



## Article

# Self-identified race, socially assigned skin tone, and adult physiological dysregulation: Assessing multiple dimensions of “race” in health disparities research <sup>☆</sup>



Ryon J. Cobb <sup>a,\*</sup>, Courtney S. Thomas <sup>b</sup>, Whitney N. Laster Pirtle <sup>c</sup>, William A. Darity Jr. <sup>d</sup>

<sup>a</sup> University of Southern California, USA

<sup>b</sup> Fielding School of Public Health, University of California, Los Angeles, USA

<sup>c</sup> University of California, Merced, USA

<sup>d</sup> Duke University, USA

## ARTICLE INFO

## Article history:

Received 16 February 2016

Received in revised form

28 June 2016

Accepted 28 June 2016

## Keywords:

Skin tone

Allostatic load

Racial identification

Socially-assigned race

Socioeconomic status

## ABSTRACT

Despite a general acceptance of “race” as a social, rather than biological construct in the social sciences, racial health disparities research has given less consideration to the dimensions of race that may be most important for shaping persistent disparities in adult physical health status. In this study, we incorporate the social constructionist view that race is multidimensional to evaluate the health significance of two measures of race, racial self-identification and the socially perceived skin tone of black Americans, in a sample of black and white adults in the Nashville Stress and Health Study (N=1186). First, we use the approach most common in disparities research—comparing group differences in an outcome—to consider self-identified racial differences in allostatic load (AL), a cumulative biological indicator of physical dysregulation. Second, we examine intragroup variations in AL among blacks by skin tone (i.e. light, brown, or dark skin). Third, we assess whether the magnitude of black-white disparities are equal across black skin tone subgroups. Consistent with prior research, we find significantly higher rates of dysregulation among blacks. However, our results also show that racial differences in AL vary by blacks' skin tone; AL disparities are largest between whites and dark-skinned blacks and smallest between whites and light-skinned blacks. This study highlights the importance of blacks' skin tone as a marker of socially-assigned race for shaping intragroup and intergroup variations in adult physiological dysregulation. These results demonstrate the importance of assessing multiple dimensions of race in disparities research, as this approach may better capture the various mechanisms by which “race” continues to shape health.

© 2016 Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## Introduction

Racial health disparities are significant and convey real differences in life chances. Research in this area consistently shows that blacks in the United States live less healthier and much shorter lives than their similarly situated white counterparts (Byrd & Clayton, 2000; Du Bois 1899; Logan, 2009; McDaniel, 1998; Steckel, 1986a, 1986b). The persistence of black-white health disparities, even after controlling for socioeconomic status (SES), has stimulated scientific interest in understanding how race is such a

consistent predictor of health disparities, especially when social scientists tend to agree that race is not a biological characteristic (Dressler, Oths, & Gravlee, 2005). The social constructionist perspective provides some insight into this question, arguing that race is a multidimensional relational construct that includes how individuals self-identify and how they are perceived by others (Roth, 2016). As Jones et al. (2008) have noted, race is often quickly and routinely assigned without the benefit of queries into individuals' self-identification, ancestry, culture, or genetic background. Therefore, understanding how and why multiple dimensions of blacks' racial identification are linked to health will move the study of black-white health disparities from mere description to an explanation of the origins of racial group differences in well-being.

The present study investigates how and why self-identified and socially-assigned markers of race are associated with disparities in allostatic load, an indicator of cumulative physiological dysregulation. Specifically, we evaluate the extent to which

<sup>☆</sup>This work was supported by the National Institute on Aging at the National Institutes of Health (grant numbers T32-AG000037 and R01-AG034067). This research was supported by grants (PI: R. Jay Turner) from the Office of Behavioral and Social Science Research and the National Institute on Aging.

\* Corresponding author.

E-mail address: [ryoncobb@usc.edu](mailto:ryoncobb@usc.edu) (R.J. Cobb).

interviewer-rated skin tone explain variations in allostatic load among blacks. We also examine black-white disparities, whether they co-vary across skin tone groupings (i.e. light, brown, and dark-skinned blacks), and the extent to which SES mediates the links between self-identified or socially-assigned race and health. To examine these links, we draw on data from a representative community sample of black and white adults in Nashville, Tennessee. Our findings suggest that racial self-identification and interviewer ascribed skin tone are important factors that shape differences in allostatic load.

## Background

There is a growing public health interest in understanding the ways that race gets “under the skin” to produce population-level health disparities. One view, known as the “weathering hypothesis,” was originally proposed by [Geronimus, Hicken, Keene, & Bound \(2006:82\)](#) and argues, “...the stress inherent in living in a race-conscious society that stigmatizes and disadvantages blacks may cause disproportionate physiological deterioration, such that a black individual may show the morbidity and mortality typical of a White individual who is significantly older”. Though originally formulated to explain black-white disparities in low birthweight and mortality among infants ([Geronimus, 1991, 1996](#)), other studies evaluating racial disparities in health have reached similar conclusions. These studies find evidence that the weathering process occurs across outcomes including hypertension ([Geronimus, Bound, Keene, & Hicken, 2007](#)), functional status ([Geronimus, Bound, Waidmann, Colen, & Steffick, 2001](#)), mortality ([Astone, Ensminger, & Juon, 2002](#)). Recent research has extended the investigation of weathering by considering biological assessments of health such as allostatic load.

Following prior research, we view allostatic load as a meaningful indicator of adult physical health status that is consistent with the weathering hypothesis. Allostatic load is a measure of the cumulative burden or “wear and tear” on the body resulting from repeated adaptation to stressors ([McEwen, 1998; McEwen & Seeman, 1999; McEwen, 2003](#)). This measure is particularly useful for examining the significance of self-identified and socially-assessed dimensions of race for several reasons. First, allostatic load is measured across multiple physiological systems ([Geronimus et al., 2006](#)), which provides a more global assessment of physical health status than the consideration of single-system measures of health. Second, allostatic load acts as a pre-clinical marker of physiopathological processes that may predict poor health and lower life expectancy, but have yet to be detected clinically ([Karlamañgla, Zhou, Reuben, Greendale, & Moore, 2006](#)). Third, prior studies have shown that allostatic load is an effective measure that predicts not only poorer levels of health, but also elevated risk for premature mortality ([Crimmins & Beltrán-Sánchez, 2010; McDade, Williams, & Snodgrass, 2007](#)). Finally, allostatic load may effectively capture the broad physiological impact of the structural and interpersonal stressors associated with racial minority status, which prior research suggests is an important underlying mechanism of health disparities ([Geronimus et al., 2006; Lewis, Cogburn, & Williams, 2015; Williams, Priest, & Anderson, 2016;](#)). Given these strengths, an examination of allostatic load may yield important new insights into the ways that multiple indicators of race may shape intra- and intergroup differences in health.

Accumulating evidence documents racial disparities in allostatic load, such that blacks report significantly higher levels of allostatic load than whites ([Crimmins & Saito, 2000; Geronimus et al., 2006; Kaestner, Pearson, Keene, & Geronimus, 2009; Peek et al., 2010; Seeman, Epel, Gruenewald, Karlamañgla, & McEwen, 2010](#)). Consistent with the weathering hypothesis, these patterns

also persist across the life course. For instance, [Crimmins, Johnston, Hayward, and Seeman \(2003\)](#) find that the age pattern in allostatic load varies by race/ethnicity in the National Health and Nutrition Study, suggesting accelerated dysregulation among blacks. Furthermore, [Geronimus et al. \(2006\)](#) note that although black-white allostatic load disparities were present across all age groups, they were especially pronounced after age 30; in the same study, they find racial disparities were also observed at every SES level and greatest among high SES blacks. Taken together, these studies demonstrate significant black-white differences in allostatic load. Nevertheless, the pathways linking race to physiological well-being remain unclear.

Although prior research has made significant contributions to our understanding of ways that race, vis-à-vis racial self identification, is linked to health differentials, the question of how and why multiple dimensions of blacks’ racial identification are linked to health disparities remains unanswered. Specifically, while the conceptualization and measurement of race is critical in health disparities research, most studies in this area to date have relied on measures of self-reported racial identification that corresponds to one of predetermined racial classifications outlined by the Office of Management and Budget ([Saperstein, Penner, & Light, 2013; Snipp, 2003](#)). In reality, race is a multidimensional marker of difference based on how individuals describe themselves, and how others perceive them ([Campbell & Troyer, 2007; Harris, 2002](#)).

A key dimension of socially-assessed race is skin tone. In this study, we consider interviewer-ratings of blacks’ skin tone as one aspect of blacks’ observed racial identification or socially-assigned race because interviewer assessments represent perceptions of generalized others. As noted earlier, within the context of social interactions, individuals often rely on external phenotypical characteristics to determine the racial identification of others ([Jones et al., 2008](#)). Therefore, inclusion of interviewer-rated skin tone allows for the examination of how socially perceived skin tone, a proxy for socially-assigned racial identification, may impact the physiological well-being of black Americans and shape racial health disparities. In other words, we consider whether individuals’ own racial group identification or the way they are identified by others via socially perceived skin tone, differentially shape patterns in allostatic load. By examining both self-identified and socially-assigned race, we aim to clarify the ways the multidimensional construct of race influences health and well-being.

### *Socially-Assigned Skin Tone and Health*

Prior research on skin tone and physical health provides some of the strongest evidence of the importance of skin tone for health among black Americans. For example, studies of skin tone and hypertension have long shown that dark-skinned blacks have elevated blood pressure relative to light-skinned blacks, though adjusting for SES has explained some of the connection ([Klonoff & Landrine, 2000; Krieger, Sidney, & Coakley, 1998](#)). In addition, recent findings documenting the association between interviewer-assessed skin tone and blacks’ self-rated physical health status further suggest links between skin tone and health risk, with dark-skinned blacks reporting worse self-rated health status ([Monk, 2015](#)). Although these and other studies underscore the importance of socially perceived skin tone for shaping the health of black Americans, less is known about the ways that these racial identifications shape physiological well-being.

Since research on the association between skin tone and health is limited, explanations of the mechanisms that may undergird this relationship are not yet well-developed. Nevertheless, extant research points to both structural and interpersonal processes. There is consistent evidence that lighter skin tone is associated with more years of education, more prestigious occupations, and

higher rates of employment and wages among the black population in the United States (Goldsmith, Hamilton, & Darity, 2007; Keith & Herring, 1991; Monk, 2014)). Moreover, recent studies find that racial differences are conditional on blacks' skin tone, with the smallest disparity observed between whites and light-skinned black men, with the gap widening with the darkening of blacks' skin shade (Goldsmith et al., 2007; Kreisman & Rangel, 2015). Thus, prior research suggests there are substantial differences in SES between skin tone subgroups that may not only shape health among blacks, but may also contribute to black-white disparities. Furthermore, since lower levels of SES also are associated with higher allostatic load scores among blacks, and account for a portion of the black-white disparities in allostatic load scores, SES may explain some of the association between other's perceptions of blacks' skin tone and allostatic load score differentials (Crimmins et al., 2009; Howard & Sparks, 2015; Seeman et al., 2008; 2010).

In addition, extant research shows that socially assigned skin tone is a major source of differential exposure to discrimination among blacks (Adams, Beth, & Adam, 2016; Klonoff & Landrine, 2000). For instance, studies of skin tone bias from blacks and whites among a subsample of African American respondents in the National Survey of American Life find that lighter skinned African Americans are less likely to perceive skin tone bias from whites than their darker counterparts (Monk, 2015; Uzogara & Jackson, 2016; Uzogara, Lee, Abdou, & Jackson, 2014). These findings fit within the broader context of colorism, a system of racial stratification that privileges individuals with lighter skin tone while penalizing those of darker hues (see Hunter, 2007 for a review). Specifically, Hunter (2007) argues that while "African Americans of all skin tones are subject to certain kinds of discrimination, denigration, and second-class citizenship, simply because they are African American, the intensity of that discrimination, the frequency, and the outcomes of that discrimination will differ dramatically by skin tone" (p. 238). Consequently, skin tone may add an additional dimension of racial identification that further nuances differences in allostatic load. Since blacks' exposure to both systematic and interpersonal biases vary by skin tone, it is likely that the degree to which individuals must repeatedly adapt to such exposures vary by skin tone and may differentially impact health.

## Present Study

Bridging prior research on the social construction of race, skin tone among black Americans, and health disparities, the present study examines the extent to which multiple dimensions of blacks' racial identification may shed new light on the mechanisms underlying persistent black-white health disparities. Specifically, we ask:

- (1) What is the association between socially-perceived (i.e. interviewer-rated) skin tone and allostatic load among blacks?
- (2) Are there significant differences in the allostatic load scores of self-identified blacks and whites? If so, do these disparities vary across black skin tone subgroups (i.e. light, brown, and dark-skinned blacks)?
- (3) To what extent does SES mediate self-identified vs. socially-perceived race (i.e. interviewer-rated skin tone) differences in allostatic load?

This examination offers several advantages that may collectively provide an advance over prior research on racial health disparities. First, in contrast to most research in this area, we empirically assess the health significance of two dimensions of

racial identification: racial self-identification and a marker of socially assigned race as measured by social perceptions of blacks' skin shade (Roth, 2016). Second, rather than utilize a subjective assessment of health status, we examine variations in allostatic load, a cumulative indicator of physiological dysregulation that has been also viewed as a conceptually useful measure to assess how social inequality "gets under the skin" (Green & Darity, 2010). To our knowledge, we are the first study to examine skin tone variations in allostatic load.

Third, we use a conceptually relevant measure to understand links between skin tone and health. Many prior studies have relied on a handheld narrow-band reflectance meter designed and validated for measuring skin pigmentation in a person's inner arm (e.g., Borrell, Kiefe, Williams, Diez-Roux, & Gordon-Larsen, 2006). Though important, measurement of skin tone in the inner arm fails to distinguish the significance of skin tone as a biological parameter from its influence as a marker of socially assigned race (Monk, 2015). Thus, our utilization of interviewers' perceptions of blacks' skin tone may more closely capture the degree to which individuals' experiences within racialized social interactions vary by how they are racially categorized based on color by others (Jones et al., 2008). Finally, given the strong links between race and SES established in prior research, we also consider the extent to which SES may contribute to these disparities, using comprehensive measures of SES (i.e. educational attainment, household income, and occupational prestige).

## Method

### Study procedures

Data for this study come from the Nashville Stress and Health Study (NSHS), a representative community sample of 1270 non-Hispanic black and white adults between the ages of 22 and 69 in the greater Nashville, Tennessee metropolitan area. To obtain the study's probability sample, the NSHS used simple random sampling to draw 199 block groups from within the county. From these, a list of 7000 addresses were randomly selected, of which a total of 4634 residential addresses were successfully screened. Stratified random samples were then drawn, such that half were self-identified black/African American and half non-Hispanic white with roughly equal numbers of women and men. This approach insured an oversampling of blacks with adequate socioeconomic diversity needed to assess the nature of racial and SES disparities in health.

Participants provided information on health status and life experiences during three-hour computer-assisted, in-person interviews with interviewers of the same race; they also provided biological samples and additional medical history during a separate clinician. All participants signed informed consent forms prior to the interview, and were provided instructions regarding the clinician's visit and 12-hour urine sample that would be collected the following morning. Clinicians arrived before breakfast, collected the urine sample, drew blood samples, measured blood pressure (three measurements, spaced two minutes apart), and took measures of the hip, waist, height, and weight. Information was also obtained on participants' medication usage, including those for blood pressure and high cholesterol. Virtually all participants agreed to provide biomarker data, with less than two percent refusing the clinician visit. All study-related procedures received ethical approval from the Institutional Review Board.

The overall success rate for completed interviews was 66 percent. Accounting for success across the screening and interviewing phases, the American Association for Public Opinion Research (AAPOR) Response Rate 1 is 30.2, with a Cooperation Rate 1 of

74.2, a Refusal Rate I of 9.4, and a Contact Rate I of 40.7. All analyses were weighted for the probability of non-contact during the household screening phase and non-response during the interviewing phase. Post-stratification weights also were incorporated into the final design weight to allow generalizability of findings to the county population. For additional information on sampling and weights see [Turner, Brown, and Hale \(in press\)](#).

Several characteristics make the NSHS well-suited for examining the role of self-identified vs. socially-assigned race in allostatic load disparities. First, the wide array of biological health indicators collected allows for a comprehensive assessment of allostatic load. Second, the NSHS includes a measure of interviewer-rated skin tone for black respondents, providing a measure of socially assigned race. This skin tone measure has been used in a number of studies exploring intragroup variation in wages among blacks and other racial groups in the United States ([Monk, 2015](#)); nevertheless, this measure of skin tone has been less utilized in health studies, despite its usefulness in capturing socially perceived skin shade, rather than individuals' own perceptions of their skin tone or a mechanically-determine assessment of color. Third, these data include multiple SES indicators and utilize a socioeconomically diverse sample of blacks and whites, which is an advance over prior health disparities research, much of which has relied on small or socioeconomically disadvantaged samples of blacks to draw racial contrasts. In the present study, all respondents with viable allostatic load data were included, producing an effective analytic sample of 1222 respondents. [Table 1](#) provides descriptive statistics for the study sample.

## Measures

### Allostatic load

In the NSHS, two categories of biomarkers are used to derive estimates of allostatic load: *primary mediators* involve substances released by the body in response to stress and *secondary mediators* are produced by the effects of primary mediators. Following the recommendations of the Allostatic Load Working Group of the MacArthur Research Network, the NSHS employed the primary mediators of epinephrine, norepinephrine, cortisol, and dehydroepiandrosterone sulfate (DHEA-S) and the secondary mediators of systolic and diastolic blood pressures, total cholesterol, high density lipids (HDL), glycated hemoglobin, and waist to hip ratio ([Seeman et al., 1997](#)). Allostatic load scores are then estimated by a count of the number of dimensions with scores falling above the 75th percentile (or below the 25th percentile for HDL and DHEA-S), which represent "high-risk" levels of each indicator. Allostatic load scores are continuous, and range between zero and ten with higher scores indicating increased levels of dysregulation across physiological systems.

### Self-identified race

NSHS respondents were first asked to provide their racial self-

identification. In these analyses, respondents are coded as white (0) or black (1).

### Socially perceived skin tone among blacks

Skin tone differences in health were assessed using a measure of interviewer-rated skin tone among the black subsample only. Although past studies document the importance of skin tone for shaping perceptions of socially assigned race across different groups, research in this area also suggests that marginalization based on skin shade does not represent a socially relevant experience among non-Hispanic whites ([Jones et al., 2008](#); [Veenstra, 2011](#)). Consequently, we focus on skin tone variation among blacks for shaping within-group and black-white disparities in allostatic load.

The skin tone of black respondents assessed by interviewers using the following scale: "very dark," "dark," "somewhat dark," "medium," "somewhat light," "light," and "very light." To account for possible nonlinearities in the relationship between blacks' perceived skin tone and health, we re-coded skin tone into three categories: "dark," "brown," and "light." In analyses among blacks only, we use this three-category variable coded as (1) "light," (2) "brown," and (3) "dark." To compare each black skin tone group to whites, we created a four-level variable: (1) whites, (2) light-skinned blacks, (3) brown-skinned blacks, and (4) dark-skinned blacks.

### Socioeconomic status (SES) and other covariates

The SES of respondents was assessed using self-reported indicators (1) their annual pre-tax household income, (2) years of education completed, and (3) level of occupational prestige based on the Nam-Boyd scale (see [Turner et al., in press](#) for detailed coding procedures). Each indicator was standardized and summed, and the number of dimensions on which data were available divided the sum. Age (measured in years) and sex (0=female, 1=male) of respondent were also included as covariates in all analyses.

## Statistical analysis

To address the research questions proposed in this study, we use a three step approach. First, we examined the mean and distribution of allostatic load across self-identified race and black skin tone groups. Weighted percentages of respondents with high risk levels of each indicator, in addition to mean total allostatic load scores, are presented in [Table 2](#); chi-squared and analysis of variance (ANOVA) tests were also used to determine whether frequencies vary across self-identified race or blacks' socially perceived skin tone subgroups. Second, negative binomial regression (NBR) coefficients were estimated to examine whether skin tone is a source of intragroup variation in allostatic load among blacks (see [Table 3](#)); we also consider differences in allostatic load

**Table 1**  
Sociodemographic characteristics of Nashville stress and health study respondents, by self-identified race and socially perceived skin tone.

	Full sample	Whites	Blacks	Among blacks only		
				Light skin	Brown skin	Dark skin
N	1222	613	609	142	276	191
Age	44.32	44.61	43.57	44.42	43.21	43.34
Female	0.48	0.50	0.55	0.26	0.43	0.31
Education	14.43	14.84	13.39	13.70	13.32	13.22
Household Income	\$59,999	\$69,999	\$42,499	\$42,999	\$39,999	\$22,499
Occupational Prestige <sup>a</sup>	54.43 [0.00]	59.19 [0.19]	42.61 [-0.48]	47.08 [-0.27]	41.56 [-0.52]	39.20 [-0.60]

<sup>a</sup> Standardized value in brackets.

**Table 2**  
Weighted descriptive statistics for 10 allostatic load biomarkers.

	All respondents	Whites	Blacks	Light-skinned blacks	Brown-skinned blacks	Dark-skinned blacks
Mean allostatic load score <sup>1</sup>	2.75	2.50	3.38 <sup>a</sup>	3.16	3.25 <sup>b</sup>	3.75
<b>Primary mediators</b>						
Cortisol	25%	22%	33% <sup>a</sup>	28%	34%	35% <sup>a</sup>
Dehydroepiandrosterone sulfate (DHEA-S)	25%	22%	32% <sup>a</sup>	36%	29%	31% <sup>a</sup>
Epinephrine	24%	20%	35% <sup>a</sup>	31%	29%	46% <sup>a,b</sup>
Norepinephrine	25%	21%	35% <sup>a</sup>	32%	32%	43% <sup>b</sup>
<b>Secondary mediators</b>						
Diastolic blood pressure	42%	37%	54% <sup>a</sup>	49%	55%	58% <sup>a</sup>
Glycated hemoglobin	24%	18%	38% <sup>a</sup>	38%	32%	45% <sup>a</sup>
High density lipids (HDL)	24%	25%	22% <sup>a</sup>	13%	25% <sup>b</sup>	23% <sup>a</sup>
Systolic blood pressure	40%	35%	52% <sup>a</sup>	47%	52%	55% <sup>a</sup>
Total cholesterol	38%	40%	31% <sup>a</sup>	41%	25%	30% <sup>a</sup>
Waist-to-hip ratio	22%	22%	25%	25%	23%	26%

<sup>1</sup> Percent of respondents in high-risk category based on 75th/25th percentile.

<sup>a</sup> Relative to whites ( $p < 0.05$ ).

<sup>b</sup> Relative to light-skinned blacks ( $p < 0.05$ ).

**Table 3**  
Incident rate ratios of allostatic load and socially perceived skin tone among blacks.

	Model 1	Model 2	Model 3	Model 4
<b>Socially perceived skin tone<sup>a</sup></b>				
Brown Skin	1.07 (0.06)	1.07 (0.06)	1.07 (0.06)	1.07 (0.06)
Dark Skin	1.26 <sup>***</sup> (0.08)	1.25 <sup>***</sup> (0.08)	1.25 <sup>***</sup> (0.08)	1.26 <sup>***</sup> (0.08)
Age	1.01 <sup>***</sup> (0.00)	1.01 <sup>***</sup> (0.00)	1.01 <sup>***</sup> (0.00)	1.01 <sup>***</sup> (0.00)
Female	1.01 (0.04)	1.01 (0.05)	1.01 (0.05)	1.01 (0.05)
Education		1.00 (0.01)	0.99 (0.00)	1.00 (0.01)
Household Income			1.00 (0.01)	0.99 (0.01)
Occupational prestige				1.02 (0.03)
Constant	1.70 <sup>***</sup> (0.18)	1.81 <sup>***</sup> (0.28)	1.81 <sup>***</sup> (0.29)	1.87 <sup>***</sup> (0.32)
Observations	601	601	601	601

SE in parentheses.

<sup>a</sup> "Light Skin" is reference category. \*  $p < 0.05$  \*\*  $p < 0.01$

\*\*\*  $p < 0.001$ .

between whites and blacks (see Table 4, Models 1–4) and then whites and each black skin tone subgroup (see Table 4, Models 5–8). We chose to model the relationship using NBR because the indicator of allostatic load is a count outcome, with an over-dispersed distribution. Therefore, we use NBR, which assumes the variance is larger than the mean and is more appropriate in situations where events of interest—here dysregulation—are not independent. NBR accounts for this by adding a parameter to reflect unobserved heterogeneity among observations (Long & Freese, 2006). Finally, we evaluated the extent to which SES explains these patterns, following Baron and Kenny's (1986) criteria for mediation (see Table 4).

All analyses control for the effects of age and gender, and include analytical weights to account for the complexity of the survey design; analyses were performed using STATA 14.

**Results**

Results from Table 2 indicate that the mean allostatic load score for blacks is higher than whites (3.38 vs. 2.50), and that this

pattern varies across black skin tone subgroups. The largest gap in allostatic load observed between whites and dark-skinned blacks (2.50 vs. 3.75). Among blacks, the mean allostatic load score for light and brown-skinned blacks is higher relative than darker skinned blacks.

Table 3 displays incident rate ratios (IRRs) estimated by NBR models. Here, we assess the significance of interviewer-assessed skin tone for shaping disparities in allostatic load among blacks, and whether SES explains some of this link. In Model 1, we observe a significant association between darker skin tone and allostatic load. Relative to blacks with lighter skin tone, darker-skinned blacks have significantly higher levels of allostatic load (IRR: 1.25,  $p < 0.001$ ). There are no significant differences in the allostatic load of brown-skinned and light-skinned blacks. Models 2–4 incorporate each dimension of SES individually with interviewer assessed skin tone, and the full model (Model 4) displays interviewer assessed skin tone and all the SES measures simultaneously. Results show there are no significant associations between any of the SES indicators and allostatic load among black Americans. Furthermore, consideration of these factors in the full model results in only a slight (4 percent) reduction in the relationship between being ascribed as having dark skin and allostatic load. In sum, the results from the first stage of the analysis suggest that dark-skinned blacks have elevated levels of allostatic load relative to their light-skinned counterparts. Moreover, differences in SES among blacks does little to explain these skin tone patterns in allostatic load.

Table 4 shows multiple measures of blacks' racial identification and their relationships with allostatic load. While within-racial group analyses suggest that dark skin tone is an important predictor of allostatic load disparities among black Americans, we know little about its role in shaping black-white disparities in this indicator of biological functioning. We then regress allostatic load on skin tone and SES among both blacks and whites. Here, variation across skin tone subgroups is assessed relative to whites, who are the reference group in these analyses. Controlling for age and gender (Model 1), blacks have significantly higher levels of allostatic load relative to whites (IRR 1.3,  $p < 0.001$ ). However, our subsequent models indicate that using racial self-identification (alone) masks how the magnitudes of these differences vary across skin shade groups. For instance, while the estimated allostatic load score is higher for blacks compared to whites, there is a clear skin tone gradient in levels of allostatic load. The black-white allostatic load differentials are largest between whites and dark-skinned blacks, the second largest between whites and brown-skinned blacks, and smallest between whites and light-skinned blacks. In

**Table 4**  
Incident rate ratios of allostatic load, self-identified race, and socially perceived skin tone among blacks and whites.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
<b>Self-identified race<sup>a</sup></b>								
Black	1.31*** (0.05)	1.25*** (0.05)	1.25*** (0.05)	1.25*** (0.05)				
<b>Socially perceived skin tone<sup>a</sup></b>								
Light skinned-blacks					1.20*** (0.07)	1.16*** (0.07)	1.17*** (0.07)	1.17*** (0.07)
Brown skinned-blacks					1.26*** (0.06)	1.21*** (0.06)	1.21*** (0.06)	1.21*** (0.06)
Dark skinned-blacks					1.46*** (0.07)	1.39*** (0.07)	1.39*** (0.07)	1.39*** (0.07)
Age	1.02*** (0.00)	1.02*** (0.00)	1.02*** (0.00)	1.08*** (0.00)	1.02*** (0.00)	1.02*** (0.00)	1.02*** (0.00)	1.02*** (0.00)
Female	1.14*** (0.04)	1.14*** (0.04)	1.15*** (0.04)	1.15*** (0.04)	1.13*** (0.04)	1.13*** (0.04)	1.14*** (0.04)	1.14*** (0.04)
Education		0.98*** (0.01)	0.98*** (0.01)	0.98*** (0.01)	0.98*** (0.01)	0.98*** (0.01)	0.98*** (0.01)	0.98*** (0.01)
Household Income			1.00 (0.01)	0.99 (0.01)			1.00 (0.01)	0.99 (0.01)
Occupational prestige (Standardized)				1.00 (0.00)				1.00 (0.00)
Constant	1.05*** (0.08)	1.52*** (0.194)	1.50*** (0.19)	1.50*** (0.19)	1.06*** (0.09)	1.49*** (0.19)	1.46*** (0.190)	1.46*** (0.190)
Observations	1222	1222	1222	1222	1222	1222	1222	1222

SE in parentheses.

<sup>a</sup> "White" is reference category. \* $p < 0.05$ .

\*\* $p < 0.01$ .

\*\*\* $p < 0.001$ .

short, the black-white disparity in allostatic load is not equivalent across skin tone groupings.

To address the question of whether these relationships are independent of SES, regression analysis were extended. Models 3 through 8 assess the extent to which SES mediates this association by adding the dimensions of SES individually and then collectively in the final model. Across models, higher levels of education are significantly associated with lower levels of allostatic load. Though our measure of skin tone also remained significant across models, our results suggest that the association between skin tone and allostatic load may be partially explained by years of education. Specifically, the black-white gap in allostatic load was reduced by four percent among light-skinned blacks, four percent among brown-skinned blacks, and seven percent among dark-skinned blacks. This suggests that variation in years of education partially explains the black-white disparity in allostatic load across skin tone subgroups of blacks, and this mediating effect is greatest for darker-skinned blacks. Nevertheless, racial disparities persist for all skin tone subgroups, relative to whites, even once SES is controlled. Taken together, these findings suggest that blacks' skin tone significantly shapes within-group variation, while also contributing to black-white disparities in allostatic load.

## Discussion

Despite an increased focus on health disparities in the United States by research and policymakers (US Department of Health and Human Services, *Healthy People, 2010*; Williams and Jackson, 2005), the sources of black-white disparities and the ways they might be ameliorated remain poorly understood. Here, we argue that progress toward this goal has been impeded by the problematic tendency among researchers to treat racial self-identification as a proxy for other potentially significant dimensions of race

that may drive differences in lived outcomes (Saperstein, 2013; Stewart, 2008; Zuberi, Patterson and Stewart, 2015), and extend this reasoning to racial health disparities. Moreover, we contend that race is a multidimensional marker of difference that not only includes how individuals describe themselves, but also how they are perceived by others (Campbell & Troyer, 2007; Harris, 2002). Consequently, the goal of this paper was to assess self-identified vs. socially perceived markers of race and the ways they shape disparities in allostatic load among blacks, in addition to their contribution to black-white differences in health. Our study shows that the operationalization of blacks' racial identification matters in shaping our understanding of health among blacks, as well as black-white health disparities. In doing so, our analysis makes several contributions to the literature on black-white health disparities in the United States.

Our first aim was to examine differences in allostatic load based on respondents' self-identified race. This approach is common in health disparities research, and consistent with prior research, we also find that self-reported blacks report higher allostatic load scores than self-reported whites. Next, we considered how socially-assigned race, measured by interviewer-rated skin tone, accounts for allostatic load differences among blacks. Prior research suggests the importance of observers' perception of blacks' skin tone for shaping blacks' daily experiences, opportunities, and health (Adams et al., 2016). However, most of the studies outlining skin tone variations in blacks' health examined hypertension, leaving the question of whether skin tone importantly shapes the physical health status of blacks more broadly.

To overcome this limitation, the present study investigated the role of blacks' socially assigned skin tone for shaping intragroup variations in allostatic load. Our results suggest that relative to light-skinned blacks, dark skinned skin have significantly higher levels of allostatic load. There were no differences in the allostatic load of light and brown skin blacks. We then considered the extent

to which SES might explain these patterns. Given the prior work noting significant skin tone gradients in various indicators of SES among blacks (see [Hunter, 2007](#) for a review), it was plausible that differences in SES might also contribute to allostatic load differentials. After incorporating each dimension of SES into the models separately and simultaneously, we did not, however, observe any statistically significant relationships between education, income, and/or occupational prestige and allostatic load among blacks. Furthermore, controlling for each dimension of SES in the full model only resulted in only a small reduction in the association between respondents who were perceived to have dark skin and allostatic load among blacks. Taken together, our findings lend partial support prior studies, which have largely found that darker-skinned blacks face the highest health risk relative to their lighter skinned counterparts. However, our finding that the allostatic load of brown-skinned blacks does not differ significantly from the scores of blacks with lighter skin differs from prior studies of the link between interviewer assessed skin tone and health among blacks. This may be due to the tendency among researchers in this area to use subjective indicators of health, whereas we consider allostatic load, a biological indicator of physical dysregulation. Perhaps our more global measure of health captures underlying physiological processes that may not vary significantly for light and brown-skinned blacks, but differ substantially for dark-skinned blacks. Additional research that considers whether links between blacks' socially-assigned skin tone and health over time may provide some insight into how black-white health disparities persist across the life course.

Another major goal of this study was to evaluate the significance of multiple measures of race for shaping black-white disparities in physical health. Our results show that black-white differences in allostatic load vary by blacks' skin tone. Specifically, with both self-identified race and interviewer's perception of blacks' skin tone (i.e. a marker of socially assigned race) considered together, we observe considerable differences in the magnitude of the black-white disparity in physical health status across the skin shade subgroups. Not surprisingly, the largest disparity was between dark-skinned blacks and whites and the magnitude of the disparity decreased as skin tone became lighter. Given ongoing link between racial incongruence and health (i.e., [Pirtle & Brown, 2015](#)), it may be fruitful if future work were to include measures of socially-assigned and self-reported racial identification to examine if the link between racial incongruence and health also includes biological indicators of physiological functioning. Recent studies have also noted a skin tone gradient in self-reports of skin tone bias among African Americans ([Adams et al., 2016](#); [Uzogara et al., 2014](#); [Uzogara & Jackson, 2016](#)). Given ongoing links between perceived discrimination and allostatic load among blacks, future studies should also examine whether skin tone bias may skin tone variations in allostatic load scores among blacks.

Again, considering the extent to which SES may contribute to these trends, we observe that SES mediated some of the disparities between whites and black skin tone subgroups. However, this effect was not equivalent across groups as the inclusion of SES reduced the allostatic load disparity between whites and dark-skinned blacks by more than seven percent. These results demonstrate that once SES is accounted for, the risk of elevated dysregulation is substantially lowered and the black-white disparity reduced, especially for dark skinned blacks. Overall, our findings lend support the weathering hypothesis. Specifically, we show that interviewer ascribed skin tone allows us to tap into view how generalized others embedded in our "race-conscious society" might first perceive blacks' and then apply differential treatment that "stigmatizes and disadvantages" those with the darkest skin the most, thus causing "disproportionate physiological deterioration" ([Geronimus et al., 2006:82](#)). Future research is needed to

investigate the ways in which blacks' skin shade contributes to differential treatment from in-group and out-group sources, and the ways in which such treatment may differentially shape patterns in allostatic load. Furthermore, studies should also examine the ways in which socially assigned skin tone may interact with SES to create distinct patterns of intra- and intergroup differences in health.

The findings presented in this study should be understood in light of its limitations. First, our study of black-white allostatic disparities relies on cross-sectional data, limiting our abilities to assess how links between self-identified race, blacks' perceived skin shade, and allostatic load change over time. The use of cross-sectional data prevents us from assessing time ordering, however, our use of biological measures of health give us some confidence that these sub-clinical markers are not driving individuals' own racial identifications or how they are perceived by others. Second, the use of a community sample in the southern United States may limit the extent to which our results can be generalized to the broader population. Thus, future work should consider these processes within a nationally representative sample. To our knowledge, however, we know of no current longitudinal data source that includes multiple measures of racial identification and allostatic load. Nonetheless, our sample is generalizable to the county level and drawn from a mid-sized, diverse, metropolitan area. As such, the results presented here provide reliable support for the continued significance of blacks' skin tone for shaping life chances among this population, in addition to conditioning the magnitude of black-white health disparities. Third, though socially assigned skin tone is an observed dimension of blacks' racial identification that is thought to be an indicator of one's social standing in the United States, SES did little to explain links between blacks' skin tone and intra- and intergroup variations in allostatic load scores. Since the analyses here did not include a measure of net worth, it is possible that other aspects of SES may explain these associations. Finally, prior work has shown that skin tone (measured by a spectrometer) is one factor that accounts for intragroup variations in education levels among whites ([Brannigan et al., 2013](#)). Though we know of no study that examines if health among whites varies by socially assigned skin tone, future studies should also consider whether skin tone and other phenotypic features are factors that account for health differentials among whites.

Despite these limitations, this study underscores the importance of assessing multiple dimensions of race in disparities research, as this approach may better capture the various mechanisms by which "race" continues to shape health. We contribute to the substantial body of research that document longstanding black-white disparities in physical health by evaluating the extent to which both racial self-identification and a marker of socially assigned race, socially assigned skin tone among blacks, shape physiological dysregulation among adults. Our findings that black-white disparities in allostatic load are shaped by blacks' socially assigned skin tone, suggest that blacks' risk is importantly shaped by both their racial self-identification as well as their skin tone. By considering both of these dimensions, we provide some of the first evidence that markers of race, beyond one's own identification, matter for allostatic load risk. By incorporating multiple measures of race that better capture the various dimensions of a racialized social experience, future work may more effectively evaluate the ways by which the social construct of race continues to have real physiological consequences.

## References

- Adams, Elizabeth A., Kurtz-Costes, Beth E., & Hoffman, Adam J. (2016). Skin tone bias among African Americans: Antecedents and consequences across the life span. *Developmental Review, 40*, 93–116.

- Astone, N. M., Ensminger, M., & Juon, H. S. (2002). Early adult characteristics and mortality among inner-city African American women. *American Journal of Public Health*, 92(4), 640–645.
- Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173.
- Borrell, L. N., Kiefe, C. I., Williams, D. R., Diez-Roux, A. V., & Gordon-Larsen, P. (2006). Self-reported health, perceived racial discrimination, and skin color in African Americans in the CARDIA study. *Social Science & Medicine*, 63(6), 1415–1427 (Chicago).
- Brannigan, A. R., Freese, J., Patir, A., McDade, T. W., Liu, K., & Kiefe, C. I. (2013). Skin color, sex, and educational attainment in the post-civil rights era. *Social Science Research*, 42(6), 1659–1674.
- Byrd, W. M., & Clayton, L. A. (2000). *An American health dilemma: Race, medicine, and healthcare in the United States*. New York: Routledge.
- Campbell, M. E., & Troyer, L. (2007). The implications of racial misclassification by observers. *American Sociological Review*, 72(5), 750–765.
- Crimmins, E. M., & Beltrán-Sánchez, H. (2010). Mortality and morbidity trends: Is there compression of morbidity? *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* (p. gbq088), gbq088.
- Crimmins, E., & Saito, Y. (2000). Change in the prevalence of diseases among older Americans: 1984–1994. *Demographic Research* (p. 3), 3 (Chicago).
- Crimmins, E., Johnston, M., Hayward, M., & Seeman, T. (2003). Age differences in allostatic load: An index of physiological dysregulation. *Experimental Gerontology*, 38, 731–734.
- Crimmins, E. M., Kim, J. K., & Kim, Seeman, T. E. (2009). Poverty and biological risk: The earlier “aging” of the poor. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, 64(2), 286–292.
- DuBois, W. E. B. (1899). *The Philadelphia Negro: A social study*, 14. Published for the University of Pennsylvania.
- Dressler, W. W., Oths, K. S., & Gravelle, C. C. (2005). Race and ethnicity in public health research: Models to explain health disparities. *Annual Review of Anthropology*, 34(1), 231.
- Geronimus, A. T. (1996). Black/white differences in the relationship of maternal age to birthweight: A population-based test of the weathering hypothesis. *Social Science & Medicine*, 42(4), 589–597.
- Geronimus, A. T. (1991). The weathering hypothesis and the health of African-American women and infants: Evidence and speculations. *Ethnicity Disease*, 2(3), 207–221.
- Geronimus, A. T., Bound, J., Keene, D., & Hicken, M. (2007). Black-white differences in age trajectories of hypertension prevalence among adult women and men, 1999–2002. *Ethnicity Disease*, 17(1), 40–49.
- Geronimus, A. T., Bound, J., Waidmann, T. A., Colen, C. G., & Steffick, D. (2001). Inequality in life expectancy, functional status, and active life expectancy across selected black and white populations in the United States. *Demography*, 38(2), 227–251.
- Geronimus, A. T., Hicken, M., Keene, D., & Bound, J. (2006). “Weathering” and age patterns of allostatic load scores among blacks and whites in the United States. *American Journal of Public Health*, 96(5), 826–833.
- Goldsmith, A. H., Hamilton, D., & Darity, W. (2007). From dark to light: Skin color and wages among African-Americans. *Journal of Human Resources*, 42(4), 701–738.
- Green, T. L., & Darity, W. A., Jr. (2010). Under the skin: Using theories from biology and the social sciences to explore the mechanisms behind the black-white health gap. *American Journal of Public Health*, 100(S1), S36–S40.
- Harris, D. R. (2002). *In the eye of the beholder: Observed race and observer characteristics*. Population Studies Center Research Report, (02-522). Chicago.
- Howard, J. T., & Sparks, P. J. (2015). The role of education in explaining racial/ethnic allostatic load differentials in the United States. *Biodemography and Social Biology*, 61(1), 18–39.
- Hunter, M. (2007). The persistent problem of colorism: Skin tone, status, and inequality. *Sociology Compass*, 1(1), 237–254.
- Jones, C. P., Truman, B. I., Elam-Evans, L. D., Jones, C. A., Jones, C. Y., Jiles, R., et al. (2008). USING socially assigned in health status. *Ethnicity Disease*, 18, 496.
- Kaestner, R., Pearson, J. A., Keene, D., & Geronimus, A. T. (2009). Stress, allostatic load, and health of Mexican immigrants. *Social Science Quarterly*, 90(5), 1089–1111.
- Karlamangla, A., Zhou, K., Reuben, D., Greendale, G., & Moore, A. (2006). Longitudinal trajectories of heavy drinking in adults in the United States of America. *Addiction*, 101(1), 91–99.
- Keith, V. M., & Herring, C. (1991). Skin tone and stratification in the Black community. *American Journal of Sociology* (pp. 760–778), 760–778.
- Klonoff, E. A., & Landrine, H. (2000). Is skin color a marker for racial discrimination? Explaining the skin color–hypertension relationship. *Journal of Behavioral Medicine*, 23(4), 329–338.
- Krieger, N., Sidney, S., & Coakley, E. (1998). Racial discrimination and skin color in the CARDIA study: Implications for public health research. Coronary artery risk development in young adults. *American Journal of Public Health*, 88(9), 1308–1313.
- Kreisman, D., & Rangel, M. A. (2015). On the blurring of the color line: Wages and employment for Black males of different skin tones. *Review of Economics and Statistics*, 97(1), 1–13.
- Lewis, T. T., Cogburn, C. D., & Williams, D. R. (2015). Self-reported experiences of discrimination and health: Scientific advances, ongoing controversies, and emerging issues. *Annual Review of Clinical Psychology*, 11, 407–440.
- Logan, T. D. (2009). Health, human capital, and African-American migration before 1910. *Explorations in Economic History*, 46(2), 169–185.
- Long, J. S., & Freese, J. (2006). *Regression models for categorical dependent variables using Stata*. Stata Press.
- McDade, T. W., Williams, S., & Snodgrass, J. J. (2007). What a drop can do: dried blood spots as a minimally invasive method for integrating biomarkers into population-based research. *Demography*, 44(4), 899–925 (Chicago).
- McDaniel, A. (1998). The “Philadelphia Negro” then and now: Implications for empirical research. *WEB Du Bois, race, and the city: The Philadelphia Negro and its legacy* (pp. 155–194), 155–194.
- McEwen, B. S. (1998). Stress, adaptation, and disease: Allostatic and allostatic load. *Annals of the New York Academy of Sciences*, 840(1), 33–44.
- McEwen, B. S. (2003). Mood disorders and allostatic load. *Biological Psychiatry*, 54(3), 200–207.
- McEwen, B. S., & Seeman, T. (1999). Protective and damaging effects of mediators of stress: Elaborating and testing the concepts of allostatic and allostatic load. *Annals of the New York Academy of Sciences*, 896(1), 30–47.
- Monk, E. P., Jr. (2015). The cost of color: Skin color, discrimination, and health among African-Americans. *American Journal of Sociology*, 121(2), 396–444.
- Monk, E. P. (2014). Skin tone stratification among black Americans, 2001–2003. *Social Forces*, 92(4), 1313–1337.
- Peek, M. K., Cutchin, M. P., Salinas, J. J., Sheffield, K. M., Eschbach, K., Stowe, R. P., et al. (2010). Allostatic load among non-Hispanic whites, non-Hispanic blacks, and people of Mexican origin: Effects of ethnicity, nativity, and acculturation. *American Journal of Public Health*, 100(5), 940–946.
- Pirtle, W. N. L., & Brown, T. N. (2015). Inconsistency within expressed and observed racial identifications implications for mental health status. *Sociological Perspectives*. 0731121415602133
- Roth, W. D. (2016). The multiple dimensions of race. *Ethnic and Racial Studies* (pp. 1–29), 1–29.
- Saperstein, A. (2013). Representing the multidimensionality of race in survey research. *Mapping Race: Critical Approaches to Health Disparities Research* (pp. 190–209), 190–209.
- Saperstein, A., Penner, A. M., & Light, R. (2013). Racial formation in perspective: Connecting individuals, institutions, and power relations. *Annual Review of Sociology*, 39, 359–378.
- Seeman, T., Epel, E., Gruenewald, T., Karlamangla, A., & McEwen, B. S. (2010). Socioeconomic differentials in peripheral biology: Cumulative allostatic load. *Annals of the New York Academy of Sciences*, 1186(1), 223–239.
- Seeman, T., Merkin, S., Crimmins, E., Koretz, B., Charette, S., & Karlamangla, A. S. (2008). Education, income and ethnic differences in cumulative biological risk profiles in a national sample of US adults: NHANES III (1988–1994). *Social Science & Medicine*, 66, 72–87.
- Seeman, T. E., Singer, B. H., Rowe, J. W., Horwitz, R. I., & McEwen, B. S. (1997). Price of adaptation—allostatic load and its health consequences: MacArthur studies of successful aging. *Archives of internal medicine*, 157(19), 2259–2268.
- Snipp, C. M. (2003). Racial measurement in the American census: Past practices and implications for the future. *Annual Review of Sociology* (pp. 563–588), 563–588.
- Steckel, R. H. (1986a). Birth weights and infant mortality among American slaves. *Explorations in Economic History*, 23(2), 173–198.
- Steckel, R. H. (1986b). A peculiar population: The nutrition, health, and mortality of American slaves from childhood to maturity. *Journal of Economic History*, 46(3), 721–741.
- Stewart, Q. T. (2008). *Chasing the race effect: An analysis of traditional quantitative research on race in sociology*. Racism in post-race America: New theories, new directions. .
- Turner, R. J., Brown, T., & Hale, W. B. (2016). Race socioeconomic position and physical health: A descriptive analysis. *Journal of Health and Social Behavior*. (in press).
- U.S. Department of Health and Human Services, Healthy People 2010. *Understanding and Improving Health*, 2nd ed. Washington, DC: U.S. Government Printing Office, November, 2000.
- Uzogara, E. E., Lee, H., Abdou, C. M., & Jackson, J. S. (2014). A comparison of skin tone discrimination among African American men: 1995 and 2003. *Psychology of Men Masculinity*, 15(2), 201.
- Uzogara, E. E., & Jackson, J. S. (2016). Perceived skin tone discrimination across contexts: African American women's reports. *Race and Social Problems* (pp. 1–13), 1–13.
- Veenstra, G. (2011). Mismatched racial identities, colourism, and health in Toronto and Vancouver. *Social Science & Medicine*, 73(8), 1152–1162.
- Williams, D. R., & Jackson, P. B. (2005). Social sources of racial disparities in health. *Health Affairs*, 24(2), 325–334.
- Williams, D. R., Priest, N., & Anderson, N. B. (2016). Understanding associations among race, socioeconomic status, and health: Patterns and prospects. *Health Psychology*, 35(4), 407.
- Zuberi, T., Patterson, E. J., & Stewart, Q. T. (2015). Race, methodology, and social construction in the genomic era. *The Annals of the American Academy of Political and Social Science*, 661(1), 109–127.