Self-reported health, perceived racial discrimination, and skin color in African Americans in the CARDIA study

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Abstract

This study investigates the association between self-reported physical and mental health and both perceived racial discrimination and skin color in African American men and women. We used data from the longitudinal coronary artery risk development in young adults study (CARDIA) in African American men and women ($n = 1722$) in the USA. We assessed self-reported mental and physical health status and depressive symptoms at the Year 15 (2000–2001) follow-up examination using the Medical Outcomes Study Short Form (SF-12) and the Center for Epidemiologic Studies Depression scale. Skin color was measured at the Year 7 examination (1992–1993). To assess racial discrimination, we used a summary score (range 0–21) for 7 questions on experiencing racial discrimination: at school, getting a job, getting housing, at work, at home, getting medical care, on the street or in a public setting. Self-reported racial discrimination was more common in men than in women (78.1% versus 73.0%, $p < 0.05$) and in those with higher educational attainment, independent of gender. Discrimination was statistically significantly associated with worse physical and mental health in both men and women, before and after adjustment for age, education, income, and skin color. For example, mental health (0–100 scale) decreased an average of 0.29 units per unit increase in racial discrimination score in men; this became 0.32 units after adjustment. There was no association between self-reported physical and mental health and skin color. Further studies of the health consequences of discrimination will require investigation of both the upstream determinants of discrimination and the downstream mechanisms by which perceived discrimination affects health outcomes.
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Introduction

Disparities in heath status between blacks (or African Americans) and whites are large, pervasive and persistent over time (Danzinger & Gottschalk, 1993; Lenfant, 1996; "National Institutes of Health", October 6, 2000; US Department of Health and Human Services. Healthy People 2010:

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Understanding and Improving Health. 2nd ed., 2000; Williams, 2005). There are large socioeconomic status (SES) differences between these two racial groups and they account for a substantial portion of the racial differences in health. However, the persistence of racial differences in health, even when SES is considered, has stimulated scientific interest in identifying other race-related factors that are adversely affecting the health of African Americans. Discrimination has recently emerged as an important risk factor for health that is differentially distributed across race and may contribute to elevated health risks for African Americans (Krieger, 1999; Williams, 1999; Williams & Collins, 1995; Williams, Neighbors, & Jackson, 2003; Williams, Yu, Jackson, & Anderson, 1997).

Recent research reveals that a substantial proportion of African Americans experience discrimination and there is evidence that discrimination is adversely related to multiple indicators of health status. For example, discrimination has been found to be associated with multiple indicators of mental and physical health (Harrell, Hall, & Taliaferro, 2003; Krieger, 1999; Krieger & Sidney, 1996; Schulz, Israel et al., 2000; Schulz, Williams et al., 2000; Williams et al., 2003). In sum, these studies have found that African Americans reporting experiencing racial discrimination are more likely to exhibit negative health outcomes than their counterparts experiencing no discrimination.

The shade of skin color (or skin tone), another potential risk factor for the health of African Americans, has received inadequate research scrutiny. In many cultures the color black is associated with negative attributes (Brown, Ward, Lightbourn, & Jackson, 1999; Franklin, 1968; Williams, 1997) and the African American population is no an exception (Brown et al., 1999). Research has long indicated that skin tone is a maker of social status and an important predictor of access to opportunity and resources within the black population in the United States (Drake & Clayton, 1945; Frazier, 1957). Since the days of slavery, when lighter skin tone reflected family ties to whites, lighter skinned blacks were more likely to obtain freedom and had greater access than others to education, property and employment opportunities (Frazier, 1957). More recent studies indicate the persistence of skin tone in affecting the quality of life of African Americans. For example, the National Study of Black Americans conducted in 1979–1980, found that compared to their darker complexioned peers,

lighter-skinned blacks had higher levels of education, occupational prestige, personal and family income and were more likely to have spouses with more education and higher occupational prestige (Hughes & Hertel, 1990; Keith & Herring, 1991). Moreover, these associations were stronger for women than for men.

Skin tone may also be related to health, at least under certain conditions. Early studies of African Americans examined the association between skin color and health status with skin tone as a proxy for genetic admixture, with darker skinned blacks presumed to be of purer African ancestry (Boyle, 1970; Gillum, 1979; Harburg, Gleibermann, Roeper, Schork, & Schull, 1978). These initial studies found a positive association between darker skin color and hypertension (Boyle, 1970; Gillum, 1979; Harburg et al., 1978). Subsequent studies revealed that this association was reduced to non-significance when adjusted for SES, confirming the importance of skin tone as a marker of social status (Keil, Sandifer, Loadholt, & Boyle, 1981; Keil, Tyroler, Sandifer, & Boyle, 1977). However, one study documented that the association between skin color, SES and health may be complex (Klag, Whelton, Coresh, Grim, & Kuller, 1991). These researchers found that darker skin color was associated with higher levels of blood pressure only among low SES African Americans. Apparently, the occupancy of two low status positions (low SES and dark skin color) was especially deleterious to health.

Prior research has shown that skin tone is also a marker for discrimination, with darker skinned blacks reporting higher levels of discrimination than their lighter skinned peers (Keith & Herring, 1991; Klonoff & Landrine, 2000). Because dark skinned African Americans experienced more discrimination than their light skin peers, skin color may interact with discrimination to affect health. However, prior research has not examined potential interactions between skin color and discrimination on health outcomes. Moreover, women, both African-American and white, are more likely to report gender discrimination. However, African American women are less likely to report racial discrimination than African American men (Keith & Herring, 1991; Klonoff & Landrine, 2000; Krieger, Sidney, & Coakley, 1998) but more likely to be educated and be in executives and professional occupations. Finally, because women tend to have lighter skin than men, it is possible that the association between skin color and health outcomes

vary with gender. Therefore, skin color, discrimination and SES could be related to health in complex ways. These associations could also vary by gender, due to differences in levels and sources of discrimination experienced by men and women. However, at the present time, we do not have a clear understanding of how discrimination, skin color, and SES relate to each other and combine to affect the health risks of contemporary African American men and women. Some evidence suggests that the significance of skin color within the African American population may be declining in the post-1960s black consciousness era (Brown et al., 1999), while other evidence indicates that the shade of one's skin continues to matter for Blacks (Herring, Keith, & Horton, 2004).

The availability of data from CARDIA, a 15-year longitudinal study of the evolution of cardiovascular risk among young adults, affords the opportunity to investigate the association of self-reported physical and mental health status with perception of racial discrimination and also with skin color, before and after adjusting for selected covariates, including indicators of socioeconomic position (SEP), in African American men and women. We hypothesized that racial discrimination and darker skin color would each be associated with worse mental and physical health in African American men and women. We further hypothesized that the potential associations between skin color and health outcomes might be mediated by racial discrimination (skin color causing discrimination that causes poor health outcomes). Alternatively, skin color, as a marker of genetic admixture, might be confounding associations between discrimination and health outcomes (genetic effects on phenotypes associated both with discrimination and health outcomes). We also hypothesized that these complex associations of racial discrimination and skin color with health would differ by gender and by socioeconomic indicators.

Methods

CARDIA is a prospective study of cardiovascular risk factors in 5115 persons aged 18–30 years at the baseline examination (1985–1986), recruited primarily through telephone contact from community lists in three cities (Birmingham, AL; Chicago, IL; and Minneapolis, MN) and from the membership roster of a large prepaid health plan (Oakland, CA) (Cutter et al., 1991; Friedman et al., 1988). The

goal of the recruitment was to obtain at each of the four centers nearly equal numbers of African Americans and whites, men and women, persons less than 25 and 25 or more years of age, and persons with high school education or less and more than high school education. After the initial baseline examination, the cohort was re-examined at years 2, 5, 7, 10, and 15. Overall retention of the cohort at the Year 15 follow-up examination (2000–2001), on which this analysis was based, was 74%. This analysis was limited to African Americans, yielding a sample of 1722 after excluding the few individuals with missing information on perceived racial discrimination ($n = 15$). Although information on discrimination was collected in whites, there was not enough variation to examine associations of discrimination with health outcomes in this group. The Institutional Review Board at each center approved the CARDIA study protocol and informed consent was obtained for each participant.

Age and gender were collected at baseline and verified or updated at the Year 2 examination. At Year 15, participants were asked about their experiences of discrimination due to race/ethnicity, gender and socioeconomic status (Krieger & Sidney, 1996; Krieger et al., 1998). In this manuscript, we focus on racial discrimination. Participants were asked whether they had ever experienced discrimination, or had been hassled or made felt inferior because of their race/ethnicity in any of seven domains: at school, getting a job, getting housing, at work, at home, getting medical care, on the street or in a public setting. For participants answering "Yes" to any of these questions, a follow-up question asked how often this happened (rarely, sometimes and often). To assess racial discrimination, a summary scale was created as the sum score of answers to the seven discrimination questions (for each question, 0 points were given to those who answered "No", 1 point for "rarely" as a follow-up to an affirmative answer, 2 points for "sometimes", and 3 points for "often"). The summary score ranges from 0 to 21, with increasing values indicating higher frequency/intensity of experiencing discrimination. In addition, we dichotomized the racial discrimination variable into none versus any experience of racial discrimination. We also examined the presence of discrimination in each domain as separate dichotomous variables.

Self-reported mental and physical health status were ascertained at Year 15 using the 12 standardized questions from the Medical Outcomes Study

Short Form (SF-12) (Ware, Kosinski, & Keller, 1995). The responses to the 12 questions were summarized through standardized scoring into two summary scores, one for mental health, the Mental Component Score (MCS), and another for physical health, the Physical Component Score (PCS) (Ware et al., 1995). The psychometric properties of these widely used scales have been evaluated and they support the validity and reliability of the scale (Gandek et al., 1998; Ware, Kosinski, & Keller, 1996). Briefly, six questions regarding health and ability to perform daily activities were used for the PCS summary score and 6 questions related to emotional status and depression were used for the MCS summary score. PCS and MCS scoring have been normalized to range between 0 (worst health status) and 100 (best), with 50 representing average health status for a population-based sample (Ware et al., 1995). PCS ranged from 7.8 to 66.4 and MCS from 9.7 to 68.4 in the African American CARDIA sample. In addition, the single item for self-perceived health ("In general would you say your health is: Excellent, very good, good, fair, poor?") was used to complement the analyses. Consistent with previous studies (Kawachi, Kennedy, & Glass, 1999; Kennedy, Kawachi, Glass, & Prothrow-Stith, 1998; Malmstrom, Sundquist, & Johansson, 1999; Subramanian, Kawachi, & Kennedy, 2001; Yen & Kaplan, 1999), we dichotomized self-perceived health into those rating their health as excellent, very good or good versus those rating their health as fair or poor. We also investigated the Center for Epidemiologic Studies Depression (CES-D) scale to assess depressive symptoms. The validity and reliability of this score have been previously reported (Hann, Winter, & Jacobsen, 1999; Radloff, 1977). The theoretical range of the score is 0 (best, no depressive symptoms) to 60 (worst) and for this sample a range of 0–54 was observed. The correlation of $r = 0.07$ between MCS and PCS indicates that these outcomes tap into different aspects of health. CES-D shows a stronger correlation with both PCS ($r = -0.23$) and MCS ($r = -0.68$).

Skin color data were obtained from the Year 7 follow up examination of the CARDIA cohort during 1992–1993. Measurement of skin color, using amber, blue, and green filters of a Photovolt 577 reflectance meter, was based on readings taken from the medial aspect of the upper arm (a surface typically not exposed to the sun, and therefore, with little or no variation in color over time). This instrument has been used in several studies (Clark, Stark, Walsh, Jardine, & Martin, 1981; Dwyer, Muller, Blizzard, Ashbolt, & Phillips, 1998; Krieger et al., 1998; Shriver & Parra, 2000) and has been validated (Shriver & Parra, 2000). Values pertain to percentage of reflected light and range from 0 to 100, with low values (low reflectance) indicative of dark skin. Because values for the amber, blue and green filters were highly correlated ($r = 0.87$ for amber and blue; $r = 0.96$ for amber and green and $r = 0.89$ for blue and green), consistent with a previous study (Krieger et al., 1998) we used only amber reflectance measures in the analyses.

Income and education obtained from the Year 15 interview of the CARDIA cohort were used as SEP indicators. Each participant selected his/her total combined family annual income from 10 categories (under $5,000; $5,000–$11,999; $12,000–$15,999; $16,000–$24,999; $25,000–$34,999; $35,000–$49,999; $50,000–$74,999; $75,000–$99,999; $100,000 and more; and non response). Income was missing for 2.1% of the sample ($n = 37$). For these analyses, the first two categories of income were collapsed into one category due to the small sample size. Educational attainment was collected in years from 1 to 20 and as a categorical variable (high school diploma or general equivalence diploma (GED); associate degree; bachelor's degree; master's degree; doctorate; and professional, MD, JD, DDS, etc.). For these analyses, we recoded education as less than high school; high school; some college; college graduate; and graduate school.

Statistical analysis

We conducted all analyses separately by gender because evidence suggests that the relationship of discrimination and skin color with health outcomes may differ by gender. Descriptive statistics for selected covariates were calculated by racial discrimination (Yes/No). To determine statistical significance of differences, chi-square (discrete variables) and *t*-tests (continuous variables) were used.

Linear regression was used to estimate the association of physical health (PCS), mental health (MCS) and CES-D with racial discrimination and skin color before and after controlling for age, marital status, and SEP indicators. In addition, logistic regression was used to assess the strength of the association between racial discrimination and self-perceived health as a dichotomous outcome. To test whether skin color might be a confounder for the associations between racial discrimination and

health outcomes, we also adjusted for skin color. Similar analyses were conducted when tertile of skin color was used as the main independent variable.

Interaction terms between skin color and discrimination (as a dichotomous variable representing any discrimination as well as separately by domain) were tested. We also tested interactions of income and education with racial discrimination and skin color by including appropriate interactions terms in regression models. Trend tests were conducted by including skin color tertile as an ordinal variable in the models. Two-sided p values of <0.05 were considered statistically significant. Analyses were performed using SAS V9.1 (SAS Institute Inc., SAS/STAT 9.1 User's Guide, 2004).

Results

On average, African American men were more likely to be married, less educated and more likely to be in the higher income categories than African American women (Table 1). Women reported significantly worse mental (mean MCS 48.6 versus 51.5) and physical health (mean PCS 50.1 versus 51.3) than men. The same pattern held for the CES-D score (11.2 for women versus 9.5 for men). Men were more likely to report any experience of discrimination than women (78.1% versus 73%). This pattern is present across the seven domains of discrimination but gender differences are statistically significant only for discrimination getting a job (42.5% and 51.6% for women and men, respectively) and at work (46.3% and 54.0% for women and men, respectively). However, there was no significant gender difference for the racial discrimination summary score, overall or restricted to those reporting any discrimination. Women had significantly higher mean skin reflectance (lighter skin color) than men. There was a higher proportion of women than men in the lightest skin tertile and a higher proportion of men than women in the darkest tertile.

Among men and women, those who reported experiencing any racial discrimination were more educated than those who report no experience of discrimination (Table 2). In addition, women reporting experiencing any discrimination tend to report higher income than their counterparts reporting no discrimination. Men and women who report experiencing any discrimination had lower mean MCS (51.1 and 47.8, respectively) than their counterparts experiencing no discrimination (52.9

and 50.7, respectively). The CES-D score was also higher in men and women who reported discrimination, although the differences were not statistically significant. There was, however, no significant difference in the proportion of either men or women reporting excellent, very good or good health or the mean PCS score between those reporting and not reporting discrimination. Men were more likely than women to be in the darkest skin color tertile regardless of their experience of discrimination. Men who reported discrimination were slightly more likely to be in the lighter skin color tertile than those who did not, but no clear differences in skin color by reported discrimination were observed in women.

Table 3 shows odds ratios (OR) of excellent to good versus fair to poor health and mean differences in PCS, MCS and CES-D scores associated with one unit increases in perceived racial discrimination summary score, by gender. Self-perceived discrimination was associated with a reduced odds of excellent to good health, a decrease in mean PCS and MCS scores and an increase in the CES-D score, indicating worse mental and physical health, in both men and women. However, in general, self-perceived racial discrimination tends to be more strongly associated with worse mental and physical health in women than in men. For example, comparing the estimates for MCS and PCS after adjusting for age, income and education (Model 2), the estimates for women were almost twice the magnitude of the estimates for men. Specifically, there was a decrease of 0.25 and 0.56 in the mean PCS and MCS score for women as compared to 0.13 and 0.31 for men (p—for gender differences: 0.29 for PCS and 0.03 for MCS). The same pattern was observed for CES-D, however, the difference between estimates for women and men was less striking (0.41 vs 0.29; p—for gender differences: 0.24). These results barely changed after additional adjustment for skin color (Model 3).

We repeated the analysis for Model 2 using perceived discrimination as a dichotomous variable (none versus any perceived racial discrimination) and the results were consistent in terms of the magnitude and direction with those described for the continuous discrimination score for men and women (data not shown in Table 3). Furthermore, we assessed the association between discrimination in each domain separately (as dichotomous variables) and each outcome in men and women. For

Table 1

Sociodemographic characteristics, self-reported health, perceived racial discrimination and skin color among African Americans, by gender: the CARDIA study 2000–2001

Characteristics	N	Women	N	Men
Age in years: mean (SD)	1016	39.7 (3.9)	706	39.5 (3.7)
Married (%)	1008	46.2	702	54.8[**]
Education (%)	1012		704	
Incomplete high school		6.6		9.7
Complete high school or GED		21.7		28.5
1–3 years of college		42.5		37.8
4 years of college		19.1		17.0
Some graduate or professional school		10.1		7.0[**]
Income (%)	999		686	
<$12,000		11.4		10.3
$12,000–$15,999		5.5		5.1
$16,000–$24,999		10.8		7.0
$25,000–$34,999		12.9		13.0
$35,000–$49,999		18.6		18.4
$50,000–$74,999		20.9		19.7
$75,000–$99,999		11.6		13.8
⩾$100,000		8.2		12.7[**]
Perception of Health (%)	1010		706	
Excellent		10.2		15.5
Very good		34.1		38.7
Good		42.8		33.4
Fair		11.7		11.3
Poor		1.2		1.1[**]
Physical health summary-PCS: mean (SD)[a]	1002	50.1 (8.0)	701	51.3 (7.5)[*]
Mental health summary-MCS: mean (SD)[a]	1002	48.6 (10.3)	701	51.5 (8.5)[**]
CES-D Score[b]	996	11.2 (8.9)	702	9.5 (7.4)[**]
Discrimination				
Any racial discrimination (%)	1016	73.0	706	78.1[*]
Ever experience of discrimination				
At school		30.4		31.7
Getting a job		42.5		51.6[**]
Getting housing		27.1		29.0
At work		46.3		54.0[**]
At home		3.9		4.0
Getting medical care		15.1		13.5
On the street or in a public setting		58.2		62.4
Racial discrimination summary score[c] Mean (SD)	1016	4.25 (4.2)	706	4.58 (4.1)
Racial discrimination score for those reporting any discrimination: mean (SD)	741	5.8 (3.8)	551	5.8 (3.9)
Skin color[d]				
Reflectance: mean (SD)	883		605	
Amber		23.2 (7.2)		20.4 (6.9)[**]
Skin color reflectance tertiles (%)	883		605	
Darkest		25.2		43.5
Medium		34.4		32.2
Lightest		40.3		24.3[**]

p-values comparing women and men for chi-square and *t*-tests [*] <0.05, [**] <0.01.

[a]PCS and MCS score on scale from 0 (worst) to 100 (best).

[b]CES-D on scale from 0 (best) to 60 (worst).

[c]On a scale from 0 (no discrimination) to 21 (frequent discrimination in all domains).

[d]Measured in Year 7 (1992–1993): lower means darker.

Table 2
Sociodemographic characteristics, self-reported health and skin color by self-perceived racial discrimination and gender: the CARDIA Study, 2000–2001

Characteristics	Women		Men	
	Discrimination			
	No ($n = 275$)	Yes ($n = 741$)	No ($n = 155$)	Yes ($n = 551$)
Education (%)				
Incomplete high school	11.4	4.9	9.0	9.8
Complete high school or GED	30.4	18.5	38.7	25.7
1–3 years of college	42.9	42.3	36.8	38.1
4 years of college	11.4	21.9	12.3	18.4
Some graduate or professional school	4.0	12.3**	3.2	8.0**
Income (%)				
<$12,000	18.5	8.8	13.3	9.5
$12,000–$15,999	7.0	4.9	6.7	4.7
$16,000–$24,999	12.9	10.0	10.0	6.2
$25,000–$34,999	11.1	13.6	12.7	13.1
$35,000–$49,999	17.0	19.2	16.7	18.8
$50,000–$74,999	17.8	22.1	22.0	19.0
$75,000–$99,999	9.6	12.3	8.7	15.3
⩾$100,000	5.9	9.0**	10.0	13.4
Perception of health (%)				
Fair or poor	13.6	12.6	15.5	11.6
Physical health summary-PCS: mean (SD)	50.3 (7.5)	50.0 (8.2)	51.3 (7.7)	51.3 (7.4)
Mental health summary-MCS: mean (SD)	50.7 (8.6)	47.8 (10.8) **	52.9 (8.2)	51.1 (8.6)*
CES-D Score	10.4 (7.9)	11.5 (9.3)	9.3 (7.3)	9.6 (7.4)
Skin color amber reflectance: mean (SD)	22.9 (6.9)	23.3 (7.3)	19.2 (6.7)	20.8 (6.9)*
Tertiles (%[c])				
Darkest	26.9	24.6	53.6	40.5
Medium	34.8	34.3	28.3	33.4
Lightest	38.2	41.1	18.1	26.1*

p-values for chi-square and *t*-tests *<0.05, **<0.01.

women, perceiving discrimination at work was associated with worse physical and mental health, and perceiving discrimination in getting housing was associated with worse mental health. For men, experiencing discrimination at work was associated with worse physical health and perceiving discrimination in getting medical care was associated with worse mental health. It is worth noting that the estimates were not substantially different from the ones presented in Table 3 for summary measures of discrimination in men and women.

There were no robust associations of skin color with the outcomes investigated, for either women or men (Table 4). In unadjusted analyses, and after adjusting for age only, darker skin color was associated with worse physical health, but additional adjustment for socioeconomic factors rendered the association statistically insignificant.

Further adjustment for each domain of discrimination did not change the results presented in Table 4.

For both men and women, we found no evidence that discrimination interacted with skin color or with education. However, for women only, an interaction was found between income and discrimination in the model for MCS (*p*—interaction = 0.03, data not shown). For purpose of examining the interaction, income was categorized as follows: less than $16,000, $16,000–$34,999, $35,000–$74,999 and $75,000 or more. In women with an income of less than $16,000, between $16,000–$34,999 and $35,000–$74,999, a one unit increase in the discrimination scale was associated with a decrease of 0.77, 0.65 and 0.60 in the mean MCS score, respectively; in contrast in women with income greater than $75,000, there was no association

Table 3
Measures of association (95% confidence intervals) between unit increase in the perceived racial discrimination score (main independent variable) and self-reported health status, for African Americans, by gender: the CARDIA study, 2000–2001[a]

Health status measure[b]	Crude	Model 1[c]	Model 2	Model 3
Women				
Perception of health: odds ratio	0.95 (0.91, 0.99)	0.95 (0.91, 0.99)	0.92 (0.88, 0.97)	0.92 (0.88, 0.97)
Physical health summary (PCS): regression coefficient	−0.16 (−0.28, −0.04)	−0.15 (−0.27, −0.04)	−0.25 (−0.36, −0.13)	−0.23 (−0.35, −0.10)
Mental health summary (MCS): regression coefficient	−0.52 (−0.67, −0.37)	−0.52 (−0.67, −0.37)	−0.56 (−0.71, −0.41)	−0.60 (−0.76, −0.43)
CES-D Score: regression coefficient	0.32 (0.19, 0.45)	0.32 (0.19, 0.45)	0.41 (0.28, 0.54)	0.42 (0.28, 0.56)
Men				
Perception of health: odds ratio	0.97 (0.92, 1.03)	0.98 (0.93, 1.03)	0.97 (0.92, 1.03)	0.96 (0.90, 1.02)
Physical health summary (PCS): regression coefficient	−0.14 (−0.27, −0.003)	−0.12 (−0.26, 0.01)	−0.13 (−0.26, 0.002)	−0.11 (−0.26, 0.02)
Mental health summary (MCS): regression coefficient	−0.29 (−0.45, −0.14)	−0.29 (−0.44, −0.13)	−0.31 (−0.46, −0.16)	−0.32 (−0.48, −0.15)
CES-D Score: regression coefficient	0.27 (0.14, 0.40)	0.26 (0.13, 0.41)	0.29 (0.17, 0.41)	0.34 (0.20, 0.47)

[a]For each column, four separate models are presented, one for each health status measure, i.e., each cell represents a separate model.
[b]Increasing values of the physical and mental health summary indicate better health while decreasing values of CESD indicates better health. Estimates for perception of health are odds ratios modeling excellent, very good to good versus poor to fair. Estimates for the other outcomes are linear regression coefficients. Estimates are presented with their 95% CI.
[c]Coefficients and odds ratios adjusted as follows: (1) for age; (2) age, income and education; and (3) additionally adjusted for skin color reflectance.

between discrimination and the MCS score. There was no interaction between skin color and income or education in neither men nor women.

Discussion

In our cohort of 33–45 year old African-Americans from four urban areas in the US, self-reported racial discrimination was reported in 75% of participants, but was somewhat more common in men than in women and in those with higher educational attainment independent of gender. We confirmed our initial hypotheses that perceived racial discrimination is associated with worse physical and mental health in both men and women, a finding that persisted after adjustment for age, education and income. Interestingly, the associations of self-reported physical and mental health and of depressive symptoms with self-reported racial discrimination were stronger among women than among men. Although we found a moderate association between skin color and racial discrimination, there was no consistent association between skin color and the measures of self-reported health that we investigated. No interaction was observed between discrimination and skin color for men or women.

Our findings are consistent with those of others focusing on the association between self-reported physical health and perceived discrimination, which have used self-rated health as the outcome and have reported that discrimination was associated with poorer health status (Finch, Hummer, Kolody, & Vega, 2001; Gee, 2002; Karlsen & Nazroo, 2002; Ren, Amick, & Williams, 1999; Schulz & Israel, 2000; Schulz, Israel, et al., 2000). With few exceptions (Gee, 2002), studies have generally found an inverse association between perceived racial discrimination and physical health (Finch et al., 2001; Karlsen & Nazroo, 2002; Krieger & Sidney, 1996; Ren et al., 1999; Schulz & Israel, 2000; Schulz, Israel et al., 2000). We found that self-reported experience of racial discrimination was associated with poor self-reported physical health in men and women regardless of skin color, with women exhibiting stronger associations than men. Further, these gender differences in the effect of discrimination persisted after adjusting for education, income and skin color. Analyses not shown indicated that among those reporting racial discrimination, the mean gender discrimination score was higher for women (4.6, SD 3.9) than for men (4.1, SD 3.9;

Table 4

Measures of association (95% confidence intervals) between tertile of skin color (main independent variable) and self-reported health status, for African Americans by gender: the CARDIA study, 2000–2001

Health status measure[a]	Skin color			
	Crude	Model 1[b]	Model 2	Model 3
Women				
Perception of health				
Darkest	0.80 (0.49, 1.30)	0.78 (0.48, 1.27)	0.85 (0.51, 1.41)	0.85 (0.51, 1.42)
Medium	1.16 (0.72, 1.87)	1.14 (0.70, 1.84)	1.32 (0.80, 2.19)	1.29 (0.78, 2.14)
Lightest	1.00	1.00	1.00	1.00
P-Trend	0.45	0.38	0.55	0.64
Physical health summary (PCS)				
Darkest	−1.33 (−2.65, −0.01)	−1.43 (−2.74, −0.11)	−0.98 (−2.28, 0.32)	−0.94 (−2.23, 0.36)
Medium	−0.45 (−1.66, 0.75)	−0.51 (−1.71, 0.69)	−0.02 (−1.20, 1.15)	−0.07 (−1.24, 1.10)
Lightest	Reference	Reference	Reference	Reference
P-Trend	0.05	0.04	0.17	0.18
Mental health summary (MCS)				
Darkest	0.56 (−1.19, 2.30)	0.56 (−1.19, 2.31)	0.71 (−1.06, 2.48)	0.82 (−0.90, 2.54)
Medium	1.05 (−0.54, 2.64)	1.05 (−0.54, 2.64)	1.29 (−0.30, 2.89)	1.17 (−0.38, 2.73)
Lightest	Reference	Reference	Reference	Reference
P-Trend	0.43	0.43	0.33	0.27
CES-D Score				
Darkest	0.38 (−1.11, 1.88)	0.38 (−1.12, 1.87)	−0.29 (−1.76, 1.17)	−0.33 (−1.77, 1.10)
Medium	−0.45 (−1.82, 0.91)	−0.46 (−1.83, 0.91)	−1.05 (−2.38, 0.28)	−0.98 (−2.29, 0.32)
Lightest	Reference	Reference	Reference	Reference
P-Trend	0.71	0.71	0.55	0.52
Men				
Perception of health				
Darkest	0.75 (0.40, 1.39)	0.74 (0.40, 1.39)	1.23 (0.62, 2.44)	1.16 (0.58, 2.32)
Medium	0.79 (0.41, 1.54)	0.78 (0.40, 1.51)	1.00 (0.49, 2.05)	0.96 (0.47, 1.98)
Lightest	1.00	1.00	1.00	1.00
P-Trend	0.38	0.38	0.51	0.61
Physical health summary (PCS)				
Darkest	−0.94 (−2.47, 0.59)	−0.95 (−2.47, 0.57)	−0.05 (−1.55, 1.45)	−0.17 (−1.68, 1.33)
Medium	−1.20 (−2.82, 0.42)	−1.29 (−2.90, 0.32)	−0.85 (−2.42, 0.73)	−0.92 (−2.49, 0.66)
Lightest	Reference	Reference	Reference	Reference
P-Trend	0.30	0.30	0.89	0.98
Mental health summary (MCS)				
Darkest	0.46 (−1.31, 2.23)	0.45 (−1.32, 2.22)	1.48 (−0.27, 3.23)	1.14 (−0.60, 2.88)
Medium	1.11 (−0.76, 2.99)	1.06 (−0.81, 2.94)	1.37 (−0.47, 3.21)	1.18 (−0.64, 3.00)
Lightest	Reference	Reference	Reference	Reference
P_{-Trend}	0.75	0.74	0.12	0.24
CES-D Score				
Darkest	1.89 (0.35, 3.43)	1.89 (0.35, 3.43)	0.70 (−0.76, 2.17)	1.08 (−0.36, 2.52)
Medium	0.96 (−0.67, 2.59)	0.98 (−0.65, 2.61)	0.52 (−1.02, 2.06)	0.73 (−0.78, 2.25)
Lightest (Referent)	Reference	Reference	Reference	Reference
P-Trend	0.01	0.01	0.36	0.15

[a]Increasing values of the physical and mental health summary indicate better health while decreasing values of CESD indicates better health. Estimates for perception of health are odds ratios modeling excellent, very good to good versus poor to fair. Estimates for the other outcomes are linear regression coefficients. Estimates are presented with their 95% CI.

[b]Coefficients and odds ratios adjusted as follows: (1) for age; (2) age, income and education; and (3) additionally adjusted for racial discrimination.

$p = 0.02$). These findings may be underscoring the interacting effect of race and gender in our society. Specifically, women could be experiencing a double load of discrimination because of their race and their

gender and the health consequences of discrimination may be enhanced by sex discrimination.

Mental health has been the outcome most commonly examined when studying the effects of

racial discrimination, with most studies reporting an association between perceived discrimination and worse mental health, regardless of the indicator used (Finch, Kolody, & Vega, 2000; Gee, 2002; Jackson et al., 1996; Karlsen & Nazroo, 2002; Kessler, Mickelson, & Williams, 1999; Siefert & Bowman, 2000; Whitbeck, McMorris, Hoyt, Stubben, & Lafromboise, 2002). Consistent with these findings, our study also shows an association between self-reported discrimination and poor mental health status, with women exhibiting stronger associations than men. These patterns persisted after adjusting for income, education and skin color. Moreover, the association between discrimination and mental health as measured by MCS among women was modified by income. Women with low income exhibited a greater decrease in their mean MCS score associated with discrimination than women with high income. We repeated the analyses including marital status in the model and the results remain nearly identical (data not shown). Therefore, it is possible that high income women have social and material resources that allow them to effectively cope with discrimination and buffer its health effects. Our findings therefore suggest that gender and socioeconomic position need to be considered when studying the health effects of discrimination.

Only a few previous studies have investigated skin color, either as an adjustment variable or as a proxy for perceived discrimination in its relationship with blood pressure or other specific physical health outcomes (Keil et al., 1981; Keith & Herring, 1991; Klag et al., 1991; Krieger et al., 1998), and no studies have investigated the association between skin color, as a proxy for discrimination, and global physical or mental health. Existing studies have examined the association between skin color and hypertension (Klag et al., 1991), racial discrimination and skin color (Krieger et al., 1998) and skin color, SEP and blood pressure (Keil et al., 1981). In general, these studies have found an association between skin color and health that could be explained or modified by SEP. For example, Klag et al. found that African Americans with darker skin who had not completed high school exhibited higher systolic and diastolic blood pressure than those with lighter skin color, while the opposite was true for African Americans who completed high school (Klag et al., 1991). Keil et al. found no effect of skin color on the incidence of hypertension among men after controlling for education (Keil et

al., 1981). However, among those with less education, systolic and diastolic blood pressures were slightly higher in those with lighter skin color. In parallel to the health studies summarized above, a large body of work in sociology has demonstrated that skin color is associated with income, education and occupation, which in turn have implications for health. For example, Keith and Herring show that skin tone influences African Americans' life chances: dark skinned African Americans achieve less education, are more likely to hold low pay jobs and more likely to have lower income than their light skinned counterparts (Keith & Herring, 1991). These associations were also present in the CARDIA sample. Specifically, dark skin African Americans were more likely to have less than a high school diploma (9.9%) and have lower income (18.4%) than their light skin counterparts (4.4% and 13.8%, respectively with p-values < 0.001 and 0.004). This pattern was observed regardless of gender.

A previous study using the CARDIA data examined the association between skin color and racial discrimination (Krieger et al., 1998). This study found that among African American men, those with light skin color reported having experienced racial discrimination at school more often than those with dark skin, regardless of their SEP. However, in that study the association between skin color and health was not investigated. Our findings showed no consistent associations of skin color with physical or mental health in African American men or women, before or after controlling for socioeconomic position or perceived racial discrimination. It has been suggested that skin color may be a marker for racial discrimination (Klonoff & Landrine, 2000). However, in our study, darker skin color was associated with greater reports of experiencing discrimination in men only in the unadjusted analyses. These findings on skin color and discrimination were consistent with the existing literature for men (Klonoff and Landrine, 2000; Krieger et al., 1998) and women (Hunter, 2004; Klonoff & Landrine, 2000). In our study, consistent with Klonoff and Landrine (2000), women were more likely to be in the lighter skin group and report lower discrimination than men.

Perceived discrimination and skin color were also associated with higher income and higher education. Specifically, highly educated and high income African Americans were more likely to report experiencing discrimination and have light skin

when compared to their counterparts. It is possible that lighter skinned African Americans with higher SEP report more discrimination because they have greater opportunity to be exposed to situations in which they are discriminated or because they are more aware of subtle forms of discrimination. This finding may be consistent with the fact that historically skin tone has been associated with social status and access to opportunity and resources within the black population (Drake & Clayton, 1945; Frazier, 1957). Alternatively, our null findings between skin color and the outcomes studied as well as the null findings on the interaction between skin color and discrimination or SEP indicators may be an indication that the importance of skin tone may not matter as much in our society nowadays (Brown et al., 1999), and in fact, African Americans may be seen and treated as black regardless of their tone or shade by the US majority. Furthermore, although skin color and the health outcomes were measured at different times, the time period between these measures is unlikely to explain the null findings because skin color was measured at a location (medial upper arm) where skin color shows little changes over time (Clark et al., 1981; Jablonski & Chaplin, 2000; Shriver & Parra, 2000; van der Mei, Blizzard, Stankovich, Ponsonby, & Dwyer, 2002). Nonetheless, we acknowledge that the seasonal variability in skin color could have somewhat biased our skin color findings towards the null. Moreover, all CARDIA data are collected over an entire year (June–May), so there is seasonal variation in the skin color data, but it should not apply differentially by any of our variables. This is simply inevitable "noise" in our data. These are potential limitations of our study.

Among the strengths of our study are the population-based nature of the sample; the focus on young to middle-aged adults; the wide ranges of educational attainment and income represented in the sample; and the multiple measures of health and SEP available. Important limitations are the cross-sectional and observational nature of the data that precludes us from making inferences regarding cause and effect. For example, poor health could cause people to report more discrimination or vice versa. In addition, because both exposure and outcome measures were self-reported, it is possible that same-source bias (i.e. a tendency for individuals who report worse health to also report more discrimination) could have resulted in bias away from the null. Measurements of skin color were

taken eight years before the discrimination and health assessment. Skin color is likely to remain relatively stable over time (Clark et al., 1981; Jablonski & Chaplin, 2000; Shriver & Parra, 2000; van der Mei et al., 2002); however, if skin color changed substantially during this time our results regarding associations of skin color with health could have been either under- or over-estimated.

Our study shows that racial discrimination is associated with worse self-reported physical and mental health in African Americans, regardless of gender and of skin color and socioeconomic indicators, especially in women. A greater understanding of the possible effects of perceived discrimination on health will require both upstream studies that focus on the multiple levels at which discrimination is manifested, and downstream studies that focus on the etiologic mechanisms through which perceived discrimination may exert its effects on health.

Acknowledgments

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