Original Report:
Cardiovascular Disease
and Risk Factors

Black-White Differences in 20-year Trends in Cardiovascular Risk in the United States, 1990-2010

Uchechi A. Mitchell, PhD[1]; Jennifer A. Ailshire, PhD[2];
Jung Ki Kim, PhD[2]; Eileen M. Crimmins, PhD[2]

Objective: Improvements in the Black-White difference in life expectancy have been attributed to improved diagnosis and treatment of cardiovascular diseases and declines in cardiovascular disease mortality. However, it is unclear whether race differences in total cardiovascular risk and the prevalence of cardiovascular risk factors have improved in the United States since the 1990s.

Design: Serial cross-sectional design.

Setting: Data from the 1988-1994, 1999-2002, and 2009-2012 National Health and Nutrition Examination Survey (NHANES).

Methods: We estimated total cardiovascular risk levels, the prevalence of high-risk cardiovascular risk factors and the use of antihypertensive and lipid-lowering drugs among US Black and White men and women to determine whether differential changes occurred from 1990-2010.

Results: Total cardiovascular risk declined for all races from 1990-2010. The Black-White difference was only significant in 2000 and sex-specific analyses showed that trends seen in the total population were driven by changes among women. Black and White men did not differ in risk at any time during this period. Conversely, Black women had significantly higher risk than White women in 1990 and 2000; this difference was eliminated by 2010. Improved diagnosis and treatment of high blood pressure and high cholesterol reduced risk in the total population; improved blood pressure and lipid profiles among Black women and increasing obesity prevalence among White women specifically contributed to the narrowing of the Black-White difference in risk among women.

Introduction

The Black-White disparity in life expectancy has narrowed to approximately four years, the smallest gap ever observed in the United States.[1] Advances in the diagnosis and treatment of cardiovascular diseases (CVDs) have contributed to this narrowing and to declines in CVD mortality since the 1960s.[2-4] The rate of decline, however, has slowed, particularly for non-Hispanic Blacks[5,6] and it is unclear whether improvements in CVD mortality will continue, reverse or stagnate in coming years. It is also uncertain what role current changes in the prevalence of cardiovascular risk factors will have on disparities in CVD morbidity and mortality.

National trends in the prevalence of high-risk cardiovascular risk factors reflect improvements in, or worsening of, cardiovascular functioning in the US population and offer insight into the effectiveness of past prevention and treatment efforts.[7,8] Patterns of change have been mixed[8-19] and few studies have examined race differences in trends in specific risk factors and in total cardiovascular risk. One study documented declines in high blood pressure among Whites between 1999-2010, and declines in the prevalence of high triglycerides and HDL cholesterol for all races, except Blacks.[20] Another showed that the overall increase in obesity during the same period was driven by increases among White men aged 40-59 years and Black men aged 20-

Conclusion: Cardiovascular risk and racial disparities in risk declined among US Whites and Blacks due to greater use and effectiveness of lipid-lowering and antihypertensive medications. *Ethn Dis*. 2019;29(4):587-598; doi:10.18865/ed.29.4.587

Keywords: Cardiovascular Diseases; Risk Factors; Health Disparities; Population Health; Race/Ethnicity, Sex

[1] Division of Community Health Sciences, School of Public Health, University of Illinois at Chicago
[2] Andrus Gerontology Center, University of Southern California, Los Angeles, CA

Address correspondence to Uchechi A. Mitchell, PhD; Division of Community Health Sciences, School of Public Health, University of Illinois at Chicago; 1603 W. Taylor St.; Chicago, IL 60612; 312-413-0107; umitch@uic.edu

39 years and >60 years.[17] However, little is known about Black-White differences in trends in the prevalence of other cardiovascular risk factors, especially prior to 2000.

Differences in health care access and medical care contribute to racial disparities in CVDs[21,22] and may influence trends in cardiovascular risk for Blacks and Whites.

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Cardiovascular risk factors cluster to a greater extent among Blacks[23] and place them at greater risk for poor quality of life[24,25] and mortality.[26] Although the use and effectiveness of blood pressure and lipid-lowering medications has increased for all races[19,27,28] and contributed to declines in CVD mortality,[2] the impact of recent trends in drug use on trends in the Black-White differences in cardiovascular risk is unknown. Thus, we lack a clear and comprehensive picture of trends in cardiovascular risk among US Blacks and Whites and their relation to concurrent trends in medication use.

We used data from the National Health and Nutrition Examination Surveys (NHANES) to characterize trends in cardiovascular risk for US Blacks and Whites aged >40 years. We examined trends in a summary measure of risk, total cardiovascular risk, and its individual risk factors stratifying by sex. We also examined trends in the diagnosis and treatment of two major contributors to CVD: high blood pressure and high cholesterol; their prevalence differs by race[29] and prevention efforts addressing both risk factors have contributed to significant declines in CVD mortality.[30]

Methods

Study Sample

NHANES is a series of nationally representative, cross-sectional surveys of the non-institutionalized US population. It includes interview data on health and nutrition, and biomarker data from physical examinations. NHANES III was conducted in two 3-year cycles from 1988-1991 and 1991-1994. The continuous NHANES began in 1999 and collects data biennially. We pooled data from NHANES III to approximate cardiovascular risk in 1990 and pooled four years of data from the 1999-2002 and 2009-2012 continuous NHANES to approximate risk in 2000 and 2010. These three periods are approximately 10 years apart and characterize 20-year trends in cardiovascular risk. We limit the sample to Blacks and Whites aged ≥40 years who fasted at least six hours before biomarker collection. Analyses using the summary measure of total cardiovascular risk included individuals with complete data on all biomarkers. The sample sizes for each period are: 2,825 (1988-1994), 1,613 (1999-2002) and 1,415 (2009-2012). Individuals excluded due to missing data had similar age and sex distributions as sample members. Study procedures were approved by the National Center for Health Statistics ethics committee and all participants consented to the NHANES surveys.

Table 1. Definition of high-risk for biomarkers used to measure total cardiovascular risk

High SBP	≥140 mm Hg
High DBP	≥90 mm Hg
High total cholesterol	≥240 mg/dL
Low HDL	<40 mg/dL
High triglycerides	≥200 mg/dL
High LDL	≥160 mg/dL
Obesity	BMI≥30kg/m^2
High HbA1c	≥6.5%

DBP, diastolic blood pressure; HbA1c, hemoglobin A1c; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SBP, systolic blood pressure.

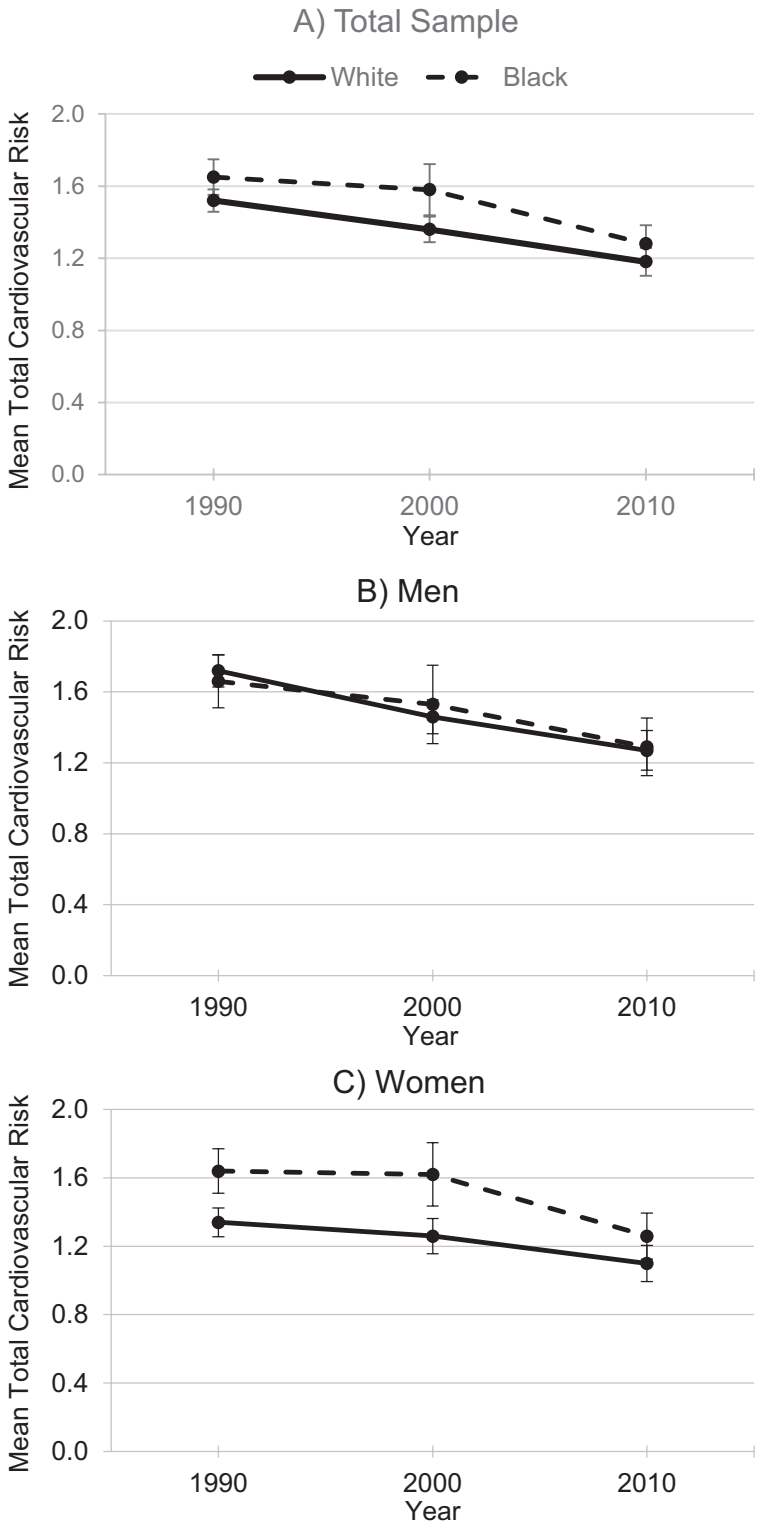

Figure 1. Mean number of cardiovascular risk factors (ie, total cardiovascular risk) for US Blacks and Whites aged >40 years in 1990 (n=2,825), 2000 (n=1,613) and 2010 (n=1,415) for A) the total population, B) men and C) women, using data from the National Health and Nutrition Examination Study.

Measures

Eight biomarkers assessed cardiovascular risk: systolic and diastolic blood pressure, total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, triglycerides, hemoglobin A1c (HbA1c), and body mass index (BMI), an indicator for obesity. Clinically established guidelines differentiated high from low risk (Table 1). In line with other work using summary risk measures, we count the number of high-risk biomarkers to measure total cardiovascular risk[13,31]; values range from 0-8 with higher values corresponding with greater risk. Change over time was examined by race and sex.

Statistical Analysis

We estimated mean total cardiovascular risk for Blacks and Whites in 1990, 2000 and 2010 for the total population and by sex. To determine the contribution of individual risk factors to change in total cardiovascular risk, we estimated the age-adjusted prevalence of high-risk values for each biomarker by period, sex and race. We then calculated change over time for each 10-year period (ie, 1990-2000 and 2000-2010) and the entire 20-year period. Changes in the absolute Black-White difference for each biomarker are also presented by period to determine which biomarkers contributed to changes in the Black-White difference in total cardiovascular risk.

We then examined the diagnosis and treatment of high systolic blood pressure and total cholesterol by race and sex to determine their contribution to differential change in the prevalence of these two conditions. Concurrent trends in medication use and control of both risk factors (eg, having a low-risk biomarker value while using medications) were examined among individuals previously diagnosed with each condition. We combined self-reported diagnosis data with biomarker values to create four groups of individuals: no condition (normal measured value and no self-reported diagnosis); controlled (normal measured value

Table 2. Prevalence of and change in high-risk biomarkers by race and sex among US adults aged ≥ 40 years, NHANES: 1990, 2000, 2010

	Men						Women					
	Prevalence, %			% change			Prevalence, %			% change		
	1990	2000	2010	1990-2000	2000-2010	1990-2010	1990	2000	2010	1990-2000	2000-2010	1990-2010
White												
High SBP	30.2	27.5	17.2	-2.7	-10.3	-13.0	39.2	44.3	20.3	5.2	-24.0	-18.9
High DBP	11.9	8.3	5.5	-3.6	-2.8	-6.4	4.4	5.4	4.2	1.0	-1.2	-0.2
High TC	23.3	21.2	13.2	-2.2	-8.0	-10.2	35.8	25.2	18.1	-10.6	-7.1	-17.7
High LDL	32.0	19.3	10.8	-12.7	-8.6	-21.2	34.9	16.0	16.2	-18.9	.3	-18.7
Low HDL	40.6	33.7	24.5	-6.9	-9.2	-16.1	12.6	10.4	12.5	-2.2	2.1	-0.1
High TG	26.8	22.4	16.5	-4.4	-5.8	-10.2	24.4	19.2	10.7	-5.3	-8.4	-13.7
High A1c	11.2	11.8	10.5	.6	-1.3	-.7	8.6	8.1	8.6	-.5	.5	0
Obesity	25.1	32.3	34.4	7.2	2.1	9.3	20.3	34.9	31.4	14.6	-3.6	11.1
Black												
High SBP	38.5	36.9	25.0	-1.5	-11.9	-13.5	40.6	44.4	22.8	3.7	-21.6	-17.8
High DBP	21.1	18.4	8.9	-2.7	-9.6	-12.3	12.3	15.7	5.7	3.4	-10.0	-6.6
High TC	23.2	15.4	7.9	-7.8	-7.6	-15.4	34.6	24.3	15.0	-10.4	-9.3	-19.7
High LDL	41.7	23.5	12.9	-18.2	-10.6	-28.8	44.2	25.1	11.6	-19.1	-13.5	-32.7
Low HDL	24.7	23.6	23.0	-1.1	-.6	-1.7	12.5	11.6	12.1	-1.0	.5	-.4
High TG	22.6	14.6	8.1	-8.0	-6.6	-14.5	15.4	6.5	5.5	-9.0	-.9	-9.9
High A1c	16.5	22.7	17.0	6.1	-5.6	.5	21.0	18.2	17.3	-2.8	-1.0	-3.7
Obesity	22.3	29.8	31.2	7.5	1.4	8.9	44.9	51.0	43.2	6.1	-7.8	-1.7

A1c, hemoglobin A1c; DBP, diastolic blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SBP, systolic blood pressure; TC, total cholesterol; TG, triglycerides.

Table 3. Absolute Black-White difference in prevalence of high-risk biomarkers among US adults aged ≥40 years, NHANES: 1990-2010

	Men			Women		
	1990	**2000**	**2010**	**1990**	**2000**	**2010**
High SBP	8.21[a]	9.39[a]	7.79[a]	1.42	.01	2.47
High DBP	9.25	10.10	3.35	7.89[a]	10.25[a]	1.50
High TC	-.09	-5.72	-5.28	-1.18	-.95	-3.13
High LDL	9.70[a]	4.16	2.12	9.33[a]	9.14[a]	-4.67
Low HDL	-15.9[a]	-10.14[a]	-1.53	-.04	1.15	-.40
High TG	-4.15	-7.74	-8.47	-8.99[a]	-12.72[a]	-5.20[a]
High A1c	5.36[a]	10.86[a]	6.56[a]	12.45[a]	10.14[a]	8.67[a]
Obesity	-2.78	-2.46	-3.20	24.56[a]	16.01[a]	11.80[a]

A1c, hemoglobin A1c; DBP, diastolic blood pressure; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SBP, systolic blood pressure, TC, total cholesterol; TG, triglycerides.
a. Statistical significance based on examination of 95% CI

and self-reported diagnosis); uncontrolled (high-risk measured value and self-reported diagnosis); and undiagnosed (high-risk measured value and no self-reported diagnosis). Individuals with controlled and uncontrolled conditions were further stratified by self-reported medication use to assess the effectiveness of antihypertensive and lipid-lowering drugs on high blood pressure and high cholesterol, respectively.

Analyses were completed in 2016 and 2017 using Statistical Analysis System (SAS) 9.4 and weights and survey procedures to account for the complex sample design of NHANES and to reflect the non-institutionalized US population aged ≥40 years.

Results

Change in Total Cardiovascular Risk by Race and Sex

Figure 1 shows trends in total cardiovascular risk for Blacks and Whites in the total population and separately by sex. Risk declined from 1990-2010 for Blacks and Whites, but Blacks had higher total cardiovascular risk across all periods. The Black-White difference was largest and statistically significant in 2000 but narrowed and was insignificant in 2010. Among men, there were no significant differences in risk between Blacks and Whites. In contrast, Black women had significantly higher total cardiovascular risk than White women in 1990 and 2000. Although this difference narrowed and was insignificant in 2010, risk levels were still higher among Black women.

Change in Cardiovascular Risk Factors among Men

For White men, the prevalence of high blood pressure, high total, HDL, and LDL cholesterols, and high triglycerides declined (Table 2). Larger declines occurred from 2000-2010 compared with 1990-2000 for all factors, except high LDL cholesterol, which declined to a greater extent from 1990-2000. Unlike other risk factors, the prevalence of high HbA1c remained relatively constant over time.

For Black men, patterns of change in risk factors were similar to that of White men. However, the prevalence of low HDL cholesterol did not change significantly for any period and significant declines in high total cholesterol began in the 1990s for Black men compared with the 2000s for White men. Change in the prevalence of high-risk HbA1c was not significant for either group during the 20-year period but, for Black men, the prevalence increased 6.1 percentage points from 1990-2000, and then declined by 5.6 percentage points from 2000-2010.

For both groups, obesity increased by approximately 9 percentage points with greater increases occurring from 1990-2000. The greatest declines in prevalence occurred for high LDL cholesterol, which declined 21.2 percentage

Table 4. Prevalence of measured high systolic blood pressure (SBP) and total cholesterol (TC), diagnosis and medication use among White and Black US men, aged ≥40 years, NHANES: 1990, 2000, 2010

	Prevalence, %			% change		
	1990	**2000**	**2010**	**1990-2000**	**2000-2010**	**1990-2010**
			White men			
Systolic blood pressure						
Measured high SBP						
Undiagnosed	9.83	9.90	7.05	.07	-2.85	-2.78
Diagnosed, no meds	4.64	2.85	2.43	-1.79	-0.42	-2.21
Diagnosed, w/ meds	8.43	7.61	6.42	-.82	-1.19	-2.01
Measured normal SBP						
No history of condition	57.82	58.62	52.72	.80	-5.90	-5.10
Diagnosed, no meds	9.09	5.43	6.92	-3.66	1.49	-2.17
Diagnosed, w/ meds	10.19	15.58	24.47	5.39	8.89	14.28
Total	100.00	99.99	100.01			
Total cholesterol						
Measured high TC						
Undiagnosed	8.11	6.17	5.56	-1.94	-.61	-2.55
Diagnosed, no meds	13.27	10.63	5.77	-2.64	-4.86	-7.50
Diagnosed, w/ meds	2.22	2.59	1.04	.37	-1.55	-1.18
Measured normal TC						
No history of condition	51.63	50.56	45.69	-1.07	-4.87	-5.94
Diagnosed, no meds	20.23	13.88	16.46	-6.35	2.58	-3.77
Diagnosed, w/ meds	4.54	16.17	25.48	11.63	9.31	20.94
Total	100.00	100.00	100.00			
	Prevalence, %			**% change**		
	1990	**2000**	**2010**	**1990-2000**	**2000-2010**	**1990-2010**
			Black men			
Systolic blood pressure						
Measured high SBP						
Undiagnosed	11.27	10.78	8.68	-.49	-2.10	-2.59
Diagnosed, no meds	8.45	4.35	4.58	-4.10	.23	-3.87
Diagnosed, w/ meds	13.68	16.10	11.71	2.42	-4.39	-1.97
Measured normal SBP						
No history of condition	48.74	45.08	42.37	-3.66	-2.71	-6.37
Diagnosed, no meds	7.05	6.36	6.26	-.69	-.10	-.79
Diagnosed, w/ meds	10.82	17.32	26.40	6.50	9.08	15.58
Total	100.00	99.99	100.00			
Total cholesterol						
Measured high TC						
Undiagnosed	12.37	6.09	2.59	-6.28	-3.50	-9.78
Diagnosed, no meds	11.26	7.46	2.88	-3.80	-4.58	-8.38
Diagnosed, w/ meds	2.22	3.04	1.96	.82	-1.08	-.26
Measured normal TC						
No history of condition	55.29	54.47	55.75	-.82	1.28	.46
Diagnosed, no meds	15.11	13.03	12.89	-2.08	-.14	-2.22
Diagnosed, w/ meds	3.75	15.91	23.93	12.16	8.02	20.18
Total	100.00	100.00	100.00			

SBP, systolic blood pressure; TC, total cholesterol.

points for White men and 28.8 percentage points for Black men.

Change in Cardiovascular Risk Factors among Women

For White women, the prevalence of high systolic blood pressure, high total and LDL cholesterol, and high triglycerides declined significantly from 1990-2010 (Table 2). While declines in high total and LDL cholesterols and triglycerides began in the 1990s and only continued through the 2000s for high total cholesterol, declines in high systolic blood pressure did not begin until 2000 and there were no appreciable changes in the prevalence of high HbA1c, high diastolic blood pressure or low HDL cholesterol. Obesity increased 14.6 percentage points from 1990-2000 and declined 3.6 percentage points from 2000-2010.

For Black women, the prevalence of high systolic and diastolic blood pressure, high total and LDL cholesterols and high triglycerides declined from 1990-2010. Declines in high blood pressure began in the 2000s, while declines in total and LDL cholesterols and triglycerides began in the 1990s. The prevalence of low HDL cholesterol and high HBA1c did not change significantly during any 10-year period or overall. Obesity increased by 6.1 percentage points from 1990-2000 and then declined 7.8 percentage points; the effective 20-year change in prevalence, -1.7 percentage points, was not significant.

For White women, the prevalence of high systolic blood pressure and high LDL cholesterol declined the most during the 20-year period, while the prevalence of high LDL and total cholesterols declined the most for Black women.

Change in the Black-White Difference in Cardiovascular Risk Factors

In 1990, Black men had a higher prevalence of high systolic and diastolic blood pressure, LDL cholesterol and HbA1c compared with White men, but a lower prevalence of low HDL cholesterol (Table 3). By 2010, the Black-White difference in high diastolic blood pressure and HDL cholesterol was not significant. In contrast, the difference for high triglycerides widened: although the prevalence among White men was consistently higher than that of Black men, this difference increased and was only significant in 2010.

Black women had a higher prevalence of high diastolic blood pressure, high LDL cholesterol, high HbA1c and obesity in 1990, while White women had a higher prevalence of high triglycerides. By 2010, Black women still had a higher prevalence of high HbA1c and obesity, but differences in diastolic blood pressure and LDL cholesterol were not significant. White women had a higher prevalence of high triglycerides compared with Black women, but the magnitude of this difference was reduced by 42% from 1990-2010.

Change in the Diagnosis and Treatment of High Blood Pressure and High Cholesterol

Among men with controlled blood pressure, the use of anti-hypertensive medications increased significantly from 1990-2010 (Table 4). For White men, the prevalence increased 14.3 percentage points from 10.2% in 1990 to 24.5% in 2010. For Black men, the prevalence increased from 10.8% to 26.4%. For both races, the increase in medication-controlled blood pressure coincided with a decrease in uncontrolled blood pressure and increases in the effectiveness of anti-hypertensive medications: Among individuals taking medications for high blood pressure, the proportion with normal systolic blood pressure levels increased 24.5 percentage points among White men and 25.1 percentage points among Black men. At the same time, the proportion of men without a history of high blood pressure decreased 5.1 percentage points and 6.4 percentage points among White and Black men, respectively, indicating a decline in the primary prevention of high blood pressure.

From 1990-2010, there was an approximately four-fold increase in the use of lipid-lowering medications for White and Black men. The effectiveness of these medications also improved during this period, from 67.2% to 96.1% for White men and from 62.8% to 92.4% for Black men. While the proportion of White men without a history of high cholesterol declined by 5.9 percentage points, the proportion among Black men did not change appreciably, suggesting that more White men experienced the onset of high cholesterol compared with Black men.

Table 5 presents the patterns of diagnosis and treatment for women. From 1990-2010, anti-hypertensive medication use increased 9.9 percentage points among White women

Table 5. Prevalence of measured high systolic blood pressure (SBP) and total cholesterol (TC), diagnosis and medication use among White and Black US women, aged ≥40 years, NHANES: 1990, 2000, 2010

	Prevalence, %			% change		
	1990	**2000**	**2010**	**1990-2000**	**2000-2010**	**1990-2010**
	White women					
Systolic blood pressure						
Measured high SBP						
Undiagnosed	8.64	11.92	6.24	3.28	-5.68	-2.40
Diagnosed, no meds	3.81	3.76	0.86	-.05	-2.90	-2.95
Diagnosed, w/ meds	10.58	13.84	9.6	3.26	-4.24	-.98
Measured normal SBP						
No history of condition	57.16	50.58	54.76	-6.58	4.18	-2.40
Diagnosed, no meds	6.91	4.24	5.82	-2.67	1.58	-1.09
Diagnosed, w/ meds	12.90	15.65	22.73	2.75	7.08	9.83
Total	100.00	99.99	100.00			
Total cholesterol						
Measured high TC						
Undiagnosed	12.55	8.21	8.83	-4.34	.62	-3.72
Diagnosed, no meds	18.72	12.29	6.25	-6.43	-6.04	-12.47
Diagnosed, w/ meds	3.66	2.93	2.67	-.73	-.26	-.99
Measured normal TC						
No history of condition	46.29	51.15	46.59	4.86	-4.56	.30
Diagnosed, no meds	14.43	12.59	11.43	-1.84	-1.16	-3.00
Diagnosed, w/ meds	4.35	12.82	24.23	8.47	11.41	19.88
Total	100.00	99.99	100.00			
	Prevalence, %			**% change**		
	1990	**2000**	**2010**	**1990-2000**	**2000-2010**	**1990-2010**
	Black women					
Systolic blood pressure						
Measured high SBP						
Undiagnosed	10.82	9.91	7.73	-.91	-2.18	-3.09
Diagnosed, no meds	6.38	6.11	2.13	-.27	-3.98	-4.25
Diagnosed, w/ meds	18.72	24.07	10.94	5.35	-13.13	-7.78
Measured Normal SBP						
No history of condition	38.64	34.17	45.47	-4.47	11.3	6.83
Diagnosed, no meds	7.46	4.89	4.67	-2.57	-.22	-2.79
Diagnosed, w/ meds	17.98	20.85	29.05	2.87	8.20	11.07
Total	100.00	100.00	99.99			
Total cholesterol						
Measured high TC						
Undiagnosed	13.19	11.04	7.30	-2.15	-3.74	-5.89
Diagnosed, no meds	14.33	9.75	5.28	-4.58	-4.47	-9.05
Diagnosed, w/ meds	3.72	3.92	2.07	.20	-1.85	-1.65
Measured normal TC						
No history of condition	48.64	51.71	52.98	3.07	1.27	4.34
Diagnosed, no meds	16.18	16.34	12.56	.16	-3.78	-3.62
Diagnosed, w/ meds	3.95	7.24	19.81	3.29	12.57	15.86
Total	100.01	100.00	100.00			

SBP, systolic blood pressure; TC, total cholesterol.

and 3.3 percentage points among Black women. For both groups, the greatest increases occurring between 1990-2000; however, in the most recent 10-year period, medication use among Black women declined by 4.9 percentage points. The effectiveness of anti-hypertensive medications also improved (from 54.9% to 70.3% for White women and from 49.0% to 72.6% for Black women) and corresponded with declines in uncontrolled blood pressure. Declines in uncontrolled blood pressure were greatest from 2000-2010 and were more than two times greater among Black women than White women.

For high total cholesterol, the use of lipid-lowering medications also increased from 8.0% in 1990 to 26.9% in 2010 for White women and from 7.7% to 21.8% for Black women; the greatest increases were seen from 2000-2010. Increases in the effectiveness of lipid-lowering medications were greater than increases in the effectiveness of anti-hypertensive medications. Effectiveness rates reached 90% by 2010 for both medications; prior to then they were only 54.3% and 51.5% effective for White and Black women, respectively.

Discussion

Notable improvements in cardiovascular risk occurred from 1990-2010 for US Whites and Blacks. Total cardiovascular risk and the prevalence of nearly all risk factors declined for both sexes and races. Prior research on sex differences in trends in total cardiovascular risk documented steady improvements among men since the 1990s, while improvements among women began in the 2000s.[13] We build upon this work by examining race differences in sex-specific trends in cardiovascular risk, and evaluating how changes in individual risk factors and in the diagnosis and treatment of high blood pressure and high cholesterol influenced these trends.

Blacks consistently had higher total cardiovascular risk than Whites, but this difference was only significant in the 2000s, which suggests disparities in cardiovascular risk worsened from 1990-2000 and then improved. However, within-sex analyses revealed that the trend in the overall disparity was driven by disparities among women: compared with White women, Black women had significantly higher risk in the 1990s and 2000s; thereafter, Black women experienced greater improvements in risk than Whites eliminating the difference. Conversely, differences between White and Black men were not significant at any time. Thus, from 1990-2010, the presence of and change in Black-White disparities in total cardiovascular risk in the total population were driven by disparities among women.

For Black and White women, improvements in total cardiovascular risk reflected declines in the prevalence of high blood pressure and improved lipid profiles. These changes corresponded with increases in the use of lipid-lowering and antihypertensive medications and improvements in their effectiveness. However, differential change in the prevalence of high LDL cholesterol, high diastolic blood pressure and obesity likely contributed to the narrowing of the disparity in risk among women. While rates of high LDL cholesterol and high diastolic blood pressure improved among Black women from 1990-2010, White women experienced little or no change in these risk factors. Consequently, previously observed disparities in LDL cholesterol and diastolic blood pressure were absent by 2010. Additionally, obesity among White women increased from 1990-2010 but showed no effective change among Black women, despite their having the highest obesity rates. Thus, the combination of improving blood pressure and lipid profiles among Black women, and increasing rates of obesity among White women, likely contributed to the reduction of the Black-White disparity in total cardiovascular risk among women.

…compared with White women, Black women had significantly higher risk in the 1990s and 2000s; thereafter, Black women experienced greater improvements in risk than Whites, eliminating the difference.

Black and White men had similar total cardiovascular risk the entire 20-year period. This absence of a significant difference in risk is an unexpected finding because prior research has shown that Blacks have a greater average number of cardiovascular risk factors than Whites regardless of sex.[20,23,32,33] One possible explanation is that past efforts at reducing disparities in cardiovascular risk factors and improving the cardiovascular health of Black men have been successful. However, it is unlikely that disparities in cardiovascular risk would have been eliminated prior to the 1990s. Another explanation is that heterogeneity in the direction of race differences for the individual risk factors resulted in similar total cardiovascular risk levels for this count measure. Our data lend some support to this explanation: the number of risk factors for which the race difference favored White men was equal to the number of risk factors for which the difference favored Black men. Moreover, this study and past research has shown that, while Black men tend to have worse blood pressure values, their lipid profiles tend to be comparable to or better than those of White men.[34] This balance in the distribution of race differences across individual risk factors potentially resulted in similar overall risk levels. Thus, studies of change in summary risk measures are useful for global assessments of changing risk but should be accompanied by an examination of changes in individual risk factors to more clearly understand what drives trends in the summary measure.

Study Limitations

One limitation of this study is that we did not consider changes in diet, physical activity or medication adherence. We also cannot account for changes in the prescribing behavior of providers. Recent changes in the guidelines for the use of lipid-lowering drugs and the diagnosis of high blood pressure[35] could affect prevalence estimates and the apparent efficacy of medications for these conditions. Lastly, this study focused on prevalence instead of other metrics, such as the age at onset of high-risk values and disease severity, which would be useful for comprehensively evaluating the effectiveness of our health care system and discerning whether population health and health disparities are improving.

Conclusion

Significant improvements have been made in the cardiovascular health of US middle-aged and older adults and declines in racial disparities in cardiovascular risk since the 1990s. These improvements in population health are partly due to improvements in the use and effectiveness of lipid-lowering and antihypertensive medications. Whether these trends will continue or translate into further declines in disparities in CVD mortality is unclear. Recent trends in obesity risk[36] may offset some of the improvements seen from 1990s to 2010s. The prevalence of obesity and class 3 obesity is increasing among women and may lead to a slowing or reversal of trends in racial disparities in total cardiovascular risk. Future research should examine trends in risk factors that extend into the next decade and investigate the link between changes in cardiovascular risk factors and CVD mortality for Blacks and Whites. Such research would elucidate how the prevention, treatment and management of these factors influence racial disparities in life expectancy.

Acknowledgements

The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The research reported in this paper was supported by the National Institute on Aging of the National Institutes of Health under award numbers P30AG043073, P30AG17265, R00AG039528, R24AG037898, R24 AG045061, T32AG000037. The NIH had no role in the design, conduct, or reporting of the research, or in the decision to submit the manuscript for publication.

Conflict of Interest

No conflicts of interest to report.

Author Contributions

Research concept and design: Mitchell, Ailshire, Crimmins; Acquisition of data: Kim, Crimmins, Data analysis and interpretation: Mitchell, Kim, Crimmins; Manuscript draft: Mitchell, Ailshire; Statistical expertise: Mitchell, Ailshire, Kim; Acquisition of funding: Crimmins; Administrative: Mitchell, Crimmins; Supervision: Crimmins

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