

Higher Cardiovascular Disease Prevalence and Mortality among Younger Blacks Compared to Whites

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ABSTRACT

BACKGROUND: Blacks have higher rates of cardiovascular disease than whites. The age at which these differential rates emerge has not been fully examined.

OBJECTIVE: We examined cardiovascular disease prevalence and mortality among black and white adults across the adult age spectrum and explored potential mediators of these differential disease prevalence rates.

METHODS: We conducted a cross-sectional analysis of National Health and Nutrition Examination Survey data from 1999-2006. We estimated age-adjusted and age-specific prevalence ratios (PR) for cardiovascular disease (heart failure, stroke, or myocardial infarction) for blacks versus whites in adults aged 35 years and older and examined potential explanatory factors. From the National Compressed Mortality File 5-year aggregate file of 1999-2003, we determined age-specific cardiovascular disease mortality rates.

RESULTS: In young adulthood, cardiovascular disease prevalence was higher in blacks than whites (35-44 years PR 1.9; 95% confidence interval [CI], 1.1-3.4). The black-white PR decreased with each decade of advancing age (P for trend = .04), leading to a narrowing of the racial gap at older ages (65-74 years PR 1.2; 95% CI, 0.8-1.6; ≥ 75 years PR 1.0; 95% CI, 0.7-1.4). Clinical and socioeconomic factors mediated some, but not all, of the excess cardiovascular disease prevalence among young to middle-aged blacks. Over a quarter (28%) of all cardiovascular disease deaths among blacks occurred in those aged <65 years, compared with 13% among whites.

CONCLUSIONS: Reducing black/white disparities in cardiovascular disease will require a focus on young and middle-aged blacks. © 2010 Elsevier Inc. All rights reserved.

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Reducing racial disparities in health is the stated objective of many public health policies and programs.¹⁻⁴ Insights gained from studies examining differences in prevalence and mortality from various diseases between blacks and whites can inform interventions aimed at reducing these

disparities.^{3,5-9} Despite considerable research, interventions, and policy changes, the magnitude of racial disparities in health appear to be widening and mortality differences remain high.⁹⁻¹¹ Disparities in cardiovascular disease have received particular focus because cardiovascular disease is common and a major contributor to differences in mortality between blacks and whites.^{4,8,12-14}

Most studies of racial cardiovascular disease disparities have noted higher age-adjusted prevalence and mortality among blacks, thought to be attributable to differences in cardiovascular disease risk factors, socioeconomic factors, and access to health care.^{8,14-17} Few studies have examined in detail the effects of age on differential disease patterns of cardiovascular disease prevalence and mortality across a broad adult age range or explored potential mediators of

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differential disease rates by age, particularly among young to middle-aged adults.¹⁷⁻¹⁹ Understanding potential differences by age in disease rates is important for primary care providers who play a key role in identifying those at risk. It also is important for targeting effective interventions and policies aimed at reducing health disparities.

We examined differences in cardiovascular disease prevalence and mortality between blacks and whites using national population data from over a 7-year time period by defined age categories across an adult age range. We explored potential interactions and trends by age and sex for prevalence and examined whether traditional cardiovascular disease risk factors, socioeconomic factors, and access to health care mediated these differences.

METHODS

National Health and Nutrition Examination Survey

We combined data from the 1999-2006 waves of National Health and Nutrition Examination Survey (NHANES) data, a cross-sectional, nationally representative survey of the noninstitutionalized US civilian population administered by the National Center for Health Statistics.²⁰ Details of recruitment and study procedures are published and available on the website.²⁰ We focused on 2 racial groups, those who self-identified as non-Hispanic black or non-Hispanic white. We included participants who completed the questionnaire portion of the survey and limited our sample to those 35 years of age or older in an attempt to minimize the influence of congenital heart disease.

In the health interview portion of NHANES, participants were asked a series of questions in order to obtain information about their health. We estimated prevalence of self-reported cardiovascular disease by responses to these questions: Has a doctor or other health professional ever told you that you had congestive heart failure? Has a doctor or other health professional ever told you that you had a stroke? Has a doctor or other health professional ever told you that you had a heart attack (also called myocardial infarction)? For our study, we defined cardiovascular disease as a composite measure of self-reported history of heart failure, stroke, or myocardial infarction. We determined the self-reported prevalence of any cardiovascular disease and of each of the 3 cardiovascular conditions separately.

We used the weight, stratum, and primary sampling unit variables provided with the NHANES dataset²⁰ in conjunction with standard analytic methods as implemented in the

complex survey commands in STATA 10.0 (StataCorp, College Station, Tex), to obtain estimates and inferences that correctly account for complex NHANES sampling design. Specifically, the NHANES weights are inversely proportional to the differential sampling rates within the pop-

ulations targeted by NHANES, resulting in estimates that are representative of the noninstitutionalized US population for non-Hispanic blacks and whites. In addition, STATA survey commands use the stratum and primary sampling unit information to calculate standard errors, 95% confidence intervals (CI), and *P*-values that properly reflect the stratification and clustering of observations in NHANES. We used the Zhang method to obtain prevalence ratios (PR) and 95% CIs for the comparisons of blacks and whites.²¹ This method computes the PR from the odds ratio (OR) at the weighted average value of the prevalence in the reference group, *p*₀, using the formula $PR = OR / ([1 - p_0] + [p_0 * OR])$; 95% confidence limits for the PR are calculated by applying this formula to the confidence limits for the OR.

We estimated prevalence ratios for blacks versus whites unadjusted and age-adjusted, with age as a continuous variable. We then categorized age by decade (35-44, 45-54, 55-64, 65-74, and ≥75 years), and estimated the association of race with our cardiovascular disease outcomes within each resulting age and sex category, using Wald tests to assess heterogeneity in the effects of race across these strata.²² We tested for race/sex interactions within each age stratum. We then tested for race/age interactions within each sex, in particular for heterogeneity and trend across age strata, using standard orthogonal contrasts. Lastly, we tested for 3-way interaction, as measured by between-sex difference in the trends across age strata.

We selected a priori several potential mediators of racial differences in cardiovascular disease rates by age, and examined their effects in multivariable logistic regression models. We examined traditional cardiovascular disease risk factors, including self-reported history of high blood pressure, high cholesterol, being overweight, current smoking, or diabetes. We also examined 2 socioeconomic factors: highest educational attainment (less than a high school education vs high school graduate)^{16,23,24} and annual household income level (<\$20,000 vs ≥\$20,000).²⁴ Finally, we examined 2 measures of access to health care: having health insurance and having a usual source of outpatient health care.^{20,25}

CLINICAL SIGNIFICANCE

- Blacks are more likely than whites to manifest clinical cardiovascular disease, including heart failure, stroke, and myocardial infarction, in their 30s, 40s, and 50s.
- Deaths from these conditions also are higher in blacks than whites in these age groups.
- Clinical programs and policies to address racial disparities in cardiovascular disease should recognize the age at which these disparities are most evident and focus attention on these high-risk groups.

By age category (years)	Cardiovascular Disease			Heart Failure			Stroke			Myocardial Infarction		
	White n (95% CI)	Black n (95% CI)		White n (95% CI)	Black n (95% CI)		White n (95% CI)	Black n (95% CI)		White n (95% CI)	Black n (95% CI)	
Overall	9666 (8790-10,541)	10,397 (8985-11,808)		3391 (2978-3804)	4135 (3253-5019)		3563 (3083-4043)	4890 (4125-5656)		5359 (4761-5957)	4297 (3426-5167)	
35-44	1959 (1199-2719)	3718 (2121-5316)		462 (127-797)	956 (204-1709)		1009 (427-1590)	1479 (589-2368)		811 (369-1253)	1430 (450-2410)	
45-54	4844 (3507-6182)	6915 (4349-9481)		1395 (743-2046)	3344 (1689-5000)		1490 (815-2165)	3515 (1798-5233)		2533 (1636-3431)	2487 (1139-3836)	
55-64	9842 (7868-11,817)	15241 (11,719-18,763)		3190 (2124-4257)	6112 (4300-8924)		2870 (1835-3906)	6197 (4190-8204)		6711 (5034-8387)	7053 (4559-9547)	
65-74	17,120 (14,462-19,778)	19,738 (16,393-23,085)		6637 (5029-8246)	7648 (5615-9681)		6033 (4755-7310)	10,483 (7949-13,017)		10,102 (7907-12,298)	7020 (4797-9244)	
≥75	29042 (26,384-31,700)	29,707 (24,210-35,205)		11,114 (9404-12,824)	11,082 (7500-14,665)		12,213 (10,460-13,966)	14,721 (10,464-18,978)		14,614 (12,721-16,507)	14,106 (9933-18,278)	
CI = confidence interval.												

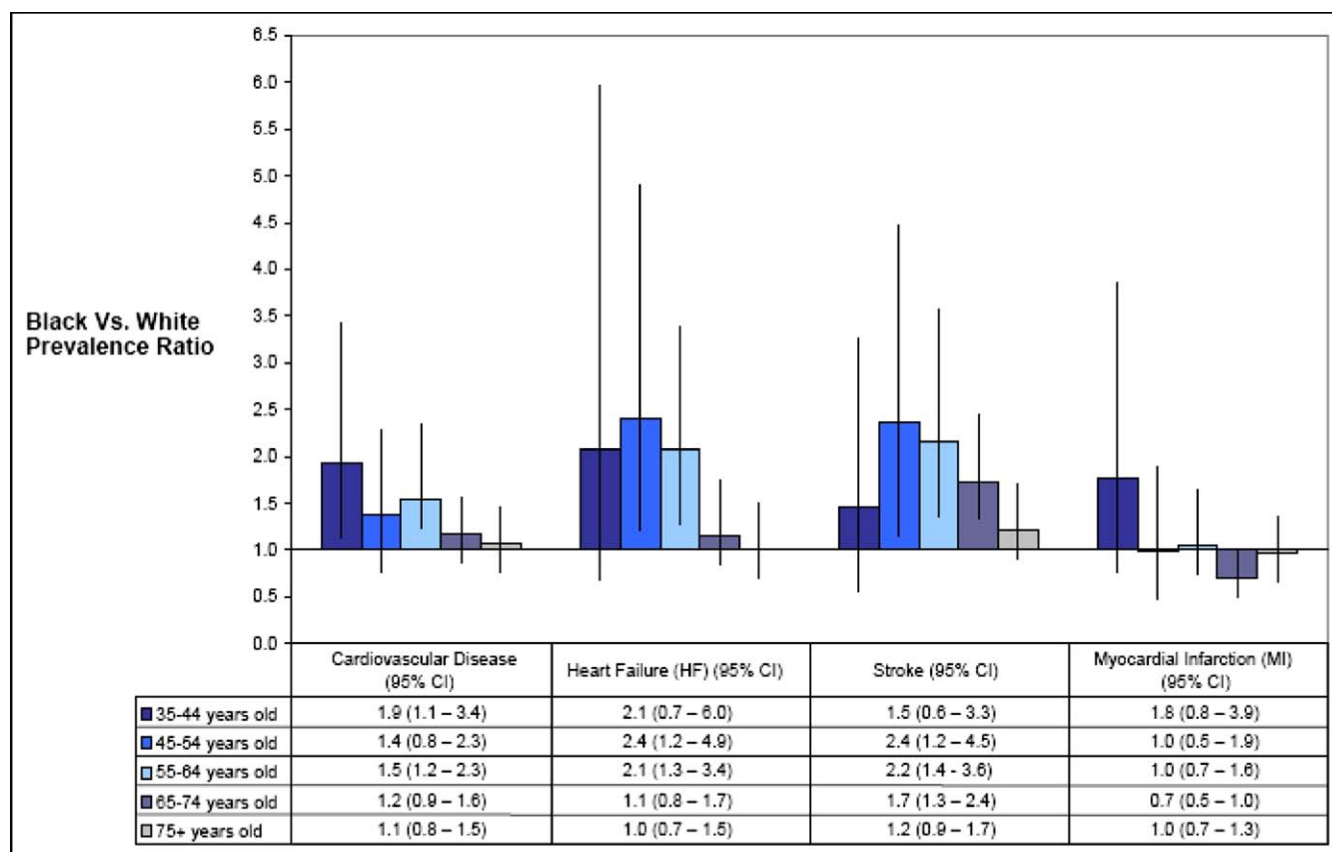


Figure 1 Prevalence ratios of self-reported cardiovascular disease, congestive heart failure, myocardial infarction, and stroke for black versus white adults by age categories, National Health and Nutrition Examination Survey, 1999-2006.

Patterns were similar for each of the specific cardiovascular conditions examined. No black-white differences were observed for heart failure in those in the oldest 2 age groups examined ($P = .10$ for heterogeneity, $P = .07$ for linear trend), or for stroke in those aged 75 years and older ($P = .21$ for heterogeneity, $P = .52$ for linear trend). For myocardial infarction, black-white differences in prevalence were observed only in the 35- to 44-year-olds.

Traditional cardiovascular disease risk factors, socioeconomic factors, and access to care each appeared to mediate part of the black-white difference in disease prevalence ratios in the youngest adults (Table 2). In our final model, adjusting for sex, self-reported hypertension, diabetes, and elevated cholesterol, obesity, smoking, education, income, health insurance, and a usual source of health care, cardiovascular disease prevalence remained higher in blacks ver-

Table 2 Prevalence Ratios for Cardiovascular Disease among Adult Blacks versus Whites, Accounting for Potential Mediators of Difference in Risk

Prevalence Ratios for Blacks versus Whites (95% CI)				
Age Category (Years)	Unadjusted	Adjusted for Cardiovascular Disease Risk Factors*	Adjusted for Cardiovascular Disease Risk Factors Plus Socioeconomic Factors†	Adjusted for Cardiovascular Disease Risk, Socioeconomic Factors, and Access to Health Care‡
35-44	1.9 (1.1-3.4)	1.8 (1.0-3.0)	1.6 (0.9-2.7)	1.6 (0.9-2.7)
45-54	1.4 (0.8-2.2)	1.1 (0.6-1.7)	0.9 (0.6-1.5)	0.9 (0.6-1.5)
55-64	1.6 (1.2-2.1)	1.2 (0.9-1.6)	1.1 (0.7-1.5)	1.1 (0.8-1.5)
65-74	1.2 (0.8-1.6)	1.0 (0.8-1.2)	0.8 (0.7-1.1)	0.9 (0.7-1.1)
≥75	1.0 (0.7-1.4)	0.9 (0.7-1.2)	0.8 (0.6-1.1)	0.8 (0.6-1.1)

CI = confidence interval.

*Sex and self-reported history of hypertension, diabetes, elevated cholesterol, obesity, current smoking.

†Self-reported highest educational attainment (less than high school or high school grad or higher), annual household income (<\$20 K, ≥\$20 K).

‡Self-report of having health insurance; self-report of usual source of outpatient health care.

Table 3 Prevalence Ratios of Self-reported Cardiovascular Disease Stratified by Age and Sex among Adult Blacks and Whites

	Prevalence per 100,000 Population		Prevalence Ratio (95% CI)	
	White n (95% CI)	Black n (95% CI)	Black vs White	P Value
Female				
Unadjusted	8747 (7680-9813)	10,708 (8712-12,703)	1.2 (1.0, 1.5)	
Age-adjusted			1.6 (1.2, 2.0)	
By age category (years)				P for heterogeneity* .30 P for linear trend† .14
35-44	1694 (683-2706)	4196 (1809-6584)	2.5 (1.1, 5.3)	
45-54	4707 (2999-6415)	6799 (3397-10,200)	1.5 (0.8, 2.6)	
55-64	7616 (5365-9868)	14,596 (10,989-18,203)	1.9 (1.3, 2.8)	
65-74	12,646 (9914-15,378)	18,629 (14,142-23,115)	1.5 (1.1, 2.0)	
≥75	26,848 (23,470-30,227)	30,499 (22,955-38,043)	1.1 (0.9, 1.5)	
Male				
Unadjusted	10,661 (9447-11,874)	9992 (8107-11,877)	0.9 (0.8, 1.1)	
Age-adjusted			1.2 (0.9, 1.4)	
By age category (years)				P for heterogeneity* .33 P for linear trend† .11
35-44	2224 (1209-3239)	3131 (749-5512)	1.4 (0.5, 3.4)	
45-54	4980 (3340-6620)	7064 (3775-10,353)	1.4 (0.8, 2.4)	
55-64	12,201 (9073-15,329)	16,044 (10,039-22,049)	1.3 (0.9, 2.0)	
65-74	22,381 (18,455-26,307)	21,126 (1516-26,635)	0.9 (0.7, 1.3)	
≥75	32,344 (28,811-35,877)	27,993 (21,097-34,890)	0.9 (0.6, 1.1)	

CI = confidence interval.

*P for heterogeneity, or interaction, tests the hypothesis that the black versus white prevalence ratio differs across the 5-age strata. This test is more sensitive to arbitrary patterns in the prevalence ratio than the test for trend.

†P for linear trend tests the hypothesis that the black versus white prevalence ratio increases or decreases across the 5-age strata. This test is more sensitive to approximately linear patterns in the prevalence ratio than the test for heterogeneity.

sus whites in the 35-44 years age category (PR 1.6; 95% CI, 0.9-2.7).

We observed high rates of cardiovascular disease among young to middle-aged black women (Table 3). The estimated prevalence for cardiovascular disease among black women aged 35-44 years exceeded that of white women and black and white men of the same age. This racial difference in disease rates was only partially mediated by differences in cardiovascular disease risk factors (adjusted PR among black women vs white women 35-44 years old = 2.1; 95% CI, 1.0-4.5) and for socioeconomic factors and access to health care (final adjusted PR 1.8; 95% CI, 0.8-4.0).

Using CDC WONDER data, we also examined annual average cardiovascular disease mortality rates by age category. We found that cardiovascular disease mortality was higher among blacks compared with whites at younger ages (Table 4). Over a quarter (28%) of all deaths from cardiovascular disease among blacks occur in those aged <65 years, while only 13% of all deaths from cardiovascular disease among whites occur in those aged <65 years (Figure 2).

DISCUSSION

Racial differences in cardiovascular disease prevalence vary by age, with the largest black-white disparities observed in young to middle age. These racial differences in disease rates across the age spectrum are masked in the traditional

age adjustment of disease rates. Our results highlight the importance of understanding the current epidemiology of disease patterns for research, clinical, and public health efforts aimed at reducing cardiovascular disease health disparities.

Prior studies have noted higher age-adjusted prevalence, incidence,^{12,28} or mortality rates^{14,17,29} of cardiovascular disease among blacks compared with whites. A smaller number of studies have commented on the differential disease rates between blacks and whites by age or statistical interactions between age and race.^{12,30} We found that the higher burden of cardiovascular disease among blacks compared with whites occurs at younger ages in adulthood than previously described.^{15,17,19} The higher rates of cardiovascular disease begin in the 30s and 40s.

We observed a similar pattern of higher cardiovascular disease mortality in blacks compared with whites in young to middle age. Cardiovascular disease processes appear to have similar outcomes at young to middle age as they do in older ages, and a higher prevalence of nonfatal cardiovascular disease events among blacks is unlikely to account for the differential disease prevalence that we report. Another explanation of the higher cardiovascular disease prevalence among young to middle-aged blacks compared with whites is the higher burden of traditional cardiovascular disease risk factors and lower socioeconomic status. Our analyses do suggest that these factors account for much of the black-

Table 4 Annual Average Mortality Rates per 100,000 Population for Cardiovascular Disease, Heart Failure, Stroke, and Myocardial Infarction, CDC WONDER, 1999-2003

Age Category (Years)	Cardiovascular Disease		Heart Failure		Stroke		Myocardial Infarction	
	White n (95% CI)	Black n (95% CI)	White n (95% CI)	Black n (95% CI)	White n (95% CI)	Black n (95% CI)	White n (95% CI)	Black n (95% CI)
35-44	14.8 (14.7-15.0)	36.7 (36.0-37.4)	3.8 (3.7-3.9)	13.3 (12.9-13.8)	4.2 (4.1-4.3)	13.4 (13-13.9)	6.9 (6.8-7.0)	10 (9.6-10.3)
45-54	46.8 (46.5-47.2)	110.6 (109.3-112.0)	8.6 (8.4-8.7)	30.5 (29.7-31.2)	11.4 (11.2-11.5)	41 (40.1-41.8)	26.9 (26.6-27.1)	39.2 (38.4-40.0)
55-64	133.7 (133.0-134.4)	265.1 (262.3-267.9)	23.9 (23.7-24.2)	63.9 (62.5-65.3)	31.5 (31.2-31.8)	90.4 (88.8-92.1)	78.2 (77.7-78.8)	110.8 (109-112.7)
≥65	1099.7 (1098.1-1101.4)	1196.8 (1191.2-1202.4)	264.3 (263.5-265.1)	285.4 (282.7-288.1)	403.9 (402.9-404.9)	460.1 (456.7-463.6)	431.5 (430.5-432.5)	451.3 (447.9-454.7)

CDC WONDER = Centers for Disease and Control and Prevention Wide-ranging On-line Data for Epidemiologic Research program; CI = confidence interval.

white differences in disease prevalence, although excess cardiovascular disease prevalence remained in the 35- to 44-year age group even after accounting for these factors. We cannot rule out the possibility that excess variation observed among blacks might still be due to differences in traditional cardiovascular disease risk factors or socioeconomic factors that cannot be fully accounted for in our adjustment.

Our findings suggest that studies examining the causes for racial differences in cardiovascular disease rates should focus on young to middle-aged adults. To date, most of the cardiovascular disease disparities literature has examined older populations,³¹⁻³⁵ both because cardiovascular disease is more common with advancing age and because administrative data (ie, Medicare) and cohort data are more readily available on older adults. Our study suggests that a reliance solely on data from older adults may miss opportunities to explore the root causes of the high burden of cardiovascular disease in blacks presenting in adulthood at young to middle age. Comprehensive data collection across the age spectrum, not just the elderly, of the population, is needed to understand the epidemiology of cardiovascular disease. Research on how biological susceptibility, environmental factors, early life events, and social determinants of health may together play a role in increasing cardiovascular disease risk among young to middle-aged blacks are needed.

Because traditional, modifiable cardiovascular disease risk factors likely account for some of the excess risk among blacks at younger ages,^{8,16,17,36,37} clinicians and public health programs should target the prevention and treatment of conditions such as hypertension, diabetes, smoking, and obesity at younger ages in order to reduce the burden of disease in young to middle-aged adults. Programs aimed at cardiovascular disease risk factor reduction or prevention do not generally target young to middle-aged adults. This group may be more challenging to reach with these programs, as they are more likely to be uninsured and therefore less likely to have access to medical care, and less likely to be able to afford medications.³⁸⁻⁴⁵ Adherence to medications also may be lower in young and middle-aged adults. These difficulties may be exacerbated by lower awareness among young to middle-aged adults of their cardiovascular disease risk, and reluctance on the part of clinicians to treat cardiovascular disease risk factors at younger ages.^{46,47}

Although focusing on young to middle-aged adults for disease prevention may be challenging, interventions in this group also could yield significant benefits. Older populations have experienced a substantial decrease in cardiovascular disease mortality because of improvements in the prevention and treatment of this disease; the same magnitude of benefits has not been observed among younger adults, partly because of unfavorable trends in cardiovascular disease risk factors.⁴⁸ This pattern may continue to be exacerbated as the high prevalence of overweight among today's adolescents will likely mean record obesity rates among future young to middle-aged adults.⁴⁹

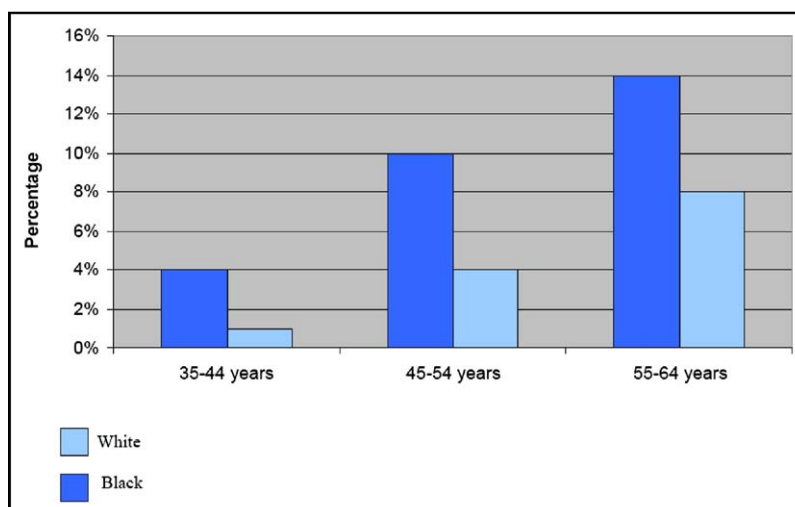


Figure 2 Percentage of all deaths from cardiovascular disease among adult Blacks and Whites that occur within particular age categories, Centers for Disease and Control and Prevention Wide-ranging On-line Data for Epidemiologic Research program, 1999-2003.

Our study has several limitations to note. This is a cross-sectional study, and therefore, we cannot determine causality nor account for changes in our outcome or covariates over time. Specifically, we do not know whether the disparity described for 35- to 44-year-olds in 1999-2006 will close as that cohort ages, which would require prospective confirmation. Disease status was determined by self-report in NHANES and thus may not accurately reflect true prevalence; prior studies, however, have shown self-report of these conditions to be reliable.^{50,51} Although NHANES was designed to be representative of the noninstitutionalized population, and specific groups, such as blacks, were over-sampled, our population prevalence estimates may not reflect true prevalence. Racial misclassification in CDC WONDER CMF is possible, although vital statistics administrative coding of race was found to be reliable for blacks and whites in a prior study.⁵² Racial misclassification is not likely to be different across age or age and sex categories and therefore is unlikely to affect the results of our study. ICD-10 codes for the underlying cause of death were used to capture mortality from the cardiovascular conditions of interest and thus, miscoding also is possible. However, it is unlikely that miscoding would be differential between whites and blacks, and prior work has shown the codes to be reliable.⁵²

We describe a high burden of cardiovascular disease among young and middle-aged blacks. Continued work is needed to better understand the causes of excess cardiovascular disease morbidity and mortality in blacks in young and middle age. Policy-makers, public health officials, and clinicians aimed at reducing health disparities should focus on the period when these black-white cardiovascular disease disparities appear to emerge among those over age 35 years who are young to middle-aged.

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