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Racial Disparities in Cardiovascular Health Behaviors: The Coronary Artery Risk Development in Young Adults Study

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Abstract

Introduction—There are known racial differences in cardiovascular health behaviors, including smoking, physical activity, and diet quality. A better understanding of these differences may help identify intervention targets for reducing cardiovascular disease disparities. This study examined whether socioeconomic, psychosocial, and neighborhood environmental factors, in isolation or together, mediate racial differences in health behaviors.

Methods—Participants were 3,081 men and women from the Coronary Artery Risk Development in Young Adults study who were enrolled in 1985–1986 (Year 0) and completed a follow-up examination in 2015–2016 (Year 30). A health behavior score was created at Years 0, 7, 20, and 30 using smoking, physical activity, and diet assessed that year. The race difference in health behavior score was estimated using linear regression in serial cross-sectional analyses. Mediation analyses computed the proportion of the race and health behavior score association attributable to socioeconomic, psychosocial, and neighborhood factors.

Results—Data analysis conducted in 2016–2017 found that blacks had significantly lower health behavior scores than whites across 30 years of follow-up. Individual socioeconomic factors mediated 48.9%–70.1% of the association between race and health behavior score, psychosocial factors 20.3%–30.0%, and neighborhood factors 22.1%–41.4% ($p < 0.01$ for all).

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Conclusions—Racial differences in health behavior scores appear to be mediated predominately by correspondingly large differences in socioeconomic factors. This study highlights the profound impact of socioeconomic factors, which are mostly not under an individual's control, on health behaviors. Policy action targeting socioeconomic factors may help reduce disparities in health behaviors.

INTRODUCTION

Smoking, physical activity, and healthy eating are important behaviors that influence cardiovascular health (CVH).^{1–3} Known racial differences in CVH behaviors may contribute to existing racial disparities in cardiovascular disease mortality and morbidity. For example, tobacco use was higher among blacks than whites in the 2013–2014 National Adult Tobacco Survey⁴ and U.S. surveys have found the prevalence of leisure time physical activity lower among blacks than whites.⁵ Racial differences in dietary patterns exist, with less healthy diet quality observed in blacks versus whites.⁶ Among adults in the Atherosclerosis Risk in Communities study, the prevalence of ideal health behaviors as defined by the American Heart Association (AHA),⁷ was lower in blacks than whites for smoking (68.5% and 73.5%), physical activity (22.0% and 42.8%), and diet (4.4% and 5.6%).³

Much of the existing literature has focused on socioeconomic and psychosocial factors to explain racial disparities in CVH behaviors. For example, Kiefe and colleagues⁸ found that much of the observed race difference in smoking cessation rates was statistically explained by socioeconomic status. Perceived racial discrimination, more frequently reported by blacks, is associated positively with smoking and negatively with physical activity.⁹ Recently, there has been a growing interest in the role of contextual factors, such as the neighborhood environment, when examining race and CVH.¹⁰ Much of the research examining the association between race and CVH behaviors has focused on individual determinants, and less is known about the relative contribution of these determinants in explaining race differences in CVH behaviors. Clarifying which mechanisms mediate the associations between race and CVH behaviors may allow identification of potential interventions or policies to reduce disparities in health behaviors.

The primary objective is to examine the extent to which racial differences in overall CVH behaviors are attributed to individual-level socioeconomic, psychosocial, and neighborhood factors. It is hypothesized that racial differences in CVH behaviors are largely mediated by socioeconomic, psychosocial, and neighborhood factors. Further, in accord with studies which examined contributions of these factors to specific health behaviors (physical activity and diet) and outcomes (diabetes),^{11,12} it is hypothesized that socioeconomic factors would explain a larger proportion of the race difference in CVH behaviors than psychosocial or neighborhood factors.

METHODS

Study Population

Coronary Artery Risk Development in Young Adults (CARDIA) is a prospective cohort study of 5,115 black or white men and women recruited in 1985–1986 (Year 0) at the ages

of 18–30 years from four centers: Birmingham, Alabama; Minneapolis, Minnesota; Chicago, Illinois; and Oakland, California. Participants completed additional clinic examinations in 1987–1988 (Year 2), 1990–1991 (Year 5), 1992–1993 (Year 7), 1995–1996 (Year 10), 2000–2001 (Year 15), 2005–2006 (Year 20), 2010–2011 (Year 25), and 2015–2016 (Year 30). Attendance of the surviving cohort at each exam were 91% (Year 2), 86% (Year 5), 81% (Year 7), 79% (Year 10), 74% (Year 15), 72% (Year 20), 72% (Year 25), and 71% (Year 30). Details on study design have been previously reported.¹³ Written informed consent was obtained at each exam, and the IRB at each center approved study protocols.

Individuals examined in Year 30 ($n=3,358$) were included in the primary cross-sectional analyses; excluding those who were missing data on CVH behaviors or covariates left 3,081 participants for analyses. Used in additional analyses, there were complete data for 4,786 at Year 0, for 3,560 at Year 7, and for 2,554 at Year 20. Appendix Table 1 provides detailed information on the number of participants with missing data by characteristics across all exam years.

Measures

Race was self-reported as non-Hispanic black or white during recruitment using a brief screening interview to determine eligibility and was verified at the first and second exam. Confirmed race from the second exam was used for the present analyses. Hispanic ethnicity was not assessed.

Definitions of poor, intermediate, and ideal health behaviors for each behavior are in Appendix Table 2. Smoking was self-reported on a tobacco use questionnaire validated in CARDIA using serum cotinine levels.¹⁴ Smoking status was categorized as current smoker, former smoker who quit ≥ 12 months prior, or never smoker/quit >12 months prior, reflecting poor, intermediate, and ideal health behaviors, respectively, using the AHA criteria.⁷

Physical activity was assessed as frequency of participation over the prior 12 months for vigorous and moderate intensity activities and reported as a score in exercise units using the validated CARDIA Physical Activity History at all exams.¹⁵ Participants were categorized as inactive (<100 exercise units), active but not meeting guidelines (100–299 exercise units), and meeting guidelines (≥ 300 exercise units), representing poor, intermediate, and ideal health behaviors, respectively, to approximate the AHA criteria for physical activity.¹⁶

A detailed diet history was assessed at Years 0, 7, and 20 using a validated interviewer-administered questionnaire, described elsewhere.¹⁷ Participants with extreme energy intake (<800 or $>8,000$ kcal/day for men and <600 or $>6,000$ kcal/day for women) were set to missing. Dietary intake was assessed with five components used by the AHA to define a healthy diet (Appendix Table 2).⁷ Because full diet history was not assessed at Year 30, the diet score at Year 30 was created using two approaches. First, by summing self-reported fast food and sugar-sweetened beverage consumption assessed at Year 30 with frequency per week of two or more categorized as poor, some but less than two as intermediate, and none as ideal. Second, the value of the Year 20 diet score (using the AHA criteria) was used to approximate diet at Year 30.

For each of the CVH health behaviors, a score of 0, 1, or 2 was assigned for poor, intermediate, or ideal health behaviors, respectively. An overall CVH behavior score was calculated at each of Years 0, 7, 20, and 30 by summing the scores for the three behaviors, with a potential range of 0–6, higher scores indicating more ideal behaviors. BMI or weight were not included as a health behavior because the writing group does not view this as a behavior, but rather as an outcome of behaviors (physical activity and diet) and genetics.

Detailed descriptions of all proposed mediators and timing of assessment are in Appendix Table 3. At Year 30, the following individual-level socioeconomic factors were assessed: education level, current household income, net worth (assets minus debt), unemployment, difficulty paying for basics like food and heating, home ownership, and health insurance coverage over the prior 2 years. Subsets of these variables were assessed at Years 0, 7, and 20.

Psychosocial factors at Year 30 included: depressive symptoms by the 20-item Center for Epidemiologic Studies Depression Scale¹⁸; racial discrimination by reported frequency of discrimination based on race/color in seven situations¹⁹; chronic burden, or strains lasting 6 months²⁰; and mental and physical quality of life by the Medical Outcomes Study Short Form.²¹ At Year 0, hostility was measured using the Cook–Medley Hostility Subscale of the Minnesota Multiphasic Personality Inventory,²² and the John Henryism Scale for Active Coping assessed self-determination.²³ Because none of the psychosocial measures assessed at Year 30 were assessed at Year 0, Cook–Medley Hostility and John Henryism were used to represent Year 0 psychosocial factors. Subsets of these psychosocial variables were assessed at Year 7 and 20.

Neighborhood factors at Year 30 included: neighborhood poverty based on 2007–2011 American Community Survey Data and calculated as the percentage of the population living below the U.S. poverty threshold; racial/ethnic residential segregation, measured using the G_i^* statistic, using 2010 U.S. Census data²⁴; self-reported neighborhood cohesion²⁵; and self-reported neighborhood resources.²⁶ Subsets of these variables were assessed at Year 0, 7, and 20.

Statistical Analysis

Means and frequencies of participant characteristics and levels of the CVH behavior score, represented in four groups (score of 0–2=low, score of 3=low–moderate, score of 4=moderate–high, and score of 5–6=high) were calculated by race. The race difference in CVH behavior score at Years 0, 7, 20, and 30 was estimated using linear regression in a series of cross-sectional analyses. The mediation analyses used in this study required a single variable representing each domain (socioeconomic, psychosocial, and neighborhood factors). Thus, with some similarity to propensity scoring, the association of explanatory variables with the CVH behavior score was summarized for each domain. Specifically, the CVH behavior score was regressed on the variables representing a given domain; each individual's predicted value was entered into the mediation analysis for that domain.

Per MacKinnon,²⁷ mediation analyses estimated the amount of the association between race (exposure) $\times$ CVH behavior score (outcome) explained by socioeconomic, psychosocial, and

neighborhood factors (mediating variables), separately and jointly. As supplementary analyses, the mediating effect of each individual factor within each domain was also calculated. The percentage mediated was calculated as ab/c , where a is the regression coefficient summarizing the relation between exposure and mediator, b is the regression coefficient summarizing the relation between mediator and outcome, adjusted for the exposure, and c is the regression coefficient summarizing the relation between exposure and outcome.²⁷ There was no evidence of multicollinearity in joint models. Interactions between the exposure $\times$ mediators were examined in separate models; none were significant. All mediation analyses were adjusted for age, sex, and center. P -values were calculated using the partial posterior method, a high power alternative test to Sobel's method.²⁸

First, the Year 30 mediators were used in the regression models, because all factors of interest had been collected at Year 30 but not necessarily previously. For the primary analyses, the diet score calculated at Year 30 using fast food and sugar-sweetened beverage information was used and then repeated using Year 20 dietary data. To determine whether the race $\times$ CVH behavior association was consistent across exams, this regression modeling was repeated separately for Years 0, 7, 20, and 30 using the available variables for each year. Clustering within neighborhoods was not accounted for in the models because CARDIA participants moved often over the course of the study,²⁹ resulting in minimal clustering by neighborhood. All statistical analyses used SAS, version 9.4. All tests were two-sided, with statistical significance set at $p < 0.05$. Data analysis was conducted in 2016–2017.

RESULTS

There were statistically significant differences by race for all Year 30 participant characteristics, except for mental quality of life and neighborhood resources (Table 1). Blacks reported poorer values across all socioeconomic factors, higher levels of depressive symptoms, more racial discrimination, greater levels of neighborhood poverty and racial segregation, and less neighborhood cohesion than whites. Blacks were also less likely to report ideal smoking, physical activity, and diet. Significant linear trends across increasing levels of the CVH behavior score were observed for all Year 30 participant characteristics (Appendix Table 4). For example, education and income increased significantly with CVH behavior score.

Figure 1 shows the unadjusted CVH behavior score at each exam by race. Two scores are shown for Year 30: the Year 20 AHA diet score and the Year 30 fast food and sugar-sweetened beverage diet score. Across exam years, scores range from 3.5 (SD=1.2) to 4.2 (SD=1.3) for whites and 2.8 (SD=1.4) to 3.2 (SD=1.3) for blacks (range, 0–6). There are significant differences by race at all exams ($p < 0.01$).

After adjustment for sex, age, and center (Model 1), blacks had an average CVH behavior score of 3.13 (SD=0.04) vs 4.12 (SD=0.03) for whites at Year 30 ($p < 0.01$; Table 2). The magnitude of this difference decreased but remained statistically significant after adjustment in separate models for socioeconomic, psychosocial, or neighborhood factors (all $p < 0.01$). Individual-level socioeconomic factors mediated 51.0% of the race $\times$ CVH behavior score association, psychosocial factors 27.2%, and neighborhood factors 34.6%. Joint associations

mediated 68.3%. Appendix Table 5 displays the contribution of each individual factor within the three domains. For example, among the socioeconomic, psychosocial, and neighborhood factors, net worth, quality of life, and racial segregation were the strongest mediators, respectively.

At each year, the race difference in CVH behaviors remained significant after adjustment for potential mediators, with blacks having less healthy scores than whites ($p = 0.02$; Table 3). Individual-level socioeconomic factors consistently mediated the largest proportion of the race $\times$ CVH behavior score association (52.8% at Year 0, 48.9% at Year 7, 70.1% at Year 20, and 66.3% at Year 30). Psychosocial factors mediated 20.3%–30.0%, and neighborhood factors 22.1%–42.4%, with 69.0%–76.5% mediation for joint associations. Participants included in the Year 0, 7, 20, and 30 analyses were similar to the overall study population in characteristics and health behaviors at study entry (Appendix Table 6). In sensitivity analyses the authors restricted the models to participants who were present across all exams ($n=1,478$); findings did not materially differ (Appendix Table 7).

DISCUSSION

Blacks had significantly less healthy CVH behavior scores over thirty years and were at striking socioeconomic disadvantage compared with whites. Observed racial differences in the CVH behavior score were predominately mediated by individual-level socioeconomic factors, less so by neighborhood factors and the least by psychosocial factors, a consistent pattern at all exams, robust to different approaches to assessing dietary quality. The combination of these factors explained approximately 75% of the race differences in the CVH behavior score. This manuscript contributes to the evidence that societal factors, often beyond an individual's control, play a large role in explaining racial differences in CVH behaviors.

This is one of the first studies to use formal mediation analyses to explain race differences in CVH behaviors considered jointly, rather than focusing on health outcomes.^{12,30} Similar to the present study, Wang et al.¹¹ found that socioeconomic factors played a larger role than psychosocial factors in explaining racial/ethnic disparities in physical activity and diet among U.S. adults. A more recent study found that black–white differences in smoking was reduced by 31.4% after adjustment for neighborhood context, but similar adjustments had no effect on black–white differences in physical activity or diet.¹⁰ A consistent finding across studies is the persistent race difference in CVH behaviors, with blacks reporting less ideal CVH behaviors than whites.

CVH behaviors are more commonly incorporated as intermediate rather than primary outcomes when examining racial disparities in cardiovascular outcomes. Piccolo and colleagues¹² examined the relative contributions of socioeconomic, psychosocial, environmental, lifestyle/behavioral, biophysiological, and ancestral factors to racial disparities in Type 2 diabetes among blacks, Hispanics, and whites. The largest mediating influence was socioeconomic factors, which explained 22% of the effect of black race on incident Type 2 diabetes. There was no direct effect of black race on behavioral factors, which included smoking, physical activity, and diet. However, black race indirectly affected

behavioral factors through socioeconomic risk. Dwyer-Lingren et al.,³¹ recently reported that 24% of the variation in U.S. life expectancy was attributable to black race, with 60% of the variation explained by a combination of socioeconomic and race/ethnicity factors. Although the studies differ in their primary outcome, all observed a strong mediation effect for socioeconomic factors.

In the present analyses, individual-level socioeconomic factors mediated about half of the association between race and CVH behaviors at Year 30 (more in some previous years). This is more than reported by others, perhaps because more diverse variables representing SES were included. The neighborhood environment, representing contextual socioeconomic factors, such as poverty and racial segregation, is increasingly recognized as important in population health,³² and mediated a high percentage of the race–CVH behavior association (34%). The psychosocial composite score mediated the smallest proportion of the association (27%). This pattern may have been influenced by more accurate measurement of individual socioeconomic factors than neighborhood or psychosocial factors; however, it appears that most of the race difference in CVH behaviors comes from individual and contextual socioeconomic factors.

Limitations

There were several study limitations. Diet history was not assessed in detail at Year 30; therefore, a proxy of self-reported fast food and sugar-sweetened beverage consumption was used at Year 30, followed by diet using the AHA criteria from Year 20. Notably, the percentage of individuals with ideal diet scores using the first approach (9% for blacks and 28% for whites) is higher than in the general population.³ However, the overall results were similar for the two approaches. The mediators assessed at Year 30 were not assessed consistently across time, rendering analyses at Years 0, 7, 20, and 30 not directly comparable; however, regardless of the mediators included the same pattern was observed. There are also limitations of mediation analysis as it requires strong assumptions about causal structure, model specification, and variable measurement. Although there was no evidence of exposure–mediator interaction the study might have been underpowered to detect significant interactions. Another approach to account for exposure–mediator interactions is to estimate the natural indirect effects, but many have argued that these methods are inappropriate due to the untestable cross-world independence assumptions.³³ Moreover, if there were unmeasured confounders of the exposure–outcome or mediator–outcome associations the results might have produced an overestimate (or underestimate depending on the direction of confounding) of the indirect effect. Also, although multiple socioeconomic, psychosocial, and neighborhood indicators were available, each of these cannot fully capture the given domain of interest. Conceptualization of these factors is inherently complex, with no gold standard for their measurement. As compared with this study, others have included additional objective measures of neighborhood environment.¹⁰ As always, unmeasured variables and measurement error could have resulted in biased estimates. Furthermore, it is unknown how mortality over follow-up may have influenced results. CARDIA includes black and white adults only, therefore these findings may not be generalizable to other racial/ethnic groups; future studies should include more diverse

populations. Finally, the serial cross-sectional study design limits the ability to infer causality.

CONCLUSIONS

Blacks had significantly poorer CVH behavior scores than whites over 30 years. The observed racial differences in CVH behavior scores appear to be mediated predominately by individual and contextual socioeconomic factors. Racial differences in lifestyle behaviors may be driven in part by a high burden of socioeconomic inequality, mostly beyond an individual's control. Clarifying which mediating mechanisms drive the association between race and CVH behaviors should enable a better understanding of the causes of CVH behavior disparities and provide an opportunity to identify potential interventions or policies to reduce or eliminate these disparities. Testing interventions and policy-level approaches that target individual-level (e.g., education) and contextual (e.g., racial segregation) socioeconomic factors may be necessary to determine whether mitigating the effects of these drivers have the potential to reduce disparities in CVH behaviors. In other words, the data suggest that societal change is paramount in addressing CVH disparities.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Cardiovascular Health Behavior Score by Race

Figure 1.

Unadjusted cardiovascular health behavior score, by race, sex, and exam year, the CARDIA Study (1985–2016).

Notes: The cardiovascular health behavior score at Years 0, 7, and 20 was calculated using the American Heart Association dietary criteria at the corresponding year.

^aThere were two versions of the cardiovascular health behavior score at Year 30. The first Year 30 score (N=2,392) was calculated using the American Heart Association dietary criteria applied to data from Year 20. The second Year 30 score (N=3,081) was calculated using fast food and sugar-sweetened beverage consumption from Year 30.

CARDIA, Coronary Artery Risk Development in Young Adults; CVH, cardiovascular health

Table 1

Participant Characteristics at Year 30 by Race, N=3,081 (2015–2016)

Characteristics	Blacks (N=1,412)	Whites (N=1,669)	<i>p</i> -value ^a
Age, mean (SD), years	54.5 (3.7)	55.7 (3.4)	<0.01
Socioeconomic factors			
Education, mean (SD), years	14.3 (2.4)	16.0 (2.5)	<0.01
Annual family income, n (%) ^b			<0.01
<\$50,000	647 (45.8)	304 (18.2)	
\$50,000–\$99,999	430 (30.5)	486 (29.1)	
\$100,000	335 (23.7)	879 (52.7)	
Net worth, n (%) ^c			<0.01
\$0	426 (30.2)	146 (8.7)	
\$1–\$99,999	357 (25.3)	198 (11.9)	
\$100,000–\$249,999	162 (11.5)	140 (8.4)	
\$250,000–\$499,999	277 (19.6)	385 (23.1)	
\$500,000	190 (13.5)	800 (47.9)	
Unemployed, n (%)	186 (13.2)	99 (5.9)	<0.01
Difficulty paying for basics, n (%)	415 (29.4)	230 (13.8)	<0.01
Home owner, n (%)	827 (58.6)	1392 (83.4)	<0.01
Health insurance, n (%)	485 (86.1)	698 (91.7)	<0.01
Psychosocial factors			
Depressive symptoms, mean (SD) ^d	9.5 (8.1)	8.1 (7.4)	<0.01
Racial discrimination, n (%)	899 (63.7)	300 (18.0)	<0.01
Chronic burden, mean (SD) ^e	1.6 (0.6)	1.7 (0.5)	<0.01
Quality of life, mean (SD) ^f			
Physical component score	47.7 (9.4)	51.1 (8.0)	<0.01
Mental component score	52.1 (9.0)	51.6 (9.1)	0.12
Neighborhood factors			
Poverty, mean (SD) ^g	18.3 (12.9)	9.3 (8.6)	<0.01
Racial segregation, mean (SD) ^h	2.4 (2.6)	–0.4 (1.7)	<0.01
Cohesion, mean (SD) ⁱ	17.5 (3.6)	19.1 (3.1)	<0.01
Resources, mean (SD) ^j	5.5 (1.5)	5.4 (1.8)	0.20
Cardiovascular health behavior scores			
Smoking, n (%)			<0.01
Poor	248 (17.6)	149 (8.9)	
Intermediate	38 (2.7)	39 (2.3)	
Ideal	1126 (79.7)	1481 (88.7)	
Physical activity, n (%)			<0.01
Poor	434 (30.7)	221 (13.2)	
Intermediate	507 (35.9)	546 (32.7)	

Characteristics	Blacks (N=1,412)	Whites (N=1,669)	<i>p</i> -value ^a
Ideal	471 (33.4)	902 (54.0)	
Diet, n (%) ^k			<0.01
Poor	836 (59.2)	526 (31.5)	
Intermediate	455 (32.2)	683 (40.9)	
Ideal	121 (8.6)	460 (27.6)	
Composite score ^l	3.1 (1.4)	4.2 (1.3)	<0.01

^aP-value for differences by race tested using independent samples *t*-tests or chi-square tests, as appropriate. *Note:* Boldface indicates statistical significance ($p < 0.05$).

^bAnnual family income modeled as a continuous variable with 9 levels.

^cNet worth calculated as family assets or wealth minus negative wealth or debt, and modeled as a continuous variable with 9 levels.

^dDepressive symptoms measured with the Center for Epidemiologic Studies Depression scale, higher scores indicate more depressive symptoms (range 0–60).

^eChronic burden assessed ongoing strains in four domains, higher scores indicate higher burden (range 1–4).

^fQuality of Life measured with the Medical Outcomes Study Short Form (SF-12), higher scores indicate better health status (range 0–100).

^gPoverty defined as the percent of the population living below the U.S.-defined poverty threshold.

^hHigher racial segregation scores indicate higher racial/ethnic segregation or clustering, scores near 0 indicate racial integration, and lower negative scores suggest lower racial/ethnic representation, compared to the racial composition of the larger areal unit.

ⁱHigher scores indicate more neighborhood cohesion (range 5–25).

^jHigher scores indicate more neighborhood resources (range 0–8).

^kDiet score using fast food and sugar-sweetened beverage consumption.

^lHigher composite scores indicate more ideal health behaviors (range 0–6).

Table 2
Associations of Race and a Year 30 Cardiovascular Health Behavior Score, N=3,081 (2015–2016)

CVH behavior score ^b	Overall model prediction	Blacks N=1,412		Whites N=1,669		Race difference		Mediation ^d	
		Mean (SE)		Mean (SE)		B	p-value	%	95% CI
Model 1	R ²	3.13 (0.04)		4.12 (0.03)		-1.00	<0.01	Base model	Base model
Model 1 + SS		3.41 (0.04)		3.89 (0.03)		-0.49	<0.01	51.0	50.0, 51.7
Model 1 + Psych		3.27 (0.04)		4.00 (0.03)		-0.72	<0.01	27.2	25.5, 28.7
Model 1 + NBH		3.31 (0.04)		3.96 (0.03)		-0.65	<0.01	34.6	32.4, 36.5
Model 1 + SS + Psych + NBH		3.50 (0.04)		3.82 (0.03)		-0.32	<0.01	68.3	68.2, 68.4

Note: Boldface indicates statistical significance ($p < 0.05$).

^aCalculated as ab/c, where a is the regression coefficient summarizing the relation between exposure and mediator, b is the regression coefficient summarizing the relation between mediator and outcome, adjusted for exposure, and c is the unadjusted regression coefficient summarizing the relation between exposure and outcome (i.e., the total effect); p-value corresponds to the ab cross-product.

^bCalculated using smoking, physical activity, and the diet score (fast food and sugar sweetened beverages) calculated from Year 30. Model 1 adjusted for sex, age and field center. Model 1 + SS additionally adjusted for a composite socioeconomic score including education, income, net worth, employment status, difficulty paying for basics, home ownership, and health insurance assessed at Year 30. Model 1 + Psych additionally adjusted for a composite psychosocial score including depressive symptoms, race discrimination, chronic burden, and quality of life assessed at year 30. Model 1 + NBH additionally adjusted for a composite neighborhood score including neighborhood poverty, residential racial segregation, neighborhood cohesion and neighborhood resources assessed at Year 30. Model 1 + SS + Psych + NBH additionally adjusted for a composite score including socioeconomic, psychosocial, and neighborhood factors.

CVH, cardiovascular health; NBH, neighborhood score; Psych, psychosocial score; SS, socioeconomic score.

Table 3
Associations of Race and a Cardiovascular Health Behavior Score Calculated at Years 0, 7, 20, and 30 (1985–2016)

CVH behavior score	Overall model prediction	Blacks N=2,461	Whites N=2,325	Race difference		Mediation ^a		
		Mean (SE)	Mean (SE)	B	p-value	%	95% CI	p-value
Year 0, 1985–1986 ^b								
Model 1	0.08	2.91 (0.03)	3.54 (0.03)	−0.62	<0.01	Base model	Base model	
Model 1 + SS	0.18	3.07 (0.03)	3.37 (0.03)	−0.29	<0.01	52.8	52.4, 53.3	<0.01
Model 1 + Psych	0.11	2.98 (0.03)	2.98 (0.03)	−0.50	<0.01	20.3	18.8, 21.6	<0.01
Model 1 + NBH	0.08	2.98 (0.03)	3.46 (0.03)	−0.49	<0.01	22.1	15.8, 27.0	<0.01
Model 1 + SS + Psych + NBH	0.19	3.14 (0.03)	3.30 (0.03)	−0.16	<0.01	74.6	73.0, 76.6	<0.01
Year 7, 1992–1993 ^b								
Model 1	0.10	2.80 (0.03)	3.55 (0.03)	−0.75	<0.01	Base model	Base model	
Model 1 + SS	0.20	2.99 (0.03)	3.37 (0.03)	−0.38	<0.01	48.9	48.6, 49.1	<0.01
Model 1 + Psych	0.13	2.91 (0.03)	3.45 (0.03)	−0.54	<0.01	20.3	14.7, 27.5	<0.01
Model 1 + NBH	0.11	2.89 (0.04)	3.46 (0.03)	−0.57	<0.01	23.7	17.7, 28.5	<0.01
Model 1 + SS + Psych + NBH	0.19	3.07 (0.03)	3.30 (0.03)	−0.23	<0.01	69.0	68.3, 69.9	<0.01
Year 20, 2005–2006 ^b								
Model 1	0.10	3.11 (0.04)	3.78 (0.03)	−0.66	<0.01	Base model	Base model	
Model 1 + SS	0.21	3.38 (0.04)	3.58 (0.03)	−0.20	<0.01	70.1	68.5, 72.2	<0.01
Model 1 + Psych	0.15	3.22 (0.04)	3.69 (0.03)	−0.46	<0.01	30.0	28.4, 31.1	<0.01
Model 1 + NBH	0.14	3.28 (0.04)	3.71 (0.04)	−0.43	<0.01	36.4	33.3, 38.7	<0.01
Model 1 + SS + Psych + NBH	0.35	3.43 (0.04)	3.61 (0.04)	−0.18	<0.01	73.9	72.5, 75.8	<0.01
Year 30, 2015–2016 ^b								
Model 1	0.11	3.19 (0.04)	3.90 (0.03)	−0.71	<0.01	Base model	Base model	
Model 1 + SS	0.23	3.46 (0.04)	3.70 (0.03)	−0.24	<0.01	66.3	65.5, 67.4	<0.01
Model 1 + Psych	0.18	3.29 (0.04)	3.82 (0.03)	−0.53	<0.01	25.6	23.6, 27.0	<0.01
Model 1 + NBH	0.16	3.36 (0.04)	3.77 (0.03)	−0.41	<0.01	42.4	40.5, 43.8	<0.01
Model 1 + SS + Psych + NBH	0.27	3.50 (0.04)	3.67 (0.03)	−0.17	<0.01	76.5	74.7, 78.9	<0.01

Note: Boldface indicates statistical significance ($p < 0.05$).

^aCalculated as ab/c , where a is the regression coefficient summarizing the relation between exposure and mediator, b is the regression coefficient summarizing the relation between mediator and outcome, adjusted for exposure, and c is the unadjusted regression coefficient summarizing the relation between exposure and outcome (i.e., the total effect).

^bCalculated using smoking, physical activity, and the diet score (American Heart Association criteria) at Year 0, 7, or 20. Model 1 adjusted for sex, age and field center. Model 1 + SS additionally adjusted for a composite socioeconomic score including education, employment status, and difficulty paying for basics at Year 0; a composite score including education, income, employment status, difficulty paying for basics, home ownership, and health insurance at Years 20 and 30. Model 1 + Psych additionally adjusted for a composite psychosocial score including the Cook Medley Hostility and John Henryism Scales at Year 0; a composite score including depressive symptoms, race discrimination, and Cook Medley Hostility at Year 7; a composite score including depressive symptoms, race discrimination, chronic burden, and quality of life at Years 20 and 30. Model 1 + NBH additionally adjusted for a composite neighborhood score including neighborhood poverty and racial segregation at Years 0 and 7; and a composite score including neighborhood poverty, racial segregation, neighborhood cohesion and neighborhood resources at Years 20 and 30. Model 1 + SS + Psych + NBH additionally adjusted for a composite score including socioeconomic, psychosocial, and neighborhood factors at Years 0, 7, 20, or 30.

NBH, neighborhood score; Psych, psychosocial score; SS, socioeconomic score.