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Associations between Perceived Racial Discrimination, Racial Residential Segregation, and Cancer Screening Adherence among Low-Income African Americans: A Multilevel, Cross-Sectional Analysis

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Abstract

Objectives: African Americans suffer disproportionately from cancer compared to their White counterparts. Racism may be an important determinant, but the literature on its association with cancer screening is limited. We examine associations between racism and cancer screening among a sample of African Americans.

Design: Guided by the Public Health Critical Race Praxis and the Behavioral Model of Health Services Use, we conducted a multilevel, cross-sectional study using cancer risk assessment data collected from 405 callers to the 2–1-1 Texas helpline. We merged these data with contextual data from the U.S. Census Bureau. We assessed perceived racial discrimination using the Experiences of Discrimination Scale and racial residential segregation using the Location Quotient for Racial Residential Segregation. We used multilevel regression models to test hypothesized associations between each indicator of racism and four cancer screening adherence outcomes (Pap test, mammography, colorectal cancer screening [CRCS], and any cancer screening).

Disclosure Statement

The authors have no conflicts of interest to declare.

Human Subject Protection Statement

This study received approval for all study procedures from the Committee for the Protection of Human Subjects at The University of Texas Health Science Center at Houston (Study HSC-SPH-10-0241; Study HSC-SPH-20-1103).

Results: Participants were 18–83 years old (mean=45 years). Most (81%) were non-adherent to at least one recommended screening. Approximately 42% reported experiencing discrimination and 73% lived in a segregated neighborhood. Discrimination was non-significantly related to lower odds of mammography (aOR=0.68; 95%CI: 0.38–1.22), CRCS (aOR=0.79; 95%CI: 0.41–1.52), and any cancer screening adherence (aOR=0.88; 95%CI: 0.59–1.32). Segregation was related to greater odds of mammography (non-significant; aOR=1.43; 95%CI: 0.76–2.68) and CRCS (significant; aOR=2.80; 95%CI: 1.21–6.46) but not associated with any cancer screening. Neither indicator of racism was associated with Pap test screening adherence.

Conclusions: Racism has a nuanced association with cancer screening among low-income, medically underserved African Americans. Specifically, discrimination appears to be associated with lower odds of screening, while segregation maybe associated with higher odds of screening in certain situations. Future research is needed to better explicate relations between indicators of racism and cancer screening among African Americans.

Keywords

Cancer screening; Racism; Discrimination; Segregation; African Americans; Critical Race Theory

Introduction

Despite declines in cancer incidence and mortality and an increase in uptake of cancer prevention and control behaviors, African Americans suffer disproportionately from cancer in comparison to their White counterparts (Aizer et al. 2014; National Cancer Institute 2019). For example, while national data indicate that overall cancer incidence rates are slightly higher for White Americans (451.0 per 100,000) in comparison to African Americans (447.6 per 100,000), the mortality rate is higher among African Americans (181.7 per 100,000) than Whites (159.0 per 100,000) (U.S. Cancer Statistics Working Group 2019). Cervical, breast, and colorectal cancer are of particular concern, as they are among the most common causes of cancer death among African Americans (Aizer et al. 2014). Nevertheless, with adherence to recommended screening, cervical and colorectal cancer are among the most preventable (American Cancer Society 2019).

Texas ranks among the lowest in cervical, breast, and colorectal cancer screening nationally. Further, while statewide prevalence rates are comparable between African Americans and Whites (Center for Health Statistics 2020), spatial differences reveal a greater extent of disparities (Bambhroliya, Burau, and Sexton 2012; Haddock 2014; Highfield 2013; Office of Disease Prevention & Health Promotion 2020a, 2020b; U.S. Preventive Services Task Force 2016). Research on such disparities in health and health behavior suggests that indicators of racism, such as perceived racial discrimination (Paradies et al. 2015; Pascoe and Smart Richman 2009) and racial residential segregation (Williams and Collins 2001; Williams, Lawrence, and Davis 2019), may be important determinants.

A growing body of evidence has attributed many of the disparities in health observed among racial minorities to racism (Paradies et al. 2015). Manifestations of racism, such as perceived racial discrimination and racial residential segregation, are key dimensions of racism that can affect health (Williams, Lawrence, and Davis 2019). Notably, evidence suggests that

perceptions of discrimination can trigger a stress response and decrease an individual's self-control resources and self-regulation capacity, which may lead to nonparticipation in healthful behaviors, such as cancer screening (Pascoe and Smart Richman 2009; Ahmed, Mohammed, and Williams 2007; Paradies 2006). Residential segregation, on the other hand, creates communities of concentrated economic and social disadvantage with living conditions and a range of chronic and acute stressors (e.g., financial stress and hardship) at the individual, household, and neighborhood level that make it difficult to practice healthy behaviors (e.g., seeking preventative healthcare services) (Williams and Collins 2001; Williams, Lawrence, and Davis 2019). In addition, it limits access to high-quality care (e.g., lack of availability and/or affordability) (Gee and Ford 2011) and weakens interpersonal relationships and trust (Williams and Sternthal 2010), all important determinants of health.

Perceived racial discrimination, a subjective, individual-level measure, and racial residential segregation, an objective, contextual-level measure are associated with a variety of health behaviors and outcomes (Paradies et al. 2015; Pascoe and Smart Richman 2009; Williams and Collins 2001; Williams, Lawrence, and Davis 2019; Williams and Mohammed 2009), including use of preventive care and delays or failure to seek treatment. The literature on these relations as they relate to cancer, however, focus primarily on cancer outcomes (e.g., breast cancer incidence and mortality) and less on cancer prevention and control behaviors (e.g., screening) (Krieger et al. 2018; Landrine et al. 2017). Further, the findings on the relation between perceived racial discrimination, racial residential segregation, and cancer screening are mixed (Benjamins 2012; Buehler et al. 2019; Crawley, Ahn, and Winkleby 2008; Dailey et al. 2007; Facione and Facione 2007; Fowler-Brown et al. 2006; Hausmann et al. 2008; Hoyo et al. 2005; Jacobs et al. 2014; Mobley et al. 2008; Mobley et al. 2017; Mouton et al. 2010; Shariff-Marco, Klassen, and Bowie 2010). For example, in cross-sectional and longitudinal studies of African Americans and multiethnic populations on the association between cancer screening and perceived racial discrimination, some researchers found a significant inverse association between perceived racial discrimination and breast (Crawley, Ahn, and Winkleby 2008; Facione and Facione 2007; Jacobs et al. 2014), cervical (Facione and Facione 2007; Hoyo et al. 2005; Mouton et al. 2010), and colorectal cancer screening (Crawley, Ahn, and Winkleby 2008), while others found a significant positive association (Benjamins 2012) or no association at all (Benjamins 2012; Dailey et al. 2007; Facione and Facione 2007; Fowler-Brown et al. 2006; Hausmann et al. 2008; Jacobs et al. 2014; Shariff-Marco, Klassen, and Bowie 2010). In three cross-sectional studies that investigate the association between racial residential segregation and cancer screening, one study found that women who live in more segregated communities had a lower probability of mammography use in some states but a higher probability of use in others (Mobley et al. 2008). The other two studies found an inverse association, i.e., living in a segregated neighborhood was associated with lower odds of mammography (Mobley et al. 2017) and colorectal cancer screening (Buehler et al. 2019).

The purpose of this study is to better understand the association between racism and cancer-related disparities among African Americans. To accomplish this, we examined the independent, cross-sectional associations of perceived racial discrimination and racial residential segregation with four types of cancer screening adherence (Pap test, mammography, colorectal cancer screening [CRCS], and any cancer screening) among

a sample of African Americans who were participating in a study to increase cancer prevention and control behaviors among medically underserved populations across Texas. We expected a significant inverse association between cancer screening adherence and perceived racial discrimination (Hypothesis 1) and racial residential segregation (Hypothesis 2).

Materials and Methods

Study Design

This multilevel, cross-sectional study examined the association of perceived racial discrimination and racial residential segregation with cancer screening adherence among a sample of medically underserved African Americans who needed at least one type of cancer prevention and control service. Data for the study were collected as part of a larger randomized controlled trial (RCT), the 2–1-1 Cancer Prevention and Control Phone Navigation study (hereafter referred to as the 'parent study'), and were merged with neighborhood-level data (i.e., census tract) from the U.S. Census Bureau. The Committee for the Protection of Human Subjects (CPHS) at The University of Texas Health Science Center at Houston (UTHealth) reviewed and approved all procedures for the parent study (Study HSC-SPH-10–0241) and deemed the current study exempt given that it is a secondary data analysis of the parent study (Study HSC-SPH-20–1103).

Conceptual Framework—The Public Health Critical Race Praxis (PHCRP) research approach (Ford and Airhihenbuwa 2010) and the Behavioral Model of Health Services Use (Andersen 1995) informed the conceptual framework for the study (Figure 1). PHCRP is an iterative methodology, grounded in Critical Race Theory (CRT), that guides research into the causes of health inequities, using racial equity approaches. PHCRP combines theory, experiential knowledge, science, and action to counter racial inequities while maintaining methodologic rigor. The PHCRP process is a race-consciousness approach to research that involves addressing the ways in which racism may be operating (Ford and Airhihenbuwa 2010).

The Behavioral Model (Andersen 1995) posits that health service use is influenced by a series of population characteristics, including factors that incline individuals to use care (*predisposing factors*, such as age, sex, race, marital status, and education), that enable or impede use of care (*enabling factors*, such as income and health insurance coverage), and that indicate the extent of individuals' perceived or evaluated need for care (*need factors*, such as perceived health status and evaluated health status). It also suggests that environmental factors, such as the healthcare system environment (e.g., health policy, resources, organization) and the external environment (e.g., physical, political, and economic components), influence health service use through their effect on population characteristics as well as through direct effects.

The Behavioral Model guides the study's hypothesized causal associations between key individual-level and contextual determinants, while PHCRP's race-consciousness approach is used throughout the research process. For example, within the Behavioral Model, race is categorized as a predisposing factor for health behavior. In PHCRP, however, race is socially

constructed, and, as such, it is recognized as a proxy for racism-related exposures rather than an actual risk factor. Given this, race is not included as an exposure in this study. Instead, we included two indicators of racism (i.e., perceived racial discrimination and racial residential segregation) and restricted the sample to African Americans. This shifts the focus of the study from 'how Black race might influence cancer screening behavior' to 'how the racialized experiences of African Americans might influence cancer screening behavior' (Ford and Airhihenbuwa 2010; Ford et al. 2009).

We examined a subset of the relations depicted in Figure 1, specifically, the independent associations of perceived racial discrimination (predisposing factor) and racial residential segregation (external environmental exposure) on cancer screening. Other factors, such as predisposing, enabling, need, and environmental factors, were included as covariates to tease out the independent contributions of discrimination and segregation.

Study Setting and Participants

2–1-1, a community-based service agency partly funded by the Health and Human Services Commission, is a nationally designated telephone service that connects callers to basic health and social services within their communities. Callers typically hear about 2–1-1 by word of mouth, referral from other social service agencies and community organizations, and from agency outreach efforts including print and social media and community events. 2–1-1 Texas/United Way Helpline (also referred to as the Gulf Coast Regional 2–1-1 Texas Area Information Center [AIC or call center]) based in Houston, TX is the largest 2–1-1 helpline in the country, receiving an average of 60,600 calls per month. The Center for Health Promotion and Prevention Research at UTHealth School of Public Health partnered with 2–1-1 Texas/United Way Helpline to address an identified need for referral to cancer prevention and control services among its largely low-income, racially diverse, and medically underserved population.

A detailed description of the participant recruitment methods for the parent study are described elsewhere (Fernandez et al. *in press*). Briefly, a randomly selected sample of individuals who called the Gulf Coast Regional 2–1-1 call center between February 2011 and May 2013 were recruited to participate in the parent study. After addressing callers' reason for contacting the helpline, callers were invited to participate in a brief survey to assess their need for breast, cervical, and/or colorectal cancer screening (based on American Cancer Society cancer screening guidelines in place at the time of the parent study [American Cancer Society 2021]) as well as other cancer prevention and control services of interest in the parent study (i.e., smoking cessation, HPV vaccination of a daughter). Callers in need of at least one of these services were invited to participate in the study. Ultimately, 1,554 individuals were enrolled and completed a baseline survey assessing sociodemographics and psychosocial determinants hypothesized to be related to use of cancer prevention and control services.

In the parent study, 52% (n=866) of the sample were administered the perceived discrimination scale (due to the planned missingness approach employed to reduce survey burden [Enders 2010]), and 56% (n=483) of those who received the scale were African American, and thus, eligible for inclusion in the current study. To be included in the final

analytic sample for this study, participants had to have been deemed in need of cervical, breast, and/or CRCS. Given these criteria, data from 387 participants in the parent study were pulled for Pap test analyses in the current study; 237, for mammography analyses; 168, for CRCS analyses; and 405, for any cancer screening analyses.

Data Collection

We used individual-level, self-report baseline data collected between February 2011 and May 2013 as part of the parent study. In addition, we obtained census tract and metropolitan statistical area (MSA) population values from the U.S. Census Bureau, 2011–2015 American Community Survey 5-Year Estimates to compute levels of racial residential segregation, and census-tract-level measures of poverty and educational attainment (U.S. Census Bureau 2015a, 2015c, 2015b). These data were appended to the individual-level data.

Cancer Screening Outcomes—Based on the American Cancer Society (2021) cancer screening recommendations at the time of data collection, the primary outcomes were: (1) Pap test screening adherence, a binary variable that indicates whether eligible participants had a Pap test within the last year; (2) mammography adherence, a binary variable that indicates whether eligible participants had a mammogram in the last year; (3) CRCS adherence, a binary variable that indicates whether eligible participants had a home-based stool test within the last year, sigmoidoscopy within the last five years, or colonoscopy within the last ten years; and (4) any cancer screening adherence, a binary variable that indicates whether eligible participants were adherent to at least one of the above cancer screenings. Each outcome variable was coded as 0=nonadherent or 1=adherent.

Indicators of Racism—The primary independent variables were perceived racial discrimination (Hypothesis 1) and racial residential segregation (Hypothesis 2).

Perceived racial discrimination.: We assessed perceived racial discrimination using a two-step method. First, a modified version of the validated 9-item Experiences of Discrimination (EOD) scale (Krieger et al. 2005) (Cronbach's α =.81) was administered to participants. Using a yes/no scale, 2–1-1 information specialists asked participants to indicate whether they had experienced discrimination, been prevented from doing something, or been hassled or made to feel inferior in nine different situations in the last five years. The situations included: (1) while at school; (2) when getting hired or getting a job; (3) while at work; (4) when getting housing; (5) in accessing or while getting medical care; (6) when getting service in a store or restaurant; (7) when getting credit, bank loans, or a mortgage; (8) while on the street or in a public setting; and (9) from the police or in the courts. For each situation in which a participant indicated 'yes,' the information specialist followed up by asking how many times they had had this experience (open-coded).

Next, if participants answered 'yes' to any of the nine situations indicated above, using a single item, they were asked to indicate what they thought was the main reason for their collective experiences. The reasons included: (1) ancestry or national origin, (2) gender, (3) race/ethnicity, (4) shade of skin color, (5) age, (6) religion, (7) sexual orientation, (8)

education or income level, (9) physical disability, or (10) other. We reviewed the “other” category and recoded all responses that indicated ancestry or national origin (coded 1), race/ethnicity (coded 3), and/or shade of skin color (coded 4). If an individual indicated more than one reason (other than those classified above as racial discrimination) or a reason not among those listed, the reason was coded as ‘other’.

For each participant who reported racial discrimination (i.e., race/ethnicity, ancestry or national origin, and/or shade of skin color indicated as the main reason for their collective experiences), we calculated a sum of all situations in which they indicated they had experienced discrimination (i.e., number of items affirmed within the 9-item scale). A summary score of zero was assigned to those who reported no experiences of discrimination or who reported the main reason for the discrimination they experienced as something other than race/ethnicity, ancestry or national origin, or shade of skin color. Due to the non-normal distribution of the variable, with more than 50% of the sample as having a summary score of zero and the remaining as having a score of 1 or more, we generated a binary variable. For those who reported some other discrimination or none, we categorized the level of perceived racial discrimination as ‘no perceived racial discrimination’ (coded 0). Reports of experiencing racial discrimination in at least one of the nine situation types were categorized as ‘perceived racial discrimination’ (coded 1).

Racial residential segregation.: We measured racial residential segregation within participants’ neighborhoods, defined at the census-tract level, using the Location Quotient for Racial Residential Segregation (LQRRS) (Sudano et al. 2013). The LQRRS is a local area measure of relative segregation that quantifies the relative racial homogeneity of a residential neighborhood (i.e., census tract) compared to the racial homogeneity within the larger MSAs in which the census tract is located. It is a ratio of two proportions that indicates how much more segregated an individual’s neighborhood is relative to the MSA; that is, the proportion of African Americans who reside in a neighborhood (numerator) and the proportion of African Americans who reside in the MSA (denominator) (Pruitt et al. 2015; Sudano et al. 2013). This is not simply a measure of racial composition. Rather, it is a measure the unevenness, or relative differences, which is important when assessing racial residential segregation (Massey and Denton 1988; Williams and Collins 2001). Thus, LQRRS captures the complexity of residential segregation by looking at a local community within the confines of a larger metropolitan statistical area, or urbanized region. Residential racial segregation within urban areas reflects the impact of many interrelated processes historically rooted in racism (e.g., Jim Crow segregation, red-lining, mortgage lending bias) and unhealthy for African Americans (Sudano et al. 2013; Williams and Collins 2001). As such, LQRRS is a more appropriate measure for assessing local area segregation for the investigation of individual-level health outcomes, such as cancer screening, as compared to using traditional large-area measures (e.g., dissimilarity index measured at the MSA level) that are more appropriate for investigating aggregate outcomes (Pruitt et al. 2015; Sudano et al. 2013). LQRRS also is able to provide a measure of relative deprivation or one’s position in society relative to others (Sudano et al. 2013).

LQRRS can be calculated for any two groups or characteristics (e.g., Black-White segregation, Black-Non-Black segregation). For this study, we calculated racial residential

segregation for African Americans vs. all other racial groups (i.e., Black-Non-Black residential segregation). We identified the census tract and MSA location for each participant, using the U.S. Census Bureau Geocoder based on the 2010 census tract and MSA delineations (the Census year closest to when residential data was collected from study participants), and obtained census tract and MSA population values from the US Census Bureau (2015a).

We generated a continuous variable using the following LQRRS equation: $LQRRS_i = (b_i/t_i)/(B/T)$, where $LQRRS_i$ is the level of Black- Non-Black segregation within a neighborhood relative to the larger MSA; b_i is the total number of African Americans who live within a neighborhood; t_i is the total number of residents who live within a neighborhood (all racial groups); B is the total number of African Americans who live in the MSA; and T is the total number of residents who live in the MSA. Following similar studies of segregation, we categorized LQRRS to facilitate interpretation (Sudano et al. 2013). An LQRRS of 1.2 or greater was categorized as high Black segregation (i.e., overrepresentation of African Americans in a neighborhood in comparison to the representation in the larger MSA), an LQRSS less than 1.2 and greater than 0.85 is categorized as integrated (i.e., equal representation), and an LQRSS of 0.85 or less is categorized as high Non-Black segregation (i.e., under-representation of African Americans in a neighborhood in comparison to their representation in the larger MSA). These thresholds roughly correspond with one standard deviation above or below LQRSS=1.0 (Brown and Chung 2006). Based on the distribution of the sample, the LQRSS measure was dichotomized by collapsing the integrated and high other segregation categories into a single ‘no high Black segregation’ category (hereafter referred to as ‘not living in a segregated neighborhood’; coded 0) versus the ‘high Black segregation” category (hereafter referred to as ‘living in a segregated neighborhood’; coded 1).

Covariates—In alignment with the factors identified in our conceptual framework, which were informed by the Behavioral Model (Andersen 1995) and PHCRP (Ford and Airhihenbuwa 2010), we accounted for predisposing, enabling, and environmental covariates in our analysis. We relied on existing associative research (Benjamins 2012; Buehler et al. 2019; Crawley, Ahn, and Winkleby 2008; Dailey et al. 2007; Facione and Facione 2007; Fowler-Brown et al. 2006; Hausmann et al. 2008; Hoyo et al. 2005; Jacobs et al. 2014; Mobley et al. 2008; Mobley et al. 2017; Mouton et al. 2010; Shariff-Marco, Klassen, and Bowie 2010) and the available set of variables collected within the parent study and available publicly to determine potential predisposing, enabling, and environmental covariates for adjustment. *Predisposing factors* considered were age (in years), sex (0=male, 1=female; CRCS and any cancer screening outcomes only), educational attainment (1=less than high school, 2=high school or GED, 3=post-high school (vocational, technical, or associate’s degree, some college, bachelor’s degree or higher), and marital status (0=not married or living with someone, 1=married or living with someone). *Enabling factors* considered were annual household income (1=less than $10,000; 2=$10,000–$19,999; 3=$20,000 or more) and insurance status (0=no insurance or the Texas Children’s Health Insurance Plan (CHIP) available to only low-income pregnant women who do not qualify for Medicaid and do not have health insurance), 1=public and/or private insurance). We also

included social support (0=low/moderate; high=1) assessed with the validated 8-item Duke-UNC Functional Social Support Questionnaire (FSSQ) (Cronbach's α =.91) (Broadhead et al. 1988). *Environmental factors* considered were neighborhood poverty (% of residents who live in poverty in the census tract) and educational attainment (% of residents aged 25 and older who had graduated from high school and % of residents aged 25 and older who had earned a bachelor's degree) obtained from the U.S. Census Bureau (2015c, 2015b). Given that the primary outcomes for this study are an assessment of need, we did not include any need factors as covariates.

Data Analysis

Prior to conducting the main analyses, we assessed the extent of missing data for the indicators of racism and covariates. We determined that missing data did not represent a problem (criterion: < 5% missing per variable) (Schafer 1999); thus, no imputations were deemed necessary, and a complete case analysis approach was employed. We examined correlations between each indicator of racism and other covariates (i.e., predisposing, enabling, and environmental factors) to assess potential multicollinearity. We also conducted bivariate analyses using standard logistic regression to examine the association between covariates and each indicator of racism. Covariates associated with an outcome in bivariate analyses and that did not exhibit high collinearity with the indicators of racism or other covariates (criterion: variance inflation factor < 10) (Hair et al. 2009) were entered into the multivariable analyses below.

We used multivariable logistic regression models, using generalized estimating equations (GEE) to adjust for clustering at the census tract level, to test our hypotheses: there will be a significant inverse association between each cancer screening adherence outcome and (1) perceived racial discrimination and (2) racial residential segregation. GEE is the preferred multilevel approach when the neighborhood-level units are not a random sample of a larger universe of census tracts (Ford et al. 2009). GEE also tends to be a better choice when handling clustering with non-continuous outcomes and when the N per cluster is small, which is the case for this study (range per census tract: n=1–9). We specified an exchangeable correlation structure as well as robust standard errors.

To test Hypothesis 1, first, the perceived racial discrimination variable and the screening adherence outcome variable (Pap Test, mammography, CRCS, or any cancer screening) were entered into the models. Then, we adjusted the main effects model by simultaneously adding the covariates found to be associated with the outcome in the bivariate analyses. These procedures were conducted for each of the four cancer screening outcomes separately. To test Hypothesis 2, we performed the same procedures as those used to test Hypothesis 1 but with racial residential segregation as the exposure of interest. We conducted appropriate data diagnostics (e.g., checking linearity in the logit) to ensure that there were no violations to the logistic regression model assumptions. Stata/SE Version 16 (StataCorp 2019) was used to conduct all analyses. For the bivariate analyses, we set α < .25 as a threshold for consideration of associations in subsequent models (Bursac et al. 2008). The threshold for significance for multivariable analyses was set at α < .05 (two-tailed).

Results

Descriptive Statistics

Table 1 provides the individual- and neighborhood-level characteristics for participants in need of any cancer screening. The study sample consisted of 405 individuals, with an average age of 45 years, in need of at least one of the cancer screenings of interest (Pap test, mammography, and CRCS). Most participants were female (95.6%) and not married (88.4%) and had a post-high school education (e.g., vocational, technical, or associate's degree, some college, bachelor's degree or higher; 45.2%). Nearly half of the sample (46.8%) reported an annual household income of less than $10,000, and more than half (55.5%) indicated they had public and/or private health insurance. Less than half (42.4%) reported experiencing racial discrimination in the last five years in at least one of the nine situations assessed, and, as shown in Table 2, the situations most frequently endorsed were 'when getting service in a store or restaurant' (61.4%) and 'while at work' (52.6%). In addition, 31.6% of participants reported discrimination 'in accessing or while getting medical care.' Those who reported discrimination tended to report lower levels of social support, lived in neighborhoods with a greater percentage of adults with a bachelor's degree or with a greater percentage of adults who lived below the federal poverty line, and lived in non-segregated neighborhoods (Table 1).

Participants resided in 239 neighborhoods/census tracts (i.e., clusters) within the Houston-The Woodlands-Sugar Land, TX, MSA. The number of participants per neighborhood ranged between 1–9 (mean=1.7). On average, about a quarter of the population in these neighborhoods had household incomes below the federal poverty level, nearly 30% of the population aged 25 and older were high school graduates (includes equivalency), and more than 10% of the population aged 25 and older had a bachelor's degree (Table 1). A majority of the participants (72.9%) lived in a segregated neighborhood. Those who lived in segregated neighborhoods tended be insured, reported lower levels of racial discrimination, and lived in neighborhoods with a greater percentage of adults with a high school education or bachelor's degree (Table 1).

Table 2 indicates cancer screening adherence in the sample. Overall, a majority were not adherent to cancer screening guidelines; 37.5% of eligible women had completed a Pap test within the last year, 37.1% of eligible women had completed a mammogram in the last year, and 36.9% of eligible men and women had completed a home-based stool test in the last year, sigmoidoscopy in the last five years, or a colonoscopy in the last ten years. Only 19.0% of the sample was adherent to guidelines for at least one of the cancer screenings for which they were eligible.

Perceived Racial Discrimination and Cancer Screening Adherence

We tested the hypothesis that there would be a significant inverse association between reporting experiences of racial discrimination and four cancer screening adherence outcomes among African Americans: Pap test, mammography, CRCS, and any cancer screening adherence (Hypothesis 1). Tables 3–6 summarize the unadjusted OR and adjusted odds ratios (aOR), *p*-values, and 95% confidence intervals (CI) for each outcome.

Pap Test Screening Adherence—As shown in Table 3, there was no statistically significant association between perceived racial discrimination and Pap test screening adherence in the unadjusted (OR=0.97, 95% CI: 0.64–1.45) and adjusted (aOR=1.01, 95% CI: 0.66–1.53) models. The statistical controls included in the multivariable model were health insurance status and percentage of neighborhood who lives below the federal poverty line.

Mammography Adherence—When examining the association between perceived racial discrimination and mammography, we determined that the results from the adjusted model were in the hypothesized direction (aOR=0.68, 95% CI: 0.38–1.22), suggesting that African Americans who reported racial discrimination had lower odds of being adherent to mammography recommendations compared to those who had not reported racial discrimination (Table 4). This finding, however, was not statistically significant. We included age, education, health insurance status, percentage of neighborhood with a high school/GED education, and percentage of neighborhood who lives below the federal poverty line in the multivariable model.

Colorectal Cancer Screening Adherence—The association between perceived racial discrimination and CRCS adherence also was in the hypothesized direction (inverse association) in both the unadjusted (OR=0.80, 95% CI: 0.43–1.49) and adjusted (aOR=0.79, 95% CI: 0.41–1.52) models, although, again, the results were not statistically significant (Table 5). We adjusted for age, income, and health insurance status in the multivariable model.

Any Cancer Screening Adherence—For the any cancer screening adherence outcome, the association with perceived racial discrimination was in the hypothesized direction in the adjusted (aOR=0.88, 95% CI: 0.59–1.32) models (Table 6). This result, however, was not statistically significant. Age and health insurance status were adjusted for in the multivariable model.

Racial Residential Segregation and Cancer Screening Adherence

Next, we tested the hypothesis that there would be a significant inverse association between living in a segregated neighborhood and each cancer screening adherence outcome (Pap test, mammography, CRCS, and any cancer screening) among African Americans (Hypothesis 2). Tables 3–6 present the OR and aOR *p*-values, and 95% CI for the four outcomes of interest.

Pap Test Screening Adherence—In the unadjusted (OR=0.99, 95% CI: 0.62–1.58) and adjusted (aOR=0.92, 95% CI: 0.58–1.47) models, there was no association between segregation and Pap test screening adherence (Table 3). The statistical controls in the multivariable model included age, health insurance status, and percentage of neighborhood who lives below the federal poverty line.

Mammography Adherence—As shown in Table 4, the association between racial residential segregation and mammography adherence was not in the hypothesized direction

(aOR=1.43, 95% CI: 0.76–2.68). This finding suggests that African Americans who live in a segregated neighborhood had greater odds of mammography adherence as compared to those who did not live in a segregated neighborhood. This finding, however, was not statistically significant. Age, education, health insurance status, percentage of neighborhood with a high school/GED education, and percentage of neighborhood who lives below the federal poverty line were adjusted in the multivariable model.

Colorectal Cancer Screening Adherence—Similar to the mammography adherence outcome, results for the CRCS outcome (Table 5) were not in the hypothesized direction and indicated a positive association in the unadjusted (OR = 2.73, 95% CI: 1.23–6.03) and adjusted models (aOR=2.80, 95% CI: 1.21–6.46). These results were statistically significant, suggesting that individuals who lived in a segregated neighborhood had significantly greater odds of being CRCS adherent compared to those who did not live in a segregated neighborhood. We adjusted for age, income, and health insurance status.

Any Cancer Screening Adherence—For the any cancer screening adherence outcome, there was an initial positive association with living in a segregated neighborhood in the unadjusted (OR=1.21, 95% CI: 0.79–1.85), although not statistically significant. However, there was no longer an association in the adjusted (aOR=1.03, 95% CI: 0.63–1.70) model (Table 6). Age and health insurance status were added as statistical controls in the multivariable model.

Discussion

It is well established that racism, measured in this study as perceived racial discrimination and racial residential segregation, is a fundamental cause of racial and ethnic health disparities in the United States. Despite cancer's being the second leading cause of death among African Americans (Heron 2019), research on how racism influences cancer-related disparities is limited, especially regarding cancer prevention and control behavioral outcomes, such as cancer screening. With 81% of the sample as non-adherent to at least one recommended cancer screening, this study aimed to fill a major gap by investigating independent associations of perceived racial discrimination and racial residential segregation with adherence to four cancer screening outcomes among a sample of mostly single African American women with at least a high school education, very low income (less than $20,000/year), and living in the Greater Houston, TX, metropolitan area. Many of the findings of the association of perceived racial discrimination with cancer screening adherence were in the hypothesized direction, although not statistically significant. Specifically, African Americans in the sample who reported racial discrimination, on average, had lower odds of being adherent to three out of the four outcomes examined (mammography, CRCS, and any cancer screening). In contrast, two out of four of the associations tested between racial residential segregation and cancer screening were not in the hypothesized direction. African Americans in the sample who lived in a segregated neighborhood, on average, had greater odds of mammography (non-significant) and CRCS adherence (significant).

Our findings for the discrimination-cancer screening association aligns with results reported in previous studies. For example, Crawley et al. (2008), Shariff-Marco et al. (2010), and

Jacobs et al. (2014) examined the association between perceived racial discrimination and adherence to mammography guidelines among African Americans. In all three studies, an inverse association was found—although the only significant association was the one reported by Crawley et al. Hausmann et al. (2008) also reported an inverse association between perceived racial discrimination and CRCS. Whereas our study assessed discrimination using the EOD scale (Krieger et al. 2005), Crawley et al., Shariff-Marco et al., and Hausmann et al. focused specifically on healthcare discrimination, which is also measured within the EOD. In addition, Jacobs et al. assessed perceived discrimination using the Everyday Discrimination Scale (EDS), which has been found to be highly correlated with the EOD scale (Krieger et al. 2005). In our study, the lack of a significant association between perceived racial discrimination and Pap test screening is similar to findings reported by Mouton et al. (2010), who found no association between Pap test screening and racial discrimination, using the EDS and a major discrimination scale that has components similar to the EOD scale. The same lack of association was reported by Benjamins (2012), who assessed perceived racial discrimination using the EOD and EDS scales.

It is important to note that the proportion of individuals who reported experiences of discrimination in our study (42.2%) was similar to percentages reported in studies by Dailey et al. (2007) (42%) and Kessler et al. (1999) (49%). It was much less, however, than the 69.5% reported by African Americans in a population-based study that assessed the prevalence of racial discrimination reported in the United States (Lee et al. 2019). This may suggest underreporting in our study, which would lead to an underestimation of the effect of discrimination on screening, if those who failed to report their experiences of discrimination also were less likely to be screened.

To the authors' knowledge, there are only three empirical studies in the peer-reviewed literature that quantify the association between racial residential segregation and cancer screening, one of which aligns with the findings in our study. Mobley et al. (2008) found that racial residential segregation (measured using the isolation index [Massey and Denton 1988] at the zip code [ZCTA] level) was positively associated with mammography in African American women who lived in three of the 11 states examined and in a pooled analysis of those 11 states. The remaining two studies, whose results differed from ours, found an inverse association of segregation with mammography (measured using the isolation index [Massey and Denton 1988] at the county level) (Mobley et al. 2017) and CRCS (measured using local Gi* statistic [Environmental Systems Research Institute 2021] at the census tract level) (Buehler et al. 2019). These mixed findings may be a result of the varied experiences of individuals who live in segregated neighborhoods. For example, our findings tended to contradict our expectations, which is that high levels of segregation are associated with worse health outcomes; however, this association is dependent on the social capital available in the neighborhood (Kramer and Hogue 2009) and other cultural, social, and environmental factors. Research has investigated the mixed findings reported in the literature regarding the association between racial residential segregation and health, and in recent years, findings have challenged the conventional wisdom that segregation is detrimental to minority health (Yang, Zhao, and Song 2017). Some studies suggest that, for some racial/ethnic minorities, living in neighborhoods with those of a similar race/ethnicity can create communities with increased social support; greater social, economic, and structural resources; and less

exposure to direct racial discrimination (Yang, Zhao, and Song 2017). Our findings suggest that similar factors may be influencing the association between segregation and cancer screening. We did not measure social capital in our study but did assess perceived social support and found that those who lived in a segregated neighborhood reported higher levels of social support. We also observed a positive association between segregation and health insurance and an inverse association between segregation and discrimination. This may explain the positive association of segregation with mammography and CRCS. Another explanation may be the presence of cancer screening programs specifically targeting Black neighborhoods. This targeted programming directly aims to combat the trend of worse health outcomes in majority minority communities. Future studies should investigate these associations further to generate data to inform interventions designed to increase cancer screening among African Americans, including how discrimination and segregation may interact to influence screening outcomes as well as how these associations may differ between those who report discrimination in health care versus those who report other types of discrimination. Given that very little is known about the mechanisms of perceived racial discrimination and racial residential segregation on cancer screening behaviors, the intent of this paper is to shed partial light on the direction and magnitude of the relations described rather than demonstrate causality. Future research would benefit from the use of directed acyclic graphs (DAGs) to help identify the minimal set of covariates needed for adjustment. There is also a great need for more investigators concurrently measuring multiple indicators of racism and cancer screening outcomes in their work so that future studies can examine the interplay of these factors on health using more contemporaneous data.

Limitations

There are a few limitations of this study. First, this was a secondary data analysis of a larger cancer prevention and control study collected between 2011–2013. While we recognize the relative age of these data and its limitations, we selected this dataset because it uniquely included two indicators of racism along with cancer screening outcomes. Furthermore, the relationships tested are related to a conceptual model; thus, we did not expect the basic hypotheses to have changed over time and still expect them to be relevant to current conditions. There was limited power to detect significant associations, and it is difficult to infer causality, given that this is an observational study with high potential for residual confounding. The findings cannot be generalized to African Americans broadly because this study focused only on African Americans in Texas who were largely low income and medically underserved. It is also important to note that individuals who call 2–1-1 may be different from those who do not. Given that all participants within the sample resided in the Greater Houston MSA, a racially and ethnically diverse urban region, there also may be differences in participants' perceptions of discrimination. In addition, perceived discrimination tends to be more prevalent among those with higher education and higher income and who live in more integrated neighborhoods. Our sample is very low income, most have a post-high school education (primarily vocational, technical, associate's degrees, or some college), and most live in high Black segregated neighborhoods. These characteristics may explain the lower level of discrimination reported in our study (42%) compared to a recent population-based prevalence reported (70%). We used one single residential segregation measure in a single, highly diverse metropolitan area that comprises

many racial and ethnic populations. Houston also is the largest city in the nation without zoning; thus, our context is unique. All participants had to be non-adherent to at least one cancer prevention service to be eligible for participation in the parent study, suggesting some form of selection bias from attenuation of the range of exposure. Finally, self-reported outcome data in the study may be vulnerable to recall bias and social desirability. Despite these limitations, there are many strengths that make this study a significant contribution to the literature.

A major strength of our study is that CRT principles and health-equity approaches guided the research. To the authors' knowledge, no other studies have examined the association between segregation and Pap test screening, specifically among African Americans, and only one has examined the association between segregation and CRCS. This is also the first study to examine a combined cancer screening adherence outcome and its association with indicators of racism. Another strength of our study is that we used multilevel modeling. In addition, our examination of racial residential segregation and consideration of other contextual-level factors extends the literature beyond its disproportionate focus on individual-level determinants of health behavior. Measurement issues are often a concern in similar studies; however, we assessed perceived racial discrimination using a validated, multi-item measure, a methodology that tends to be lacking in the current literature (Krieger et al. 2005; Williams and Mohammed 2009). We also assessed racial residential segregation, using a local area measure more appropriate for investigating individual-level health outcomes compared to more traditional, large area measures of segregation (e.g., dissimilarity index measured at the MSA level) that are more appropriate for examining aggregate health outcomes (Pruitt et al. 2015; Sudano et al. 2013).

Conclusions

Using a racial equity approach, we found that racism is associated with cancer screening behavior but that this association is nuanced. The specific indicator of racism may be important, e.g., perceived racial discrimination appears to be associated with lower odds of cancer screening among African Americans, whereas racial residential segregation may, in certain situations, be associated with higher odds of cancer screening. While the takeaway from these findings certainly should not be that racism is health promoting, it does suggest that future research should be conducted to better explicate the relation between perceived racial discrimination, racial residential segregation, and cancer screening among Africans Americans.

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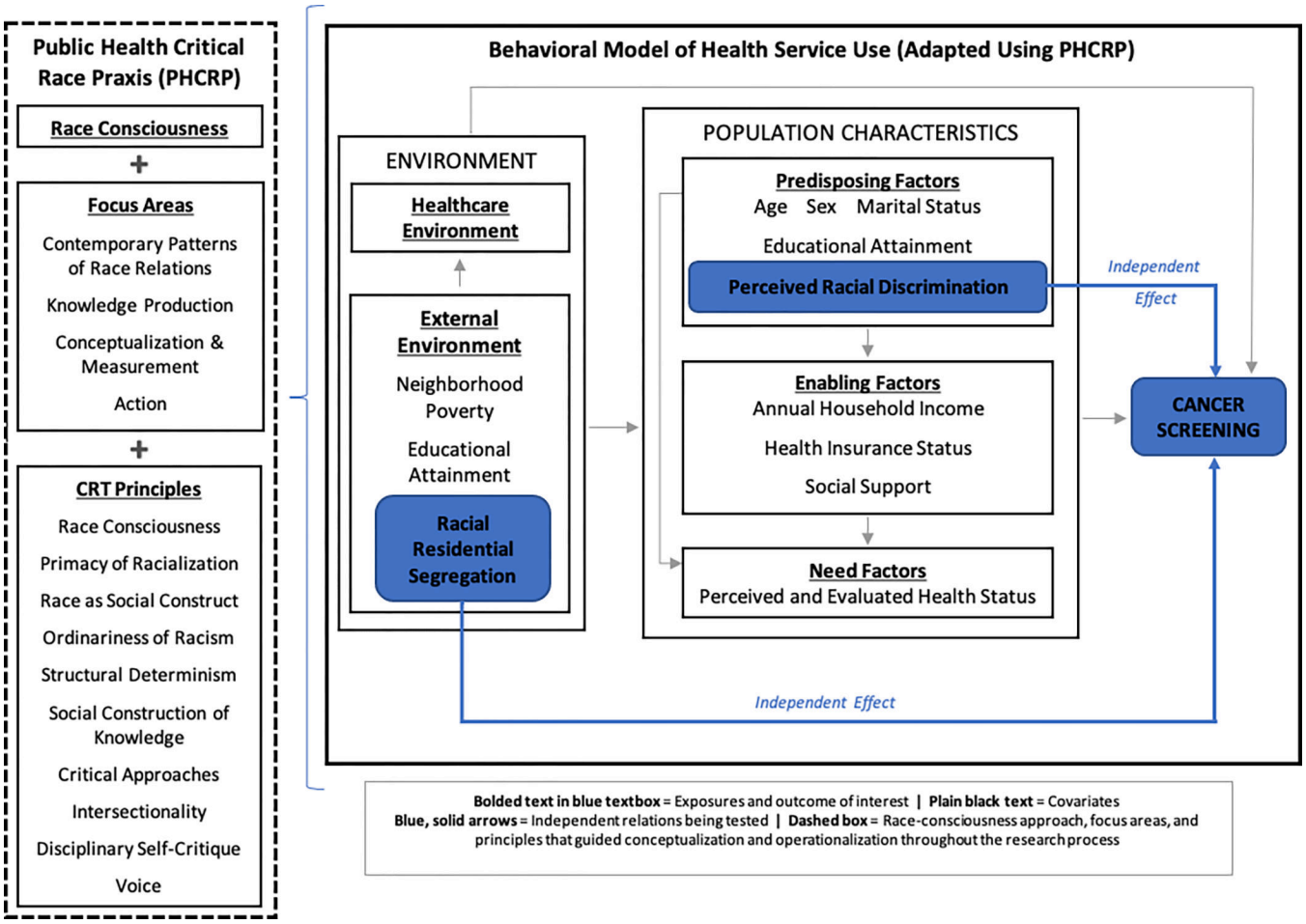

Figure 1:

Conceptual Framework: Adapted Behavioral Model of Health Service Use Using Public Health Critical Race Praxis

Table 1.

Characteristics of African American Sample by Perceived Racial Discrimination and Racial Residential Segregation, Greater Houston, TX, 2011–2013 (N=405)

INDIVIDUAL-LEVEL CHARACTERISTICS, N(PERCENT)							
	Total Sample	**Perceived Racial Discrimination**			**Living in a Segregated Neighborhood**		
		No	**Yes**	***p*** *	**No**	**Yes**	***p*** *
Age (years), mean(SD)	44.6 (12.7)	44.5 (12.5)	44.8 (13.0)	.816	43.1 (12.5)	45.2 (12.8)	.154
Gender				.435			.933
Male	18 (4.4)	12 (5.1%)	6 (3.5)		5 (4.6)	13 (4.4)	
Female	387 (95.6)	222 (94.9%)	165 (96.5)		104 (95.1)	283 (95.6)	
Marital Status				.576			.812
Not Married	357 (88.4)	205 (87.6%)	152 (89.4)		97 (89.0)	260 (88.1)	
Married/Living with a Someone	47 (11.6)	29 (12.4%)	18 (10.6)		12 (11.0)	35 (11.9)	
Education				.142			.925
Less than High School	73 (18.0)	46 (19.7%)	27 (15.8)		19 (17.4)	54 (18.2)	
High School or GED	149 (36.8)	92 (39.3%)	57 (33.3)		39 (35.8)	110 (37.2)	
Post High School[a]	183 (45.2)	96 (41.0%)	87 (50.9)		51 (46.8)	132 (44.6)	
Annual Household Income				.360			.727
None – $9,999	185 (46.8)	113 (50.0%)	72 (42.9)		52 (49.5)	133 (45.9)	
$10,000 – $19,999	141 (35.7)	78 (34.4%)	63 (37.5)		37 (35.2)	104 (35.9)	
$20,000 or more	69 (17.5)	36 (15.9%)	33 (19.6)		16 (15.2)	53 (18.3)	
Health Insurance Status				.714			.120
No Insurance (or CHIP only)	180 (44.6)	102 (43.8)	78 (45.6)		55 (50.9)	125 (42.2)	
Public and/or Private Insurance	224 (55.5)	131 (56.2%)	93 (54.4)		53 (49.1)	171 (57.8)	
Social Support							
Social Support Score, mean(SD)	22.9 (5.9)	23.4 (5.8)	22.1 (5.9)	.030	22.7 (5.8)	22.9 (5.9)	.722
Levels of Social Support				.508			.223
Low	91 (29.4)	52 (30.0%)	39 (31.5)		29 (34.5)	62 (27.4)	
Moderate/High	219 (70.7)	134 (72.0%)	85 (68.6)		55 (65.5)	164 (72.6)	
Perceived Racial Discrimination							
# of Situations Reported, mean(SD)	1.4 (2.1)	-	-	-	1.7 (2.3)	1.4 (2.0)	.147
Experienced Racial Discrimination							.113
No	234 (57.8)	-	-	-	56 (51.4)	178 (60.1)	
Yes	171 (42.2)	-	-	-	53 (48.6)	118 (39.9)	
NEIGHBORHOOD-LEVEL CHARACTERISTICS, N (PERCENT)							
Educational Attainment [b]							
% with High School/GED, mean(SD)	29.2 (8.5)	29.4 (8.5)	29.0 (8.4)	.681	26.0 (8.3)	30.4 (8.2)	<.0001
% with Bachelor's Degree, mean(SD)	11.6 (7.8)	11.1 (7.3)	12.4 (8.5)	.098	12.8 (10.8)	11.2 (6.3)	.069

INDIVIDUAL-LEVEL CHARACTERISTICS, N(PERCENT)							
	Total Sample	**Perceived Racial Discrimination**			**Living in a Segregated Neighborhood**		
		No	**Yes**	***p*** *	**No**	**Yes**	***p*** *
% Below Federal Poverty Line, mean(SD)	25.9 (12.2)	26.6 (11.9)	24.8 (12.6)	.149	24.8 (14.4)	26.2 (11.2)	.287
Racial Residential Segregation							
Location Quotient (unitless), mean(SD)	2.5 (1.5)	2.6 (1.6)	2.3 (1.5)	.055	-	-	-
Living in Segregated Neighborhood				.113			
No	109 (26.9)	56 (23.9)	53 (31.0)		-	-	-
Yes	296 (73.1)	178 (76.1)	118 (69.0)		-	-	-

Unless otherwise noted, statistics reported are total number of participants and column percentages

*Pearson Chi-squared Test (two-tailed) for categorical variables

Independent Samples T-test (two-tailed) for continuous variables

CHIP: Texas Children's Health Plan available to low-income, uninsured pregnant women who do not qualify for Medicaid

[a]Includes vocational, technical, or associate degree, some college, and bachelor's degree or higher

[b]Percentage of the population 25 years and older

Table 2.

Self-Reported Experiences of Racial Discrimination and Cancer Screening Adherence among African Americans, Greater Houston, TX, 2011–2013

DISCRIMINATION SITUTATIONS (N=171)	Total Sample N (Percent)
While at school	23 (13.5)
When getting hired or getting a job	82 (48.0)
While at work	90 (52.6)
When getting housing	42 (25.4)
In accessing or while getting medical care	54 (31.6)
When getting service in a store or restaurant	105 (61.4)
When getting credit, bank loans, or a mortgage	37 (28.5)
While on the street or in a public setting	79 (46.2)
From the police or in the courts	73 (42.7)
CANCER SCREENING ADHERENCE	
Pap Test[a] (N=387)	145 (37.5)
Mammography[b] (N=237)	88 (37.1)
Colorectal Cancer Screening[c] (N=168)	62 (36.9)
Any Cancer Screening[d] (N=405)	207(51.1)

[a]Pap Test: Had a Pap test within the last year

[b]Mammography: Had a mammogram in the last year

[c]Colorectal Cancer Screening: Had home-based stool test within last year, sigmoidoscopy within last five years, or colonoscopy within last ten years

[d]Any Cancer Screening: Had at least one of the cancer screenings for which they were eligible

Table 3.

Unadjusted and Adjusted Odd Ratios for Pap Test Screening Adherence among African Americans, Greater Houston, TX, 2011–2013 (N=387)

	Unadjusted Models	Adjusted Discrimination Model	Adjusted Segregation Model
INDICATORS OF RACISM	**OR (95% CI)**	**aOR (95% CI)**	**aOR (95% CI)**
Perceived Racial Discrimination			
No	Reference	Reference	Not Included
Yes	0.97 (0.64–1.45)	1.01 (0.66–1.53)	Not Included
Racial Residential Segregation (High Black Segregation)			
No	Reference	Not Included	Reference
Yes	0.99 (0.62–1.58)	Not Included	0.92 (0.58–1.47)

OR, odds ratio; aOR, adjusted odds ratio; 95% CI, 95% confidence interval

Covariates included for adjustment in discrimination and segregation models: age (years), health insurance status (no insurance/Texas Children's Health Plan only; public and/or private insurance), and percent neighborhood below federal poverty line

† p <.25, two-tailed (unadjusted results only)

* p < .05, two-tailed

** p < .01, two-tailed

*** p < .001, two-tailed

Table 4.

Unadjusted and Adjusted Odd Ratios for Mammography Adherence among African Americans, Greater Houston, TX, 2011–2013 (N=237)

	Unadjusted Models	Adjusted Discrimination Model	Adjusted Segregation Model
INDICATORS OF RACISM	**OR (95% CI)**	**aOR (95% CI)**	**aOR (95% CI)**
Perceived Racial Discrimination			
No	Reference	Reference	Not Included
Yes	0.64 (0.38–1.11)[a,†]	0.68 (0.38–1.22)	Not Included
Racial Residential Segregation (High Black Segregation)			
No	Reference	Not Included	Reference
Yes	1.57 (0.85–2.91)[a,†]	Not Included	1.43 (0.76–2.68)

OR, odds ratio; aOR, adjusted odds ratio; 95% CI, 95% confidence interval

Covariates included for adjustment in discrimination and segregation models: age (years), education (less than high school; high school/GED; post high school), health insurance status (no insurance/Texas Children's Health Plan only; public and/or private insurance), percent neighborhood with high school diploma/GED, percent neighborhood below federal poverty line

[a] Not estimable via generalized estimating equation. Standard logistic regression performed.

† p <.25, two-tailed (unadjusted results only)

* p < .05, two-tailed

** p < .01, two-tailed

*** p < .001, two-tailed

Table 5.

Unadjusted and Adjusted Odd Ratios for Colorectal Cancer Screening Adherence among African Americans, Greater Houston, TX, 2011–2013 (N=165)

	Unadjusted Models	Adjusted Discrimination Model	Adjusted Segregation Model
INDICATORS OF RACISM	**OR (95% CI)**	**aOR (95% CI)**	**aOR (95% CI)**
Perceived Racial Discrimination			
No	Reference	Reference	Not Included
Yes	0.80 (0.43–1.49)	0.79 (0.41–1.52)	Not Included
Racial Residential Segregation (High Black Segregation)			
No	Reference	Not Included	Reference
Yes	2.73 (1.23–6.03) *	Not Included	2.80 (1.21–6.46) *

OR, odds ratio; aOR, adjusted odds ratio; 95% CI, 95% confidence interval

Covariates included for adjustment in discrimination and segregation models: age (years), annual household income ($0–$9,999; $10,000–$19,999; $20,000 or more), and health insurance status (no insurance/Texas Children's Health Plan only; public and/or private insurance)

† p <.25, two-tailed (unadjusted results only)

* p < .05, two-tailed

** p < .01, two-tailed

*** p < .001, two-tailed

Table 6.

Unadjusted and Adjusted Odd Ratios for Any Cancer Screening Adherence among African Americans, Greater Houston, TX, 2011–2013 (N=405)

	Unadjusted Models	Adjusted Discrimination Model	Adjusted Segregation Model
INDICATORS OF RACISM	**OR (95% CI)**	**aOR (95% CI)**	**aOR (95% CI)**
Perceived Racial Discrimination			
No	Reference	Reference	Not Included
Yes	0.90 (0.62–1.31)	0.88 (0.59–1.32)	Not Included
Racial Residential Segregation (High Black Segregation)			
No	Reference	Not Included	Reference
Yes	1.21 (0.79–1.85)	Not Included	1.03 (0.63–1.70)

OR, odds ratio; aOR, adjusted odds ratio; 95% CI, 95% confidence interval

Covariates included for adjustment in discrimination and segregation models: age (years) and health insurance status (no insurance/Texas Children's Health Plan only; public and/or private insurance)

† p <.25, two-tailed (unadjusted results only)

* p < .05, two-tailed

** p < .01, two-tailed

*** p < .001, two-tailed