



# Racial discrimination, the superwoman schema, and allostatic load: exploring an integrative stress-coping model among African American women

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**Racial discrimination has been linked to allostatic load (i.e., cumulative biological stress) among African American women. However, limited attention has been given to psychosocial processes involved in the stress response—critical for understanding biological pathways to health—in studies examining racial discrimination as a social determinant of health. We examined whether the superwoman schema (SWS), a multidimensional culture-specific framework characterizing psychosocial responses to stress among African American women, modifies the association between racial discrimination and allostatic load. We used purposive sampling to recruit a community sample of African American women ages 30–50 from five San Francisco Bay Area counties ( $n = 208$ ). Path analysis was used to test for interactions while accounting for the covariance among SWS subscales using both linear and quadratic models. Significant interactions were observed between racial discrimination and four of the five SWS subscales. Feeling obligated to present an image of strength and an obligation to suppress emotions were each protective whereas feeling an intense motivation to succeed and feeling an obligation to help others exacerbated the independent health risk associated with experiencing racial discrimination. Our findings affirm the need to consider individual variability in coping and potentially other psychosocial processes involved in the stress response process, and offer several insights that may help elucidate the mechanisms by which racial discrimination gets “under the skin.”**

**Keywords:** stress; coping; allostatic load; racial discrimination; African American; women; racial health disparities

## Introduction

### *Social stress and integrated physiology*

Chronic social stress plays a critical role in the progression of dysregulated physiologic systems via prolonged activation of the body's primary stress response system—combined activity of the hypothalamic–pituitary–adrenal (HPA)

axis and sympathoadrenal–medullary (SAM) axis.<sup>1–5</sup> Though short-term stress can have beneficial/protective effects, prolonged activation of the body's stress response can lead to sustained arousal and impaired plasticity across a number of physiologic systems (i.e., neuroendocrine, cardiovascular, metabolic, and immune—i.e., cumulative biological

stress) compromising the body's ability to adaptively respond to stressors.<sup>6–12</sup> Allostasis is an active regulatory process involving adaptation among integrated biological systems intended to meet changing environmental demands.<sup>13–18</sup> In such a model, physiologic flexibility rather than rigidity is favorable.<sup>13–18</sup> However, prolonged adaptation to sustained arousal precipitated by chronic stress can lead to increased allostatic load.<sup>1,2,14,16</sup>

Studies show significant associations between various forms of psychosocial stress and a variety of biological parameters responsible for maintaining physiologic balance.<sup>9,12,19–21</sup> Although definitions of stress have varied over time, contemporary scholars generally understand stress as the dynamic interplay (i.e., transactions) between a person and their environment, involving environmental demands, psychosocial processes that determine appraisal of threat/harm/loss ([di]stress), or alternatively motivation/challenge ([eu]stress), and concomitant biological adaptation.<sup>22–24</sup> Hence, although stress is not inherently positive or negative, scholars using a risk-based (versus resilience-based) model emphasize the imbalance between perceived demands and perceived resources resulting in a deleterious cognitive, affective, and ultimately physiologic state. Accordingly, Cohen *et al.* define stress as the “process in which environmental demands tax or exceed the adaptive capacity of an organism, resulting in psychological and biological changes that may place a person at risk for disease.”<sup>22</sup> Similar to allostatic load, a key aspect of this definition and, respectively, the concept of person–environment fit, is the idea of adaptive capacity, one's actual and perceived capacity for lessening the harmful impact of environmental stressors—that is, coping.

Coping involves two components, *dispositional coping-styles*, relatively stable traits (cognitive and affective) that determine one's usual interactions with the environment, and *context-dependent coping*, conscious strategies to regulate emotion, cognition, behavior, and/or physiology in response to specific stressful encounters.<sup>25–28</sup> Studies show little correlation between measures capturing these two components of coping.<sup>27</sup> Hence, not only do these components capture different aspects of coping, but they may also intersect in ways that have implications for health. However, research on coping has generally fallen into one of the two camps without considering the ways in which the two

interrelate. Understanding how dispositional coping styles relate to different types of stressors may elucidate understanding of biological sensitivity to social context.

### *Racial discrimination, coping, and integrated (psychobiological) specificity*

Social evaluative threat (SET), such as that experienced with racial discrimination, is a particular form of stress that studies show is associated with biological disruption via dysregulation of both the HPA and SAM axes.<sup>29,30</sup> Until recently, research on stress and health has been largely based on Selye's *general adaptation syndrome*, which suggests that the physiologic stress response is non-specific and includes a common set of physiologic responses for any given stressor.<sup>31</sup> This would suggest that experiencing a form of SET, such as racial discrimination, and something more innocuous, such as giving a speech, would elicit the same physiologic stress response. However, studies show this is not the case.<sup>29,32</sup> Evidence suggests that rather than having uniform effects on physiology, stressors are met with integrated cognitive and affective responses that determine the physiologic response.<sup>14,29,30,33</sup> In particular, studies suggest that specific stress exposures (e.g., racial discrimination) in combination with specific cognitive stress appraisals (e.g., threat versus challenge) and coping-styles determine the biological stress response (i.e., integrated specificity).<sup>30</sup> Additionally, coping-style influences cognitive stress appraisal, and thus may have a particularly meaningful impact on physiologic adaptation.<sup>24,26,34,35</sup>

Numerous studies show that African American (AA) women report racial discrimination as a unique and salient form of social stress,<sup>36–39</sup> and report using a combination of active and passive as well as problem- and emotion-focused coping-styles in response to racial discrimination relative to other forms of social stress.<sup>36,37,40,41</sup> This finding is novel given dominant views of coping as categorical (e.g., active versus passive, emotion- versus problem-focused) suggesting that AA women do not fit neatly into one category; and calls attention to the need for measures that capture the synergy of coping-styles among AA women, especially in relation to context-dependent situations such as racial discrimination, which may engender particularly intense cognitive appraisals and affective responses.

### *AA women, schema development, and gendered racial identity*

Schemas are an important aspect of social cognition and play a fundamental role in shaping the coping response.<sup>42–47</sup> Several studies have documented adoption of what has become known as the strong black woman role or, more recently, the superwoman schema (SWS) among AA women.<sup>40,48–51</sup> Schemas are internal representations of the self, the social world, and the self in relation to the social world.<sup>42,43,45</sup> Schemas are mental models—a network of core beliefs—constructed from past experience and consist of generally stable patterns of cognitions, emotions, and memories that aid in the processing and interpretation of information. Schemas are often activated and operate subconsciously (i.e., habitual), especially within the context of chronic or repeated activation.<sup>45,46</sup> Triggered by situational cues in the environment, schemas aid in stress appraisal and influence coping responses (e.g., integrating dispositional- and context-dependent coping); and ultimately affect behavior and psychophysiological stress responses, as well as future expectancies (e.g., anticipatory threat).<sup>28,42,43,45,46,52,53</sup> Schemas play a fundamental role in how people experience, interpret, and respond to the social world. Hence, they are an essential component of various mechanisms linking stress to health.

Culture influences how people experience, interpret, and respond to the social world.<sup>42,46,47</sup> Thus, certain schemata may be common to members of a specific cultural group due to “shared histories.”<sup>28,46,47</sup> Schemas also reflect individual differences in information processing (e.g., beliefs, values, exposures, coping resources, and personal salience).<sup>28,47,54</sup> Hence, schemata are shaped by both individual and social context, and provide “interpretive context”<sup>42</sup> for assessing experiences, particularly those appraised as personally relevant.<sup>42,45–47,55</sup>

AAAs report greater overall stress exposure relative to their white counterparts, including experiences of racial discrimination. AA women have reported racial discrimination as a particularly salient form of psychosocial stress. Specifically, experiences of racial discrimination, especially those experienced early in life, have been described as pivotal to their understanding of themselves in relation to the broader social world—that is, stigmatized, stereo-

typed, excluded, and devalued.<sup>37</sup> AA women identify racial discrimination as a persistent stressor occurring throughout their life across numerous life domains.<sup>37</sup> These experiences are described as being particularly painful, having long-lasting effects on their self and group identities, and on how they perceive situations involving encounters with others, particularly Whites.<sup>37</sup> They describe ruminating on past experiences, putting on what has been called their “armor” in anticipation of future threats, and feeling the need to overcompensate for negative stereotypes about AAAs and about AA women in particular (e.g., working harder to prove themselves, suppressing emotions, and code switching).<sup>36,37,56,57</sup> These cognitive, affective, and behavioral responses are, therefore, triggered by a combination of past experiences and current situational/environmental cues that activate expectancies about the present situation.<sup>37,42,43</sup> These expectancies convey for many the need to engage in what some have referred to as the “invisible labor” that characterizes AA women’s lives across a variety of social contexts.<sup>58,59</sup> The SWS framework provides cultural context for the unique ways AA women experience and respond to life stress, including but not limited to racism, sexism, and gendered racism. However, the personal relevance of gendered racism for AA women may intensify and prolong schema activation potentially resulting in impaired cognitive flexibility and hence limit capacity for adaptive coping.<sup>36,37,43,44,55,60–63</sup>

AA women have been characterized by what has been called “psychological androgyny,” embodying at once the traditionally masculine traits of self-reliance, independence, hard work and achievement, assertiveness, and obstinate strength<sup>64</sup> while also assuming the role of nurturer and caregiver.<sup>65–68</sup> These “habits of surviving”<sup>69</sup> form the “armor”<sup>57</sup> AA women have been socialized to wear, as a strategy for maintaining psychological resilience in socially threatening situations.<sup>67,68,70–72</sup> These gendered racial socialization experiences begin early in life and are reinforced throughout the lifecourse.<sup>50,70,71,73–76</sup> Hence, the strong black woman role, or SWS framework, has been described as a “collective [and ubiquitous] feature of African American womanhood.”<sup>65</sup> One study examining racial and gender identity among AA women asked women to rate the importance of being “black,” being a “woman,” and being a “black

woman” to their identity. The results showed that being a black woman was significantly more important than being a woman and marginally more important than being black,<sup>54</sup> suggesting a unique and salient identity related to the intersection of race and gender among AA women (for detailed discussion, see Supplemental Information, online only).

### *Being a superwoman: tonic or toxic?*

The SWS framework has its roots in the black feminist movement of the 1960s and 1970s. During this time, social movements tended to focus on unitary systems of power (e.g., civil rights, black power, feminism/women’s liberation, and worker’s rights), subordinating the unique challenges black<sup>a</sup> women faced across axes of race, class, and gender.<sup>77</sup> Within this context, the core beliefs of intersectionality were born. Among these core beliefs are notions of power (interpersonal, cultural, and structural), inequality, relationality, and social context. As both a conceptual and analytic tool, intersectionality situates black women in an autonomous social position and motivates understanding of their experiences from what Collins calls a “distinctive angle of vision,” where black women are at once gendered and racialized.<sup>77,78</sup> Referring to this intersection, the Combahee–River–Collective’s “A Black Feminist Statement” reads, “The synthesis of these oppressions creates the condition of our lives.”<sup>77</sup> Stemming from the mutually constructed disadvantages associated with these intersecting systems of power and privilege, the strong black woman role/SWS framework is understood as a strategy for withstanding the social adversity related to being a member of a dually oppressed group.<sup>77–80</sup> Accordingly, AA women were urged to “possess the spirit of independence...possess the spirit of men, bold and enterprising, fearless and undaunted.”<sup>78</sup>

Dating back to the mid-19th century, Sojourner Truth—born into slavery and later an AA abolitionist and women’s rights activist—became a symbol of strength and resilience among AA women.<sup>81,82</sup> Her 1851 speech “Ain’t I a Woman?” reflects her social position and need to develop a toughness as an AA woman that enabled her to “work [the fields]...as

much as a man....and bear the lash [i.e., endure the pain/whippings of slavery] as well!” while simultaneously bearing the responsibility of motherhood and caretaking; despite being denied the simple pleasures of womanhood, such as being “helped into carriages” and “lifted over ditches.”<sup>83</sup> As reflected in these excerpts, black women have historically been denied the normal conveniences of womanhood because of (mis)perceived inferior racial status, and often have been treated like their male counterparts, yet prohibited themselves expressions of weakness or vulnerability for the sake of survival. This image of the strong black woman has persisted throughout generations and is described, even today, as an asset that allows AA women to manage their lives in race- and gender-conscious societies.<sup>36,37,40,48</sup>

According to the SWS framework, the coping styles adopted by AA women exist within a unique sociocultural and historical context and influence the ways in which they experience stress, including, but not limited to, race-related stress (i.e., racial discrimination and gendered racism). The framework is based on previously collected qualitative data among a socioeconomically diverse sample of AA women ages 19–72.<sup>40</sup> In response to questions about experiencing and coping with stress, participants commented on the need to be strong indicating that it was “just part of a woman’s life, and more specifically, an African American woman’s life.” Among AA women, being strong was described as (1) feeling an obligation to present an image of strength, even when one did not feel strong (SWS<sub>strength</sub>)<sup>b</sup>, (2) feeling an obligation to suppress emotions (SWS<sub>emosupp</sub>), (3) resistance to being vulnerable or dependent on others (SWS<sub>vuln</sub>), (4) determination to succeed despite limited resources (SWS<sub>succeed</sub>), and (5) obligation to help others (SWS<sub>help</sub>). Hence, the SWS is conceptualized as a double-edged sword for AA women, providing them with the fortitude and determination to withstand and support others in the context of race and gender specific stressors, while simultaneously placing them at greater risk for stress-related health outcomes. For example,

<sup>b</sup>SWS<sub>strength</sub> indicates a dimension of the larger SWS framework; other dimensions, denoted with specific subscripts, follow. Further discussion of the dimensions (and SWS subscales) is found in later parts of the paper.

<sup>a</sup>“Black” is used here instead of AA to situate the discussion in the origins of the black feminist movement.

some aspects of the SWS (e.g., resistance to being vulnerable or dependent on others, such as not asking for help) may lead to excessive or chronic use of internal resources resulting in the “wear and tear” of physiological mechanisms meant to be compensatory in acute stressful situations.<sup>84</sup> Whereas the SWS may be adaptive initially, it has been described as “an overused asset that develops uncritically without ongoing evaluation and attention to changing needs and demands [that] runs the risk of becoming a *liability*.”<sup>85</sup>

Although some research suggests that caregiving and volunteering positively impact overall health and longevity,<sup>86,87</sup> caregiving activities—particularly within a context of inadequate resources, perceived obligations to suppress emotion, and resistance to vulnerability—that require AA women to habitually and chronically delay their own self-care may have deleterious effects on health.<sup>40,88</sup> For example, prioritization of caregiving can result in excessive fatigue and inadequate time to engage in health promoting activities, such as exercise and preparing meals. Importantly, although these characteristics and perceived obligations may contribute to limited self-care, they are critical and central components of self-concept for many AA women, which may itself be protective.<sup>40</sup> However, aspects of the SWS may also lead to chronic psychological distress, which is associated with physiological processes, including the activation of the HPA axis, chronic inflammation, and abdominal obesity, which increases the risk for cardiometabolic diseases.<sup>1,2,40,89</sup>

Some studies suggest that AA women may be particularly vulnerable to the psychological and physiologic effects of racial discrimination due to their endorsement of the caretaker role. For example, AA women report significant psychological distress as a result of their own discrimination experiences as well as the discrimination experiences of others in their social network, especially their spouses and children.<sup>36,37,41,90–92</sup> Indeed, studies show that whereas men tend to be more “egoistic,” women report significantly higher levels of “network distress,” thereby increasing their overall stress burden.<sup>93–95</sup> Studies show that chronic stress reduces one’s capacity for coping with future stressors.<sup>42,60,96,97</sup> Thus, the heightened stress experienced by AA women owing to both self- and social network-induced factors has important implica-

tions for reducing the capacity for coping effectively and for long-term health and well-being of AA women. In their seminal study of social network stress, Kessler and McLeod (see Ref. 93) found that network events accounted for 75% of the difference in distress between men and women in the labor force, leading researchers to conclude that considering AA women’s roles as caretakers, nurturers, mothers, and “other mothers” (i.e., mothers to the extended AA community) is essential when contextualizing their stress experiences.<sup>94,95</sup>

Accordingly, AA women describe the SWS as a liability, in part, due to the postponement of self-care. In one study of AA women in the Southern United States, one woman stated, “I would work long hard hours because I wanted to make a good appearance but it didn’t make a difference, I was still a black person.”<sup>36</sup> In another study, AA women described the need to “work harder” to prove themselves because of their low social status. They also described the need to suppress their emotions when anticipating racial discrimination: “I know this person is going to say something that’s going to make me, my heart rate go up, or maybe have to hold back my tears while I’m talking to them.”<sup>37</sup> In other work, when AA women were asked about factors contributing to their adoption of the superwoman role, they identified several factors, including the historical legacy of racial and gender stereotyping, lessons from foremothers, past history of mistreatment or abuse, and spiritual values. One woman noted, “Our past makes us have to be a strong woman and it’s annoying as hell.” Another commented, “People always say, oh you look so calm ... and I’m thinking I’m just about to crumble in two seconds and I think a lot of people don’t know when black women are stressed because of the superwoman syndrome....”<sup>40</sup> These quotes illustrate the dissonance between the image AA women feel they must portray and what they feel they can truly bear. In a qualitative study examining gendered racism among AA women, one woman explained: “We feel an obligation not only to ourselves but our family and our community to keep it strong and to keep it together.”<sup>36</sup> These quotes represent samples from three different qualitative studies conducted with AA women in various regions of the United States suggesting that being a superwoman is not a singular phenomenon, but a schema shared by many.

### Summary and study hypotheses

Previous studies have demonstrated associations between discrimination and a range of individual biomarkers, most consistently cortisol and measures of inflammation. The majority of these studies have examined general discrimination without attention to the specific type of discrimination reported.<sup>6,9,11,98–100</sup> However, previous evidence indicates that the specific type of stressor matters in determining the biological response to stress (i.e., integrated specificity).<sup>30</sup> AAs attribute the majority of their discrimination experiences to race.<sup>101</sup> Moreover, AA women report racial discrimination as a particularly salient and chronic psychosocial stressor over their lifecourse, and as distinct from other forms of unfair treatment.<sup>36,37,40</sup> Previous research shows associations between racial discrimination and allostatic load among AA women.<sup>102</sup> Accordingly, researchers have called for measuring racial discrimination as a particular form of SET, and considering intersectionality in both measuring and assessing the health effects of racism.<sup>103</sup> Scholars also suggest a need to study simultaneous dysregulation across multiple systems rather than individual biomarkers to better understand how psychosocial factors contribute to stress-related illness.<sup>7</sup> Last, the transactional model of stress (TMS) suggests that coping is a central component of the stress response process.<sup>22,24</sup> However, limited attention has been given to the role of coping or schemas, which are central to coping processes, in studies examining racial discrimination as a social determinant of health.

The strong black woman role/SWS develops over time starting early in life.<sup>43,46,50,70,71</sup> Although psychological schemas are activated by situational cues, studies also suggest that (1) schemas can become stabilized over time and are activated not only as a result of situational cues but become enduring aspects of the “self” (i.e., dispositions) that are invariant across situations,<sup>44,45,47</sup> (2) racial discrimination is a chronic stressor among AA women,<sup>37,102,104,105</sup> (3) when salient and frequent, discrimination can make relevant schemas more accessible, resulting potentially in chronic accessibility or activation;<sup>43</sup> and (4) schemas influence threat appraisals,<sup>43,60</sup> which influence the biological stress response.<sup>22–24</sup> Given our sample of midlife AA women, many of whom report having experienced frequent racial discrimination over their life-

course, we hypothesize that one or more dimensions of the SWS can become relatively stable dispositions that moderate how racial discrimination affects allostatic load.

Hence, the purpose of our study here was to examine whether the SWS modifies the association between racial discrimination and allostatic load, and whether the effects differ by SWS dimension. We hypothesize that, as a multidimensional construct with potentially protective as well as harmful effects, the various SWS dimensions will have variable effects on the association between racial discrimination and allostatic load. Given that exhibiting strength has both health protective and health damaging properties,<sup>40</sup> we did not specify hypotheses about the direction of association for the SWS<sub>strength</sub> dimension. However, previous research indicates that anger is the most common response to racial discrimination<sup>106</sup> and has further shown the particularly damaging effects of anger on health, compared to the effects of other emotional responses (e.g., sadness).<sup>107</sup> Hence, within the context of racial discrimination, we hypothesize that emotion suppression will be health protective. Additionally, for the reasons noted above, we hypothesize that dimensions SWS<sub>vuln</sub> (e.g., not asking for help), SWS<sub>succeed</sub> (e.g., “working harder”), and SWS<sub>help</sub> (i.e., taking care of others) will have unfavorable health consequences in the context of increasing racial discrimination. Given the exploratory nature of our study, the aim was to explore, for the first time, (1) whether specific dimensions of the SWS uniquely modify the association between racial discrimination and allostatic load among midlife AA women, and if so (2) the nature of the relationships. Therefore, these are preliminary hypotheses only, meant to inform the interpretation of our findings and the generation of hypotheses to guide future work.

## Methods

### Study design and participants

Data are from the African American Women’s Heart & Health Study, an observational cross-sectional study designed to examine associations between socioenvironmental stressors and mental and physical health among a community sample of midlife AA women residing in the San Francisco Bay area ( $n = 208$ ). The study design has been

described in detail elsewhere.<sup>102</sup> Briefly, purposive sampling was used to recruit a socioeconomically and geographically diverse sample of AA women from specific Bay area counties: Alameda, Contra Costa, San Francisco, and Solano. Eligibility criteria were (1) self-identify as AA, (2) female gender since birth, (3) ages 30–50, (4) U.S.-born, (5) parent(s)/primary caregiver(s) U.S.-born AA, and (6) English literacy. Women who were pregnant or lactating or who self-reported a physician-diagnosed inflammatory or autoimmune disease were excluded to minimize confounding. Recruitment took place from March 2012 through March 2013.

Participation consisted of two study visits. Visit 1 included an interviewer-administered questionnaire—health history, housing and other sociodemographics, and general health status—and a computer-assisted self-interview (CASI). The CASI was used to enhance confidentiality and minimize potential response bias (i.e., acquiescence and social desirability bias). Visit 2 included a physical examination and fasting venous blood draw. Participants were compensated with a \$70 gift card, study t-shirt, heart-healthy cookbook, and packet of health promoting materials. Informed consent was obtained from all study participants. The study was approved by the Office for the Protection of Human Subjects at the University of California, Berkeley.

### Measures

**Allostatic load.** Allostatic load was calculated as a composite of 15 biomarkers—primary mediators and secondary outcomes associated with stress-related pathophysiologic processes—reflecting activity of the HPA axis, SAM axis, and inflammatory, cardiovascular, and metabolic systems.<sup>2,5</sup> Primary mediators include cortisol, epinephrine and norepinephrine, interleukin 6 (IL-6), and C-reactive protein. Cortisol reflects HPA-axis activity, and epinephrine and norepinephrine represent activity of the SAM-axis, which together comprise the body's primary stress response system (“fight or flight”). IL-6 is a proinflammatory cytokine commonly elevated as a result of HPA and SAM activity. C-reactive protein (hsCRP) is an acute phase reactant released from the liver and found in plasma in response to inflammation. The remaining 10 biomarkers represent secondary outcomes resulting from the cumulative effect of primary

mediators and primary outcomes (i.e., cellular events), including systolic and diastolic blood pressure (SBP and DBP, respectively) reflecting cardiovascular activity; and waist circumference; body mass index (BMI); glucose; glycosylated hemoglobin (HbA1c; average glucose elevation over previous 2–3 months); high- and low-density lipoprotein (HDL and LDL, respectively); triglycerides; and total cholesterol—all indicative of metabolic function.

Resting SBP and DBP were measured from the sitting position after a 5-min rest period using an automated oscillometric blood pressure monitor. We took four consecutive measures in 1-min intervals. The first measure was discarded and the average of the last three measures was recorded.<sup>108</sup> Waist circumference was measured just above the top of the iliac crest, according to standard protocol.<sup>109</sup> BMI was assessed via bioelectrical impedance using a handheld body fat analyzer. All other biomarkers were assayed from fasting venous blood specimens stored at  $-80^{\circ}\text{C}$  by one of two CLIA certified laboratories.

Table 1 displays the cutpoint for each biomarker. We used a combination of clinically based cutpoints and cutpoints based on the distribution of the study sample to ascertain level of risk.<sup>110</sup> Consistent with the concept of allostatic load, established cutpoints for subclinical risk were used where available (e.g., prehypertension: 120 for SBP and 80 for DBP; prediabetes: HbA1c = 5.7 and glucose = 100). Otherwise, risk was defined as being above the 75th-percentile for the selected biomarker as has been done in prior research.<sup>4,5,111</sup> Each biomarker was dichotomized at the specified cutpoint (0 = not at risk, 1 = at risk) and then summed. Scores range from 0 to 15, where higher scores reflect higher levels of allostatic load.

**Racial discrimination.** We used a modified version of the Experiences of Discrimination Scale.<sup>112</sup> Eight items assessed how often respondents “have ever been treated unfairly, judged differently than others, prevented from doing something, or hassled or made to feel inferior because of their race, ethnicity, or skin color” in any of eight different situations (i.e., at school, getting hired or getting a job, at work, getting housing, getting medical care, getting credit, on the street or in a public setting, from police or in the courts;  $\alpha = 0.92$ ). Responses were

**Table 1. Allostatic load biomarker cutpoints**

Biomarker	Guideline used	Cutpoints	% above cutpoint
<b>Metabolic system</b>			
HDL (mg/dL)	ATPIII	<50	41.06
LDL (mg/dL)	ATPIII	≥100	52.17
Waist circumference (in)	ATPIII	>35	72.46
Glucose (mg/dL)	ATPIII	≥100	17.39
HbA1c (mmol/mol)	ADA	≥5.7	19.32
Total cholesterol (mg/dL)	ATPIII	≥160	66.18
Triglycerides (mg/dL)	ATPIII	≥150	7.25
BMI (kg/m <sup>2</sup> )	ATPIII	≥25	85.51
<b>Cardiovascular system</b>			
Systolic BP (mm Hg)	AHA	≥120	47.34
Diastolic BP (mm Hg)	AHA	≥80	47.83
<b>Neuroendocrine system</b>			
Cortisol (μg/dL) <sup>a</sup>	n/a	>12.69	25.12
Epinephrine (pg/mL) <sup>a</sup>	n/a	>77.70	24.15
Norepinephrine (pg/mL) <sup>a</sup>	n/a	>686.30	25.12
<b>Inflammatory system</b>			
IL-6 (pg/mL) <sup>a</sup>	n/a	>7.85	29.47
hsCRP (mg/L)	AHA	>3	49.28

<sup>a</sup>75th percentile cutpoints used for biomarkers that do not have established clinical guidelines.

Biomarker abbreviations: HDL, high-density lipoprotein; LDL, low-density lipoprotein; HbA1c, hemoglobin A1c (glycated hemoglobin); BMI, body mass index; systolic BP, systolic blood pressure; diastolic BP, diastolic blood pressure; IL-6, interleukin 6; hsCRP, high-sensitivity C-reactive protein.

SI conversion factors: to convert HDL to mmol/L, multiply values by 0.0259; LDL to mmol/L, multiply values by 0.0259; glucose to mmol/L, multiply values by 0.0555; total cholesterol to mmol/L, multiply values by 0.0259; triglycerides to mmol/L, multiply by 0.0113; cortisol to nmol/L, multiply by 27.588; epinephrine to pmol/L, multiply by 5.459; norepinephrine to pmol/L, multiply by 5.911; IL-6 mmol/L, multiply by 2.539 e<sup>13</sup>; hsCRP to nmol/L, multiply by 9.524.

coded on a 5-point Likert scale ranging from 1 = “Never” to 5 = “6 or more times.” Summary scores were averaged generating a final score ranging from 1 to 5.

**The superwoman schema.** The SWS is a 35-item scale comprising five subscales, each representing a different dimension of the SWS: (1) obligation to present an image of strength (6 items, e.g., “I try to present an image of strength,”  $\alpha = 0.76$ ); (2) obligation to suppress emotions (7 items, e.g., “My tears are a sign of weakness,”  $\alpha = 0.87$ ); (3) resistance to being vulnerable (7 items, e.g., “Asking for help is difficult for me,”  $\alpha = 0.84$ ); (4) intense motivation to succeed (6 items, e.g., “No matter how hard I work, I feel like I should do more,”  $\alpha = 0.77$ ); and (5) obligation to help others (9 items, e.g., “I put everyone else’s needs before mine,”  $\alpha = 0.89$ ).<sup>113,114</sup> Relevant items were reverse coded for consistent valence. Responses for each subscale were coded on a 4-point Likert scale ranging from 0 = “This is not true for me” to 3 = “This is true for me all the time,”

summed across items, and averaged to generate a final score.

**Covariates.** Potential confounders were theoretically informed and based on prior literature: age in years, educational attainment ( $\leq$  versus  $>$  high school diploma), poverty status categorized as  $\leq$  or  $>$  100% of the federal poverty threshold (FPT), employment status (employed versus not employed), marital status (married/domestic partner versus not married/no domestic partner), health insurance (insured versus uninsured), and the neuroticism subscale of the Big Five Personality Inventory. We also adjusted for medication use (yes/no) to ensure accurate risk assessment. Health behaviors, such as smoking, alcohol use, diet and physical activity, were conceptualized as mediators and therefore excluded from the moderation analysis to avoid overcontrolling as we were interested in assessing total (direct) effects. All dichotomous variables were coded 0 for the not-at-risk group and 1 for at-risk.

**Table 2. Zero-order correlations of SWS subscales, discrimination, allostatic load, and covariates**

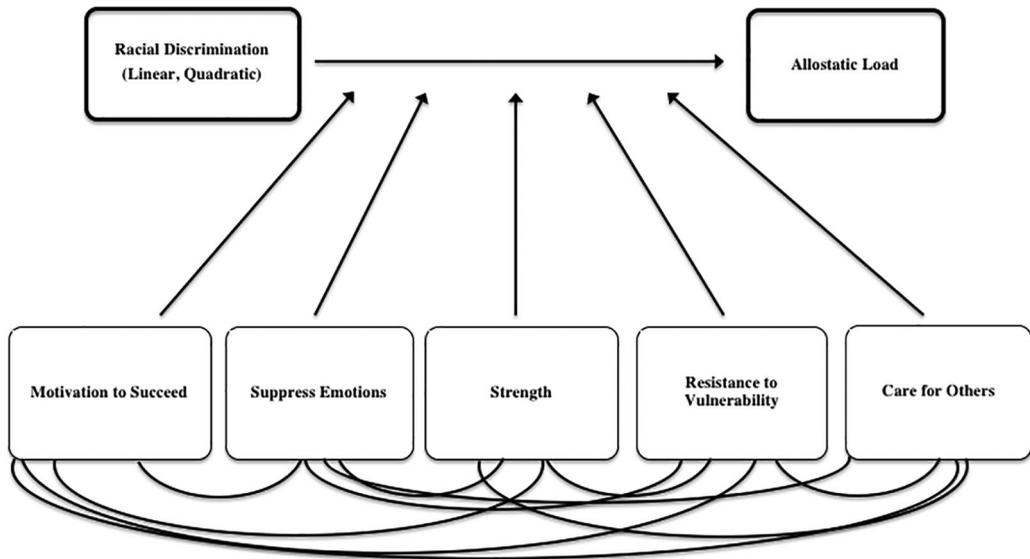
	1	2	3	4	5	6	7	8	9	10	
1. Strength											
2. Emotion	.19**										
3. Vuln	.26***	.57***									
4. Succeed	.47***	.43***	.60***								
5. Help	.32***	.45***	.59***	.59***							
6. EOD	.15*	.03	.17*	.18**	.27***						
7. AL	.01	.01	-.05	-.03	.01	-.06					
8. Med_CV	.04	-.01	-.03	.00	.02	.04	.24**				
9. Med_DB	.00	.03	.08	.03	.06	-.02	.23***	.13			
10. Education	-.03	.17*	-.05	-.04	.07	-.12	.22**	-.01	-.04		
11. Poverty	-.11	-.17*	-.19**	-.15*	-.08	.08	.06	.00	-.01	.05	
12. Age	.05	-.13	-.10	-.03	-.09	.13	.2***	.23***	.09	.05	
13. Smoking	-.01	.10	.01	-.05	.11	.12	.09	.04	.04	.30***	
14. Alc use	-.03	.05	-.01	-.02	.04	.01	.08	.16*	.10	.09	
15. Exercise	-.07	.10	.08	.06	.01	-.03	-.01	.01	-.03	.01	
16. Coping	.07	.06	.21**	.06	.24***	.29***	.13	.09	.00	-.05	
17. Fruit	.08	.11	.09	.03	.18**	.04	.02	-.08	-.03	.14*	
18. Employ	.13	.06	.04	-.01	-.07	-.09	-.01	-.02	-.11	-.27***	
19. Marital status	-.02	-.10	-.08	-.10	.05	.00	.00	.14	-.02	.08	
20. Health ins	-.01	-.05	-.02	-.07	.00	.06	-.02	.09	.01	-.18*	
21. Neuroticism	.07	.12	.30***	.19**	.36***	.21**	-.02	.14*	.08	.08	
Mean	2.31	1.33	1.56	1.88	1.61	2.41	6.02	.43	.18	.64	
Variance	.38	.55	.56	.47	.64	1.27	4.46	.25	.15	.23	
SD	.61	.74	.75	.69	.80	1.13	2.11	.49	.39	.48	
	11	12	13	14	15	16	17	18	19	20	21
1. Strength											
2. Emotion											
3. Vuln											
4. Succeed											
5. Help											
6. EOD											
7. AL											
8. Med_CV											
9. Med_DB											
10. Education											
11. Poverty											
12. Age	-.05										
13. Smoking	.16*	-.05									
14. Alc use	.03	-.10	.09								
15. Exercise	-.26***	.00	-.21**	-.06							
16. Coping	.16*	.08	.27***	.12	-.03						
17. Fruit	-.07	-.03	.18**	.02	-.22**	.02					
18. Employ	-.09	-.05	-.35***	-.05	.14*	-.10	-.19**				
19. Marital status	-.04	.05	.23**	-.01	-.09	.03	-.01	-.14*			
20. Health ins	-.16*	-.05	-.07	-.08	.12	-.04	-.01	.05	.13		
21. Neuroticism	.09	-.10	.16*	.09	-.02	.35***	.06	-.13	-.08	.05	
Mean	2.57	.21	.06	.33	.19	.00	.30	.55	.30	.73	3.07
Variance	1.22	.17	.06	.22	.15	34.62	.21	.25	.21	.20	.57
SD	1.10	.41	.23	.47	.39	5.88	.46	.50	.46	.44	.76

AL, allostatic load; Vuln, vulnerability; EOD, racial discrimination; Med\_CV, medication for cardiovascular diseases; Med\_DB, medication for diabetes; Alc use, alcohol use; Employ, employment; Health ins, health insurance; SD, standard deviation. \**P* < .05. \*\**P* < .01. \*\*\**P* < .001.

**Analytic strategy**

Multiple imputation was used to account for missing data. The majority of the study sample (86%) had less than 5% missing data. One observation, with 32% missing data, was excluded because it had missing data on both the right- and left-hand side of the imputation model, and therefore had missing data postimputation (*n* = 207). Relative efficiency ranged from 98% to 100%, and relative variance increase and percent increase in standard error were both within 5%.

Univariate and bivariate analyses were conducted to assess variable distributions, crude associations between study variables, test for confounders, assess collinearity among study variables, and ensure enough unique variance among SWS subscales to estimate independent effects. Correlations between SWS subscales were in the low to moderate range (Table 2). Next, we conducted path analysis within a structural equation modeling framework to test for interactions according to the specification in Figure 1. We tested interactions between racial



**Figure 1.** Path analysis model.

discrimination and each SWS subscale concurrently, while accounting for the covariance among subscales. We first tested a linear interaction model, estimating the main effects of racial discrimination and the five SWS subscales, centered and their means, as well as the interaction between racial discrimination and each of the five SWS subscales on allostatic load. Next, given prior evidence of a nonlinear association between racial discrimination and allostatic load, we tested a quadratic interaction model by introducing a quadratic term for racial discrimination and testing the interaction effects between the quadratic racial discrimination term and each of the SWS subscales. For all significant interaction effects, we conducted simple slope analyses to examine the extent to which racial discrimination was associated with allostatic load when a given SWS subscale was high (i.e., one standard deviation above the mean) versus low (i.e., one standard deviation below the mean).<sup>115</sup>

Models were adjusted for age, educational attainment, poverty status, and medication use regardless of significance to account for known or theoretical confounders and ensure accurate risk assessment. Remaining covariates were included in final models if  $P < 0.10$ . Employment, poverty status, marital status, health insurance, and neuroticism were not significantly associated with allostatic load in bivariate analysis ( $P$  ranged from 0.29 to 0.95) and were not statistically significant

in multivariable models. Additionally, results were unchanged after including these variables. For parsimony, we excluded them in the final models.

As a secondary aim, we assessed whether smoking, alcohol use, diet, and physical activity mediated the effects of SWS dimensions on the association between racial discrimination and allostatic load to better understand the potential mechanisms driving associations with health.<sup>116</sup>

Additionally, to test an alternative hypothesis also supported by the literature, we assessed whether the SWS may operate as a mediator rather than a moderator of the association between racial discrimination and allostatic load.

Finally, we conducted a sensitivity analysis related to risk classification for allostatic load, where participants were coded as at-risk for values considered clinically low or high, given the health risk associated with low values for select biomarkers: BMI ( $<18.5/>25$ ), glucose ( $<70/>100$ ), SBP ( $<90/>120$ ), and DBP ( $<60/>80$ ); there were no appreciable differences in the study findings (data available upon request). Hence, consistent with previous work,<sup>4,84</sup> in what follows we present findings for allostatic load coded based on high values only.

The recommended sample size for path analysis is  $>200$ . Hence, all models had adequate power to detect differences.<sup>117</sup> Two observations for SWS<sub>strength</sub> were removed because they were outside of the 3 SD range with Z values of  $-3.76$  and  $-3.22$ ;

**Table 3. Sample characteristics (n = 207)**

Covariates	n	%
Age (mean, SD)	41.72	5.90
Educational attainment		
>High school diploma	138	66.67
≤High school diploma	69	33.33
Poverty status		
>100% FPL	168	81.16
≤100% FPL	39	18.84
Employment status		
Employed	114	55.07
Not employed	93	44.93
Health insurance		
Insured	152	73.43
Not insured	55	26.57
Marital/domestic partnership status		
Married/domestic partnership	61	29.47
Not married	146	70.53
Taking cardiovascular medication		
No	164	79.23
Yes	43	20.77
Taking diabetes medication		
No	195	94.20
Yes	12	5.80
Neuroticism (mean, SD)	3.08	0.75
<b>Racial discrimination</b>	Mean	SD
	2.41	1.13
<b>Superwoman schema</b>	Mean	SD
Strength	2.31	0.61
Suppress emotions	1.33	0.75
Resistance to vulnerability	1.56	0.75
Motivation to succeed	1.88	0.69
Help others	1.61	0.80
<b>Allostatic load</b>		
Allostatic load (mean, SD)	6.02	2.11

and one for allostatic load with a Z value of 3.28 was also removed. Multiple imputation was conducted using Stata®/SE v14 (College Station, TX). All other analyses were conducted using Mplus 8. In Mplus, the nonnormality in the data is handled by the maximum likelihood parameter estimates with standard errors (MLR) and is robust to outliers.<sup>118</sup> Significance was assessed at  $P < 0.05$ .

**Results**

*Sample description*

Sample characteristics are shown in Table 3. Mean age was 42 years. Approximately two-thirds of the study sample had more than a high school edu-

cation, over half were employed, 73% had health insurance, and 81% were above the FPT. The sample was generally healthy with a mean level of allostatic load in the low to moderate range (6.10 + 2.23). Mean level of racial discrimination was also in the moderate range (2.41 + 1.13). Racial discrimination experienced “on the street or in a public setting” was the most common form of discrimination reported followed by “from the police or in the courts” and “at work,” “getting hired or getting a job,” and “at school”: 73%, 67%, 67%, 65%, and 61%, respectively (Fig. S1, online only). The majority of women reported moderate to high levels of SWS across the five subscales (mean ranged from 1.33 to 2.31).

*Exploratory associations between study variables*

Table 2 shows zero-order correlations between the study variables. Correlations between SWS measures are in the low to moderate range ( $r = 0.18-0.60$ ).<sup>119</sup> Being in poverty showed a significant but weak negative correlation with SWS (SWS<sub>emosupp</sub>, SWS<sub>vuln</sub>, and SWS<sub>succeed</sub>). There was also a weak but significant correlation between lower educational attainment and both higher SWS<sub>emosupp</sub> and higher allostatic load. Higher levels of SWS<sub>vuln</sub> and SWS<sub>help</sub> were correlated with using food or substances to cope with stress ( $r = 0.21$  and  $0.24$ , respectively), as was racial discrimination ( $r = 0.29$ ). With the exception of SWS<sub>emosupp</sub>, racial discrimination showed a weak but significant positive correlation with SWS dimensions. In these bivariate correlations, neither racial discrimination nor any of the SWS measures was significantly correlated with allostatic load.

*Linear assessment of racial discrimination × SWS*

Table 4 displays results of the two path models, one based on the linear assessment of racial discrimination and the other based on the quadratic assessment of racial discrimination, with all SWS subscales estimated concurrently. For the linear assessment of racial discrimination, there was a significant interaction between discrimination and SWS<sub>emosupp</sub>. Higher levels of racial discrimination were associated with lower allostatic load among those reporting higher (versus lower) levels of SWS<sub>emosupp</sub> ( $B = -0.41$ ,  $SE = 0.17$ ,  $P = 0.02$ ,  $\beta = -0.17$ ).

**Table 4.** Interaction effects between racial discrimination and SWS subscales on allostatic load

	Linear model ( $R^2 = 0.219$ )				Quadratic model ( $R^2 = 0.295$ )			
	<i>B</i>	SE	<i>P</i>	$\beta$	<i>B</i>	SE	<i>P</i>	$\beta$
Discrimination	-0.20	0.12	0.09	-0.11	0.05	0.15	0.73	0.03
Discrimination (Q)					-0.28	0.10	0.00	-0.21
SWS								
Strength	0.11	0.26	0.67	0.03	-0.32	0.34	0.34	-0.09
Emotion	0.04	0.22	0.87	0.01	-0.42	.32	.18	-0.15
Vulnerability	-0.15	0.24	0.54	-0.05	-0.08	0.34	0.81	-0.03
Succeed	-0.03	0.29	0.92	-0.01	0.60	0.33	0.07	0.19
Help	0.12	0.20	0.55	0.05	0.39	0.25	0.11	0.15
Interaction								
Discrimination $\times$ strength	0.00	0.25	0.99	0.00	0.00	0.28	1.00	0.00
Discrimination $\times$ emotion	-0.41	0.17	0.02*	-0.17	-0.87	0.27	0.00	-0.35
Discrimination $\times$ vulnerability	0.07	0.20	0.74	0.03	0.17	0.29	0.56	0.07
Discrimination $\times$ succeed	0.10	0.25	0.70	0.04	0.34	0.32	0.28	0.13
Discrimination $\times$ help	-0.03	0.17	0.85	-0.01	0.23	0.21	0.28	0.10
Interaction (Q)								
Discrimination (Q) $\times$ strength					0.56	0.22	0.01*	0.29
Discrimination (Q) $\times$ emotion					0.32	0.15	0.03*	0.24
Discrimination (Q) $\times$ vulnerability					-0.17	0.16	0.28	-0.13
Discrimination (Q) $\times$ succeed					-0.45	0.17	0.01**	-0.30
Discrimination (Q) $\times$ help					-0.28	0.12	0.02*	-0.23

Q, quadratic term.

NOTE: All models adjusted for age, educational attainment, poverty status, and medication use.

\* $P < 0.05$ ; \*\* $P < 0.01$ .

### Quadratic assessment of racial discrimination $\times$ SWS subscales

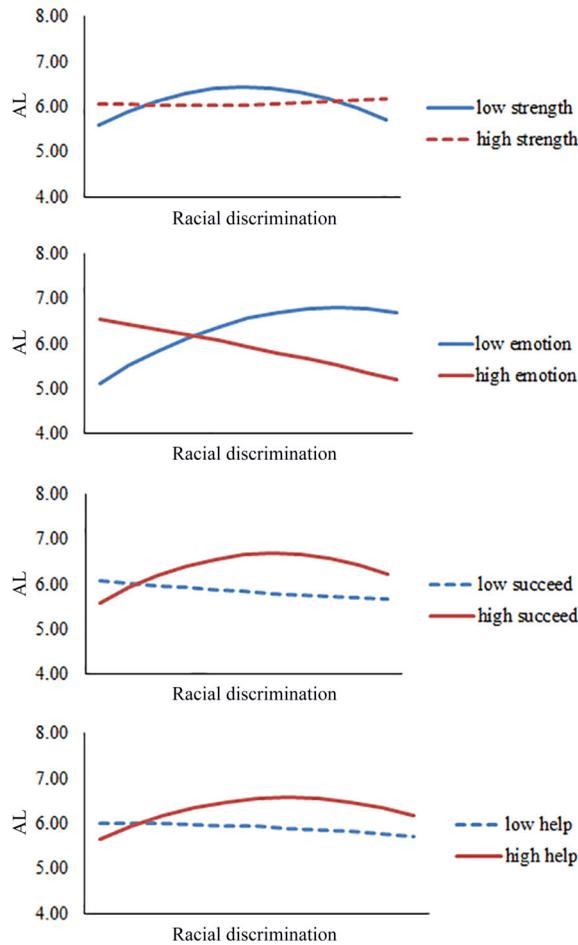
Model fit improved in the quadratic model from  $R^2 = 0.219$  to  $R^2 = 0.295$ . In the quadratic model, significant interactions were observed between racial discrimination (Q) and for four of the five SWS subscales (Table 4: strength, emotion suppression, intense motivation to succeed, and obligation to help others). The nature of those interactions is described below and displayed in Figure 2 and Table S1 (online only).

**Strength.** Simple slope analysis shows that among those reporting high  $SWS_{\text{strength}}$  (mean + 1 SD = 0.61), allostatic load did not vary significantly with increasing racial discrimination. Among those reporting low  $SWS_{\text{strength}}$  (mean - 1 SD = -0.61), a negative curvilinear relationship was observed ( $B = -0.62$ , SE = 0.19,  $P = 0.00$ ,  $\beta = -0.47$ ). When plotted, the highest allostatic load was observed among those reporting moderate levels of racial discrimination and the lowest allostatic load among those

reporting either very low or very high levels of racial discrimination.<sup>c</sup>

**Emotion suppression.** Among those reporting high emotion suppression, we did not observe a significant quadratic effect of discrimination, but rather a significant linear effect ( $B = -0.60$ , SE = 0.26,  $P = 0.02$ ,  $\beta = -0.32$ ). When plotted, there was an inverse linear relationship such that higher levels of discrimination were associated with lower allo-

<sup>c</sup>The derivative of the equation (i.e., rate of change in allostatic load per 1 SD increase in racial discrimination) may be written as:  $d(\text{allostatic load})/d(\text{discrimination}) = \alpha + \beta_{\text{linear}} + \beta_{\text{quadratic}}(\text{discrimination})$  (e.g., allostatic load =  $0.03 - 0.47(\text{discrimination}) + \text{covariates}$ ). Because discrimination is centered, values below the average are negative resulting in a positive slope; and values above the average are positive resulting in a negative slope. We use standardized betas to show effect sizes. We did not identify the exact vertex given the exploratory nature of the sample.



**Figure 2.** Interaction effects between racial discrimination and SWS subscales on allostatic load. Low and high SWS dimension corresponds to 1 SD below and above the mean, respectively. Solid lines indicate significant slopes; dashed lines indicate nonsignificant slopes.

static load. A significant quadratic effect of racial discrimination on allostatic load was observed among those reporting low emotion suppression ( $B = -0.49$ ,  $SE = 0.14$ ,  $P = 0.001$ ,  $\beta = -0.37$ ). When plotted, higher levels of discrimination were associated with higher AL; however, there appears to be a threshold beyond which further increases in discrimination are not met with additional increases in allostatic load but rather show a slight decrease.

**Intense motivation to succeed.** A negative curvilinear relationship between discrimination and allostatic load was also observed among those reporting high  $SWS_{succeed}$  ( $B = -0.58$ ,  $SE = 0.16$ ,  $P < 0.001$ ,  $\beta = -0.45$ ), indicating that, among this

group, allostatic load was the highest at moderate to high levels of racial discrimination. Specifically, there was a positive association between racial discrimination and allostatic load among those reporting high levels of  $SWS_{succeed}$ . However, as racial discrimination increased, a reversal of that association was observed. Allostatic load did not vary with increasing levels of racial discrimination among those reporting low  $SWS_{succeed}$ .

**Obligation to help others.** We found a negative curvilinear relationship between racial discrimination and allostatic load among those reporting high  $SWS_{help}$  ( $B = -0.50$ ,  $SE = 0.15$ ,  $P = 0.001$ ,  $\beta = -0.38$ ), indicating that allostatic load was the

highest at moderate to high levels of racial discrimination.

**Mediation analysis.** As in previous work, we found significant associations between racial discrimination, SWS dimensions, and a variety of health behaviors: physical activity, diet, using food to cope with stress, smoking, and alcohol use. The findings vary by SWS subscale with the most consistent findings for SWS<sub>emosupp</sub> and SWS<sub>help</sub> (data available upon request): the interaction between racial discrimination and SWS<sub>emosupp</sub> was associated with smoking, alcohol use, and physical activity; the interaction between racial discrimination and SWS<sub>help</sub> was significantly associated with using food or substances to cope with stress, and showed a marginal association with smoking and physical activity. However, none of these behaviors showed statistically significant associations with allostatic load and the test of mediation failed ( $\beta$  range:  $-0.03$  to  $0.05$ ;  $P$ -values range:  $0.15$ – $0.95$ ).

Finally, as an alternative hypothesis, we assessed whether SWS may mediate rather than moderate the racial discrimination–allostatic load relationship. Although racial discrimination significantly predicted each SWS dimension, none of the SWS dimensions were associated with allostatic load, and the test of mediation was found not to be significant ( $\beta$  range:  $-0.02$  to  $0.01$ ;  $P$ -values range:  $0.58$ – $0.87$ ) (data available upon request).

**Summary of findings.** We found significant interactions for four of the five SWS subscales. Overall, SWS<sub>strength</sub> and SWS<sub>emosupp</sub> were protective, while SWS<sub>succeed</sub> and SWS<sub>help</sub> exacerbated the negative effects of racial discrimination on allostatic load. The strongest effects were observed for SWS<sub>succeed</sub>.

## Discussion

### *Summary of study findings*

We investigated whether SWS dimensions modify the association between racial discrimination and allostatic load among a community sample of midlife AA women. Our findings indicate that among AA women (1) the relationship between racial discrimination and allostatic load is nonlinear, (2) SWS dimensions modify the relationship between racial discrimination and allostatic load, and (3) the effects of SWS dimensions vary, with some dimensions acting as a safeguard and others

exacerbating the harmful effects of racial discrimination on allostatic load. These findings add to a growing body of literature elucidating the mechanisms by which racial discrimination becomes biologically embedded.

### *Interpretation of study findings*

Our study findings offer several insights that may help elucidate the mechanisms by which racial discrimination gets “under the skin.”<sup>120</sup> First, our findings provide support for the transactional nature of the stress process. Examination of stress exposure alone (i.e., racial discrimination)—captured in our independent effects—while neglecting to capture other key elements of the stress response process (i.e., coping) will likely result in biased effect estimates. As described above, the TMS defines stress as a process involving exposure to an environmental demand, appraisal of the degree to which that demand is threatening, appraisal of one’s actual and perceived capacity to cope with or manage that demand, and the physiologic response corresponding to that appraisal.<sup>24</sup> Though our findings suggest more complex relationships between stressor exposure and coping than proposed in this classic stress framework, they affirm the need to consider individual variability in coping and potentially other psychosocial processes involved in the stress response process (e.g., threat appraisal). Second, our findings suggest that studies of racial discrimination, particularly those using the EOD scale, should consider nonlinear effects to more fully capture the range of associations with health across the exposure distribution. Previous studies have similarly found nonlinear associations between the EOD scale and physical health outcomes.<sup>6,9,104,121</sup>

Third, as hypothesized, the effects of the SWS were not uniform. Feeling an obligation to present an image of strength and an obligation to suppress emotions were generally protective. The association between racial discrimination and allostatic load was null among those in the high strength group. On the contrary, higher levels of racial discrimination was associated with higher allostatic load in the low strength group. These findings suggest that presenting an image of strength buffers the harmful effects of racial discrimination on health. However, the reversal observed at the higher end of the exposure distribution suggests other factors that may be salutogenic. This pattern may also reflect

a system no longer able to mount an appropriate stress response.<sup>1,2</sup> According to the SWS framework, SWS<sub>strength</sub> is described as feeling an obligation to present an *image* of strength even when one does not feel strong.<sup>40</sup> In addition to being strong, the concept of strength in discourse about the strong black woman in AA culture is about presenting a façade of strength, focusing on outward behavior despite one's actual emotional and physical condition.<sup>37,40,71,122</sup> In their paper, "...Grace of a Lady and the Grit of a Warrior," Abrams *et al.* discuss the ubiquitous nature of the strong black woman schema in AA culture and how AA girls are socialized by their mothers and other caretakers to adopt this schema early in life.<sup>50</sup> Others have similarly described the early adoption of this gendered racial identity.<sup>64,70,71,76</sup> Strength has been described as a core value characterized by "obligatory and volitional independence," "learned and compulsory resilience," "matriarchal leadership," and "maintaining a sense of control, confidence, pride, and self-sufficiency."<sup>50</sup> As a "collective feature of African American womanhood,"<sup>65</sup> living up to these ideals is often described as a source of pride that bolsters psychological resilience increasing one's sense of self-control, belonging, meaning and purpose, and ultimately their ability to withstand external threats.<sup>54,72</sup> Further research is needed to better understand the mechanisms driving this curvilinear relationship.

Similar curvilinear associations were found among those reporting low emotion suppression. However, this was coupled with a very strong inverse linear association among those reporting high levels of emotion suppression. These findings contradict prior literature showing the deleterious health effects of emotion suppression. However, research suggests that coping strategies may have differing effects depending upon the specific context in which they are deployed (i.e., context-dependent coping).<sup>27</sup> Racial discrimination refers to unfair treatment due to immutable characteristics (e.g., skin color) of one's social identity.<sup>37</sup> In previous work, AA women refer to the experience of racial discrimination as chronic and beyond their control: as just "another part of your life."<sup>37</sup> Within this context of high demand (i.e., requirement of constant adaptation in the context of repeated exposure to psychosocial stress) and low perceived control, previous studies have

shown associations with higher levels of psychophysiological stress indicators,<sup>123</sup> namely cortisol and markers of immune function. Evidence also shows significant associations of high emotional demand (i.e., stressors that are emotionally demanding) with both psychological symptoms and emotional exhaustion or "burnout."<sup>123</sup>

Additionally, numerous studies have identified anger as *among* the most common emotional responses to rejection or "threatened belonging" along with hurt, sadness, loneliness, and general feelings of upset or distress.<sup>106</sup> However, within the context of *unjust* rejection or devaluation based on group membership such as in the case of racial discrimination, anger is the most common and is often coupled with antisocial or avoidance behavior, such as expressive suppression (i.e., inhibition of emotion-expressive behavior) as a form of emotion regulation; particularly when the rejection is chronic.<sup>106</sup> Emotion suppression has generally been associated with poor health outcomes.<sup>107,124</sup> Indeed, AA women report "pent up" anger due to emotion suppression, due in part to their efforts to avoid being labeled as the "angry black woman," and describe this form of emotion suppression as distressing.<sup>65</sup> However, studies also report *anger* as a particularly damaging emotion, which has been associated with numerous poor outcomes.<sup>107,125,126</sup> Hence, within the context of anger, emotion suppression may be protective.

In a meta-analysis of 83 studies and 295 effect sizes, Jorgensen *et al.* found that low level of anger expression was more strongly associated with higher blood pressure in Blacks versus Whites; and one study found that low discrimination-related anger expression was associated with high DBP among black women.<sup>127</sup> However, the results of the meta-analysis suggest these findings may be moderated by age. Study results showed an inverse association between anger expression and blood pressure among younger groups, but a positive association among older samples, such that anger-in was protective among older samples, which consistent with our sample were primarily middle-age adults. Moreover, the authors note that findings across the 83 studies varied greatly and may be related to methodological issues, including, but not limited to, exposure assessment strategies. Last, curvilinear associations were not examined but, consistent with our study findings, may help explain

the mixed findings. Studies have previously shown that AA women report anger as their primary emotional response to racial discrimination; and that holding “anger in” is associated with positive blood pressure responses, whereas “anger out” is associated with maladaptive responses, such as higher resting blood pressure, incident hypertension, and greater SBP and heart rate reactivity.<sup>126</sup>

Additionally, although active coping (i.e., trying to change something about the encounter) is generally seen as more health protective than passive coping (i.e., managing/minimizing the distress associated with the experience such as with emotion suppression), studies suggest that *chronic* deployment of active coping strategies may be health damaging, especially when the stressor is perceived as particularly stressful and/or uncontrollable.<sup>128–130</sup> AA women have reported racial discrimination as a particularly salient form of psychosocial stress and note that “racism is going to be there, no matter what you do it’s going to be there.”<sup>37</sup> Hence, in such cases, where racial discrimination is perceived as chronic and uncontrollable, the benefits of active coping may be weakened.<sup>128</sup> Thus, studies suggest that perception of chronic racial discrimination coupled with chronic expressions of anger may be associated with repeated and prolonged sympathetic activation.<sup>129</sup> Indeed, one recent study found that anger mediated the association between racial discrimination and allostatic load.<sup>131</sup> Hence, suppressing anger may be health protective, particularly within the context of frequent or chronic experiences of racial discrimination. Thus, emotion suppression may buffer against the harmful effects of emotional engagement in the context of racial discrimination, which may help explain the inverse association observed among the high emotion suppression group.

On the contrary, having an intense motivation to succeed and feeling an obligation to help others exacerbated the health risk associated with racial discrimination. AA women commonly report the need to “work harder” to prove themselves, which has been attributed to being both a woman and AA (i.e., gendered racism).<sup>37,132</sup> One of the contextual factors AA women describe as contributing to their motivation to succeed is the historical legacy of racial and gender stereotyping and oppression.<sup>40</sup> Women described having to “work harder than others” in order to overcome racial bias (i.e., stereotype

threat).<sup>133</sup> Prior evidence has shown the deleterious health effects of sustained effortful coping.<sup>134</sup> Our findings suggest this may be particularly harmful in the context of high levels of psychosocial stress. Additionally, postponement of self-care has been described as a liability associated with being more nurturant versus “fixed” or egoistic.<sup>95,135</sup> Indeed, previous studies have shown that adopting a more nurturant stance is associated with fatigue and both mental and physical morbidity.

We hypothesized that the association between racial discrimination and allostatic load would be greater among women reporting high (versus low) levels of dimension SWS<sub>help</sub>. Our findings for dimension SWS<sub>help</sub> are considered in light of the literature on *network stress*, where tending to the stress experiences of others in addition to one’s own stress has been associated with poor health.<sup>93</sup> Additionally, in previous qualitative work with AA women, the obligation they feel to care for others is described within the context of neglecting their own self-care.<sup>40</sup> One study found that the frequency of network stress events was associated with emotional distress among AA women, whereas perception of the stressfulness of either self- or network-stress events was not.<sup>95</sup> These findings may point to an overall lack of attentiveness to one’s own well-being, which some studies suggest is characteristic of the strong black woman. The dimension SWS<sub>vuln</sub> was not a significant effect modifier in the present analysis. Further research is needed in larger and more representative samples spanning a wider age range.

As in the previous work, we found significant associations between racial discrimination, various SWS dimensions, and a variety of health behaviors.<sup>116</sup> The most consistent findings were for emotion suppression and feeling an obligation to help others. However, there was no evidence of mediation given that none of these behaviors were significant predictors of AL. Future research examining the SWS framework should test the mediating role of health behaviors in relation to a broader set of physical health outcomes. As a measure of cumulative physiologic dysregulation, allostatic load may not be sensitive to specific health behaviors. More targeted outcomes, such as hypertension or diabetes, or specific biomarkers, such as blood pressure, HbA1c, glucose, and blood lipids, may be more appropriate when examining mediation by health

behaviors. Certain behavioral outcomes, such as sleep quality, may also be suitable health outcome targets.

Finally, although racial discrimination significantly predicted each SWS dimension, none of the SWS dimensions were associated with allostatic load, and the test of mediation failed. Thus, our study findings suggest that the SWS is a stable disposition among this sample of midlife AA women. Whether the SWS mediates or moderates the racial discrimination–health association likely depends on the timing of exposure. It is possible that the SWS operates as a mediator earlier in life when schemas are still developing and before discrimination has become chronic. Further research is needed to assess these associations at various life stages and in experimental versus observational study designs.

### *Study limitations*

Several methodological considerations should be noted. First, we restricted our sample to AA women. We did this for several reasons: (1) to avoid conflating the racial discrimination experiences reported by AA women and white women, thus avoiding what scholars have noted as the incommensurability of measures across groups, which compromises internal validity;<sup>102,136–138</sup> (2) to acknowledge the heterogeneity that exists among AA women both with respect to the experience of racial discrimination and the SWS, thereby avoiding the conventional practice of using averages to describe the experience of a heterogeneous group (i.e., common when examining differences between groups) and better isolating variability in the exposure of interest (i.e., providing a more appropriate counterfactual quantity);<sup>138</sup> and (3) to avoid treating AAs as a monolith and instead use intersectionality as an analytic strategy to explore the unique experiences of AA women.<sup>77,138</sup> Second, the cross-sectional nature of this study and purposive sampling strategy preclude our ability to infer causality and generalize our study findings. However, the purpose of this study was not to establish causality or generalize but to explore associations to inform hypothesis generation. Compared to AA women in the 2013 American Community Survey ages 30–50 residing in the same Bay Area counties, our sample has a comparable distribution of educational attainment, employment, and marital status but has a higher % not insured and a lower % in poverty.<sup>139</sup>

We also compared the sociodemographics of our sample to that of several national samples of AA women. Compared to the National Survey of American Life (NSAL), a national household probability sample of  $n = 6082$  non-Hispanic Whites, non-Hispanic AAs, and Caribbean Blacks;<sup>140</sup> the Black Women's Health Study, a geographically diverse sample of AA women ages 21–69 with approximately equal numbers from the four major U.S. regions ( $n = 59,000$ );<sup>141</sup> and the CARDIA study, a sample of black and white men and women ages 18–30 at baseline (1985–1986) at four U.S. sites (south, west, Midwest, and upper Midwest);<sup>142</sup> our study participants were similar in terms of age (AAWHHS mean age = 42 versus 43 years in NSAL and 40 years in the BWHS and CARDIA), but were less educated (33% with  $\leq$ HS diploma in AAWHHS versus 24%, 18%, and 28.3% in the NSAL, BWHS, and CARDIA, respectively), had a lower rate of employment (45% unemployed in AAWHHS versus 10.1% in NSAL), and a lower prevalence of being married (30% married/partnered in AAWHHS versus 42% in NSAL; 42% in the BWHS and 46% in CARDIA). Although the study findings cannot be generalized beyond our study sample, the similar sociodemographic makeup of our sample compared to several other samples of midlife AA women improves the relevance and applicability of these findings and the hypotheses generated from the study results. Further research, in larger probability-based longitudinal samples, is warranted. As with all survey research, there is a possibility of reporting bias although we used well-validated survey instruments and took steps to minimize such bias. To confirm our study findings, we also performed sensitivity analyses using the expanded set of controls without regard to statistical significance, which did not appreciably change our study results.

### *Future research*

Given our results, several hypotheses have emerged that warrant further investigation. First, in relation to emotion suppression, we hypothesized that within the context of anger, emotion suppression may be health protective given the particularly pernicious health impacts of anger. An alternative hypothesis, also consistent with our results, is that anger suppression is a learned behavior among those reporting chronic experiences of racial discrimination;<sup>107</sup> and within this context has

become part of the automatic and largely unconscious cognitive-affective processing system.<sup>46,47</sup> Previous studies have shown that automatic (versus deliberate) emotion regulation tends to be unconscious and largely effortless, thereby achieving the goals of the present situation (i.e., minimize distress) without the physiologic cost of the strain associated with more active regulation efforts.<sup>107</sup> Automatic emotion regulation has been described as an adaptive regulatory strategy learned from past experience. These habitual responses are activated by situational triggers,<sup>28</sup> which actuate schemas and shape various psychological functions, often without conscious awareness.<sup>107</sup> Experimental studies have shown inverse associations of emotion control with anger experience and behavior; and with physiologic responses consistent with challenge (versus threat) appraisals.<sup>107</sup> This is particularly the case in contexts where emotion control is valued. For example, studies show in cultures that esteem emotional restraint, emotional control is associated with physiologic challenge as opposed to threat responses, and otherwise has protective health effects.<sup>143,144</sup> This is consistent with other work suggesting that culture informs the way people experience, process, and respond to the social world.<sup>47</sup> The strong black woman role has been endorsed broadly with some describing their enactment of the superwoman role as unconscious.<sup>66</sup> Hence, our study findings raise questions about whether the emotion suppression reported by AA women is a learned and hence habitual and largely automatic response to chronic racial discrimination (i.e., protective) or more deliberate in nature. AA women have described the need to actively hold anger-in during what they describe as racist experiences.<sup>37</sup> Hence, anger suppression may have both protective and damaging properties. Further research is needed to better understand these nuances as well as whether timing plays a role in the health impacts of these responses. For example, are strength and emotion suppression helpful in both the short and long term; or does being a superwoman exact a toll over time decreasing the capacity of AA women to cope with stress. The Environmental Affordances Model suggests that within the context of environmental resources and constraints, strategies are used to cope with situations in ways that preserve mental health and well-being in the present but may be harmful in

the long term.<sup>145</sup> This is consistent with Mendoza-Denton's culturally constituted cognitive-affective processing system framework, which posits that having an internal locus of control in the short term leads to feelings of agency, but that in the long-term the "consequences of swimming upstream in the face of systematic discrimination can lead to chronic stress and deteriorating health."<sup>47</sup>

Several additional questions have emerged from these findings. If not allostatic load, what specific physical health outcomes are relevant for mediation by health behaviors when considering the role of the SWS? Does mental health mediate the association between the SWS and physical health outcomes? Does the SWS moderate associations with nonracial stressors and if so does the magnitude of those interactions differ from those observed in relation to race-related stress?

Last, our findings suggest that different forms of coping may have differential health effects based on the severity or chronicity of the stressor. Further, given the context-dependent nature of stress and coping, those relationships may vary by social context (e.g., institutional versus public setting).<sup>146</sup> This may help explain the mixed findings in the literature on racism, coping, and health; and the inability to identify coping strategies that are adaptive in relation to racism stress. Further research is needed to better understand how varying coping strategies may be more or less adaptive in different contexts, including within the context of differing levels of racism.

## Conclusions

Our findings suggest a complex set of interactions between the various dimensions of SWS and racial discrimination in relation to allostatic load. Studies examining racial discrimination without considering the interacting influence of coping and potentially other aspects of the stress-coping process likely result in biased effect estimates and a distorted understanding of how racism operates to impact health. Our findings underscore the need for scholarship exploring the complexities of *how* and *for whom* racial discrimination impacts health. Feeling an obligation to present an image of strength and an obligation to suppress emotions was protective among those reporting high levels of racial discrimination; whereas having an intense motivation to succeed and feeling an obligation to nurture

and help others was associated with greater health risk. Associations were curvilinear suggesting that the influence of coping differs by stressor severity/frequency. However, the majority of the study sample examining the health risk associated with racial discrimination model linear effects, a strict and, it appears, unrealistic assumption. Notably, this study aimed to examine individual variability in the SWS and the degree to which the SWS moderated the association between racial discrimination and allostatic load. However, the SWS may be examined in relation to a wide variety of environmental stressors, given its potential role in the embodiment of stress more broadly; and its ability to guide a more culturally informed examination of the psychobiological mechanisms linking stress to health.

We restricted our sample to U.S.-born AA women because of the unique history of racial discrimination in the United States. The majority of research in the United States, focused on health disparities, tends to dichotomize risk examining for example men versus women or AAs versus whites without attention to the ways in which the lived and social experience of multiple social identities (e.g., race  $\times$  gender) intersect to regulate exposure to risk. Research, and in particular public health research, has long documented the persistence of health disparities. We aim to distinguish between health disparities and health inequities.<sup>147,148</sup> Rather than asking *do* disparities exist, we aim to better understand *why* disparities exist. In so doing, we endeavor to move beyond rudimentary notions of race and difference and instead pose a challenge to engage in a more critical understanding of both the historical and contemporary social determinants of racial health inequities.

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### Author contributions

A.M.A., principal investigator, conceptualized the study idea and study design, coordinated and carried out all logistics related to recruitment and data collection, designed the statistical analysis (and takes responsibility for the integrity of the data analyzed), and took primary responsibility for interpreting the study findings and drafting the manuscript. Y.W. performed all statistical analysis and assisted in the design of the analysis and interpretation of data and drafting the manuscript. D.H.C. assisted with overall design of the African American Women's Heart and Health Study, interpretation of study results and manuscript revisions. M.M.P. was responsible for management of data collection, made contributions to the intellectual content of the manuscript, and assisted with manuscript revisions. W.P. assisted with data interpretation and manuscript revisions. T.C.S. assisted with operationalizing study variables and manuscript revisions. A.R.B. assisted with conceptualizing the concept of strength, interpretation of results, and manuscript revisions. F.S.D. assisted with interpretation of study results and manuscript revisions. L.M.-M. assisted with interpreting the study findings and manuscript revisions. C.W.-G. assisted by conceptualizing and creating the SWS measure, and assisting with operationalizing study variables, specifically SWS, interpretation of study results, and manuscript revisions.

## Supporting information

Additional supporting information may be found in the online version of this article.

Supporting Information.

**Figure S1.** Frequency (%) of racial discrimination across EOD dimensions ( $n = 207$ ).

**Table S1.** Estimates from simple slope analyses for effects of racial discrimination on allostatic load at high versus low levels of the SWS.

**Table S2.** Interaction effects between racial discrimination and SWS subscales on allostatic load based on alternative coding scheme.

## Competing interests

The authors declare no competing interests.

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