Risk Factor Distribution Among Sociodemographically Diverse African American Adults

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Abstract:

Because African Americans tend to have lower socioeconomic status (SES) than whites and numerous health indicators are related to SES variables, it is important when examining between-group differences in health indices to account for SES differences. This study examined the effects of income and education on several biologic and behavioral risk factors in a sample of sociodemographically diverse African American adults. Approximately 1,000 African American adults (aged 18-87) were recruited from 14 churches with predominantly black membership to participate in a nutrition education intervention. Demographics, height, weight, blood pressure, self- reported cigarette and alcohol use, self-reported diet by food frequency questionnaire, serum carotenoids, serum total cholesterol, and nutrition knowledge were assessed. The association of these risk factors were examined by four levels of education and income. For men, body mass index, blood pressure, total cholesterol, daily intake of fruits and vegetables, serum carotenoids, heavy alcohol use, or exercise were not associated significantly with income or education using analysis of variance (ANOVA). Past month alcohol use and nutrition knowledge were associated positively with education, but not income. For women, body mass index and smoking were associated inversely with income, but not with education. Blood pressure, total cholesterol, intake of fruits and vegetables, heavy alcohol use, and exercise were not associated with either income or education using ANOVA. Serum carotenoids, any 30-day alcohol use, and nutrition knowledge were associated positively with both income and education. Results using linear regression generally were similar for men and women, although a few more variables were associated significantly with SES compared to ANOVA analyses. Several health indicators that have been associated with socioeconomic variables in whites were not associated or only weakly associated in this diverse sample of African Americans. One interpretation of these findings is that SES factors may function differently among blacks and whites.
KEYWORDS Blacks, Cardiovascular Risk Factors, Ethnicity, Sociodemographics.

Article:

INTRODUCTION

Substantial literature has established that African Americans are at increased risk for numerous chronic diseases, including heart disease, stroke, and several cancers, as well as the associated

behavioral and psychosocial risk factors, such as smoking, hypertension, diabetes, poor diet, and health knowledge and attitudes.[1-7] Moreover, there is evidence that the ethnic gap is widening.[7]

Because African Americans tend to have lower socioeconomic status (SES) than whites, and numerous health indicators are related to SES variables,[8] it is important when examining between-group difference in health indices to account for SES differences.[9-11] Failure to do so may lead to inappropriate attribution of differences to ethnic, racial, or genetic factors rather than socioeconomic disparities, which in turn may perpetuate views of racial inferiority or superiority and misdirect health care research and service dollars.[7] Similar to whites, total mortality and cancer rates and some chronic disease risk factors are related inversely to income and education among blacks,[12-14] and the magnitude of the association appears similar, at least with regard to all causes of mortality,[8] cancer rates,[9] and smoking prevalence.[15] Black/white differences in the risk for all causes of mortality,[8] several cancers,[9,16] and smoking rates[15] diminish, or even reverse, after controlling for SES, further suggesting that racial/ethnic differences may be related more to SES than ethnic/ cultural or biologic factors.

On the other hand, in some studies, differences in adult death rates and infant mortality rates and other health indicators such as obesity, body image preferences, high blood pressure, sedentariness, smoking quit rates, diabetes markers, poor diet, and health knowledge remain higher in blacks compared to whites even after adjustment for education and/or income [2,5,6,15,17-23] Conversely, black adolescents appear less likely to smoke cigarettes than whites independent of SES[23]; in adults, blacks have higher dietary carotenoid intake after adjusting for education and income.[24] Thus, some ethnic differences in health indicators appear independent of sociodemographic factors.

One explanation for these inconsistent results is the fact that there is often an insufficient number of middle and upper socioeconomic African American participants in such analyses, and conclusions regarding the effects of SES on health indicators across ethnic groups are often based on small samples and unstable parameter estimates.[6,18,25,26] Another explanation is that socioeconomic factors function differently among blacks and whites[7'22] For example, African Americans reap a lower increase in income per year of education, and they have lower net worth at all income levels than whites.[7,22] It is also possible that ethnicity, genetics, and socioeconomic factors can each influence the same health indicator independently.

This study examines the effects of income and education on several biologic and behavioral risk factors in a sample of African American adults that represents the entire socioeconomic spectrum. Although no whites were included in this sample, examination of the effect of SES variables on risk factors can elucidate possible cultural, ethnic, or racial differences. That is, if SES variables that have been shown previously to predict health indicators in other populations are unrelated in this sample, this may indicate unique ethnic patterns that might inform development of public health policy and intervention.

MATERIALS AND METHODS

Data for this analysis derive from the baseline assessment of the Eat for Life trial, a federally funded intervention to increase intake of fruits and vegetables among African American adults recruited through churches with predominantly black attendees in the Atlanta, Georgia, metropolitan area.27 Prior to randomization, churches were matched on SES (low, mixed, or high) and size. They were then assigned to one of three treatment conditions: (1) comparison (usual nutrition education), (2) culturally sensitive multicomponent intervention with one telephone counseling call, and (3) culturally sensitive multicomponent intervention with four telephone counseling calls. Four churches were assigned to each of Conditions 1 and 3, and six churches were assigned to Condition 2. In addition to the 14 churches from the intervention trial, data from one church that served as the pilot site are also included in the current analyses as the assessment methods used were identical to those in the full trial. All assessments were obtained prior to initiation of the intervention. Additional information regarding the study can be found elsewhere.[27]

Measures

Physiologic Measures Total cholesterol was measured in nonfasting capillary samples using the Johnson and Johnson/Kodak DT60. Precision and accuracy of this method have been reported elsewhere.[28-31] Systolic and diastolic blood pressure were assessed twice. A third reading was taken if the first two values differed by more than 5 mmHg. Height and weight were obtained by trained staff; subjects removed shoes and heavy outer clothing, and staff used the Healthometer Digital Office Scale (model 551, Springfield, IL) and converted the findings to body mass index (BMI).

Serum Carotenoids The five major carotenoids (lycopene, lutein, cryptoxanthin, α-carotene, and β-carotene) were measured in extracted serum using a high-performance liquid chromatographic method.[32] Assays were performed at the Centers for Disease Control and Prevention (CDC) Nutrition Biochemistry Branch, Division of Environmental Health Laboratory Science. Carotenoid values, which were obtained from 813 participants, were similar to those reported for a sample of African American women recruited from an inner-city hospital in Atlanta, Georgia.[33]

Food Frequency Questionnaires Three food frequency questionnaires (FFQs) of varying length and format were administered. Participants completed a 7-item fruit-and-vegetable FFQ that assessed intake in the past month; the FFQ was based on the Behavioral Risk Factor Surveillance System instrument.[34] To reduce over-reporting, the response categories of four and five times per day were removed. The second FFQ was a 2-item measure that queried the number of fruit servings and the number of vegetable servings usually consumed each day. The third FFQ was a 36-item measure of the intake of fruits and vegetables; this FFQ was developed for this study based on the Health Habits and History Questionnaire (HHHQ).[35]

To improve validity of the third instrument, several modifications were made to the original HHHQ. First, participants were asked to indicate the number of times they consumed each item in the past week rather than the longer retrospective time frame typically employed.[36] Second, respondents indicated frequency of consumption using an open-end rather than closed-end format. Third, portion size of each fruit and vegetable was embedded in the item (e.g., 1 whole apple). Portion size was fixed at a medium serving. Finally, several items that were paired on the original HHHQ instrument (e.g., tomato and tomato juice) were separated into individual items.

We excluded from the analysis any participant (n = 17) who was missing more than half of the vegetable items (i.e., 10 items) or fruit items (i.e., 8 items) from the 36-item FFQ. Participants missing fewer than one-half of the fruit or vegetable items were assigned a frequency of never for those missing items. Intakes of fruits and vegetables from the three FFQs were average to yield a composite measure. Validity of the three measures has been reported elsewhere.[37]

Nutrition Knowledge Nutrition knowledge was measured with an eight-item index that assessed awareness of a single serving size of various fruits and vegetables. Two serving sizes were presented, and the respondent was asked to check which of the two represents a single serving.[27] Correct responses were summed with a range of 0 to 8.

Behavioral Variables For behavioral variables, use of any cigarettes or alcohol in the past 30 days was assessed with single items using response categories none, 1 or 2 days, 3 to 5 days, 6 to 9 days, 10 to 19 days, and 20 to 31 days. Any use was coded as 1, and no use was coded 0. Heavy alcohol use was considered use more than nine times per month. Exercise was assessed with a single open-end item: How many times per week do you exercise hard enough to make you breathe hard or sweat?

Socioeconomic Variables

Household income was assessed with an eight-category ordinal item, with answers that ranged from less than $10,000 to more than $70,000. Income was collapsed into four categories: less than $10,000, $10,001—$19,999, $20,00—$39,999, and $40,000 or more. Education, assessed with eight categories, was also collapsed into four categories: less than high school, high school or vocational school, started college, and completed college or higher. Analyses that used three groups, collapsing the first two groups for both income and education, yielded results virtually identical to results based on four groups and are not reported here. As shown in Table 1, there was moderate agreement between income and education classification, suggesting the two variables assess related, but somewhat unique, dimensions of socioeconomic status.

Data Analyses

Analyses of risk factors across income and education categories are presented separately for men and women. Risk factors are adjusted for age, using either analysis

TABLE 1. Association of self-reported income and education in a sample of African American adults: the Eat for Life project

	Income, %			
Education	<$10,000	$10,000–$19,999	$20,000–$39,999	$40,000+
<High school	22.4	40.3	31.3	6.0
High school or vocational school	14.3	17.2	34.4	34.1
Some college	7.9	11.9	40.6	39.6
College or above	2.8	4.4	23.1	69.7

of variance (ANOVA), linear regression, or logistic regression, depending on the variable distribution. Both ANOVA and linear regression were used for continuous variables in case the pattern of differences was not linear. The number of servings of fruits and vegetables and serum carotenoid values were log transformed to normalize their distribution. Values presented in the

tables are untransformed, whereas statistical analyses and resulting P values are based on transformed values for these two variables.

RESULTS

Sample

A total of 1,015 participants completed the baseline assessment, of whom 732 (72%) were female, and 100% were African American. Approximately 11% of the sample did not provide education information, and 21% did not indicate their income. Individuals reporting income and education did not differ from those not reporting income and education with regard to age, BMI, diastolic blood pressure, total cholesterol, intake of fruits and vegetables, serum carotenoids, cigarette use, or heavy drinking. Individuals providing income data had significantly lower systolic blood pressure (131 vs. 137 mmHg) and significantly higher nutrition knowledge scores (4.2 vs. 3.8), and they were significantly more likely to report alcohol use (35% vs. 23%) than those not providing income data.

Mean age of those in the sample was 43 years, with a range of 18 to 87. Males had a significantly higher income distribution than females. Females had significantly higher BMI and nutrition knowledge than males. Males had significantly higher diastolic blood pressure and serum carotenoids, and they were more likely to report smoking and alcohol use (see Table 2).

Association of Health Indicators by Income and Education

Males Based on ANOVA or logistic regression (for categorical variables) analyses, BMI, blood pressure, total cholesterol, daily intake of fruits and vegetables, serum carotenoids, heavy alcohol use, or exercise were not associated significantly with income or education among males (Table 3). Alcohol use in the past month and nutrition knowledge were associated positively with education, but not income. That is, males with higher education were more likely to report alcohol use in the past month and to have higher nutrition knowledge scores. Smoking was related marginally *(P* = .05), in the inverse direction, with income. Although overall smoking was not related to education, those with a college education or more were significantly less likely to smoke (odds ratio [OR] 0.27, confidence interval [CI] 0.08-0.83) than those with less than a high school education.

Analyses using linear regression (continuous variables only) rather than ANOVA yielded similar results for BMI, systolic blood pressure, daily intake of fruits and vegetables, exercise, and nutrition knowledge. The effect of income was significant for total cholesterol and serum carotenoids, and the effect of education was significant for diastolic blood pressure (data not shown).

Females Using ANOVA or logistic regression (for categorical variables), BMI and smoking were associated inversely with income for females (Table 4), but not with

TABLE 2. Sample description

	Males (n = 283)	Females (n = 732)	Total (n = 1,015)
Age	43.3 (range 18–84) (13.7)	43.7 (range 18–87) (13.4)	43.6 (range 18–87) (13.5)
Education, %			
<High school	8	8	8
High school or vocational school	35	33	33
Some college	23	23	23
College or above	34	36	35
Income,* %			
<$10,000	5	11	9
$10,000–$19,999	13	13	13
$20,000–$39,999	29	33	32
$40,000+	54	43	46
Body mass index*	29.2 (6.1)	31.0 (7.6)	30.4 (7.3)
Systolic blood pressure (mm/HG)	134.1 (19.7)	131.6 (21.9)	132.2 (21.4)
Diastolic blood pressure (mm/HG)*	83.8 (11.0)	81.0 (12.3)	81.8 (12.0)
Total cholesterol (mg/dL)	204.0 (38.4)	202.9 (39.0)	203.2 (38.9)
Fruit and vegetables (servings per day)	3.7 (2.0)	3.8 (2.0)	3.8 (2.0)
Total serum carotenoids (μg per dL)*	85.0 (43.0)	74.5 (39.1)	77.5 (40.5)
30-Day smoking,* %	18	9	12
30-Day alcohol,* %	40	31	33
Heavy alcohol use,* %	8	3	4
Nutrition knowledge*	3.8 (1.5)	4.3 (1.7)	4.2 (1.7)

Numbers in parentheses are standard deviations.
*Males and females significantly different, $P < .01$, based on ANOVA for continuous variables and chi square for categorical variables.

education. Serum carotenoids, any 30-day alcohol use, and nutrition knowledge were associated positively with both income and education. Blood pressure, total cholesterol, intake of fruits and vegetables, heavy alcohol use, and exercise were not associated with either income or education.

Analyses using linear regression (continuous variables only) yielded similar results for BMI, systolic and diastolic blood pressures, total cholesterol, serum carotenoids, exercise, and nutrition knowledge. However, income and education were related significantly to daily intake of fruits and vegetables (data not shown).

DISCUSSION

For males, none of the health indicators was associated significantly with income based on ANOVA analyses, although for smoking, the effect was borderline significant (Table 5). Two variables, 30-day alcohol use and nutrition knowledge, were associated positively with education. In analysis using linear regression, the effect of income was significant for total

cholesterol and serum carotenoids, and the effect of education was significant for diastolic blood pressure. Linear regression may be a more appropriate method for analysis of such data as it is more sensitive than ANOVA in detecting trends across ordinal groups as opposed to between-group differences.

Lack of an association between SES variables and BMI is consistent with prior studies that found little difference in obesity prevalence among black males[38] The evidence has not been consistent, however, as at least one study found an inverse association between education and BMI in black men[17] Although *P* values did not achieve conventional levels of significance, there was a trend for smoking rates to decrease with increasing levels of income and education. This is consistent with several prior studies among blacks and whites.[5'39,40] In one study, the association of smoking with income was weaker among southern blacks than among those from other regions of the US.[40] It is possible that SES variables among blacks may function differently across geographic regions, where cultural factors may be more influential than SES. Given the small sample size for males, these results, both positive and null, should not be overinterpreted.

For females, the sample size was larger, and SES effects were somewhat more evident. BMI was associated inversely with income, but not education. Prior studies found conflicting results, with some finding an inverse association of obesity with education and income among black women,[5,17,38] and with another finding no effect of SES on obesity rates[18] Two of these studies found significant SES effects on BMI for white women.[5,18] On the other hand, differences in obesity rates between black and white women remained after adjustment for educational attainment.[6,17,18] In addition, neither SES variable was related to exercise habits in our study, but both have been associated with physical activity in the general popoulation.[8] Together, this suggests that cultural factors independent of SES may influence nutritional habits and body weight of black women. That black men and women prefer a larger body type than whites appears to reflect a cultural value somewhat independent of socioeconomics.[20,41-43]

For women, BMI and smoking were associated significantly with income, but not education. Prior studies have found that income was a stronger predictor of total mortality and coronary heart disease prevalence than education among blacks.[8,10] It is possible that income is a better marker of SES status. One reason may be that income is a more dynamic indicator than education, which can remain constant even as income (and therefore SES) fluctuates.[7] Another study involving black women, however, found both income and education were associated significantly with smoking and sedentariness, whereas neither SES variable was associated with obesity prevalence.[18] In addition, among men in this study, two variables (30- day alcohol use and nutrition knowledge) were associated significantly with education, but not income. There is prior evidence that the impact of education and income on health indicators may be gender specific.[5,38,44]

That nondrinking was more prevalent among women with low income and low education (and among males with low education) is consistent with several prior studies of both whites and blacks.[25,26,44] African Americans with lower SES may have more conservative norms regarding alcohol use and therefore may be more likely to abstain from use.

Among both men and women, blood pressure, total cholesterol, intake of fruits

TABLE 3. Chronic disease risk factors among African American males by income and education: the Eat for Life study, 1998

	BMI		Systolic blood pressure		Diastolic blood pressure		Total cholesterol		Daily fruits and vegetables*		Serum carotenoids*	
	Mean†	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Income												
<$10,000	30.3	1.9	128.5	5.9	87.3	3.5	176.1	11.7	3.8	.62	80.1	15.6
$10,000–$19,999	28.6	1.1	130.4	3.5	79.3	2.1	197.8	7.1	4.1	.37	76.7	8.7
$20,000–$39,999	27.9	.77	134.4	2.4	84.3	1.5	208.5	5.0	3.4	.25	81.0	5.8
$40,000+	29.4	.56	134.1	1.8	84.2	1.0	206.6	3.6	3.9	.18	94.6	4.4
P value	.40		.64		.12		.06		.30		.17	
Education												
<High school	30.9	1.5	129.9	4.4	80.0	2.6	193.1	8.7	3.8	.48	62.1	10.5
High school or technical school	28.6	.68	135.5	2.0	83.2	1.2	206.4	4.2	3.5	.21	88.8	5.0
Some college	28.9	.84	133.7	2.5	83.0	1.5	203.9	5.0	4.0	.26	83.2	6.0
College or higher	29.6	.69	135.1	2.1	86.6	1.2	205.5	4.0	3.8	.22	90.5	5.0
P value	.46		.68		.06		.58		.51		.09	

	30-day smoking prevalence, %	30-day alcohol use prevalence, %	Heavy alcohol use prevalence, %	Exercise (times per week)		Nutrition knowledge	
				Mean†	SE	Mean†	SE
Income							
<$10,000	30.0	54.5	0	3.8	.68	3.5	.44
$10,000–$19,999	36.7	40.0	13.3	2.5	.40	3.6	.26
$20,000–$39,999	14.7	31.9	5.8	2.0	.27	3.8	.18
$40,000+	16.5	45.1	8.3	2.1	.17	3.9	.13
P value	.05‡	.31‡	.66‡	.09		.61	
Education							
<High school	38.1	28.6	4.8	2.7	.59	3.0	.32
High school or technical school	18.3	29.5	6.3	2.3	.26	3.7	.15
Some college	16.1	46.8	9.7	2.3	.31	3.6	.18
College or higher	13.0	50.5	8.8	2.2	.26	4.2	.15
P value	.15‡	.02‡	.87‡	.91		.01	

SE, standard error.

**P* values based on log-transformed values.

†All means are adjusted for age.

‡*P* values based on logistic regression adjusting for age. Table presents prevalence rates.

TABLE 4. Chronic disease risk factors among African American females by income and education: the Eat for Life study, 1998

	BMI		Systolic blood pressure		Diastolic blood pressure		Total cholesterol		Daily fruits and vegetables*		Serum carotenoids*	
	Mean†	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Income												
<$10,000	32.3	1.0	129.8	2.4	80.1	1.5	205.5	5.4	3.5	.24	64.6	5.3
$10,000–$19,999	34.1	.91	135.0	2.2	82.1	1.4	203.2	4.7	3.8	.23	69.3	4.9
$20,000–$39,999	31.1	.57	131.1	1.4	80.4	.84	203.1	2.8	3.8	.14	73.6	3.0
$40,000+	29.8	.49	128.8	1.2	80.9	.74	201.7	2.5	3.9	.12	80.1	2.6
P value	.001		.09		.71		.92		.19		.01	
Education												
<High school	30.9	1.2	130.0	2.8	79.9	1.8	205.1	5.7	3.6	.28	77.7	6.0
High school or technical school	31.6	.54	133.5	1.3	82.4	.82	204.1	2.8	3.6	.13	69.4	2.9
Some college	31.0	.63	131.1	1.5	79.5	.96	200.4	3.1	3.9	.16	72.0	3.4
College or higher	30.2	.52	129.0	1.3	80.5	.80	201.0	2.6	4.0	.13	80.6	2.8
P value	.36		.10		.11		.75		.11		.01	

	30-day smoking prevalence, %	30-day alcohol use prevalence, %	Heavy alcohol use prevalence, %	Exercise (times per week)		Nutrition knowledge	
				Mean†	SE	Mean†	SE
Income							
<$10,000	14.5	26.1	2.9	1.5	.23	4.0	.21
$10,000–$19,999	17.5	16.0	2.5	1.1	.22	4.0	.20
$20,000–$39,999	8.3	33.0	1.0	1.5	.13	4.4	.12
$40,000+	6.8	38.9	4.5	1.7	.12	4.6	.11
P value	.02‡	.01‡	.21‡	.17		.01	
Education							
<High school	14.3	21.8	3.6	1.3	.27	3.7	.24
High school or technical school	8.4	22.1	1.0	1.5	.12	4.0	.12
Some college	9.9	29.0	2.5	1.3	.15	4.4	.14
College or higher	7.5	42.3	4.7	1.7	.12	4.6	.11
P value	.42‡	.01‡	.13‡	.13		.01	

SE, standard error.

**P* values based on log-transformed values.

†All means are adjusted for age.

‡*P* values based on logistic regression adjusting for age. Table presents prevalence rates.

TABLE 5. Summary of results

	BMI		Systolic blood pressure		Diastolic blood pressure		Total cholesterol		Daily fruit and vegetables		Serum carotenoids		30-day smoking		30-day alcohol		Heavy alcohol		Exercise		Nutrition knowledge	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Income	N	Y	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	Y	N	N	N	N	N	Y
Education	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	Y	Y	N	N	N	N	Y	Y

M, male; F, female; N, nonsignificant association observed in ANOVA or logistic regression analysis; Y, significant association observed in ANOVA or logistic regression analysis.

and vegetables, and exercise were not related to income or education in ANOVA analyses. Using linear regression, diastolic blood pressure was related to education, and total cholesterol and

serum carotenoids were related to income among males, whereas in females, income and education were related significantly to daily intake of fruits and vegetables. Prior studies have found an association between SES variables and these health indicators in predominantly white or ethnically mixed samples.[6,8,17,18,45,46]

A key finding from this diverse sample of African Americans is that several health indicators that have been associated with socioeconomic variables in whites were not associated, were associated weakly, or were associated inconsistently, depending on the statistical method employed. One interpretation of these findings is that SES factors may function differently among blacks and whites. Given that African Americans of middle and upper SES reap a less of an increase in income per year of education and are more likely to have friends and relatives of lower SES, to have lower total assets, to live in segregated neighborhoods, and to experience unemployment, education and income alone may not capture socioeconomic status adequately.[7,22] In addition, African Americans of middle and upper SES are more likely to have grown up poor and to be the first generation with wealth in their families. This, together with evidence that childhood SES may be a stronger predictor of adult health than adult SES,[7,22,47] could explain in part the weaker association of SES variables with health indicators. Other variables, such as the generationality of wealth, family assets, occupation, SES status of friends and relatives, experiences with racism, neighborhood segregation, and more, may be needed to capture more fully the construct among African Americans.[7,22] On the other hand, absence of SES effects may also indicate strong ethnic/cultural or possibly genetic influences that supersede SES.[24,41]

Interpretation of our findings must be tempered by several study limitations. Particularly for males, sample size was modest and several of the SES trends observed may have been significant statistically with a larger sample. Absence of a white comparison group weakens our ability to interpret these findings. Variables for which no SES effects were observed may also have shown no effect on the same health indicators in whites based on the assessment methods employed here. Church attenders may be healthier than the general population, which would restrict the range of outcomes and therefore decrease the likelihood of detecting significant effects [48,49] Nonetheless, between 50% and 70% of African Americans attend church; therefore, our sample may be representative of the majority of the black population. Measurement error in the health indicators used could have attenuated their association with SES variables. However, the direction and magnitude of the correlations between physiologic variables (e.g., BMI with blood pressure as well as self-reported diet with serum carotenoids) are consistent with prior studies, suggesting that measurement error is an unlikely explanation.[33,37,50-54] Finally, given the cross-sectional nature of the study, for those health indicators associated with SES variables, it is possible that the "illness" (in this case, mostly risk factors) caused SES status rather than the inverse. Thus, any causal interpretations about ethnic differences in the effect of SES variables on health indicators based on our findings should be drawn with caution.

Despite these limitations, our findings suggest that SES variables may function differently, and the association of SES and health indicators may be more complex among blacks. Additional research is needed to understand better the unique effects of cultural, ethnic, genetic, and socioeconomic factors on health indicators, as well as their interaction. To do so, efforts are

needed to include individuals of middle and upper SES when working with minority populations. Researchers are also encouraged to include more complex dimensions of SES status, those beyond income and education such as generationality of wealth, stability of wealth, and family assets, when assessing this construct in minority groups.

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