Chronic Exposure to Everyday Discrimination and Coronary Artery Calcification in African-American Women: The SWAN Heart Study

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Background: Emerging evidence suggests that exposure to discrimination may be associated with atherosclerosis in African-American women, although research in this area focused on short-term rather than chronic exposure to discriminatory events. **Methods:** We examined the relationship between chronic exposure to multiple types of discrimination (self-reported and averaged over 5 years) and coronary artery calcification (CAC) in a sample of 181 middle-aged African-American women. Discrimination was assessed at each time point, and the presence/absence of CAC was assessed at the fifth annual follow-up examination by electron beam tomography. We hypothesized that chronic discrimination would be more strongly associated with CAC than recent discrimination and that racial/ethnic discrimination would be more strongly associated with CAC than other types of discrimination. **Results:** Chronic exposure to discrimination was significantly associated with the presence of CAC in unadjusted logistic regression analyses ($p = .007$) and after adjustment for demographics ($p = .01$), standard cardiovascular risk factors ($p = .02$), and Body Mass Index (BMI) ($p = .05$). In contrast, recent discrimination was only marginally associated with the presence of CAC in both unadjusted ($p = .06$) and fully adjusted logistic regression models ($p = .08$). Persistent exposure to racial/ethnic discrimination was not more strongly associated with CAC compared with other types of discrimination in either unadjusted or adjusted models. **Conclusion:** Chronic exposure to discrimination may be an important risk factor for early coronary calcification in African-American women. This association appears to be driven by exposure to discrimination from multiple sources, rather than exposure to racial/ethnic discrimination alone. **Key words:** discrimination, chronic stress, atherosclerosis, coronary calcium, African-American, women.

CVD = cardiovascular disease; **CAC** = coronary artery calcification; **SWAN** = Study of Women's Health Across the Nation; **EBT** = electron beam tomographic; **CES-D** = Center for Epidemiological Studies Depression; **BMI** = body mass index; **FRS** = Framingham Risk score; **HDL-c** = high density lipoprotein cholesterol; **CRP** = C-reactive protein; **OR** = odds ratio; **CI** = confidence interval; **IMT** = intima-media thickness.

INTRODUCTION

In the United States, cardiovascular disease (CVD) is the leading cause of death for women, accounting for approximately half a million female deaths each year (1). Compared with Caucasian women, African-American women are disproportionately burdened by CVD morbidity (2,3) and mortality (1,4). On almost every major indicator of cardiovascular health status (coronary heart disease, hypertension, stroke), African-American women fare worse than their Caucasian counterparts (1,3). In many instances, adverse cardiovascular outcomes are observed in African-American women even after taking into account the effects of socioeconomic status, access to care, disease status, and behavioral risk factors (5).

Several researchers have hypothesized that the excess disease morbidity and mortality observed in African-American women may be due in part to chronic stressors associated with being black and female in the United States (6). Various forms of chronic stress have been linked to CVD morbidity and mortality in samples of Caucasian men (7,8), and more recently, Caucasian women (9,10). However, few studies have examined the role of chronic stress in the development of CVD in African-American women.

One particular chronic stressor believed to negatively affect the mental and physical health of African-American women is unfair treatment in the form of racial or gender discrimination (11–13). African-American women consistently report exposure to unfair treatment in multiple domains, including higher education, the workplace, and public settings such as restaurants and shopping centers (14–16). Based on interview data with black women in the United States and the Netherlands, Essed (17,18) coined the term "everyday" discrimination to describe the minor, everyday insults experienced by black women as a function of their marginalized status. Unlike major, overt instances of discrimination, everyday discrimination is conceptualized as "a range of events, many of which appear to be 'trivial' or even 'normal.'. . .Certain rights, respect, and recognition, which whites take for granted in their own lives, are denied to [black women]" (17) (pp 258–259).

To date, the majority of studies examining the relationship between perceived discrimination and CVD outcomes in African-American women have focused on acute rather than chronic experiences of discrimination (11,19,20), and findings have been mixed (21). To our knowledge, only one study has examined the relationship between "everyday" discrimina-

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tion and cardiovascular outcomes in African-American women. In a recent study of 334 African-American and Caucasian women transitioning through menopause, Troxel et al. (22) observed a significant concurrent association between reports of everyday mistreatment in the previous year and carotid intima-media thickness (IMT) in African-American women only, lending some support to the notion that the construct of everyday discrimination might be particularly relevant for the cardiovascular health of African-American women.

The current study is designed to expand on the cross-sectional associations observed by Troxel et al. (22) by examining the association between the accumulation of "everyday" insults over time and the presence of coronary artery calcification (CAC) in African-American women. Research suggests that it is the persistence or *chronicity* of stressors over time that contributes to most negative cardiovascular outcomes, rather than the occurrence of an acute event or series of events in a given year (23). The assessment of CAC allows us to examine the association between this accumulated stress burden and the early development of atherosclerosis in an asymptomatic sample at high risk for future clinical events. CAC has been found to be an independent predictor of clinical cardiovascular events in asymptomatic individuals (24–27), although prior studies in this area have included relatively few African-American women (24,26,28).

We hypothesized that chronic exposure to everyday discrimination over the course of 5 years would be associated with the presence of CAC in African-American women. Furthermore, we anticipated that the accumulation of everyday discrimination over time would be more strongly associated with CAC than reports of everyday discrimination during the previous year. We further hypothesized that exposure to everyday *racial* discrimination in particular would be more strongly associated with CAC compared with other types of discrimination (e.g., gender or income discrimination). Finally, in order to explore pathways through which everyday discrimination might affect CAC, we also examined negative affect (depressive symptoms and hostility) and a number of cardiovascular risk factors as potential mediators.

METHODS

Participants

Participants in the current study were from the Study of Women's Health Across the Nation (SWAN). SWAN is a community-based, longitudinal study of the menopausal transition. Details of the study design, recruitment, and procedures have been published elsewhere (29). Women were eligible for SWAN if they were between ages 42 to 52, had an intact uterus and at least one ovary, and reported a menstrual period in the preceding 3 months. Women who were pregnant, breastfeeding, or reported exogenous hormone use in the 3 months preceding the baseline examination were ineligible for participation. The baseline SWAN examination began in 1996 to 1997 and included women from seven sites (Boston, MA; Detroit, MI; Oakland, CA; Los Angeles, CA; Pittsburgh, PA; Chicago, IL; and Newark, NJ).

During the fourth and fifth annual follow-up examinations (2001–2003), the Pittsburgh and Chicago sites collected additional measures of coronary calcium on a subset of 559 SWAN participants for the SWAN Heart Study. SWAN participants were only eligible for the SWAN Heart Study if they were free of CVD (e.g., no history of myocardial infarction, symptoms of angina, intermittent claudication, cerebral ischemia, or revascularization), diabetes, and were not taking medication for hypertension or arrhythmias. SWAN participants who had had a hysterectomy (subsequent to their enrollment in the SWAN study) or reported current exogenous hormone use were ineligible. Seventy-six percent of SWAN women invited to participate in the SWAN Heart Study ultimately enrolled.

Although both Caucasian and African-American women participated in the overall SWAN Heart study, the current investigation is limited to the 206 women with data on CAC who self-identified as non-Hispanic Black/African-American. We chose to focus on African-American women for four primary reasons: 1) prior studies indicate that African-American women are particularly vulnerable to the effects of both CVD and everyday discrimination (13,22); 2) while it is possible to assess exposure to everyday discrimination in Caucasian women, it is unclear whether this measure is actually capturing the same construct for women of different racial/ethnic groups (i.e., Caucasian versus African-American women); 3) focusing on African-Americans allows us to reduce the confounding that might occur if we compare experiences between African-Americans and Caucasians, two racial/ethnic groups that clearly have different histories and experiences of discrimination in the United States (30,31); and 4) consistent with other studies of discrimination and markers of CVD (22), preliminary analyses revealed no significant associations between measures of discrimination and CAC among Caucasian women in the current sample.[1] Of the 206 African-American women with data on CAC, 19 were excluded because of missing data on the Framingham Risk Score (FRS), and an additional 6 were excluded because of missing data on educational attainment. The final sample of 181 women provided data for the current analyses.

Procedure

At the baseline SWAN examination and annually thereafter, participants underwent a standard protocol that included self- and interviewer-administered questionnaires, measured height and weight, clinical tests, and a fasting blood and urine collection. Interviews included detailed assessments of demographic, psychosocial, and behavioral characteristics. In addition to the standard SWAN protocol, participants in the SWAN Heart study also underwent electron beam tomographic (EBT) scans to measure the presence and amount of CAC.

Study procedures were approved by the institutional review boards at each site, and all participants provided written informed consent.

Measurement of Discrimination

Chronic Discrimination

Discrimination was assessed at the baseline SWAN examination and each time point thereafter with a modified version of the Detroit Area Study Everyday Discrimination Scale (32). Based on the construct defined by Essed (17,18), this 10-item scale asked participants to indicate the frequency with which they experienced various forms of interpersonal mistreatment in their day-to-day lives over the previous 12 months. Examples include "You are treated with less respect than other people," "You receive poorer service than other people at restaurants or stores," "People act as if they think you are not smart," and "People act as if they're better than you are." The items were framed in the context of general mistreatment, without reference to race, ethnicity, or gender. The frequency of each type of mistreatment was assessed with a 4-point scale (1 = never, 2 = rarely, 3 = sometimes, 4 = often), summed, and averaged across the 10 items, resulting in a possible score of 1 to 4 at each time point. The resulting five discrimination scores, representing discrimination from SWAN baseline through SWAN 2004/2005 (i.e., SWAN Heart baseline) were then averaged to create a *chronic* discrimination score. Similar to the discrimination scores at each time point, the chronic discrimination score had a possible range of 1 to 4. The Everyday Discrimination scale has shown high levels of internal consistency (32,33) and convergent and divergent validity (34) in samples of African-American men and women. Internal reliability scores for the Everyday Discrimination Scale in the current sample were very good, ranging from 0.87 to 0.90 across the five time points.

[1] Data available from first author upon request.

Recent Discrimination

Recent discrimination was defined as discrimination reported at the time of the EBT scan (SWAN Heart baseline).

Type of Discrimination

Participants who responded either "sometimes" or "often" to at least one of the 10 items on the Everyday Discrimination scale were asked to respond to an additional item inquiring about the reason(s) for their experience(s). Response categories included race, ethnicity, gender, age, income level, language, physical appearance, sexual orientation, and other. For analytic purposes, the race and ethnicity categories were collapsed into one racial/ethnic discrimination, and all other categories were combined to create an "other" category at each of the five time-points.[2]

Measures of Negative Affect

Depressive symptoms were assessed with the 20-item Center for Epidemiological Studies Depression scale (CES-D) (35) and analyzed as both a continuous variable and a presence/absence score using a previously established cut point (≥16). Hostility was measured with the 13-item Cook-Medley cynicism subscale (36). Internal reliability scores in the current sample were very good for the CES-D ($\alpha = 0.86$) and adequate for the cynicism subscale ($\alpha = 0.78$).

Assessment of Coronary Artery Calcification

EBT scans were used to quantify calcification in the coronary arteries. A trained technician at each site performed the EBT scans using an Imatron C-150 Ultrafast CT scanner (Imatron, South San Francisco, CA). The scan obtained 30 to 40 contiguous 3-mm-thick transverse images from the level of the aortic root to the apex of the heart during maximal breath holding. Electrocardiograph triggering was used so that each 100-ms exposure was obtained during the same phase of the cardiac cycle (60% of RR interval). Scans were read centrally at the University of Pittsburgh and scored by a trained technician using the method established by Agatston et al. (37). Calcification was considered to be present if at least three contiguous pixels were present with more than 130 Hounsfield units. Individual scores were obtained for each of the four major epicardial coronary arteries; the total coronary calcification score was calculated as the sum of these four scores. Consistent with previous research in this area, CAC was modeled as a presence/absence outcome, rather than a continuous score (38–41). This distinction between detectable and nondetectable disease is standard in studies of CAC and has been found to have considerable predictive validity (24–27). The presence of calcification was defined as a total coronary calcification score >0. Because calcification scores in this sample were fairly low (98% below 100), we did not make any further distinctions among women *with* calcification (e.g., categories comparing scores of 1–100 versus 101–201, etc.).

Cardiovascular Risk Factors

Framingham Risk Score

The Framingham Risk Score (FRS) for women incorporates age, total cholesterol, high-density lipoprotein cholesterol (HDL-c), systolic blood pressure, treatment for hypertension, and current cigarette smoking (42). Measurements of total serum cholesterol and HDL-c were taken from blood specimens obtained between the second and fifth days of each participant's menstrual cycle, following a 12-hour fast. Total cholesterol was analyzed using enzymatic methods on a Hitachi 747 analyzer (Boehringer Mannheim Diagnostics, Indianapolis, IN) (43). Lipid and lipoprotein fractions were analyzed on EDTA-treated plasma (43,44), and HDL-c was isolated using heparin-2m manganese chloride (44). Blood samples at both sites were analyzed at the same central laboratory (Medical Research Laboratories, Highland Heights, KY) that conforms to the quality control standards of the National Heart, Lung and Blood Institute and the Centers for Disease Control and Prevention (45). Blood pressure measurements were obtained by a trained technician and standardized for cuff size, position, and rest period. Two blood pressure readings were taken for each participant and averaged for use in the FRS. All FRS components were assessed at the SWAN Heart baseline examination via self-report (age, current smoking, and medications for high blood pressure) or clinical examination (total cholesterol, HDL-c, and systolic blood pressure).

Additional Risk Factors

Highest level of education was assessed at via self-report at SWAN baseline and categorized as high school degree or less, some college, and college degree or higher (referent). Body mass index (BMI) from the SWAN Heart baseline examination was calculated as weight in kilograms divided by height in meters squared. BMI was categorized as normal (BMI ≤24.9), overweight (BMI 25–29.9) and obese (BMI ≥30) (46) for descriptive purposes but was modeled continuously in all analyses. Measurements of C-reactive protein (CRP) were done on fasting blood samples collected at SWAN Heart baseline and assessed using an ultrasensitive rate immunonephelemetric method (Dade-Behring, Marburg, Germany). The sensitivity of the assay is 0.03 mg/dl. The interassay coefficients of variation (CV) at CRP concentrations of 0.05 and 2.2 mg/dl were 10% to 12% and 5% to 7%, respectively. Menopausal status was categorized by self-reported bleeding criteria at SWAN Heart baseline: 1) premenopausal = menstrual period in the past 3 months with no change in regularity in the past year; 2) early perimenopausal = menstrual period in the past 3 months with some change in regularity over the previous year; 3) late perimenopausal = no menstrual period within the past 3 months, but some bleeding within the past year; 4) postmenopausal = no menstrual period within the past year; 5) surgical menopause = bilateral oophorectomy; and 6) undetermined = new use of hormone therapy before 1 year of amenorrhea. Physical activity was self-reported, using an adapted version of the Kaiser Physical Activity Survey (47).

Statistical Analyses

Descriptive statistics were used to characterize the study sample on age, education, FRS (and its components), BMI, chronic discrimination, and CAC. *t* Tests and analysis of variance tests were used to examine associations between chronic discrimination and categorical variables (e.g., site, categorical CES-D). Correlation coefficients were used to examine associations between chronic discrimination, covariates of interest (potential mediators), and CAC. Because of the small sample size, psychological and/or biological covariates were only included in the multivariate models if they were associated with both the predictor (chronic discrimination) and the outcome (CAC) at $p \leq .10$ (48). All models included education and study site.

A series of multivariate logistic regression models was conducted to examine the associations between the various forms of discrimination (chronic, recent, and racial/ethnic versus other) and the presence of CAC. In each set of analyses, the first model examined the unadjusted association between the discrimination variable and the presence of CAC. The second, minimally adjusted model added site and education. The third, fully adjusted model included the discrimination variable of interest, site, education, and any additional covariates (potential mediators) meeting criteria for inclusion in the models. All of the above analyses were conducted using SPSS version 11 (SPSS, Chicago, IL).

The bootstrap technique (49) was used to validate all multivariate models. Two thousand computer-generated samples were derived from the study population by random selection with replacement (i.e., some observations were only selected once, some more than once, and others not at all). We reran the fully adjusted logistic regression models for each sample in order to obtain "bootstrap" confidence intervals (CIs) for the odds ratios (OR) observed in the original models. Bootstrap CIs were obtained for each discrimination variable of interest (chronic, recent, and racial/ethnic versus other). Bootstrap analyses were conducted using R version 2 (50).

[2] We did not analyze gender discrimination separately, because of its low frequency.

RESULTS

Participant Characteristics and Exposure to Chronic Discrimination

Descriptive statistics for sample demographic, psychosocial, and cardiovascular risk factor characteristics are presented in Table 1. On average, participants were middle aged and well educated, with approximately 84% of the sample reporting some postsecondary education. Participants were also fairly healthy, with cholesterol and blood pressure levels in the "desirable" and "normal" ranges. The majority of women in the sample were obese, with an average BMI of 31.15 (SD = 6.45). Over half of the women had CAC scores above 0, with an overall prevalence of 59.7% (N = 108). Calcium scores were fairly low: of the 108 women with calcification, 60 (55.5%) had scores between 1 and 9, 46 (42.5%) had scores between 10 and 99, and only two women (2%) had scores above 100.

Scores on the Everyday Discrimination scale were relatively stable across the five time points, at 1.88 (SD = 0.51), 1.85 (SD = 0.46), 1.81 (SD = 0.46), 1.82 (SD = 0.53), and 1.81 (SD = 0.51). The average, or *chronic*, discrimination scores were normally distributed, ranging from 1 to 3.05. Chronic discrimination scores were highest in women reporting "some college" (compared with the other educational levels; $p = .04$) and a CES-D score at or above 16 ($p < .001$), but did not significantly differ by geographic region (Pittsburgh versus Chicago; $p = .17$). Approximately 86% (N = 156) of participants answered "sometimes" or "often" to at least one of the items on the everyday discrimination scale at some point during the five assessment periods and were subsequently asked to indicate the reason(s) for these experiences. Most participants (76.9%; N = 120) attributed their experiences to race/ethnicity at least once during the five time points, with 34.8% (N = 63) making this attribution at all time points.

TABLE 1. Sample Demographic, Psychosocial, and Cardiovascular Risk Factor Characteristics

Characteristic	All Participants (N = 181)[a]
Age, yr[b]	50.5 ± 2.8
Educational level, %	
High School or less	16
Some college	38.1
College or higher	45.9
Current smoker, %[b]	15.8
Total cholesterol, mg/dl[b]	197.18 ± 37.54
HDL cholesterol, mg/dl[b]	57.13 ± 14.28
Systolic blood pressure, mm Hg[b]	125.87 ± 18.02
Framingham Risk Score	11.08 ± 4.04
Body mass index (kg/m^2), %[b]	
Normal weight	17.1
Overweight	29.8
Obese	53.0
CES-D score ≥16, %	11
Chronic Discrimination score[c]	1.84 ± 0.42

[a] Values are mean ± SD or percentage.
[b] Assessed at SWAN Heart Baseline.
[c] The average of discrimination scores across the five time points.
CES-D = Center for Epidemiological Studies Depression.

Identification of Potential Mediators

Chronic discrimination and CAC were significantly correlated with one another, at $r = 0.20$, $p = .01$. Pearson product moment (for continuous variables) and Spearman rank order (for categorical variables) correlation coefficients were used to identify potential psychological and/or biological mediators of this association. Variables correlated with chronic discrimination included overall CES-D ($r = 0.36$, $p < .001$), hostility ($r = 0.42$, $p < .001$), FRS ($r = 0.15$, $p = .04$) and BMI ($r = 0.14$, $p = .05$). Variables correlated with CAC were FRS ($r = 0.19$, $p = .01$), BMI ($r = 0.59$, $p < .001$), and CRP ($r = 0.42$, $p < .001$). Menopausal status and physical activity were unrelated to either chronic discrimination or CAC. Because FRS and BMI were the only covariates associated with both chronic discrimination and CAC at $p \leq .10$, they were the only potential mediators included in the fully adjusted logistic regression models.

Chronic Exposure to Discrimination and Coronary Artery Calcification

The first set of multivariate logistic regression models tested the association between chronic discrimination and CAC, adjusting for demographics and cardiovascular risk factors. Unadjusted logistic regression analyses revealed a significant positive association between exposure to chronic discrimination and the presence of CAC. For every one-unit increase in the chronic discrimination score, there was a 2.89-fold higher likelihood of calcification (95% CI, 1.33–6.27; $p = .007$). Adding education and study site to the model only slightly attenuated this association (OR = 2.83; 95% CI, 1.28–6.29; $p = .01$). The association between chronic discrimination and CAC remained significant after further adjustment for the FRS (OR = 2.6; 95% CI, 1.16–5.84; $p = .02$) and BMI (Table 2). Bootstrap CIs for chronic discrimination were similar to those obtained in the original models. In multivariate models including chronic discrimination, site, education, and FRS, 95%

TABLE 2. Multivariate Logistic Regression Model Predicting Coronary Artery Calcification From Chronic Discrimination[a]

Variable	Odds Ratio (95% CI)	p Value
Chronic discrimination[b]	2.6 (0.99–6.47)	.05
Education		.28
High School or less	0.68 (0.22–2.13)	
Some college	0.47 (0.19–1.18)	
College or higher (referent)	—	
Framingham Risk Score[c]	1.09 (0.99–1.21)	.06
Body mass index[c]	1.38 (1.24–1.53)	.00

CI = confidence interval.
[a] Model is adjusted for study site. Framingham Risk Score includes age, systolic blood pressure, total cholesterol, HDL-c, and current smoking status.
[b] The average of discrimination scores across the five time points.
[c] Assessed at SWAN Heart baseline.

bootstrap CIs ranged from 1.14 to 6.15. These intervals were slightly wider and less significant with the inclusion of BMI (95% CI, 0.79–7.82).

Recent Exposure to Discrimination and Coronary Artery Calcification

A second set of multivariate models was conducted to examine the effects of *recent* discrimination (reported in the 12 months preceding the EBT scan) on CAC. In unadjusted analyses, recent discrimination was only marginally associated with the presence of CAC (OR = 1.84; 95% CI, 0.98–3.4; $p = .06$). Findings were similar after adjusting for education, study site, FRS, and BMI (OR = 2.02; 95% CI, 0.90–4.5; $p = .08$). Bootstrap CIs for recent discrimination were slightly wider but comparable to those observed in the original models (95% CI for fully adjusted models, 0.79–4.88).

Type of Discrimination and Coronary Artery Calcification

Additional multivariate logistic regression models were conducted on the 156 participants who made an attribution about the type of discrimination experienced. In analyses comparing women who made an attribution to race at least once to women who never made an attribution to race, racial/ethnic discrimination was not significantly associated with the presence of CAC in either unadjusted (OR = 1.43; 95% CI, 0.65–3.12; $p = .37$) or fully adjusted models (OR = 1.87; 95% CI, 0.66–5.26; $p = .24$). Similarly, racial/ethnic discrimination was unrelated to CAC in analyses comparing women who made an attribution to race at every time point to those who did not in both unadjusted OR = 0.80; 95% CI, 0.41–1.53; $p = .50$) and fully adjusted (OR = 0.86; 95% CI, 0.35–2.09; $p = .74$) analyses. Bootstrap CIs were slightly narrower but consistent with model-based CIs in analyses comparing women who made racial/ethnic attributions at least once to those who did not (fully adjusted 95% CI, 0.18–1.67). In fully adjusted bootstrap analyses comparing those who made an attribution to racial/ethnic discrimination at all time points to those who did not, 95% CIs were quite similar to those in the original models, ranging from 0.43 to 3.12.

DISCUSSION

We observed a significant association between chronic exposure to everyday discrimination and the presence of CAC in African-American women. This association was, for the most part, independent of traditional cardiovascular risk factors and did not appear to be mediated by negative affect in the form of depressive symptoms or hostility. Most important, the association between chronic exposure to everyday discrimination and CAC was stronger and more significant than the association between recent exposure to everyday discrimination and CAC, lending some support to the notion that it is the accumulation of everyday insults over time that is most deleterious for the cardiovascular health of African-American women, rather than the experience of discrimination at any particular time point.

Exposure to racial/ethnic discrimination alone does not appear to be driving this effect. Although the majority of women attributed their experiences to racial discrimination at least once, attributions to racism were not associated with a higher likelihood of CAC compared with other types of discrimination. This is consistent with findings reported by Troxel et al. (22), who found that everyday discrimination in general, rather than racial/ethnic discrimination in particular, was associated with increased levels of IMT in African-American women. Thus, it is possible that the attribution is less important than the *experience* of everyday discrimination. Because African-Americans consistently report higher levels of generalized everyday discrimination compared with Caucasians (13,22,32,33), their vulnerability to the health consequences of everyday discrimination may be a function of the frequency with which they are exposed to it rather than what they attribute it to. In this respect, one might expect similar findings in other groups who report consistent exposure to discrimination.

It is also possible that African-American women are sensitized to experiences of generalized (rather than racial) everyday discrimination because of some other group-level attribute. Many of the women in our sample came of age during the Civil Rights movement in the United States and may therefore have been exposed either personally or vicariously to acts of racial injustice at some point during their lifespan (15). Research suggests that previous exposure to discrimination can heighten sensitivity to subsequent experiences of discrimination (51). Members of stigmatized or socially devalued groups who have a history of experiencing a certain type of discrimination in this country (e.g., racial discrimination) may have a heightened sensitivity to unfair treatment in any form.

How might everyday discrimination be related to CAC? Previous studies have found associations between reports of discrimination and age (33), education (52), current smoking (53), blood pressure (54,55), and BMI (22). Although adjustment for these factors attenuated the association between everyday discrimination and CAC in our sample, they did not completely explain the effect. We also explored whether factors such as physical activity or inflammation might account for this effect, but these variables did not mediate the discrimination-CAC association. Thus, it is likely that other behavioral or physiological mechanisms are at play.

Psychosocial factors have been linked to increased platelet activation (56), heart rate variability (57), and endothelial dysfunction (58). Although few studies have examined the effects of discrimination per se on physiological outcomes other than blood pressure, nonhuman primate models have found a relatively strong association between the chronic stress of social subordination and coronary artery atherosclerosis, an association that is primarily mediated by neuroendocrine factors such as the hypersecretion of cortisol (59–61). Future research should focus on identifying specific physiological pathways that might explain the discrimination-CAC association in African-American women.

Findings from this study should be interpreted within the context of the study limitations. First, exposure to everyday discrimination was self-reported and is therefore a measure of the individual's perception of discrimination, which could be influenced by negative affect or other personality characteristics. Although we were able to rule out two of the most commonly assessed measures of negative affect (depression, hostility) in our study, it is possible that an unmeasured third characteristic might contribute to both the perception of discrimination and the prevalence of CAC. Second, we observed higher than previously reported rates of CAC in African-American women (62,63). This is potentially due to the high prevalence of obesity in our sample (64), but it raises some questions about the generalizability of our findings to other cohorts. Additionally, because relatively few studies of CAC and clinical events have included large numbers of African-Americans (24), the clinical significance of CAC in African-American women remains unclear. Finally, our study was limited to a relatively small sample of fairly educated African-American women; findings may or may not generalize to less well-educated African-American women or to women of other racial/ethnic groups. It is also unclear whether these findings would generalize to men. Additional research in this area is warranted.

Despite these limitations, our study has several strengths. Multiple assessments of everyday discrimination over time allowed for a more precise estimate of overall, as well as cumulative exposure to discriminatory events. By focusing on African-American women, we were able to examine the within-group heterogeneity that is often obscured in comparative (African-American versus Caucasian) studies. Other strengths include our community-based cohort design, state-of-the-art assessment of CAC, and statistical control for potential confounds.

In conclusion, we report for the first time that chronic exposure to discrimination from multiple sources may be an important risk factor for early coronary calcification in middle-aged African-American women. The mechanisms underlying this association have yet to be determined. Future research should focus on identifying the psychosocial and biological mediators of this association. Interventions aimed at reducing the emotional impact of everyday discrimination may prove to be beneficial for the cardiovascular health of African-American women.

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