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REGULAR ARTICLE

Race and Gender Differences in the Association Between Experiences of Everyday Discrimination and Arterial Stiffness Among Patients With Coronary Heart Disease

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Abstract

Background Self-reported experiences of discrimination have been linked to indices of cardiovascular disease. However, most studies have focused on healthy populations. Thus, we examined the association between experiences of everyday discrimination and arterial stiffness among patients with a history of myocardial infarction (MI).

Purpose We hypothesized that higher reports of discrimination would be associated with greater arterial stiffness and that associations would be more pronounced among Black women, in particular, relative to other race–gender groups, using an "intersectionality" perspective.

Methods Data were from 313 participants (49.2% female, mean age: 50.8 years) who were 6 months post-MI in the Myocardial Infarction and Mental Stress 2 study. Data were collected via self-reported questionnaires, medical chart review, and a clinic visit during which arterial stiffness was measured noninvasively using pulse wave velocity.

Results Reports of discrimination were highest in Black men and women and arterial stiffness was greatest in Black and White women. After adjustment for demographics and relevant clinical variables, discrimination was not associated with arterial stiffness in the overall study sample. However, discrimination was associated with increased arterial stiffness among Black women but not White women, White men, or Black men.

Conclusions Despite no apparent association between discrimination and arterial stiffness in the overall study sample, further stratification revealed an association among Black women but not other race–gender groups. These data not only support the utility of an intersectionality lens but also suggest the importance of implementing psychosocial interventions and coping strategies focused on discrimination into the care of clinically ill Black women.

Keywords: Discrimination · Psychosocial factors · Arterial stiffness · Cardiovascular disease

Introduction

Self-reported experiences of discrimination are a form of psychosocial stress that have been linked to both mental and physical health outcomes [1, 2]. Relative to individuals from other racial/ethnic groups, Blacks report the highest prevalence of discrimination, and reports of discrimination have been linked to indicators of cardiovascular disease (CVD), such as hypertension, elevated nighttime blood pressure (BP), intima-media thickening, and coronary artery calcification, as well as adverse CVD outcomes across a range of racial groups [3–8].

The majority of prior research on discrimination and CVD has been conducted in healthy populations. Less is known about whether reports of discrimination adversely impact cardiovascular health in populations with prevalent CVD. Thus, the current study was

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designed to investigate whether reports of discrimination are associated with arterial stiffness in young to middle-aged Black and White women and men with a recent myocardial infarction (MI). This is a particularly important population to study because hospitalizations and deaths attributed to coronary heart disease (CHD) have increased for women under 60 [9–11]. Additionally, young and middle-aged women with a history of CVD have been shown to have poorer outcomes than their male counterparts [10, 12, 13]. Similarly, among those post-MI or with prevalent CVD, Blacks have poorer outcomes and a higher mortality rate than other racial/ethnic groups [14, 15].

Arterial stiffness is a known risk factor for CVD [16]. Greater arterial stiffness is associated with increased risk for a first CVD event [17] but is also a predictor of future CVD events and mortality in populations with a history of CVD, such as individuals with acute coronary syndrome and ischemic heart disease, or with CVD risk factors, such as diabetes and hypertension [18–21]. Identifying risk factors for arterial stiffness in a population with previous MI who may be at an increased risk for poorer outcomes would allow for intervention prior to the development of additional adverse CVD outcomes.

In the current analysis, we hypothesized that experiences of everyday discrimination would be associated with greater arterial stiffness among post-MI women, and Black women, in particular, based on intersectionality theory. In the original 1989 presentation of this concept, Crenshaw noted that: "Black women sometimes experience discrimination in ways similar to white women's experiences; sometimes they share very similar experiences with Black men. Yet often they experience double discrimination–the combined effects of practices [that] discriminate on the basis of race, and on the basis of sex. And sometimes, they experience discrimination as Black women–-not the sum of race and sex discrimination, but as Black women" p. 149 [22].

Across disciplines, scholars have argued for the utility of intersectional approaches for understanding health-relevant processes that may differ across social identities (e.g., race and gender) [23–26]. An intersectional perspective may be particularly relevant for a post-MI population because studies have found that Black women with CVD are less likely to receive guideline-concordant care than their White female, White male, or Black male counterparts [27, 28], potentially, due to discrimination [29]. In qualitative studies, Black women, in particular, report feeling invisible and unheard when seeking medical care relative to other race–gender groups [30]. Consequently, along with experiencing discrimination in daily life as a consequence of being Black and female, Black women post-MI may also experience discrimination in clinical encounters—which could occur with some frequency due to the ongoing need for medical care following a recent clinical event.

In addition to examining the primary association between everyday discrimination and arterial stiffness, we also investigated whether associations were independent of perceived stress and depressive symptoms. Several researchers have emphasized the importance of considering other dimensions of stress in studies of discrimination and health [2, 31], and depressive symptoms have been strongly correlated with reports of everyday discrimination across a range of populations [1, 32]. Furthermore, both perceived stress and depressive symptoms have been found to be elevated in post-MI cohorts [33–35], which could potentially confound the relationship between everyday discrimination and additional CVD risk.

Methods

Study Participants

The current analysis was conducted among post-MI participants in the Myocardial Infarction and Mental Stress 2 (MIMS2) study, designed to evaluate gender differences in the prevalence, mechanisms, and consequences of mental stress-induced myocardial ischemia (MSI) in survivors of MI [36]. Participants were recruited from medical record reviews of patients admitted for MI at three major Emory-affiliated hospitals (Emory University Hospital, Emory Hospital Midtown, and Grady Memorial Hospital). Medical records were reviewed weekly to identify all women ≤60 years of age who were hospitalized for an MI in the previous 8 months (or since the last weekly review). The diagnosis of Type 1 MI was based on standard criteria of troponin level increase with symptoms of ischemia and electrocardiogram (ECG) changes or other evidence of myocardial necrosis documented in the medical record [37]. Men ≤60 years old with a Type 1 MI were frequency matched by age to identified women each week in order to recruit approximately 50% men and 50% women with similar mean ages in each group. Potential participants were sent a letter informing them of the study (and the ability to opt out of being contacted if desired) and prescreened via telephone. Participants were ineligible if they had unstable angina, acute MI, or decompensated heart failure within the past week or weighed over 450 lbs (due to equipment weight-bearing limits).

Other ineligibility criteria included having a severe comorbid medical or psychiatric condition that would confound study results, such as cancer, renal failure, severe uncontrolled hypertension, current alcohol/substance abuse, or schizophrenia; being pregnant or breastfeeding; or currently using immunosuppressant

or psychotropic medications other than antidepressants. The final cohort included 313 post-MI patients. The MIMS2 study protocol was approved by the Emory University Institutional Review Board and all participants provided written informed consent.

Data Collection

Baseline data were obtained through self-administered questionnaires and medical record review. Trained staff conducted in-person interviews to obtain information on participants' demographics, education, poverty status, cigarette smoking status, physical activity, and self-report of prior comorbid conditions. Clinical information, including medical history and CVD risk factors, were assessed using standardized questions and by reviewing medical records.

Experiences of Everyday Discrimination

Discrimination was measured using a 10-item Everyday Discrimination Scale (EDS)[38], which was adapted from the EDS used in the Detroit Area Study [39]. The scale assessed various forms of unfair treatment experienced day-to-day over the previous 12 months. Participants were asked how often (a) they were treated with less courtesy than other people, (b) treated with less respect than other people, (c) received poorer service than other people at restaurants or stores, (d) people act as if they were not smart, (e) people act as if they are afraid of you, (f) people act as if they were dishonest, (g) people act as if they are better than them, (h) they had been called names or insulted, (i) they were threatened or harassed, and (j) people ignored them or acted as if they were not there. These questions were intentionally framed without reference to race or ethnicity, age, gender, or other demographic characteristics. The frequency of each type of mistreatment was assessed with a four-point Likert scale where 1 = never, 2 = rarely, 3 = sometimes, and 4 = often. The items were averaged, resulting in a possible score of 1.0 to 4.0. The EDS has been widely used across studies, and psychometric analyses indicate that it validly assesses discriminatory exposures for both Blacks and Whites [40].

Arterial Stiffness

Arterial Stiffness was assessed via pulse wave velocity (PWV), which was measured noninvasively with the use of the SphygmoCor Pulse Wave Velocity system (PWV Medical, NSW, Australia). PWV was determined by acquiring waveforms at the radial artery at the wrist using applanation tonometry with a high-fidelity micromanometer. The corresponding central aortic waveform was generated after 20 sequential waveforms with a validated generalized transfer function. All measurements were taken with the participant in a seated position in a quiet room after a 5 min resting period. Blood pressure (BP) measurements were performed with a validated, automated BP monitor, with radial artery kept at heart level during measurement.

Covariates

Covariates were chosen based on their association with discrimination or PWV in prior studies. Self-reported sociodemographic factors were collected using standard questions from population studies (included age, race/ethnicity, income, education, and marital status). Race/ethnicity was categorized as Black or White/Other. Poverty status was defined as having family income ≤$25,000. Education was categorized as greater than or less than a high school education. Marital status was defined as either being married or partner living as married versus being single, separated, divorced, or widowed. Physical activity was assessed using the Baecke Questionnaire of Habitual Physical Activity [41]. Height and weight were measured during the clinic visit and used to calculate the body mass index (BMI; kg/m^2). CHD severity was quantified with the Gensini scoring method [42].

The Perceived Stress Scale (PSS), a self-reported 10-item survey, was used to measure perceived stress [43]. Participants were asked to rate their feelings about situations and experiences during the past month across 10 items using a five-point Likert scale ranging from Never (0) to Very Often (4). Positively stated items were reverse coded, and items were averaged so that higher scores indicated greater perceptions of stress.

Depressive symptomology was assessed with the Beck Depression Inventory Second Edition (BDI-II), a reliable and valid self-report measure that has been widely used across clinical and population studies [29]. The BDI-II includes 21 questions that ask participants to rate their feelings, cognitions, and physical symptoms (e.g., sadness, pessimism, guilt, and fatigue) during the past 2 weeks. Each item contains a four-point Likert scale to indicate the severity of each feeling from 0 (not at all) to 3 (extreme form of each symptom) [44]. Responses across the items were summed so that higher scores indicated greater symptoms of depression.

Statistical Analyses

Baseline characteristics were calculated by race/ethnicity and gender. Group differences were tested using chi-squared tests for categorical variables and *t*-tests for continuous variables. Average experiences of everyday

discrimination score and resting PWV were calculated by racial groups, gender groups, and race–gender groups. Linear regression models were used to evaluate the association between experiences of everyday discrimination as a continuous score and PWV. Initial regression models included age, race, and gender (Model 1). A subsequent model included additional adjustments for poverty status, education, and marital status (Model 2). We, then, adjusted for smoking status, disease history (diabetes, hypertension, and dyslipidemia), Gensini score, and BMI in the models for the overall population (Model 3). Full covariate adjustment included all of the variables in Model 3 plus depressive symptoms and perceived stress (Model 4).

Additionally, because we were particularly interested in understanding associations at the intersection of race and gender, we also ran race–gender-stratified models. We stratified a priori in order to obtain separate effect sizes for the association between everyday discrimination and PWV for each race–gender group, given our hypothesis that associations would be more pronounced within Black women and emerging arguments across disciplines for the importance of effect sizes over *p*-values [45–47]. Stratifying from the outset also accounts for any potential differential confounding of associations of interest within each racial–gender group [48]. However, we also formally tested the three-way interaction term for discrimination by race by gender, accounting for all relevant two-way interactions. To account for missing data, we conducted multiple imputations with Markov Chain Monte Carlo equations to generate 50 data sets, which were combined for all analyses. The percentage missing for each variable included in the analysis was 2.6% for education, 0.6% for marital status, 3.2% for smoking status, 11.2% for income, 0.3% for BMI, 3.1% for the PSS scale, 3.1% for the BDI scale, 5.4% for physical activity, 6.7% for Gensini score, 4.5% for discrimination, and 9.9% for resting PWV. All analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC).

Results

Participant Characteristics

Of the 313 participants included in this analysis, 10.7% were White/Other women, 19.0% were White/Other men, 37.9% were Black women, and 32.4% were Black men. Descriptive statistics by race–gender group are presented in Table 1. All participants were on average 50 years of age. Compared to the other race–gender groups, Black women were more likely to report an income below poverty status, have less than a high school education, and have a higher BMI and were less likely to be married or living with a partner and to be physically active. Concurrent comorbidities, including diabetes and hypertension, were more common in Black women compared to other race–gender groups. Black women were also more likely to have a higher score for depressive symptoms and for perceived stress. More self-reported experiences of everyday discrimination were reported by both Black women and men compared to their White/Other counterparts (Table 2). Black men had the highest mean PWV, followed by Black women, compared to White men and White women.

The crude association between experiences of everyday discrimination and higher PWV was significant (Table 3; β = .44; 95% confidence interval [CI]: 0.06, 0.82; p = .021). After adjustment for age, race, and gender, this association attenuated (β = .34; 95% CI: −0.04, 0.72; p = .077). Further adjustments for important demographic characteristics, such as poverty status, education, and marital status revealed similar results. This association remained similar after full multivariate adjustment of behavioral risk factors, disease risk factors, CHD severity, and psychosocial factors in Model 5 (β = .34; 95% CI: −0.09, 0.78; p = .123).

In models stratified by race–gender groups (Table 4), there was a significant association between experiences of everyday discrimination and higher PWV in the unadjusted model and the model that adjusted for age among Black women (β = .68; 95% CI: 0.15, 1.21; p = .013) but not other race–gender groups (White/Other women [β = −.29; 95% CI: −1.60, 0.09; p = .686], White/Other men [β = .54; 95% CI: −0.32, 1.40; p = 0.218], and Black men [β = −.02; 95% CI: −0.73, 0.70; p = .960). This association remained after adjustment for sociodemographic characteristics among Black women (β = .68; 95% CI: 0.14, 1.23; p = 0.014) but not in White/Other women (β = −.52; 95% CI: −1.97, 0.93; p = .481), White/Other men (β = .53; 95% CI: −0.35, 1.40; p = .239), or Black men (β = .01; 95% CI: −0.73, 0.75; p = .986). After adjustment for behavioral and disease risk factors in Model 4, these associations remained the same by each race–gender group. The beta coefficient and 95% CIs after full multivariable adjustment were .85, 95% CI: 0.19, 1.52 among Black women; −.45, 95% CI: −2.39, 1.48 among White/Other women; .53, 95% CI: −0.33, 1.39 among White/Other men; and .03, 95% CI: −0.84, 0.89 among Black men. A test of the three-way interaction among experiences of everyday discrimination, race, and gender was not significant (p = .468). All models were fully adjusted for covariates included in the main test of association (Model 5).

Discussion

To our knowledge, this study is the first to examine associations between discriminatory stressors and indices of

Table 1. Descriptive characteristics of participants stratified by race/ethnicity and gender among post-MI participants (N = 313) in the Myocardial Infarction and Mental Stress 2 Study (MIMS2)

	Women		Men		p-value
	White/Other (N = 39)	Black (N = 115)	White/Other (N = 69)	Black (N = 90)	
Age, years, mean (SD)	51.6 (5.3)	50.2 (7.8)	51.5 (5.8)	50.5 (6.3)	.486
Income <$25K, N (%)	11 (28.2)	56 (48.7)	10 (14.5)	36 (40.0)	<.001
Less than a high school education, N (%)	14 (35.9)	49 (43.4)	15 (21.7)	47 (52.2)	.001
Married/living with partner, N (%)	24 (51.5)	32 (28.1)	46 (66.7)	30 (33.3)	<.001
History of smoking, N (%)	25 (64.1)	60 (53.1)	25 (36.2)	57 (63.3)	.004
Diabetes, N (%)	12 (30.8)	44 (38.3)	11 (15.9)	32 (35.6)	.013
Hypertension, N (%)	27 (69.2)	102 (88.7)	47 (68.1)	78 (86.7)	.001
Dyslipidemia, N (%)	29 (74.4)	93 (80.9)	56 (81.2)	73 (81.1)	.812
Physical activity, mean (SD)	7.4 (1.4)	6.3 (1.2)	7.6 (1.5)	6.9 (1.3)	<.001
Gensini score, median (IQR)	3.1 (2.2, 3.9)	3.1 (2.0, 3.8)	3.9 (3.1, 4.4)	3.5 (2.2, 4.2)	.007
BMI, kg/m^2, mean (SD)	30.6 (9.9)	33.6 (8.3)	29.9 (5.7)	30.2 (5.9)	.001
BDI total score, mean (SD)	11.3(9.9)	15.0 (11.1)	9.2 (8.9)	12.1 (11.0)	.005
PSS total score, mean (SD)	16.4 (8.2)	17.8 (8.4)	14.6 (8.6)	16.3 (8.7)	.123

BDI Beck depression inventory; *BMI* body mass index; *IQR* interquartile range; *PSS* Cohen's perceived stress scale; *SD* standard deviation.

Table 2. Average experience of everyday discrimination score and resting pulse wave velocity among post-MI participants (N = 313), by race and gender, in the Myocardial Infarction and Mental Stress 2 Study (MIMS2)

		Discrimination score	Pulse wave velocity, m/s
	N	Mean (SD)	
Overall	299	1.7 (0.6)	7.5 (1.9)
By Race			
Whites/Others	103	1.5 (0.5)	7.1 (1.8)
Blacks	196	1.8 (0.6)	7.7 (2.0)
By gender			
Women	148	1.7 (0.6)	7.3 (1.8)
Men	151	1.7 (0.6)	7.7 (2.1)
By race and gender			
White/Other women	38	1.4 (0.5)	6.9 (2.0)
Black women	110	1.7 (0.6)	7.4 (1.7)
White/Other men	65	1.6 (0.5)	7.2 (1.8)
Black men	86	1.8 (0.6)	8.0 (2.2)

MI myocardial infarction; *SD* standard deviation.

CVD in a cohort of Black and White men and women with heart disease. Our emphasis on a patient population is an important addition to the literature on discrimination and CVD, especially because empirical research suggests that Black women with CVD receive worse clinical care and may be more targeted by discriminatory treatment than their White female, White male or Black male counterparts with CVD [27–29]. We found that, among young and middle-aged individuals who recently survived an MI, experiences of everyday discrimination were significantly associated with increased arterial stiffness among Black women but not White/Other women, White/Other men, or Black men. These findings were independent of medical comorbidities, socioeconomic factors, perceived stress, and depressive symptoms. Thus, consistent with an intersectional perspective, our data suggest that psychosocial stress in the form of discrimination may be particularly impactful for Black women with a history of MI compared to other race–gender groups.

Because most studies in this area have focused on women *or* Blacks, there is limited research examining discrimination and health associations across race and gender groups using an intersectional approach—particularly, among a post-MI cohort, where intersectional *outcomes* are known to exist. However, our results are consistent with at least one prior study in healthy populations. In one of the few studies to examine discrimination and health associations by race and gender, Beydoun et al. observed associations between reports of everyday discrimination and decreased kidney function over time in Black women but not White women, White men, or Black men.[49] Furthermore, while studies have not consistently found stronger discrimination and health associations for Blacks compared to Whites [3, 50], studies focused on healthy Black males and females exclusively have often found stronger discrimination and health associations in Black women compared to Black men [51] and Black girls compared to Black boys [52].

Prior research has suggested that there are gender differences in response to stress, with women having more pronounced physiological responses to stress, particularly, interpersonal stressors, than men [36, 53]. In women with a history of CVD, psychological stressors have been linked to adverse vascular and inflammatory responses [10,12,31–34], which may, in turn, result in an increase in inflammation and oxidative stress [35–37]. Although there is a paucity of research examining black–white differences in physiological responses to stress among women with CVD, studies of healthy women have found that Black women have more pronounced vascular and inflammatory responses to stress than their White counterparts [54, 55] and some [54], but not all [56], studies have found that this is particularly true for discriminatory stressors. Thus, our findings showing a differential vulnerability in Black women with CVD compared to other race–gender groups are consistent with findings from prior investigations. However, the factors underlying this differential vulnerability require further elucidation.

It is important to note that our study and much of the prior research in this area, has focused on interpersonal discriminatory stressors. It is possible that Black women are simply more vulnerable to the effects of interpersonal discrimination on health compared to White women, White men, and Black men. This could potentially be due to gender role norms that foster communion and an emphasis on interpersonal relationships in women across racial backgrounds [57, 58] in the context of a society that disadvantages Black women on the basis of race. In this respect, "weathering" may also play a role. In 2006, Geronimus et al. argued that "the stress inherent in living in a race-conscious society that stigmatizes and disadvantages Blacks may cause disproportionate

Table 3. Adjusted estimates for experiences of everyday discrimination on pulse wave velocity (N = 313) in the Myocardial Infarction and Mental Stress 2 Study (MIMS2)

	B (95% CI)	*p*-value
Model 1	0.44 (0.06, 0.82)	.021
Model 2	0.34 (−0.04, 0.72)	.077
Model 3	0.33 (−0.06, 0.72)	.094
Model 4	0.34 (−0.03, 0.71)	.077
Model 5	0.34 (−0.09, 0.78)	.123

Model 1 is unadjusted. Model 2 is adjusted for age, race, and gender. Model 3 is adjusted for Model 1 + income, education, and marital status. Model 4 is adjusted for Model 2 + smoking, disease history (diabetes, hypertension, and dyslipidemia), physical activity, Gensini score, and BMI. Model 5 is adjusted for Model 3 + depressive symptoms and perceived stress.

BMI body mass index; *CI* confidence interval.

Table 4. Adjusted estimates for experiences of everyday discrimination on Pulse Wave Velocity (N = 313) in the Myocardial Infarction and Mental Stress 2 Study (MIMS2) by race and gender

	White/Other women		Black women		White/Other men		Black men	
	β (95% CI)	*p*-value	β (95% CI)	*p*-value	β (95% CI)	*p*-value	β (95% CI)	*p*-value
	N = 39		N = 115		N = 69		N = 90	
Model 1	−0.17 (−1.55, 1.22)	.815	0.71 (0.18, 1.24)	.009	0.55 (−0.31, 1.41)	0.208	−0.06 (−0.77, 0.66)	.878
Model 2	−0.29 (−1.60, 0.09)	.686	0.68 (0.15, 1.21)	.013	0.54 (−0.32, 1.40)	0.218	−0.02 (−0.73, 0.70)	.960
Model 3	−0.52 (−1.97, 0.93)	.481	0.68 (0.14, 1.23)	.014	0.53 (−0.35, 1.40)	0.239	0.01 (−0.73, 0.75)	.986
Model 4	−0.84 (−2.14, 0.45)	.201	0.69 (0.16, 1.23)	.012	0.57 (−0.25, 1.40)	0.173	0.08 (−0.66, 0.81)	.839
Model 5	−0.45 (−2.39, 1.48)	.646	0.85 (0.19, 1.52)	.012	0.53 (−0.33, 1.39)	0.224	0.03 (−0.84, 0.89)	.954

Model 1 is unadjusted. Model 2 is adjusted for age. Model 3 is adjusted for Model 1 + income, education, and marital status. Model 4 is adjusted for Model 2 + smoking, disease history (diabetes, hypertension, and dyslipidemia), physical activity, Gensini score, and BMI. Model 5 is adjusted for Model 3 + depressive symptoms and perceived stress.

BMI body mass index; *CI* confidence interval.

physiological deterioration" (p. 826), or "weathering," in Black women [59]. The weathering hypothesis posits that chronic exposure to race- and gender-related disadvantages like discrimination accelerates biological aging, disease susceptibility, and progression of chronic conditions [59–61].

However, the stressors that contribute to weathering may also extend beyond exposure to interpersonal discrimination. Compared to the White men, White women, and Black men, the Black women in our cohort were more likely to be living in poverty, less likely to be married, and reported higher levels of depressive symptoms. Consequently, in addition to discrimination, our post-MI Black women may have also had to contend with a number of other chronic stressors, such as financial strain and inadequate emotional/instrumental support, which often co-occur with poverty and being unpartnered in the context of a life-threatening event [62, 63]. Unfortunately, we did not have data on the range of chronic stressors that the Black women in our cohort may have been exposed to concurrent with the MI. Our analyses did control for at least one other dimension of stress, perceived stress, given its relevance in prior cohorts of post-MI patients [33, 34]. Our observed discrimination and health associations in Black women persisted after adjusting for perceived stress; however, perceived stress is generally conceptualized as a measure of stress appraisal [43], which, while important, does not fully account for other types of stress *exposure*.

Prior studies in healthy populations have found that independent of other types of psychosocial stress exposure (e.g., financial strain, chronic burden, and negative life events), reports of racism and discrimination are linked to adverse indices of CVD in Black women compared to their white counterparts [6]. Additionally, discrimination has been found to have a more pronounced impact on health than these other stressors [64], suggesting it may be one of the most toxic forms of chronic stress for middle-aged Black women such as those in the current study [6]. Some have argued that discriminatory stressors have a stronger impact on indices of CVD than other types of stressors because they represent threats to belonging and the "social self" [65]. Yet, to date, much of this prior work has been conducted in healthy populations; thus, additional research is needed to determine whether similar findings would be observed in Black women post-MI.

It is possible that young to middle-aged Black women with CVD are actually more "weathered" than similarly aged Black women without CVD, as well as White women, White men, and Black men under age 60 with CVD. This group has been shown to have more comorbidities, to be more likely to be rehospitalized, and to have higher mortality rates during and after hospitalization for MI than other young to middle-aged race–gender groups [9–11]. Therefore, they may be sicker from the outset than their White female, White male, and Black male counterparts. Many of the social adversities that disproportionately impacted the Black women in our cohort, such as poverty and depressive symptoms, could have preceded their MIs. Consequently, Black women who develop MIs at relatively young ages may have been exposed to a lifetime of chronic stressors, beginning with early adversities in childhood and adolescence and continuing with cumulative stressors throughout adulthood. Notably, both early adversities and adult stressors have been linked to atherosclerosis and later CVD [66, 67] and could play a role in our observed associations. However, studies of discrimination and CVD risk in healthy cohorts have found significant associations even after accounting for these factors [68]. This suggests that discriminatory stressors may matter for Black women post-MI even in the context of other lifecourse stressors. Nonetheless, future studies are needed to determine whether the accumulation of stressors across the lifespan might interact with discrimination to impact the development and progression of CVD in young to middle-aged Black women relative to other race–gender groups.

To our knowledge, only a few studies have examined associations between psychosocial stress and arterial stiffness. A study of men and women from the Netherlands found associations between a range of psychosocial stressors—including negative life events, daily hassles, and job strain—and arterial stiffness [69]. Another study examined the psychosocial correlates of arterial stiffness in Black and White adolescents [70]. Adolescents reporting greater anxiety, more hostility, and less supportive relationships had greater PWV, and associations were particularly pronounced in Blacks [70]. Similarly, among a separate study of elderly adults, inadequate emotional support was found to be associated with higher levels of arterial stiffness in older Blacks but not in Whites [71]. All of these studies focused on healthy populations and differed from the current analysis on key demographic characteristics and the psychosocial stressors studied. Still, taken together, the findings suggest that psychosocial factors more broadly may have a more adverse impact on arterial stiffness in Blacks compared to their White counterparts. Whether the associations among Blacks in the aforementioned studies were primarily driven by the Black females in those cohorts is unclear. However, given the current findings, additional research examining race–gender differences in the association between psychosocial stressors and arterial stiffness is warranted.

This study has several strengths, including having a diverse population with a high representation of women and Blacks. Our study also focused on an at-risk population of young post-MI individuals, which is a rapidly growing yet understudied population. Discrimination

was measured using a validated questionnaire and arterial stiffness was measured by trained staff using a standardized protocol. The availability of extensive data allowed us to adjust for a range of well-measured potential confounders. Despite these strengths, the findings from this study should be interpreted within the context of known and potential limitations. The current analysis was cross-sectional, which limited our ability to determine causality and temporality. Our study sample was small and, while the overrepresentation of Black women in our cohort is consistent with national trends on MI in young to middle-aged women [9–11], we had a limited number of non-Black women, which may have resulted in less power for interaction effects. Additional research in cohorts with larger numbers within each race–gender group is needed to more extensively examine intersectionalities. Lastly, these findings may not be generalizable to healthy populations as this study sample was among patients with a history of MI.

In conclusion, among participants with a history of MI, experiences of everyday discrimination were associated with an increase in arterial stiffness in Black women only. In contrast, this association was not significant among White/Other women, White/Other men, and Black men. Our findings support the weathering hypothesis by demonstrating a difference in the association between experiences of discrimination and arterial stiffness by race–gender groups. The implications of these findings suggest that targeted psychological treatments and evaluations should be incorporated into the care and treatment of young Black women with prior clinical disease in order to allow this population to better deal with discriminatory treatment and consequently improve their cardiovascular health. Future longitudinal studies are needed to explore this association over time.

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Compliance with Ethical Standards

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Authors' Contributions V.V. contributed to overall study conception, design, implementation, and data acquisition. I.U. and A.Q. contributed to study implementation and data acquisition. S.B., S.S., and L.E. contributed to statistical analyses and manuscript writing. L.L. contributed to statistical analysis. T.T.L. contributed to study conception (via the EDS) and manuscript writing. R.S., B.L., A.Y., J.D.B., A.Q., and V.V. provided critical guidance in the interpretation of results and manuscript development. All authors read and approved the final manuscript. All authors agree to be accountable for their contributions, the accuracy, and integrity of the research.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the Institutional Review Board at Emory University.

Informed Consent Written informed consent was obtained from all participants in this study.

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