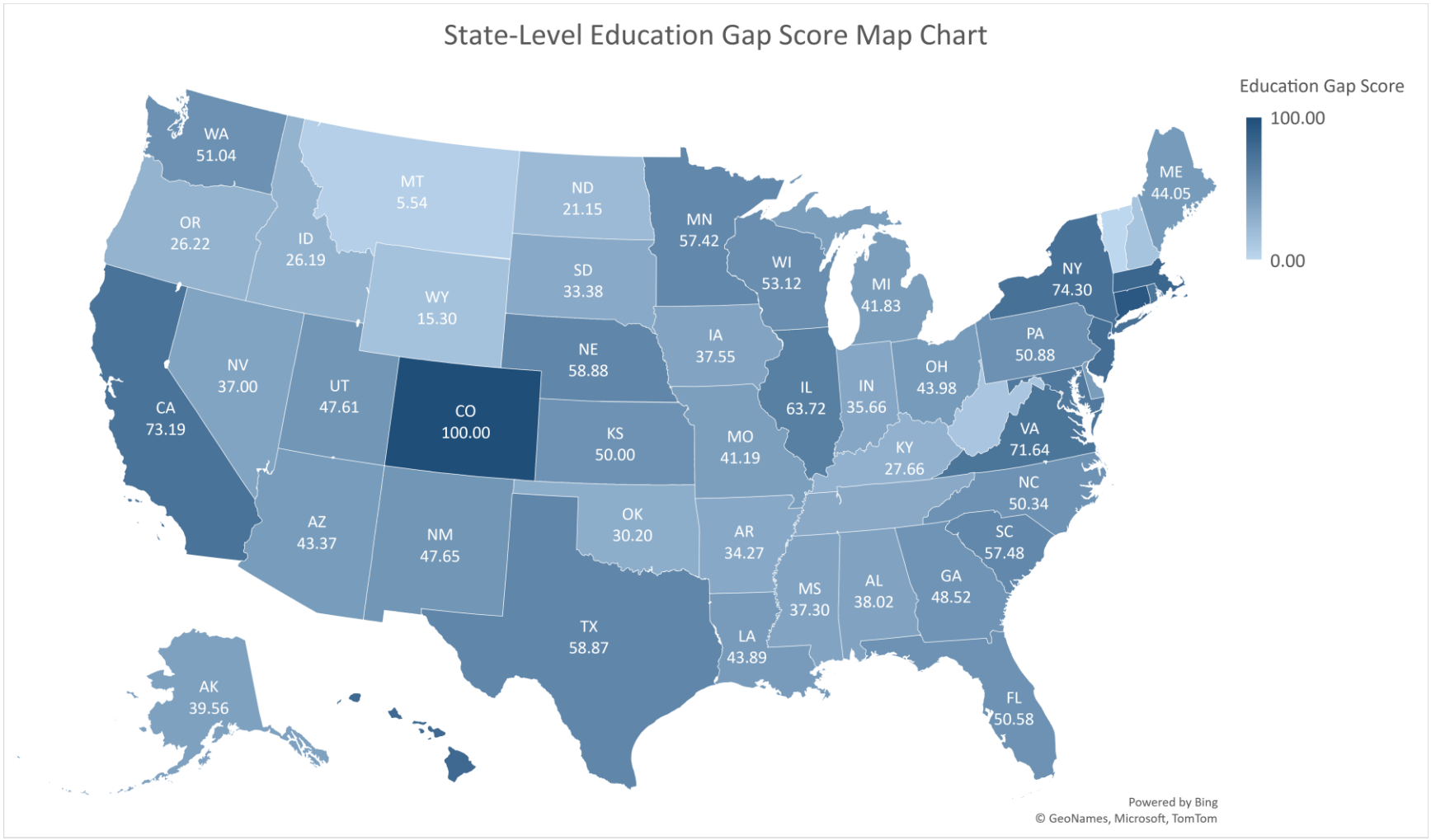

Figure 7: Values for states too small to include labels are available in Table 3.

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