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Special Issue: Psychological and Social Dynamics of the Aging Experience Among Racial/Ethnic Minorities

Correlates of Elevated C-Reactive Protein Among Black Older Adults: Evidence From the Health and Retirement Study

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Abstract

Objectives: Substantial evidence documents gender and racial disparities in C-reactive protein (CRP), a measure of systemic inflammation, among older adults. Yet, the comparative approaches of these studies may obscure distinct risk and protective factors associated with elevated CRP among older Black Americans. To pinpoint opportunities for intervention, this study utilizes a "within-group approach" to identify the sociodemographic, psychosocial, behavioral, and health-related correlates of elevated CRP among older Black women and men.

Method: The sample consisted of 2,420 Black respondents aged 51 and older in the Health and Retirement Study (2006–2016). Gender-stratified, random effects logistic regression models were used to examine correlates of elevated CRP (>3.0 mg/L).

Results: More than 50% of Black women had elevated CRP, and younger age, Medicaid, lower mastery, religiosity, overweight/obesity, physical inactivity, and activities of daily living (ADLs) contributed to elevated CRP among this group. In contrast, elevated CRP was reported among only 37.25% of Black men, for whom financial distress was associated with lower odds of elevated CRP; religiosity, less neighborhood cohesion, current smoking, overweight/obesity, ADLs, and more chronic conditions were associated with greater odds of elevated CRP among this group.

Discussion: Sociodemographic factors had a limited association with elevated CRP among older Black Americans. Rather, a range of psychosocial, behavioral, and health-related factors were more influential determinants of elevated CRP among older Black Americans. Most notably, findings demonstrate distinct correlates of CRP among Black women and men, underscoring the critical need to further evaluate the risk and protective mechanisms undergirding disparities *among* this aging population.

Keywords: Black Americans, Black men, Black women, C-reactive protein, Health and Retirement Study

A large body of research demonstrates significant racial disparities in physical health among older adults in the United States. Poor outcomes are particularly pronounced among older Black Americans, who experience disproportionately high rates of chronic conditions, early onset of physical disability, and premature mortality (Thorpe et al.,

2016, 2020) relative to Whites. To clarify the causal mechanisms of these inequalities, population health research has increasingly integrated social, psychological, and biological approaches, including the use of biological markers of disease risk and progression, such as C-reactive protein (CRP). CRP is a measure of systemic inflammation that results from the body's immune response, which is triggered to protect against infection and illness (Miller et al., 2002). However, prior research suggests that prolonged exposure to elevated inflammation can negatively affect health and indicate immune dysregulation (Nguyen et al., 2022). Elevated CRP has also been associated with numerous adverse health outcomes where there are large and persistent racial inequities, including cardiovascular disease (CVD), stroke, hypertension, obesity, and mortality (Choi et al., 2013; Sesso et al., 2003). Studies show that Black Americans have higher levels of CRP than Whites and that inflammation increases naturally with age (Franceschi & Campisi, 2014; Nazmi & Victora, 2007). Yet, as most CRP studies have utilized a comparative approach to explain racial disparities, less is known about the specific factors that contribute to elevated CRP among older Black Americans. Given its links to a range of chronic health issues, identifying the correlates of elevated CRP among Black older adults may shed new light on the biopsychosocial mechanisms that contribute to racial disparities in health and aging.

This study explores the role of social, psychological, behavioral, and health-related factors to identify the risk and protective mechanisms that uniquely shape CRP among Black older adults. Despite occurring within the body, research suggests that the individual-level physiological processes that produce systemic inflammation are likely due to the accumulation of numerous exposures over the life course (Mitchell & Aneshensel, 2017). For instance, mounting evidence shows that more frequent exposure to chronic social and psychological stressors may contribute to physiological deterioration that produces inflammation through complex and multifactorial processes (McEwen, 1998). When individuals perceive stressful events, multiple physiological systems are triggered as part of the body's generalized stress response (McEwen, 1998). In response to chronic stress, the body eventually becomes less capable of adequately responding to stressors and may experience more difficulty in halting the stress response, which elicits inflammation over time (McEwen, 1998; Miller et al., 2002); chronic exposure to stressors may also prompt individuals to engage in maladaptive coping behaviors (e.g., smoking, alcohol/substance abuse, overeating) that further undermine physical health (Mezuk et al., 2013). Consequently, socially disadvantaged individuals (e.g., members of minoritized racial/ethnic groups, women), who tend to encounter more challenges relative to their socially advantaged counterparts, may face a heightened risk of chronic inflammation (Nazmi & Victora, 2007).

These processes are also reflected in observed social inequalities in CRP, as prior research demonstrates that Black adults have higher CRP compared to White adults (Farmer et al., 2020); women tend to have higher CRP levels than men (Lakoski et al., 2006), while individuals with lower socioeconomic status (SES) have higher CRP levels than those with higher SES (Nazmi & Victora, 2007). Furthermore, studies suggest that individuals with multiple disadvantaged social identities tend to exhibit elevated CRP levels (Farmer et al., 2021; Khera et al., 2005), and recent findings show that Black women consistently have higher levels of CRP compared to other race–gender groups (Farmer et al., 2021; Khera et al., 2005).

Despite a growing body of research in this area, two critical gaps in our understanding of CRP among older Black Americans remain. *First, the distinct pathways through which older Black women and men experience risk for elevated CRP remain unclear*. Although research has commonly assessed CRP separately among gender groups to account for potential physiological variations among individuals identifying as "women" and "men" (Farmer et al., 2020; Herd et al., 2012), emerging research has only recently highlighted the complex ways in which race, gender, and other risk factors (e.g., SES) combine to shape CRP (Farmer et al., 2021). While such comparative efforts have provided some insight into group differences in CRP levels (Farmer et al., 2021), the distinct risk and protective factors associated with elevated CRP among older Black women and men remain unclear.

Second, prior research on racial disparities has often limited its scope to a narrow range of factors that may be linked to increased risk of elevated CRP among Black older adults. Specifically, many studies have focused on the role of status-based inequalities, such as gender and SES (Alley et al., 2006; Herd et al., 2012; Janicki-Deverts et al., 2012; Khera et al., 2005). Yet, there is growing evidence that Black Americans may experience "diminishing returns" with higher SES conferring limited health benefits, particularly among older adults (Assari, 2018; Boen, 2016; Farmer et al., 2021; Farmer & Ferraro, 2005; Thomas Tobin & Hargrove, 2022). Research suggests this pattern also extends to CRP, as studies show that older Black Americans exhibit only minimal improvements in CRP with greater educational attainment; recent findings also note significant differences in the influence of SES on CRP across older Black women and men, suggesting that Black women and men may differentially benefit from higher SES (Farmer et al., 2021). Taken together, this work underscores the need to clarify the ways in which SES and other sociodemographic factors may distinctly influence CRP among older Black women and men.

In addition to sociodemographic characteristics, others have emphasized differential exposures to social stressors, such as discrimination (Lewis et al., 2010; Van Dyke et al., 2017), as key explanations for CRP disparities. While these factors are undoubtedly important, research suggests there are likely additional mechanisms that contribute to elevated CRP among older Black Americans. For instance, Nguyen et al. (2022) recently demonstrated the significance of psychosocial factors beyond discrimination for shaping

CRP among this population. Specifically, they found that community characteristics, such as perceived neighborhood social cohesion and physical disadvantage, interact with negative cognitive dispositions (e.g., hopelessness and pessimism) to influence CRP in older Black adults.

Others focused on the impact of behavioral factors and CRP. In one example, scholars noted that health behaviors, including physical activity and alcohol use, were associated with higher CRP levels among older adults (McDade et al., 2006); studies also show a strong, positive association between CRP and smoking (McDade et al., 2006). Yet, only a handful of studies have evaluated the health-related correlates of CRP among older Black adults, although prior research highlights significant links between CRP and physical disability (Kuo et al., 2006), body mass index/obesity status (Choi et al., 2013), and chronic health conditions (Khera et al., 2005; Pearson et al., 2003). There has also been inadequate consideration of protective factors, despite evidence from prior work, which suggests that protective psychosocial resources, such as social support and mastery, significantly influence inflammation (Taylor et al., 2006; Yang et al., 2014). Taken together, this research collectively demonstrates the broad array of factors that may contribute to elevated CRP among older Black Americans, while simultaneously spotlighting the narrow range of factors considered by individual CRP studies. As a result, the collective influence of these sociodemographic, psychosocial, behavioral, and health-related factors on CRP among older Black women and men remains unclear. Additional research that considers a varied array of correlates, including those associated with elevated CRP in prior studies and those that capture heterogeneity in the lived experiences of older Black adults, is needed to clarify unique sources of risk and resilience among this population.

To address these limitations, the purpose of the present study was to explore the correlates of elevated CRP among older Black women and men. In order to remain consistent with the existing literature and to be able to situate our findings in the context of published work, we evaluate these relationships separately for women and men (Cushman et al., 2009; Farmer et al., 2020; Herd et al., 2012; Kelley-Hedgepeth et al., 2008; Khera et al., 2005). This study advances prior work by using nationally representative longitudinal panel data from the Health and Retirement Study (HRS) to assess a broad range of sociodemographic, psychosocial, behavioral, and health-related factors that have been linked to CRP in prior research. We consider the roles of both risk and protective factors, which we expect to play different roles among Black women and men. We also draw on a rich tradition of minority aging scholarship—one that recognizes both race and gender as socially constructed statuses that combine to uniquely pattern the health trajectories of older individuals by distinguishing their exposure to risks and access to health-protective resources across the life course (Brown et al., 2016; Whitfield et al., 2008)—to explore the distinct ways that elevated CRP risk arises among older Black women and men. While we remain consistent with prior CRP studies by examining these processes separately among gender groups (Farmer et al., 2020; Herd et al., 2012), we extend this work by utilizing a "within-group approach" (Whitfield et al., 2008) to better assess the distinct, and often nuanced, ways that health correlates may influence outcomes among subgroups of Black Americans. In utilizing this approach, the present study aimed to move beyond the traditional race-comparative strategies applied in previous CRP studies and to enhance our understanding of the heterogeneity of these processes among the aging Black population.

Method

Data

The data for the current study come from the 2006 to 2016 waves of the HRS, an ongoing nationally representative panel survey of community-dwelling midlife and older adults residing in the United States. Initiated in 1992, the HRS is sponsored by the National Institute on Aging and the Institute for Social Research at the University of Michigan. It consists of biennial interviews on a wide range of topics (e.g., SES, psychological and physical health). Starting in 2006, the HRS began to collect psychosocial and biological data from respondents from a random rotating half-sample of respondents, who are then followed up with every 4 years (Juster & Suzman, 1995). Details on the HRS, including the study design, response rates, and sampling procedures, have been extensively published elsewhere (https://hrsdata.isr.umich.edu). The University of Michigan Health Sciences Human Subject Committee approved the HRS and requires that all participants provide informed consent prior to participation.

The present study was limited to 2,697 non-Hispanic Black adults aged 51 and older who participated in the core interviews, had at least one wave of biomarker data, and were eligible for and completed at least one leave-behind questionnaire, which is used to collect psychosocial data from respondents. Because missingness was minimal (<5%) among study variables, we dropped all respondents with missing data on study variables. Thus, the final analytic sample included 2,420 Black adults who contributed a total of 3,595 observations over the study period from 2006 to 2016. Respondents could contribute one to three waves of data (mean = 1.5).

Measures

C-reactive protein

CRP was collected by HRS interviewers using a series of dried blood spots (DBS) that were placed on cards and shipped to either the University of Vermont or the University of Washington to be assayed (see Author Note 1). Based on a joint report released by the American Heart Association

and Centers for Disease Control and Prevention, which highlighted evidence showing that elevated CRP was associated with increased risk for adverse health outcomes (Pearson et al., 2003), we dichotomized CRP to compare elevated levels of CRP (>3.0 mg/L) to nonelevated levels (≤3.0 mg/L) in the present study.

Sociodemographic factors

Sociodemographic characteristics assessed included a continuous measure of respondents' *age*; *educational attainment* (less than high school [HS], HS/general education diploma [GED], and some college or more); *geographic region* (South vs. other); *rural/urban residence*; *household income* (quartiles; ≤$13,000, $13,001–$27,000, $27,001–$55,000, >$55,000); and *type of insurance coverage* (insured [without Medicaid coverage], Medicaid, and uninsured).

Psychosocial factors

We explored multiple psychosocial risks and resources that may contribute to elevated CRP among older Black adults (see Author Note 2). Cronbach's alphas for these variables among women and men are presented in Supplementary Table 1. Psychosocial risks included *marital status* (never married, married, separated/divorced, and widowed); *chronic stress*, which was based on respondent reports of stressful, ongoing problems occurring within the past 12+ months across eight domains (e.g., personal health problems, close relationships; range, 0–8); higher values indicate more chronic stressors (Troxel et al., 2003). *Financial difficulties* were assessed by asking respondents to report how difficult it is to pay bills each month, with higher values indicating more difficulty in paying bills (range, 0–4; Pearlin et al., 1981). *Everyday discrimination* was measured using the Everyday Discrimination Scale (Williams et al., 1997), which assesses frequency of unfair treatment on a day-to-day basis; higher scores indicate more frequent exposure to discrimination (range, 0–5). *Depressive symptoms* were measured with an eight-item version of the Center for Epidemiological Studies—Depression scale (Radloff, 1977), which assesses past-week symptom levels (range, 0–8). *Perceived neighborhood disorder* was calculated by averaging the scores from four items that assessed physical characteristics of the neighborhood (e.g., vandalism), and higher scores indicate more disorder (range, 0–6; Cagney et al., 2009). *Perceived poor neighborhood cohesion* was calculated by averaging responses from four items that assess levels of social cohesion/trust in one's neighborhood (e.g., most people in this area are friendly), with higher scores indicating less cohesion.

Psychosocial resources included *social support*, which was assessed using a well-established measure that captures the respondents' perceived social support (e.g., relationship quality) with spouses/partners, children, family, and friends (Smith et al., 2017; Walen & Lachman, 2000); scores across all relationship domains were averaged to create an index of social support. *Religiosity/spirituality* was assessed via four items from the Brief Multidimensional Measure of Religiousness/Spirituality (Fetzer Institute, 2003). An index of religiosity/spirituality was calculated by averaging the scores across all items (range, 0–5), and higher scores indicate greater levels of religiosity/spirituality. *Perceived mastery* was measured with five items that capture the extent to which individuals perceive personal control over their life (Lachman & Weaver, 1998); scores were derived by averaging these items (range, 0–5), and higher scores indicate greater mastery. *Sense of purpose in life* was determined using a seven-item subscale of the Ryff Measures of Psychological Well-being, (e.g., "I enjoy making plans for the future and working to make them a reality"), where higher scores indicate more purpose (Ryff, 1989).

Behavioral factors

Behavioral factors included *smoking* (never, past, or current smoker); *alcohol consumption* (no, moderate, or heavy alcohol consumption); and *physical activity*, which was based on respondent reports of any moderate or vigorous physical activity in the past month. *Overweight/obesity* was defined as having a body mass index (BMI) of ≥25 (calculated using weight in kilograms divided by height in meters, squared).

Health-related factors

Activities of daily living (ADLs) were assessed using respondent reports of any difficulty faced in five basic life functions (e.g., eating). We created an index of *chronic conditions*, including diagnoses of hypertension, diabetes, cancer (excluding skin cancer), stroke, arthritis, lung problems, and heart problems; higher scores indicate more chronic disease. *Cholesterol medications* were assessed by respondents reporting use of cholesterol-lowering medication usage. We were unable to control for medications that have documented associations with CRP, including hormone replacement therapy (HRT) use. All measures were time-varying, except gender and educational attainment.

Data Analysis

Descriptive analyses were conducted for the overall sample and stratified by women and men. Comparisons by gender across all study variables were determined by *t*-tests and χ^2 tests, as appropriate, except for median levels of CRP, which we tested differences using the K-sample equality-of-medians test. Multilevel random-effects multivariate logistic regression models were used to examine the association between study covariates and elevated CRP among older Black adults. To account for the panel design of the HRS, we nested repeated observations (Level 1) within HRS respondents (Level 2) and we clustered by respondents to obtain robust standard errors for all analyses, as has been used in previous work (Dupre et al., 2017). The data for the study were not weighted; therefore, we included

variables related to the sampling design (e.g., age, gender, region) to produce unbiased estimates, which is consistent with other studies using the HRS data (Dupre et al., 2017; Farmer et al., 2020; Winship & Radbill, 1994).

Our multivariate models assessed correlates of elevated CRP among Black women and men. We estimated a series of models with sequential inclusion of the following sets of covariates based on their likely causal ordering: sociodemographic, psychosocial, behavioral, and health-related characteristics in gender-stratified models. We also conducted sensitivity analyses identical to the analysis plan, while excluding respondents with CRP >10.0 mg/L (n = 493), and the substantive meaning of the findings did not change. Finally, we tested for the potential of nonlinearity and collinearity (Supplementary Table 2). For example, we initially assessed variables that might have nonlinear associations with elevated CRP and categorized such variables (e.g., overweight/obesity, educational attainment, income) and we performed collinearity diagnostics using the *collin* command in STATA, which showed an acceptable variance inflation factor and tolerance of all study variables. All p values were based on two-tailed tests and were statistically significant at $p < .05$. Analyses were conducted using STATA version 14.2.

Results

The distributions of study variables for the overall sample and by gender are presented in Table 1. Results from the descriptive analyses show that the average age of the 2,420 respondents was 64.5 ± 9.3. Most of the sample were women, lived in the South, were insured, did not consume alcohol, and were overweight/obese. About 23% of the sample had less than a HS education, whereas almost 34% had a HS diploma/GED, and 43% had some college or more. Nearly 50% of the sample had a household income of $27,000 or less.

Results indicate that more Black women reported elevated CRP compared to men (50.64% vs. 37.25%, respectively). Furthermore, more women reported household incomes in the lower two quartiles and had Medicaid coverage than men. Men were more likely to be currently married, while women were more likely to be widowed. Women reported more depressive symptoms, financial insecurity, and perceived neighborhood disorder compared to men. However, women had higher levels of social support and religiosity/spirituality than men. There were also significant gender differences in behavioral and health-related factors: While more men were current or former smokers, had heavy alcohol consumption, and took cholesterol medication, women had higher rates of physical inactivity, overweight/obesity, ADLs, and more chronic conditions.

Black Women

The results from random-effects logistic regression models among Black women are presented in Table 2. The results from across these models were consistent and revealed that a combination of sociodemographic, psychosocial, behavioral, and health-related factors was associated with increased odds of elevated CRP among women. The fully adjusted model showed that younger age (odds ratio [OR] = 0.96, 95% confidence interval [CI], 0.94–0.98), having Medicaid coverage (OR = 1.91, 95% CI, 1.19–3.06), greater religiosity/spirituality (OR = 1.20, 95% CI, 1.03–1.39), physical inactivity (OR = 1.56, 95% CI, 1.07–2.28), being overweight/obese (OR = 4.40, 95% CI, 2.64–7.34), and any ADLs (OR = 1.68, 95% CI, 1.07–2.64) were associated with greater odds of elevated CRP among women. By contrast, higher levels of mastery were associated with lower odds of elevated CRP (OR = 0.81, 95% CI, 0.70–0.94).

Black Men

In Table 3, results from random-effects logistic regression models examining correlates of elevated CRP among Black men are presented. In Model 2, which adjusted for sociodemographic background and psychosocial factors, we found that more depressive symptoms (OR = 1.14, 95% CI, 1.00–1.31), poor neighborhood cohesion (OR = 1.42, 95% CI, 1.13–1.77), and religiosity/spirituality (OR = 1.26, 95% CI, 1.05–1.51) were associated with greater odds of elevated CRP among men. Higher levels of financial insecurity were associated with lower odds of elevated CRP among men (OR = 0.71, 95% CI, 0.55–0.91). The association between depressive symptoms and odds of elevated CRP among men was reduced after adjusting for behavioral factors. In the fully adjusted model, the results showed that less neighborhood cohesion (OR = 1.38, 95% CI, 1.11–1.72), religiosity/spirituality (OR = 1.23, 95% CI, 1.06–1.49), being a current smoker (OR = 2.61, 95% CI, 1.24–5.49), being overweight/obese (OR = 4.91, 95% CI, 2.59–9.31), any ADLs (OR = 2.01, 95% CI, 1.01–3.98), and having more chronic conditions (OR = 1.41, 95% CI, 1.15–1.72) were associated with increased odds of elevated CRP among men. Furthermore, greater financial insecurity (OR = 0.74, 95% CI, 0.58–0.94) and cholesterol medications were associated with lower odds of elevated CRP among men.

Discussion

Despite studies demonstrating that Black Americans experience greater risk for elevated CRP relative to Whites (Farmer et al., 2020; Herd et al., 2012; Kelley-Hedgepeth et al., 2008; Khera et al., 2005), our understanding of the origins of these disparities has been hindered by the literature's race-comparative approach, limited consideration of older adults, and examination of a narrow range of CRP correlates. Therefore, the present study sought to identify the risk and protective factors associated with elevated CRP among older Black women and men. Our results demonstrate the distinct sociodemographic, psychosocial,

Table 1. Distributions of Study Variables Among Black Participants, Overall and By Gender, Health and Retirement Study (2006–2016)

	Total (n = 2,420)	Women (n = 1,558)	Men (n = 862)	p
CRP, median (IQR), mg/L	2.63 (5.07)	3.04 (5.75)	2.00 (3.72)	<.001
Elevated CRP, %	46.01	50.64	37.25	<.001
Sociodemographic factors				
Age in years, mean (*SD*)	64.46 (9.25)	64.34 (9.30)	64.69 (9.14)	.279
Lives in the South, %	58.66	59.10	57.84	.467
Rural residence, %	36.13	36.31	35.80	.763
Educational attainment, %				
Less than HS	23.09	21.81	25.50	.010
HS/GED	33.80	33.46	34.43	
Some college or more	43.12	44.73	40.06	
Household income, %				
≤$13,000	25.37	28.74	18.99	<.001
$13,001–$27,000	25.09	26.87	21.72	
$27,001–$55,000	24.90	23.64	27.27	
>$55,000	24.65	20.75	32.02	
Insurance status, %				
Insured, no Medicaid	71.43	69.52	75.06	<.001
Medicaid	17.94	19.81	14.40	
Uninsured	10.63	10.67	10.54	
Psychosocial factors				
Marital status, %				
Married	41.47	33.46	57.42	<.001
Never married	11.74	12.63	11.48	
Divorced/separated	27.29	28.71	25.87	
Widowed	19.50	24.83	9.98	
Depressive symptoms, mean (*SD*)	1.78 (2.10)	1.90 (2.20)	1.55 (1.88)	<.001
Chronic stress, mean (*SD*)	3.21 (2.05)	3.21 (2.03)	3.23 (2.09)	.761
Financial difficulties, mean (*SD*)	1.47 (1.09)	1.52 (1.11)	1.36 (1.06)	<.001
Everyday discrimination, mean (*SD*)	0.80 (0.90)	0.73 (0.84)	0.93 (0.99)	<.001
Neighborhood disorder, mean (*SD*)	2.31 (1.55)	2.36 (1.57)	2.22 (1.51)	.011
Poor neighborhood cohesion, mean (*SD*)	2.25 (1.53)	2.27 (1.56)	2.22 (1.47)	.276
Social support, mean (*SD*)	2.14 (0.57)	2.17 (0.56)	2.06 (0.58)	<.001
Mastery, mean (*SD*)	3.75 (1.19)	3.76 (1.20)	3.74 (1.16)	.576
Religiosity/spirituality, mean (*SD*)	4.43 (1.14)	4.50 (1.07)	4.28 (1.24)	<.001
Sense of purpose, mean (*SD*)	3.77 (0.93)	3.78 (0.91)	3.75 (0.97)	.316
Behavioral factors				
Smoking, %				
Never smoked	41.61	47.49	30.49	<.001
Past smoking	38.05	33.50	46.66	
Current smoking	20.33	19.01	22.85	
Alcohol consumption, %				
No consumption	70.21	75.60	60.02	<.001
Moderate consumption	21.14	19.47	24.30	
Heavy consumption	8.65	4.93	15.69	
Physical inactivity, %	22.14	26.23	14.40	<.001
Health-related factors				
Overweight/obese, %	81.25	84.27	76.54	<.001
Any activities of daily living, %	20.83	22.70	17.30	<.001
Number of chronic conditions, mean (*SD*)	2.21 (1.37)	2.27 (1.33)	2.10 (1.43)	<.001
Cholesterol medication use, %	43.59	41.07	48.35	<.001

Notes: HS = high school; GED = general education diploma; CRP = C-reactive protein. Values reported as percentages, means (*SD*), or median (interquartile range [IQR]).

Table 2. Odds of High-Risk CRP Levels From Random Effect Logistic Regression Models for Women in the 2006–2016 HRS

Characteristic	Model 1	Model 2	Model 3	Model 4
Sociodemographic background				
Age	0.97* (0.95–1.00)	0.96** (0.94–0.99)	0.95*** (0.93–0.98)	0.96*** (0.94–0.98)
Lives in the South	1.41 (0.94–2.11)	1.38 (0.91–2.09)	1.36 (0.91–2.04)	1.38 (0.93–2.04)
Rural residence	1.06 (0.71–1.60)	1.05 (0.69–1.61)	1.01 (0.67–1.54)	0.96 (0.65–1.44)
Education				
High school/GED (ref)	Reference	Reference	Reference	Reference
Less than HS	0.59 (0.34–1.02)	0.60 (0.34–1.04)	0.60 (0.35–1.03)	0.61 (0.36–1.03)
Some college or more	0.74 (0.47–1.16)	0.70 (0.44–1.13)	0.71 (0.45–1.13)	0.74 (0.47–1.16)
Household income				
> $55,000 (ref)	Reference	Reference	Reference	Reference
≤ $13,000	1.36 (0.77–2.39)	1.40 (0.75–2.63)	1.32 (0.72–2.45)	1.20 (0.66–2.20)
$13,001–$27,000	1.26 (0.75–2.12)	1.33 (0.76–2.34)	1.29 (0.75–2.25)	1.17 (0.68–2.00)
$27,001–$55,000	1.13 (0.68–1.86)	1.18 (0.70–1.97)	1.13 (0.68–1.88)	1.12 (0.68–1.84)
Insurance status				
Insured	Reference	Reference	Reference	Reference
Medicaid	1.85** (1.14–3.00)	2.06** (1.25–3.40)	2.01** (1.23–3.29)	1.91** (1.19–3.06)
Uninsured	1.12 (0.64–1.95)	1.16 (0.65–2.06)	1.25 (0.71–2.20)	1.47 (0.84–2.56)
Psychosocial factors				
Marital status				
Married		Reference	Reference	Reference
Never married		0.97 (0.50–1.89)	1.06 (0.55–2.02)	1.11 (0.60–2.09)
Divorced/separated		1.14 (0.68–1.89)	1.17 (0.71–1.91)	1.16 (0.72–1.88)
Widowed		1.22 (0.71–2.12)	1.27 (0.74–2.18)	1.30 (0.77–2.21)
Depressive symptoms		0.98 (0.89-1.07)	0.97 (0.88–1.06)	0.94 (0.86–1.03)
Chronic stress		0.94 (0.85–1.04)	0.94 (0.86–1.04)	0.93 (0.84–1.02)
Financial difficulties		0.94 (0.79–1.12)	0.94 (0.79–1.11)	0.92 (0.78–1.09)
Everyday discrimination		1.06 (0.85–1.32)	1.06 (0.86–1.31)	1.07 (0.87-1.31)
Neighborhood disorder		0.94 (0.81–1.09)	0.95 (0.82–1.10)	0.95 (0.82–1.09)
Poor neighborhood cohesion		1.05 (0.90–1.21)	1.04 (0.90–1.21)	1.04 (0.91–1.21)
Social support		1.27 (0.91–1.78)	1.30 (0.94–1.80)	1.20 (0.88–1.65)
Mastery		0.76*** (0.66–0.89)	0.78*** (0.67–0.90)	0.81** (0.70–0.94)
Religiosity/spirituality		1.23** (1.06–1.43)	1.20* (1.03–1.40)	1.20* (1.03–1.39)
Sense of purpose		1.15 (0.93–1.43)	1.19 (0.96–1.48)	1.20 (0.97–1.48)
Behavioral factors				
Smoking				
Never smoked (ref)			Reference	Reference
Past smoking			1.57* (1.02–2.42)	1.42 (0.93–2.17)
Current smoking			0.81 (0.47–1.39)	0.87 (0.51–1.47)

Table 2. Continued

Characteristic	Model 1	Model 2	Model 3	Model 4
Alcohol consumption				
No consumption			1.61* (1.04–2.49)	1.48 (0.97–2.27)
Moderate consumption (ref)			Reference	Reference
Heavy consumption			0.99 (0.43–2.27)	1.05 (0.46–2.38)
Physical inactivity			1.77** (1.20-2.60)	1.56* (1.07–2.28)
Health-related factors				
Overweight/obese				4.40*** (2.64–7.34)
Activities of daily living				1.68* (1.07–2.64)
Cholesterol medication use				0.74 (0.51–1.08)
Chronic conditions				1.15 (0.98–1.36)
Log pseudolikelihood	–1,506.98	–1,494.55	–1,483.84	–1,457.73
Wald Chi-squared	22.91**	41.20**	56.88***	85.07***
Rho (SE)	0.69 (0.04)	0.70 (0.04)	0.69 (0.04)	0.67 (0.04)

Notes: HS = high school; GED = general education diploma; CRP = C-reactive protein. Model 1 is adjusted for sociodemographic characteristics; Model 2 adjusts for psychosocial factors; Model 3 adjusts for behavioral factors; Model 4 adjusts for health-related factors. *p <.05, **p <.01, ***p <.001.

behavioral, and health-related factors that are significantly associated with elevated CRP among older Black women and men. Given the documented links between CRP and many chronic health issues (e.g., CVD) among older Black Americans, identifying and addressing these modifiable factors may reduce CRP levels and other health inequalities among this population.

We drew on a within-group approach to determine the correlates of elevated CRP among older Black women and men. There were several notable findings among women. Overall, we found that younger age, having Medicaid coverage, lower mastery, religiosity/spirituality, physical inactivity, any ADLs, and overweight/obesity were significantly associated with a greater risk of elevated CRP among this group. Typically, older age is associated with elevated CRP, yet our study shows that increasing age was associated with lower CRP among older Black women, a pattern consistent with findings from another study using HRS data showing that CRP levels among White and Black women decreased with age (Mitchell & Aneshensel, 2017). This may be related to factors that we were unable to control for, such as the use of HRT (Ridker et al., 1999). Furthermore, this finding may be the product of selection effects, where women who survive into their older ages are healthier, and thus, have lower levels of CRP. We also observed that women with Medicaid-only coverage experienced 91% greater odds of elevated CRP relative to women with insurance. Despite the benefits of Medicaid coverage, recent studies also recognize that individuals with poor health and limited socioeconomic resources are most likely to utilize Medicaid (Tavares et al., 2020). Thus, it is possible that older Black women who are Medicaid recipients experience a greater burden of CRP due to the accumulation of these challenges over the life course. More studies are required to better understand why younger Black women and those with Medicaid coverage experience elevated CRP.

Furthermore, none of the stressors we examined (i.e., chronic stress, everyday discrimination, neighborhood disorder, and financial difficulties) were associated with higher CRP in women, although existing research suggests that chronic stress-associated dysregulation can lead to heightened levels of systemic inflammation, including CRP (Glaser & Kiecolt-Glaser, 2005; Johnson et al., 2013). This finding is particularly interesting considering that Black women may experience heightened stress at the intersection of both race and gender, including gendered racism (Allen et al., 2019; Bowleg, 2012; Nuru-Jeter et al., 2009). Additional research is needed to understand whether the relationship between stress exposure and elevated CRP among Black women is contingent upon other factors, including SES and strategies used to cope with stress.

Among older Black men, we found that lower financial difficulties, lower neighborhood cohesion, religiosity/spirituality, current smoking, any ADLs, overweight/obesity, and more chronic conditions were significantly associated with increased risk of elevated CRP. Interestingly,

Table 3. Odds of High-Risk CRP Levels From Random Effect Logistic Regression Models for Men in the 2006–2016 HRS

Characteristic	Model 1	Model 2	Model 3	Model 4
Sociodemographic background				
Age	1.02 (0.99–1.05)	1.01 (0.98–1.05)	1.02 (0.99–1.05)	1.02 (0.99–1.05)
Lives in the South	1.21 (0.72–2.03)	1.21 (0.71–2.06)	1.21 (0.71–2.05)	1.21 (0.72–2.01)
Rural residence	1.08 (0.64–1.85)	0.99 (0.57–1.72)	1.03 (0.60–1.78)	0.99 (0.58–1.69)
Education				
High school/GED (ref)	Reference	Reference	Reference	Reference
Less than HS	1.13 (0.58–2.19)	1.00 (0.51–1.97)	0.99 (0.51–1.93)	1.02 (0.53–1.97)
Some college or more	0.87 (0.49–1.57)	0.93 (0.51–1.69)	0.98 (0.54–1.77)	1.03 (0.57–1.84)
Household income				
>$55,000 (ref)	Reference	Reference	Reference	Reference
≤$13,000	1.58 (0.78–3.21)	1.79 (0.83–3.88)	1.65 (0.76–3.60)	1.88 (0.87–4.08)
$13,001–$27,000	1.88 (0.97–3.63)	1.98 (0.99–3.98)	1.85 (0.92–3.73)	1.93 (0.97–3.87)
$27,001–$55,000	1.56 (0.88–2.79)	1.56 (0.86–2.83)	1.52 (0.84–2.75)	1.38 (0.77–2.48)
Insurance status				
Insured	Reference	Reference	Reference	Reference
Medicaid	0.84 (0.44–1.63)	0.74 (0.37–1.46)	0.71 (0.36–1.40)	0.73 (0.38–1.44)
Uninsured	0.65 (0.30–1.40)	0.72 (0.33–1.56)	0.69 (0.32–1.49)	0.93 (0.44–1.94)
Marital status				
Married		Reference	Reference	Reference
Never married		0.85 (0.35–2.09)	0.81 (0.33–1.98)	0.97 (0.40–2.33)
Divorced/separated		0.86 (0.47–1.56)	0.81 (0.45–1.48)	0.78 (0.43–1.40)
Widowed		1.03 (0.43–2.47)	0.93 (0.39–2.22)	1.05 (0.44–2.49)
Psychosocial factors				
Depressive symptoms		1.14* (1.00–1.31)	1.13 (0.98–1.29)	1.05 (0.91–1.21)
Chronic stress		0.98 (0.87–1.11)	0.97 (0.87–1.09)	0.95 (0.85–1.07)
Financial difficulties		0.71** (0.55–0.91)	0.71** (0.55–0.91)	0.74* (0.58–0.94)
Everyday discrimination		0.88 (0.69–1.12)	0.90 (0.70–1.15)	0.92 (0.73–1.17)
Neighborhood disorder		0.88 (0.71–1.08)	0.87 (0.71–1.08)	0.90 (0.73–1.11)
Poor neighborhood cohesion		1.42** (1.13–1.77)	1.42** (1.14–1.78)	1.38** (1.11–1.72)
Social support		0.74 (0.48–1.12)	0.74 (0.49–1.13)	0.76 (0.50–1.16)
Mastery		0.85 (0.70–1.03)	0.85 (0.70–1.02)	0.87 (0.74–1.07)
Religiosity/spirituality		1.26** (1.05–1.51)	1.25* (1.04–1.49)	1.23** (1.06–1.49)
Sense of purpose		1.01 (0.77–1.31)	1.03 (0.79–1.34)	1.04 (0.80–1.34)
Behavioral factors				
Smoking				
Never smoked (ref)			Reference	Reference
Past smoking			1.60 (0.88–2.92)	1.47 (0.82–2.65)
Current smoking			2.05 (0.98–4.30)	2.61** (1.24–5.49)
Alcohol consumption				
No consumption			0.83 (0.49–1.44)	0.79 (0.46–1.36)
Moderate consumption (ref)			Reference	Reference
Heavy consumption			1.09 (0.53–2.25)	1.15 (0.57–2.31)
Physical inactivity			1.32 (0.71–2.43)	1.00 (0.54–1.85)
Health-related factors				
Overweight/obese				4.91***(2.59–9.31)
Activities of daily living				2.01* (1.01–3.98)
Cholesterol medication use				0.61* (0.37–1.00)
Chronic conditions				1.41***(1.15–1.72)
Log pseudolikelihood	−769.57	−753.25	−750.00	−723.22
Wald Chi-squared	12.58	38.05*	42.20*	61.47**
Rho (SE)	0.65 (0.06)	0.66 (0.06)	0.65 (0.06)	0.63 (0.06)

Notes: HS = high school; GED = general education diploma; CRP = C-reactive protein. Model 1 is adjusted for sociodemographic characteristics; Model 2 adjusts for psychosocial factors; Model 3 adjusts for behavioral factors; Model 4 adjusts for health-related factors. *p <.05, **p <.01, ***p <.001.

we found that none of the sociodemographic factors were related to elevated CRP among men. For instance, age was not significantly associated with elevated CRP among men, despite existing research showing that CRP increases with advancing age, particularly among men (Mitchell & Aneshensel, 2017). Furthermore, we found that greater financial difficulties, but not other stressors (i.e., chronic stress, everyday discrimination, neighborhood disorder), were associated with 26% lower odds of elevated CRP. While it is well-established that stress exposure is positively associated with CRP (Johnson et al., 2013), this finding may reflect the unique coping strategies and/or resiliency experienced by older Black men when faced with stress. Relatedly, we found that an increase in depressive symptoms was associated with a 14% increase in elevated CRP among men, but this association was reduced to nonsignificance after adjusting for behavioral and health-related factors. Thus, additional research is required to better understand these associations and to identify the behavioral and health factors that are most salient in shaping elevated CRP among Black men.

Collectively, the findings from this work demonstrate the added clarity gained by focusing on the heterogeneity of the correlates associated with elevated CRP *among* the Black population and the importance of applying a within-group approach to pinpoint key nuances often obscured in race-comparative studies. For example, a recent race-comparative study by Farmer et al. (2020) found that physiological factors (e.g., overweight/obesity) largely accounted for Black–White gaps in elevated CRP among women, but not men, leading the authors to conclude that interventions should target overweight/obesity to reduce elevated CRP among women. However, the present study, which uses the same data, demonstrates that overweight/obesity is a key correlate of elevated CRP for *both* Black women and men, a pattern missed in investigations aimed at identifying the factors contributing to racial disparities in CRP. Thus, by identifying the correlates of CRP among Black women and men, the present study underscores the value of utilizing a within-group approach to better understand the risk and protective factors most salient for the aging Black population.

Moreover, the finding that more religiosity/spirituality is associated with increased odds of elevated CRP (20% in women and 23% in men) is inconsistent with previous literature showing that religiosity/spirituality is protective for health. However, this may be a function of the measure we used to assess religiosity. For example, one study found that dimensions of religiosity were differentially associated with health, such that when assessing religiosity through prayer, religiosity was associated with a higher likelihood of hypertension, but the meaning and forgiveness dimension of religiosity was associated with lower blood pressure and hypertension (Buck et al., 2009). In the present study, our measure of religiosity assessed one's belief in a higher power or divine plan; it does not include information on prayer, forgiveness, affiliation, or attendance, which may explain our finding that religiosity is associated with elevated CRP.

Finally, we found that the majority of the SES indicators (e.g., education, income) examined were not significantly associated with elevated CRP. Although previous research has shown that higher SES is protective against elevated CRP, the studies showing this gradient have been conducted in the majority (>50%) White samples (Alley et al., 2006). As scholars are increasingly finding evidence of diminishing returns, where SES does not carry the same health-enhancing benefits for Black adults compared to White adults (Boen, 2016; Farmer & Ferraro, 2005; Thomas Tobin & Hargrove, 2022), additional research is needed to investigate the mechanisms through which SES influences CRP among older Black adults.

Limitations

There are aspects of this study that warrant comment. First, several respondents were not eligible for the study due to missing CRP data (e.g., did not provide consent to biomarker collection, did not participate in all waves of data collection), which could present problems as it relates to external validity and interpretation. There were $n = 277$ cases who were not eligible for the study based on missing data, which may result in biases in our findings, particularly given that those who were excluded were older, more likely to have lower SES, and had more psychosocial and health-related risk factors. Another limitation of the study is that we focus on a single inflammatory marker. Thus, more research is needed to determine whether these findings extend to other markers (e.g., interleukin-6). Other factors, such as situational factors (e.g., acute stress), at the time of DBS collection may have also influenced the findings. There is heterogeneity in the thought process regarding whether cases with very high (>10.0 mg/L) CRP levels should be included in analyses. Existing work suggests that very high CRP may indicate chronic inflammation rather than resulting acute infection (Ishii et al., 2012); others note that very high CRP is associated with increased risk of cardiovascular events and other modifiable behavioral and health characteristics (Alley et al., 2006; Hamer et al., 2010). Given this growing evidence, we decided to keep these cases in our sample (Mac Giollabhui et al., 2020). It is important to note that based on our sensitivity analyses, the substantive results do not change appreciably when those with very high CRP are excluded. We also acknowledge that we may not have had sufficient power to detect small effect sizes given the sample size for women and men. While we controlled for cholesterol medication, we were unable to control for medications that have documented associations with inflammation, such as estrogen use, which may have influenced our findings. Except for CRP and BMI, the variables in the study were based on self-report, which has the potential to suffer from recall bias and social desirability bias. Finally, when studying race

in later life, there is the possibility of bias due to mortality selection. Black adults and those with lower SES often experience poor health outcomes at earlier ages and thus, may be more likely to die prior to the study initiation or to be lost to follow-up. If these groups have higher levels of CRP as suggested by the results, then the present findings are likely to be underestimates of the true associations.

There are several strengths to this study. First, our study is strengthened by examining a clinically relevant biomarker with longitudinal data from older adults in the United States. To date, few studies have examined CRP among Black older adults. Furthermore, to our knowledge, no studies have investigated such a wide range of correlates of elevated CRP across Black women and men using HRS data. Another key strength of this study is that we utilize a within-group approach (Whitfield et al., 2008) to explore the risks and resources associated with elevated CRP among Black women and men. This is an important contribution to the literature because existing studies have largely compared how Black and White adults differ, which is necessary for documenting whether disparities exist. However, as Whitfield et al. (2008) have argued, these approaches do not explicitly center the lived experiences of older Black adults, they do not consider that the mechanisms linked to adverse health outcomes may differ across race, and they often treat the Black population as a monolith, ignoring heterogeneity within this group. Thus, we sought to examine the distinct factors that contribute to elevated CRP *among* Black adults. Our approach centers the lived experiences of older Black adults and considers the correlates associated with elevated CRP among Black women and men.

Finally, we explore a wider range of factors that may be associated with elevated CRP among Black adults. Most studies to date have often been limited to a narrow range of factors, particularly differential exposure to stress, that may account for racial disparities in CRP. The present study extends prior work by focusing on various types of stress exposures, along with psychosocial factors, that may be linked to elevated CRP and better represent the lived experiences of older Black adults. This research demonstrates the importance of exploring within-group heterogeneity among older Black adults, particularly by showing that some of the well-established factors (e.g., SES) are not associated with elevated CRP among older Black adults in this sample. Moreover, we found that there was variation in the factors associated with elevated CRP for Black women and men, highlighting the heterogeneity within the population of older Black Americans. Future research should explore whether there are additional sources of heterogeneity within the Black population, such as whether the factors associated with elevated CRP among Black adults vary across SES.

This study also adds to the existing literature by documenting the specific correlates of elevated CRP among older Black women and men from 2006 to 2016. To our knowledge, the present study is the first to investigate the sociodemographic, psychosocial, behavioral, and health-related determinants of elevated CRP among older Black women and men. Collectively, our results underscore within-group heterogeneity in the factors that shape CRP among this population; our analyses also demonstrate the limited role of sociodemographic factors, while highlighting the significance of psychosocial, behavioral, and health-related factors associated with elevated CRP among older Black Americans.

We find that there were unique factors associated with elevated CRP among Black women and men. The findings from this work highlight the importance of utilizing a within-group approach to understand heterogeneity in the correlates of elevated CRP among Black adults. By determining both risk and protective factors that are most relevant for older Black women and men, we hope to inform more effective public health interventions needed to reduce racial inequalities in health and aging.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* online.

Author Notes

1. CRP samples sent to the University of Washington were assayed using a sandwich enzyme-linked immunosorbent assay using a punch from the DBS card, and samples sent to the University of Vermont were assayed using a BNII nephelometer (Siemens, Inc.). The HRS then generated adjusted DBS values of CRP that are equivalent to CRP measured using serum blood collection (Crimmins et al., 2013). This was done to account for differences between the DBS and serum blood, which are used in other population-based studies. The current guidelines suggest that "very high" levels of CRP (>10 mg/L) may indicate existing illness or ongoing infection, and therefore, these levels should be excluded from analyses (Pearson et al., 2003). However, because emerging evidence suggests that "very high" CRP levels are clinically relevant and may, in fact, indicate chronic, rather than acute, inflammation, we decided to retain all very high levels of CRP in our analyses (Alley et al., 2006; Hamer et al., 2010; Ishii et al., 2012; Mac Giollabhui et al., 2020). Additional documentation on the HRS biomarker data collection procedures, measurement and assaying, and sampling can be found elsewhere (Crimmins et al., 2013).
2. Detailed information on all of the psychosocial variables can be located through the HRS website: https://hrs.isr.umich.edu/sites/default/files/biblio/HRS%202006-2016%20SAQ%20Documentation_07.06.17.pdf

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Conflict of Interest

None declared.

Data Availability

The study materials, analytic methods, and all data except the biomarker data file are available from the corresponding author upon reasonable request. Special permission from the HRS is required for access to the biomarker data. This study was not preregistered.

References

Allen, A. M., Wang, Y., Chae, D. H., Price, M. M., Powell, W., Steed, T. C., & Woods-Giscombe, C. L. (2019). Racial discrimination, the superwoman schema, and allostatic load: Exploring an integrative stress–coping model among African American women. *Annals of the New York Academy of Sciences*, **1457**(1), 104–127. doi:10.1111/nyas.14188

Alley, D. E., Seeman, T. E., Ki Kim, J., Karlamangla, A., Hu, P., & Crimmins, E. M. (2006). Socioeconomic status and C-reactive protein levels in the US population: NHANES IV. *Brain, Behavior, and Immunity*, **20**(5), 498–504. doi:10.1016/j.bbi.2005.10.003

Assari, S. (2018). Unequal gain of equal resources across racial groups. *International Journal of Health Policy and Management*, **7**(1), 1–9. doi:10.15171/ijhpm.2017.90

Boen, C. (2016). The role of socioeconomic factors in Black–White health inequities across the life course: Point-in-time measures, long-term exposures, and differential health returns. *Social Science and Medicine*, **170**, 63–76. doi:10.1016/j.socscimed.2016.10.008

Bowleg, L. (2012). The problem with the phrase women and minorities: Intersectionality—An important theoretical framework for public health. *American Journal of Public Health*, **102**(7), 1267–1273. doi:10.2105/AJPH.2012.300750

Brown, T. H., Richardson, L. J., Hargrove, T. W., & Thomas, C. S. (2016). Using multiple-hierarchy stratification and life course approaches to understand health inequalities: The intersecting consequences of race, gender, SES, and age. *Journal of Health and Social Behavior*, **57**(2), 200–222. doi:10.1177/0022146516645165

Buck, A. C., Williams, D. R., Musick, M. A., & Sternthal, M. J. (2009). An examination of the relationship between multiple dimensions of religiosity, blood pressure, and hypertension. *Social Science & Medicine*, **68**(2), 314–322. doi:10.1016/j.socscimed.2008.10.010

Cagney, K. A., Glass, T. A., Skarupsk, K. A., Barnes, L. L., Schwartz, B. S., & Mendes de Leon, C. F. (2009). Neighborhood-level cohesion and disorder: Measurement and validation in two older adult urban populations. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, **64**(3), 415–424. doi:10.1093/geronb/gbn041

Choi, J., Joseph, L., & Pilote, L. (2013). Obesity and C-reactive protein in various populations: A systematic review and meta-analysis. *Obesity Reviews*, **14**(3), 232–244. doi:10.1111/obr.12003

Crimmins, E., Faul, J., Kim, J. K., Guyer, H., Langa, K., Ofstedal, M. B., Sonnega, A., Wallace, R., & Weir, D. (2013). *HRS documentation report documentation of biomarkers in the 2006 and 2008 Health and Retirement Study*. http://hrsonline.isr.umich.edu/modules/meta/2010/core/qnaire/online/2010PhysicalMeasuresBio

Cushman, M., McClure, L. A., Howard, V. J., Jenny, N. S. Lakoski, S. G., Howard G. (2009). Implications of increased C-reactive protein for cardiovascular risk stratification in black and white men and women in the US. *Clinical Chemistry*, **55**(9), 1627–1636. doi:10.1373/clinchem.2008.122093

Dupre, M. E., Gu, D., Xu, H., Willis, J., Curtis, L. H., & Peterson, E. D. (2017). Racial and ethnic differences in trajectories of hospitalization in US men and women with heart failure. *Journal of the American Heart Association*, **6**(11), 1–19. doi:10.1161/JAHA.117.006290

Farmer, M. M., & Ferraro, K. F. (2005). Are racial disparities in health conditional on socioeconomic status? *Social Science and Medicine*, **60**(1), 191–204. doi:10.1016/j.socscimed.2004.04.026

Farmer, H. R., Wray, L. A., & Haas, S. A. (2021). Race, gender, and socioeconomic variations in C-reactive protein using the Health and Retirement Study. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, **76**(3), 583–595. doi:10.1093/geronb/gbaa027

Farmer, H. R., Wray, L. A., Xian, Y., Xu, H., Pagidipati, N., Peterson, E. D., & Dupre, M. E. (2020). Racial differences in elevated C-reactive protein among US older adults. *Journal of the American Geriatrics Society*, **68**(2), 362–369. doi:10.1111/jgs.16187

Fetzer Institute (2003). *Multidimensional measurement of religiousness/spirituality for use in health research: A report of the Fetzer*. John E. Fetzer Institute/National Institute on Aging Working Group.

Franceschi, C., & Campisi, J. (2014). Chronic inflammation (inflammaging) and its potential contribution to age-associated diseases. *The Journals of Gerontology, Series A: Biomedical Sciences and Medical Sciences*, **69**(Suppl. 1), S4–S9. doi:10.1093/gerona/glu057

Glaser, R., & Kiecolt-Glaser, J. K. (2005). Stress-induced immune dysfunction: Implications for health. *Nature Reviews Immunology*, **5**(3), 243–251. doi:10.1038/nri1571

Hamer, M., Chida, Y., & Stamatakis, E. (2010). Association of very highly elevated C-reactive protein concentration with cardiovascular events and all-cause mortality. *Clinical Chemistry*, **56**(1), 132–135. http://clinchem.aaccjnls.org/content/clinchem/56/1/132.full.pdf

Herd, P., Karraker, A., & Friedman, E. (2012). The social patterns of a biological risk factor for disease: Race, gender, socioeconomic position, and C-reactive protein. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, **67**(4), 503–513. doi:10.1093/geronb/gbs048

Ishii, S., Karlamangla, A. S., Bote, M., Irwin, M. R., Jacobs, D. R., Cho, H. J., & Seeman, T. E. (2012). Gender, obesity and repeated elevation of C-reactive protein: Data from the CARDIA Cohort. *PLoS One*, **7**(4), 36062. doi:10.1371/journal.pone.0036062

Janicki-Deverts, D. J., Cohen, S., Kalra, P., & Matthews, K. A. (2012). The prospective association of socioeconomic status with C-reactive protein levels in the CARDIA study. *Brain, Behavior, and Immunity*, **26**(7), 1128–1135. doi:10.1016/j.bbi.2012.07.017

Johnson, T. V., Abbasi, A., & Master, V. A. (2013). Systematic review of the evidence of a relationship between chronic psychosocial stress and C-reactive protein. *Molecular Diagnosis & Therapy*, **17**(3), 147–164. doi:10.1007/s40291-013-0026-7

Juster, T. F., & Suzman, R. (1995). An overview of the Health and Retirement Study. *The Journal of Human Resources*, **30**(Special Issue), S7–S56. https://www.jstor.org/stable/pdf/146277.pdf

Kelley-Hedgepeth, A., Lloyd-Jones, D. M., Colvin, A., Matthews, K. A., Johnston, J., Sowers, M. R., Sternfeld, B., Pasternak, R. C., Chae, C. U. for the SWAN Investigators. (2008). Ethnic differences in C-reactive protein concentrations. *Clinical Chemistry*, **54**(6), 1027–1037. doi:10.1373/clinchem.2007.098996

Khera, A., Mcguire, D. K., Murphy, S. A., Stanek, H. G., Das, S. R., Vongpatanasin, W., & Boston, T. (2005). Race and gender differences in C-reactive protein levels. *Journal of the American College of Cardiology*, **46**(3), 464–469. doi:10.1016/j.jacc.2005.04.051

Kuo, H. -K., Bean, J. F., Yen, C. -J., & Leveille, S. G. (2006). Linking C-reactive protein to late-life disability in the National Health and Nutrition Examination Survey (NHANES) 1999–2002. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, **61**(4), 380–387. doi:10.1093/gerona/61.4.380

Lachman, M. E., & Weaver, S. L. (1998). Sociodemographic variations in the sense of control by domain: Findings from the MacArthur studies of midlife. *Psychology and Aging*, **13**(4), 553–562. doi:10.1037/0882-7974.13.4.553

Lakoski, S. G., Cushman, M., Criqui, M., Rundek, T., Blumenthal, R. S., Agostino, R. B., & Herrington, D. M. (2006). Gender and C-reactive protein: Data from the Multiethnic Study of Atherosclerosis (MESA) cohort. *American Heart Journal*, **152**(3), 593–598. doi:10.1016/j.ahj.2006.02.015

Lewis, T. T., Aiello, A. E., Leurgans, S., Kelly, J., & Barnes, L. L. (2010). Self-reported experiences of everyday discrimination are associated with elevated C-reactive protein levels in older African-American adults. *Brain, Behavior, and Immunity*, **24**(3), 438–443. doi:10.1016/J.BBI.2009.11.011

Mac Giollabhui, N., Ellman, L. M., Coe, C. L., Byrne, M. L., Abramson, L. Y., & Alloy, L. B. (2020). To exclude or not to exclude: Considerations and recommendations for C-reactive protein values higher than 10 mg/L. *Brain, Behavior, and Immunity*, **87**, 898–900. doi:10.1016/j.bbi.2020.01.023

McDade, T. W., Hawkley, L. C., & Cacioppo, J. T. (2006). Psychosocial and behavioral predictors of inflammation in middle-aged and older adults: The Chicago health, aging, and social relations study. *Psychosomatic Medicine*, **68**(3), 376–381. doi:10.1097/01.psy.0000221371.43607.64

McEwen, B. S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine*, **338**(3), 171–179. doi:10.1056/NEJM199801153380307

Mezuk, B., Abdou, C. M., Hudson, D., Kershaw, K. N., Rafferty, J. A., Lee, H., & Jackson, J. S. (2013). "White Box" epidemiology and the social neuroscience of health behaviors: The environmental affordances model. *Society and Mental Health*, **3**(2), 79–95.

Miller, G. E., Cohen, S., & Ritchey, K. (2002). Chronic psychological stress and the regulation of pro-inflammatory cytokines: A glucocorticoid-resistance model. *Health Psychology*, **21**(6), 531–541. doi:10.1037/0278-6133.21.6.531

Mitchell, U. A., & Aneshensel, C. S. (2017). Social inequalities in inflammation: Age variations in older persons. *Journal of Aging and Health*, **29**(5), 769–787. doi:10.1177/0898264316645546

Nazmi, A., & Victora, C. G. (2007). Socioeconomic and racial/ethnic differentials of C-reactive protein levels: A systematic review of population-based studies. *BMC Public Health*, **7**, 212. doi:10.1186/1471-2458-7-212

Nguyen, A. W., Taylor, H. O., Lincoln, K. D., Qin, W., Hamler, T., Wang, F., & Mitchell, U. A. (2022). Neighborhood characteristics and inflammation among older black Americans: The moderating effects of hopelessness and pessimism. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, **77**(2), 315–322. doi:10.1093/gerona/glab121

Nuru-Jeter, A., Dominguez, T. P., Hammond, W. P., Leu, J., Skaff, M., Egerter, S., ... & Braveman, P. (2009). "It's the skin you're in": African-American women talk about their experiences of racism. An exploratory study to develop measures of racism for birth outcome studies. *Maternal and Child Health Journal*, **13**(1), 29–39. doi:10.1007/s10995-008-0357-x

Pearlin, L. I., Menaghan, E. G., Lieberman, M. A., & Mullan, J. T. (1981). The stress process. *Journal of Health and Social Behavior*, **22**(4), 337–356. doi:10.2307/2136676

Pearson, T. A., Mensah, G. A., Alexander, R. W., Anderson, J. L., Cannon, R. O., III Criqui, M., … Vinicor, F. (2003). Markers of inflammation and cardiovascular disease. *Circulation*, **107**(3), 499–511. doi:10.1161/01.CIR.0000052939.59093.45

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, **1**(3), 385–401. https://journals.sagepub.com/doi/pdf/10.1177/014662167700100306

Ridker, P. M., Hennekens, C. H., Rifai, N., Buring, J. E., & Manson, J. E. (1999). Hormone replacement therapy and increased plasma concentration of C-reactive protein. *Circulation*, **100**(7), 713–716. doi:10.1161/01.CIR.100.7.713

Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, **57**(6), 1069. doi:10.1037/0022-3514.57.6.1069

Sesso, H. D., Buring, J. E., Rifai, N., Blake, G. J., Gaziano, J. M., & Ridker, P. M. (2003). C-reactive protein and the risk of developing hypertension. *Journal of the American Medical Association*, **290**(22), 2945–2951. doi:10.1001/jama.290.22.2945

Smith, J., Ryan, L., Fisher, G. G., Sonnega, A., & Weir, D. (2017). *Psychosocial and lifestyle questionnaire 2006–2016 documentation report core section LB*. https://hrs.isr.umich.edu/sites/default/files/biblio/HRS 2006-2016 SAQ Documentation_07.06.17_0.pdf

Taylor, S. E., Lehman, B. J., Kiefe, C. I., & Seeman, T. E. (2006). Relationship of early life stress and psychological functioning to adult C-reactive protein in the coronary artery risk development in young adults study. *Biological Psychiatry*, **60**(8), 819–824. doi:10.1016/j.biopsych.2006.03.016

Tavares, J., Cohen, M. A., Silberman, S., & Popham, L. (2020). Medicaid utilization among middle-age and older adults: a health and retirement study longitudinal analysis (1998 to 2014). *Journal of Aging & Social Policy*, 1–17. doi:10.1080/08959420.2020.1824538

Thomas Tobin, C. S., & Hargrove, T. W. (2022). Race, lifetime SES, and allostatic load among older adults. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, **77**(2), 347–356. doi:10.1093/gerona/glab160

Thorpe, R. J., Cobb, R., King, K., Bruce, M. A., Archibald, P., Jones, H. P., & Hudson, D. (2020). The association between depressive symptoms and accumulation of stress among black men in the Health and Retirement Study. *Innovation in Aging*, **4**(5), igaa047. doi:10.1093/geroni/igaa047

Thorpe, R. J., Fesahazion, R. G., Parker, L., Wilder, T., Rooks, R. N., Bowie, J. V., Bell, C.N., Szanton, S.L. & LaVeist, T. A. (2016). Accelerated health declines among African Americans in the USA. *Journal of Urban Health*, **93**(5), 808–819. doi:10.1007/s11524-016-0075-4

Troxel, W. M., Matthews, K., Bromberger, J. T., & Sutton-Tyrrell, K. (2003). Chronic stress burden, discrimination, and subclinical carotid artery disease in African American and Caucasian women. *Health Psychology*, **22**(3), 300–309. doi:10.1037/0278-6133.22.3.300

Van Dyke, M. E., Vaccarino, V., Dunbar, S. B., Pemu, P., Gibbons, G. H., Quyyumi, A. A., & Lewis, T. T. (2017). Socioeconomic status discrimination and C-reactive protein in African-American and White adults. *Psychoneuroendocrinology*, **82**, 9–16. doi:10.1016/J.PSYNEUEN.2017.04.009

Walen, H. R., & Lachman, M. E. (2000). Social support and strain from partner, family, and friends: Costs and benefits for men and women in adulthood. *Journal of Social and Personal Relationships*, **17**(1), 5–30. doi:10.1177/0265407500171001

Whitfield, K. E., Allaire, J. C., Belue, R., & Edwards, C. L. (2008). Are comparisons the answer to understanding behavioral aspects of aging in racial and ethnic groups? *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, **63**(5), 301–308. doi:10.1093/geronb/63.5.P301

Winship, C., & Radbill, L. (1994). Sampling weights and regression analysis. *Sociological Methods & Research*, **23**(2), 230–257. doi:10.1177/0049124194023002004

Williams, D. R., Yu, Y., Jackson, J. S., & Anderson, N. B. (1997). Racial differences in physical and mental health: Socio-economic status, stress and discrimination. *Journal of Health Psychology*, **2**(3), 335–351. doi:10.1177/135910539700200305

Yang, Y. C., Schorpp, K., & Harris, K. M. (2014). Social support, social strain and inflammation: Evidence from a national longitudinal study of U.S. adults. *Social Science & Medicine (1982)*, **107**, 124–135. doi:10.1016/j.socscimed.2014.02.013