US Military Service and Racial/Ethnic Differences in Cardiovascular Disease: An Analysis of the 2011-2016 Behavioral Risk Factor Surveillance System

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Objective: To determine: 1) rates of cardiovascular disease (CVD) among individuals with and without prior US military service; and 2) variation in CVD outcomes by race/ethnicity.

Methods: We performed a cross-sectional study of the 2011-2016 Behavioral Risk Factor Surveillance System during 2018-2019. Groups with (n=369,844) and without (n=2,491,784) prior service were compared overall, and by race/ethnicity. CVD odds were compared using logistic regression. Rate-difference decomposition was used to estimate relative contributions of covariates to differences in CVD prevalence.

Results: CVD was associated with military service (OR=1.34; P<.001). Among non-Hispanic Blacks, prior service was associated with a lower odds of CVD (OR=.69; P<.001), fully attenuating the net difference in CVD between individuals with and without prior service. Non-Hispanic Whites who served had the highest odds of CVD, while Hispanics with prior service had the same odds of CVD as non-Hispanic Whites without prior service. After age, smoking and body mass index status were the largest contributors to CVD differences by race/ethnicity.

Conclusions: Results from this study support an association between prior military service and CVD and highlight differences in this association by race/ethnicity. Knowledge of modifiable health behaviors that contribute to differences in CVD outcomes could be used to guide prevention efforts. *Ethn Dis.* 2019;29(3):451-462; doi:10.18865/ed.29.3.451

Keywords: Veterans Health; Military; Race/Ethnicity; Health Status Disparities; Cardiovascular Diseases; Health Behavior

INTRODUCTION

Military service is associated with a variety of both health-compromising and health-promoting factors. Health-promoting factors may include opportunities for training and education, increased physical activity, and social cohesion within military units, while health-compromising factors may include increased rates of smoking and risk of injury or psychological trauma due to combat exposure.[1] Throughout a service member's life, these military-associated factors may interact with demographic factors, such as race, sex, and socioeconomic status, to increase or decrease the likelihood of long-term health outcomes.[1] The ways in which these demographic and military-related factors impact the long-term outcome of cardiovascular disease (CVD) are unknown.

CVD is the leading cause of death in the United States (US), with more than 900,000 deaths attributed to CVD in 2016[2] and a projected prevalence of more than 45% of the US adult population by the year 2035.[3] Previous work has found that veterans of the US military have higher rates of chronic disease,[4,5] including CVD,[6] when compared with the civilian population. Both exposure to combat[7] and development of posttraumatic stress disorder[8–10] have been associated with increased risk of development of CVD. Additionally, severity of injury among service members has been associated with increase in risk of subsequent development of CVD.[11]

While racial/ethnic disparities in the civilian population have been established,[12,13] less is known about CVD outcomes in the military and veteran population. Previous studies on racial/ethnic disparities within the military population have found that Black and Hispanic service members and veterans have reported poorer outcomes

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when compared with Whites,[14,15] with higher rates of hypertension and diabetes,[14] lower self-rated health[15] and, among Black service members, higher rates of obesity.[16] However, there is also evidence that CVD mortality among Black veterans may be similar or lower to that of White veterans.[17] In a study of 6,998 veteran respondents to the 2010 National Survey of Veterans, Sheehan et al used progressive linear regression models to determine how socioeconomic (defined as a combination of income level and education), health behavior, and military factors contribute to racial/ethnic differences

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in self-reported health.[15] Findings from this analysis showed that socioeconomic factors related to military experience (including combat exposure and age of enlistment) and smoking behavior, all contributed to racial/ethnic differences in overall health.

We had three primary objectives for this study. First, we sought to examine differences in CVD outcomes based on prior military service status (yes vs no). Second, we explored the role race/ethnicity plays in modify-

ing differences in CVD outcomes based on prior military status. We also sought to understand how demographic, socioeconomic and health factors contribute to racial/ethnic CVD prevalence differences in this population. We hypothesized that: 1) prevalence of CVD would differ based on the presence or absence of prior military service; and 2) differences in CVD prevalence between those with and without prior military service would vary by race/ethnicity.

Methods

Study Population

Data were obtained from the 2011-2016 Center for Disease Control's (CDC) Behavioral Risk Factor Surveillance System (BRFSS), a nationally representative cross-sectional monthly telephone survey used to assess health-risk and health-promoting behaviors in the US adult population.[18] Responses from BRFSS are aggregated by the CDC and weighted using iterative proportional fitting.[18] All respondents to the survey were included for analysis. The Institutional Review Board at David Grant USAF Medical Center reviewed this study and determined it to be research not involving human subjects.

Study Measures

All study measures were based on self-report data from BRFSS and were available for all included years. Demographic variables included age, sex, education, income, marital status, and race/ethnicity. Smoking status was reported categorically (currently smokes every day, currently smokes sometimes,

former smoker, or never smoked), as was body mass index (obese, overweight, underweight, normal weight). Physical activity in the last 30 days, history of depression, and access to any kind of healthcare coverage were assessed with a yes or no response. The outcome of interest, CVD, was defined as a "Yes" response to a having been "ever diagnosed with" at least one of the following: 1) myocardial infarction/heart attack; 2) angina or coronary heart disease; or 3) stroke.

Prior military service was defined as a history of service in either the 1) Army, Navy, Air Force, or Marines or 2) National Guard or military reserve unit. Prior service and no prior service were indicated by a "yes" or "no" response to having "ever served on active duty in the United States Armed Forces, either in the regular military or in a National Guard or military reserve unit."

Race in BRFSS was classified as one of the following: non-Hispanic White, non-Hispanic Black, Hispanic, multiracial non-Hispanic, American Indian or Alaskan Native, or missing. In this analysis, multiracial non-Hispanic and American Indian or Alaskan Native were grouped as "other" race/ethnicity. Individuals with missing race data were excluded from final analysis.

Statistical Methods

Weighted percentages for demographics, health risk behaviors, and access to health care variables for groups with and without prior military service are reported. Weighted univariate and multivariate logistic regression models were stratified by sex, race/ethnicity, and prior military service. Covariates included were: age; sex; education; income; marital status;

Table 1. Characteristics of the studied subpopulations: weighted percentages

		Prior military service, N=369,844		No prior military service, N=2,491,784	
		n	% (95% CI)	n	% (95% CI)
Age, yrs	18 to 24[a]	5,313	4.2 (4.0 - 4.4)	144,625	14.1 (14.0 - 14.2)
	25 to 29	7,800	5.0 (4.8 - 5.1)	121,069	8.7 (8.6 - 8.8)
	30 to 34	9,667	5.7 (5.5 - 5.9)	143,188	9.6 (9.5 - 9.7)
	35 to 39	10,219	4.8 (4.7 - 5.0)	152,343	8.2 (8.2 - 8.3)
	40 to 44	13,483	6.1 (6.0 - 6.3)	166,680	9.1 (9.0 - 9.2)
	45 to 49	17,728	6.4 (6.2 - 6.6)	191,582	8.1 (8.0 - 8.2)
	50 to 54	23,411	8.3 (8.1 - 8.5)	245,906	1.0 (9.9 - 1.1)
	55 to 59	27,552	7.3 (7.2 - 7.5)	275,492	8.3 (8.2 - 8.3)
	60 to 64	42,967	1.6 (1.5 - 1.8)	276,505	7.6 (7.5 - 7.7)
	65 to 69	61,506	12.5 (12.3 - 12.6)	238,798	5.4 (5.3 - 5.4)
	70 to 74	47,365	9.4 (9.2 - 9.6)	190,936	4.1 (4.1 - 4.1)
	75 to 79	39,774	8.2 (8.1 - 8.4)	139,396	3.3 (3.2 - 3.3)
	80 or older	59,597	11.4 (11.2 - 11.6)	177,440	3.5 (3.5 - 3.6)
Sex	Male[a]	337,272	91.1 (9.9 - 91.3)	842,255	43.5 (43.3 - 43.6)
	Female	32,572	8.9 (8.7 - 9.1)	1,649,529	56.5 (56.4 - 56.7)
Education	Did not graduate high school[a]	17,619	6.8 (6.6 - 7.0)	222,215	15.7 (15.6 - 15.9)
	Graduated high school	105,010	29.7 (29.4 - 3.0)	717,230	28.4 (28.3 - 28.5)
	Attended college or technical school (TS)	112,450	37.7 (37.3 - 38.0)	665,089	29.9 (29.7 - 3.0)
	Graduated from college or TS	133,578	25.8 (25.6 - 26.1)	876,945	26.0 (25.9 - 26.1)
Income	<$15,000[a]	22,205	5.6 (5.5 - 5.8)	260,585	11.4 (11.3 - 11.5)
	$15,000 to <$25,000	51,653	13.1 (12.8 - 13.3)	374,679	15.4 (15.3 - 15.5)
	$25,000 to <$35,000	41,486	1.7 (1.5 - 1.9)	233,949	9.1 (9.0 - 9.2)
	$35,000 to <$50,000	57,505	15.4 (15.1 - 15.6)	296,026	11.2 (11.2 - 11.3)
	>$50,000	151,079	43.7 (43.4 - 44.0)	931,980	37.2 (37.1 - 37.3)
	Don't know/not sure/missing	45,922	11.6 (11.4 - 11.8)	394,614	15.6 (15.5 - 15.7)
Marital status	Married[a]	229,997	65.2 (64.9 - 65.5)	1,349,904	54.3 (54.1 - 54.4)
	Not married	138,198	34.8 (34.5 - 35.1)	1,126,225	45.7 (45.6 - 45.9)
Race/ethnicity	Non-Hispanic White[a]	301,949	75.4 (75.1 - 75.7)	1,887,206	63.0 (62.8 - 63.1)
	Non-Hispanic Black	25,497	11.8 (11.5 - 12.0)	202,964	11.6 (11.5 - 11.7)
	Other races/ non-Hispanic	20,537	5.3 (5.2 - 5.5)	157,446	8.0 (7.9 - 8.1)
	Hispanic	14,521	7.5 (7.3 - 7.7)	207,507	17.4 (17.3 - 17.5)
Smoker	Current - every day[a]	42,684	13.4 (13.2 - 13.6)	269,048	12.3 (12.3 - 12.4)
	Current - some days	13,524	4.8 (4.7 - 5.0)	108,658	5.5 (5.5 - 5.6)
	Former smoker	167,586	42.3 (42.0 - 42.6)	638,995	22.4 (22.3 - 22.5)
	Never smoked	135,897	39.5 (39.2 - 39.8)	1,400,853	59.7 (59.6 - 59.9)
BMI	Underweight[a]	3,098	.8 (.8 - .9)	42,739	2.0 (2.0 - 2.1)
	Normal Weight	92,284	24.9 (24.6 - 25.2)	793,035	35.3 (35.1 - 35.4)
	Overweight	160,316	44.5 (44.2 - 44.8)	808,081	34.4 (34.3 - 34.5)
	Obese	104,879	29.8 (29.5 - 3.1)	673,454	28.3 (28.2 - 28.4)
Physical activity	Had physical activity (PA) or exercise[a]	265,965	75.7 (75.4 - 76.0)	1,780,200	74.9 (74.8 - 75.0)
	No PA or exercise in last 30 days	91,907	24.3 (24.0 - 24.6)	625,506	25.1 (25.0 - 25.2)
Depression	Yes[a]	56,823	15.4 (15.2 - 15.6)	474,269	17.5 (17.4 - 17.6)
	No	311,131	84.6 (84.4 - 84.8)	2,005,510	82.5 (82.4 - 82.6)
Health care coverage	Yes[a]	350,054	93.1 (92.9 - 93.3)	2,228,592	83.8 (83.7 - 83.9)
	No	18,777	6.9 (6.7 - 7.1)	253,771	16.2 (16.1 - 16.3)
CVD	CVD[a]	76,581	17.4 (17.2 - 17.7)	243,412	7.1 (7.1 - 7.2)
	No CVD	285,721	82.6 (82.3 - 82.8)	2,214,900	92.9 (92.8 - 92.9)
MI	MI[a]	47,437	1.6 (1.5 - 1.8)	123,117	3.6 (3.6 - 3.6)
	No MI	320,078	89.4 (89.2 - 89.5)	2,357,230	96.4 (96.4 - 96.4)
CHD	Angina or CHD[a]	44,962	1.1 (9.9 - 1.3)	127,095	3.6 (3.6 - 3.6)
	No angina or CHD	320,239	89.9 (89.7 - 9.1)	2,344,964	96.4 (96.4 - 96.4)
Stroke	Stroke[a]	23,654	5.4 (5.2 - 5.5)	94,609	2.7 (2.7 - 2.7)
	No stroke	344,842	94.6 (94.5 - 94.8)	2,390,578	97.3 (97.3 - 97.3)

BMI, Body Mass Index; CVD, cardiovascular disease; MI, Myocardial Infarction; CHD, Coronary Heart Disease
a. P<.001

Table 2. Weighted logistic regression model for CVD with military service by race interaction

Variable (Reference)	Categories	Univariate, OR (95% CI), Pa	Multivariable, OR (95 % CI), Pa
Military service (No)	Yes	2.752 (2.703, 2.802)	1.341 (1.307, 1.375)
Race/ethnicity (non-Hispanic White)	Non-Hispanic black	.934 (.909, .959)	1.148 (1.109, 1.189)
	Hispanic	.598 (.579, .617)	.820 (.787, .856)
	Other	.658 (.630, .687)	1.135 (1.072, 1.202)
Military service * race	Yes * non-Hispanic Black, Net effect of Military Service for non-Hispanic Black	--	.687 (.630, .749), .921 (.823, 1.030)
	Yes * Hispanic, Net effect of Military Service for Hispanic	--	.911 (.813, 1.021), P=.1099, 1.222 (1.063, 1.404)
	Yes * Other, Net effect of Military Service for Other	--	.923 (.814, 1.045), P=.2049, 1.238 (1.064, 1.931)
Age (60-64)	18 to 24	.056 (.051, .061)	.060 (.054, .068)
	25 to 29	.083 (.076, .090)	.085 (.077, .093)
	30 to 34	.111 (.103, .119)	.117 (.108, .127)
	35 to 39	.155 (.145, .165)	.167 (.156, .178)
	40 to 44	.233 (.222, .246)	.259 (.245, .274)
	45 to 49	.353 (.338, .369)	.372 (.355, .390)
	50 to 54	.524 (.507, .543)	.529 (.510, .549)
	55 to 59	.732 (.709, .756)	.731 (.706, .757)
	60 to 64	1.283 (1.247, 1.320)	1.271 (1.233, 1.312)
	65 to 69	1.678 (1.630, 1.727)	1.696 (1.642, 1.751)
	70 to 74	2.032 (1.970, 2.096)	2.097 (2.025, 2.171)
	75 to 79	2.455 (2.387, 2.525)	2.671 (2.582, 2.762)
Sex (male)	Female	.746 (.734, .757)	.628 (.615, .642)
Education (graduated from college or technical school)	Attended college or technical school	1.467 (1.438, 1.497)	1.211 (1.183, 1.240)
	Did not graduate high school	2.571 (2.507, 2.636)	1.473 (1.424, 1.524)
	Graduated high school	1.794 (1.760, 1.829)	1.211 (1.183, 1.240)
Income (>$50,000)	$15,000 to < $25,000	2.434 (2.379, 2.491)	1.870 (1.815, 1.927)
	$25,000 to <$35,000	2.009 (1.954, 2.065)	1.479 (1.431, 1.528)
	$35,000 to l<$50,000	1.663 (1.619, 1.708)	1.287 (1.248, 1.326)
	Don't know/not sure/missing	1.735 (1.693, 1.778)	1.449 (1.405, 1.494)
	<$15,000	2.842 (2.771, 2.915)	2.343 (2.261, 2.429)
Marital status (married)	Not married	1.088 (1.071, 1.105)	1.000 (.980, 1.020), P=.9857
Smoking (never smoked)	Current smoker - every day	1.838 (1.794, 1.883)	1.586 (1.540, 1.633)
	Current smoker - some days	1.646 (1.587, 1.708)	1.742 (1.669, 1.818)
	Former smoker	2.691 (2.644, 2.738)	1.444 (1.416, 1.473)
BMI category (normal weight)	Obese	1.915 (1.877, 1.954)	1.539 (1.503, 1.576)
	Overweight	1.460 (1.431, 1.489)	1.164 (1.138, 1.191)
	Underweight	1.222 (1.147, 1.301)	1.222 (1.131, 1.320)
Physical activity, (had physical activity)	No physical activity or exercise in last 30 days	2.045 (2.012, 2.079)	1.294 (1.269, 1.319)
Depression (no)	Yes	2.093 (2.056, 2.129)	2.042 (1.999, 2.087)
Health plan (yes)	No	.518 (.502, .535)	.797 (.767, .828)

BMI, Body Mass Index
a. All Ps <.001, except where noted.

race; smoking; alcohol use; body mass index (BMI); physical activity; depression; and access to health care. In order to increase sample size, the 2011-2016 survey data were combined; the weights were revised by dividing them by the number of years combined.

The Oaxaca-Blinder rate-difference decomposition analysis[19] was used to estimate the percent contribution of each covariate to observed differences in CVD prevalence based on the rela-

Table 3. Decomposition of prior military-no prior military difference in unadjusted cardiovascular disease prevalence: Behavioral Risk Factor Surveillance System (BRFSS), 2011-2016

Measures	Prior military vs. no prior military			
	Non-Hispanic White	Non-Hispanic Black	Hispanic	Other
Prior military CVD prevalence (Unadjusted %)	19.2	12.6	10.3	15.2
No prior military CVD prevalence (Unadjusted %)	7.8	8.3	5.6	5.7
Difference, %	11.4	4.3	4.7	9.5
Portion of difference explained	7.5	2.9	2.6	7.3
Explained, %	65.8	66.8	55.0	76.9
Unexplained, %	34.2	33.2	45.0	23.1

tionship between each factor and the outcome, from logistic regression coefficients, and the difference in the distribution of each factor between those with and without prior military service.

All statistical analyses were performed using SAS version 9.4 software (Cary, NC). Survey procedures were used in order to account for complex survey design and population weights. Results of significance testing were reported as actual P values.

RESULTS

Of the 2,861,628 individuals included for analysis, 369,844 (12.9%) indicated a history of prior military service. Characteristics of the study population are presented in Table 1 as weighted percentages. Overall, those in the prior military service group were more likely to be non-Hispanic White (75.4%, 95%CI 75.1 – 75.7 vs 63.0%, 95%CI 62.8 – 63.1) and less likely to be Hispanic (7.5%, 95% CI 7.3 – 7.7 vs 17.4%, 95% CI 17.3 – 17.5; P<.001) than those without prior service. Individuals in the prior service group were older, with 43.1% aged ≥60 years compared with 23.9% in the no prior service group. They were also

more likely to be a current or former smoker (60.5% vs 40.2%) and more likely to have an income of $50,000 or more (43.7%, 95%CI 43.4-44.0 vs 37.2%, 95%CI 37.1-37.3; P<.001).

The outcome of interest, CVD, was more prevalent among those with prior service (17.4%, 95%CI 17.2 – 17.7) than in the no prior service group (7.1%, 95%CI 7.1 – 7.2; P<.001), and was associated with military service in the univariate (OR 2.75, 95%CI 2.70-2.80; P<.001) and multivariate model (OR 1.34, 95%CI 1.31-1.38; P<.001) (Table 2). Compared with non-Hispanic Whites, the odds of CVD were higher for non-Hispanic Blacks (OR 1.15; 95%CI 1.11-1.19; P<.001) and Other race/ethnicity (OR 1.14; 95%CI 1.07-1.20; P<.001), but were lower for Hispanics (OR 0.82; .79-.86; P<.001). Inclusion of the interaction between military service and race/ethnicity was statistically significant, but only for non-Hispanic Blacks (OR .69, 95%CI .63-.75; P<.001), and not for Hispanics (OR .91; 95%CI .81-1.02; P=.11) or Other race/ethnicity (OR .92; 95%CI .81-1.05; P=.20). The net effect of the interaction term for non-Hispanic Blacks was (OR .92; 95% CI .82-1.03), which indicates no significant difference in

odds of CVD associated with military service for non-Hispanic Blacks.

Non-Hispanic Whites had the largest difference in unadjusted CVD prevalence (prior military, 19.2%; no prior military, 7.8%; difference, 11.4%) compared with non-Hispanic Blacks (prior military, 12.6%; no prior military, 8.3%; difference, 4.3%), Hispanics (prior military, 10.3%; no prior military, 5.6%; difference, 4.7%), and Other (prior military, 15.2%; no prior military, 5.7%; difference, 9.5%) (Table 3; Figure 1). Adjusting for age attenuated this gap, although non-Hispanic Whites still had the largest difference in CVD prevalence between those with and without prior service (5.6%), followed by Other (3.5%), Hispanics (2.8%) and non-Hispanic Blacks (.8%) (Figure 2).

Decomposition estimates of percent contribution of each variable to the observed difference in CVD prevalence between individuals with and without prior service are reported in Figure 3. Age was the largest contributor to the gap in CVD prevalence between those with and without prior military service, accounting for 66.1% of the CVD increase in non-Hispanic Whites, 94.4% in non-Hispanic Blacks, 71.8% in Hispanics,
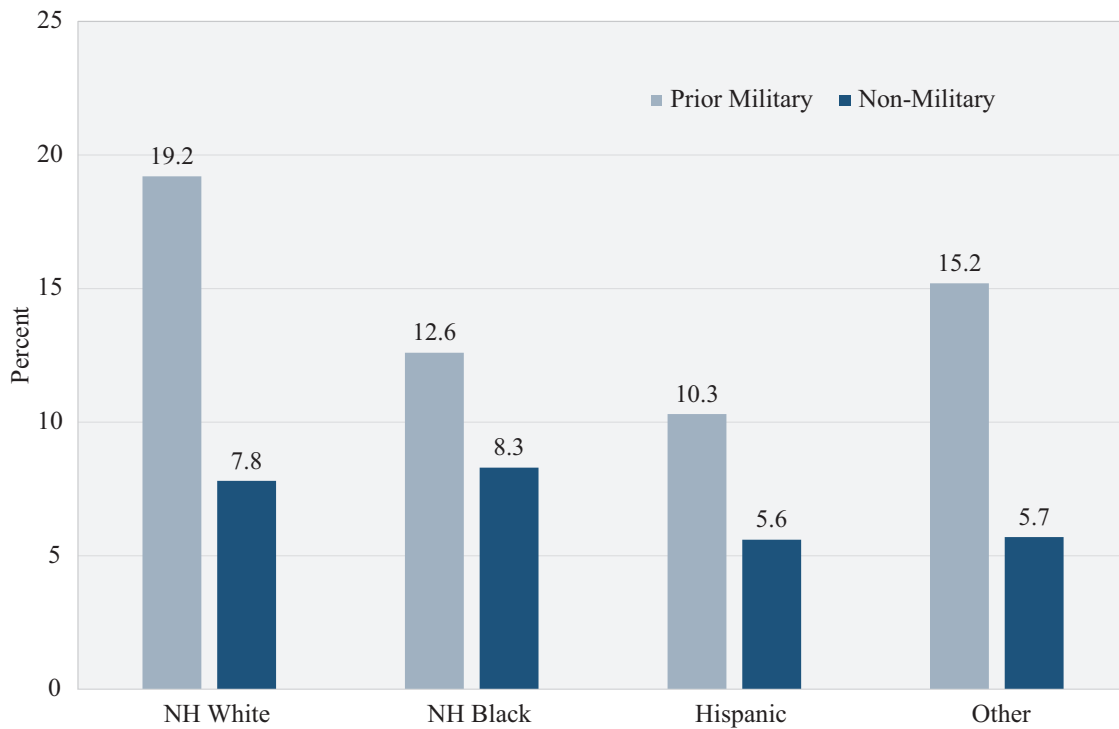
Figure 1. Weighted, unadjusted prevalence of cardiovascular disease by race/ethnicity
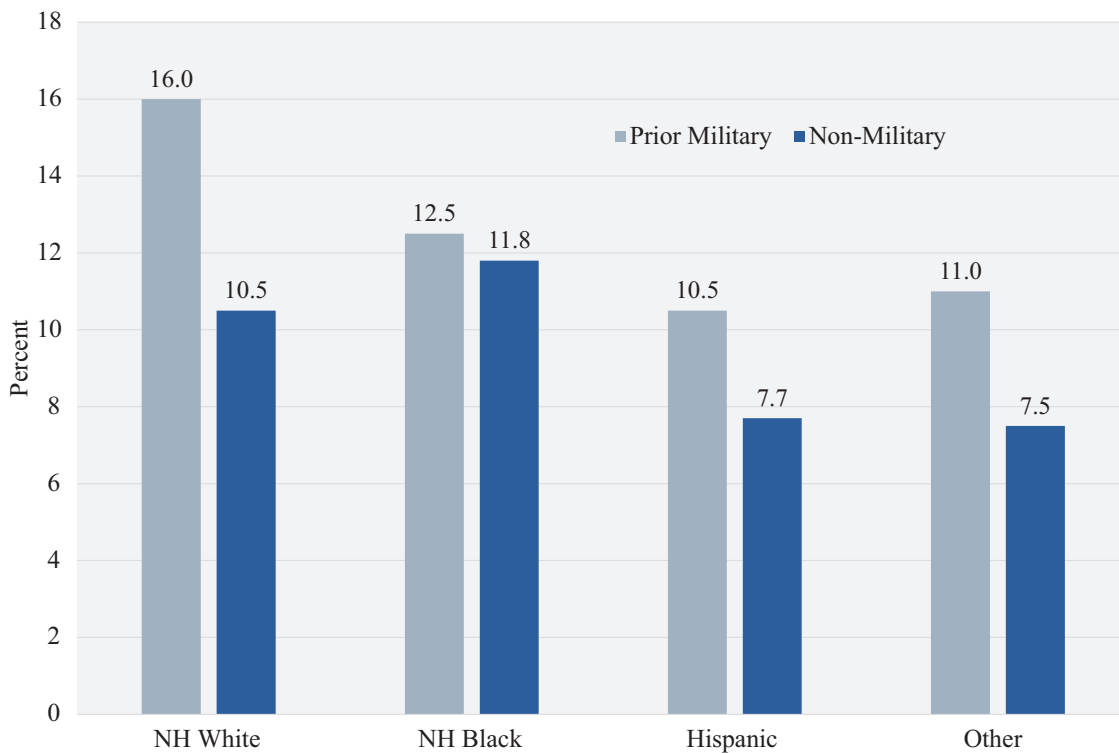

Figure 2. Age-adjusted prevalence of cardiovascular disease by race/ethnicity

and 61.9% in Other race/ethnicity. After age, most of the difference was driven by socioeconomic factors and health behaviors. Among non-Hispanic Blacks and Hispanics, the two largest health-promoting factors were income (25.1% and 23.1% contribution, respectively) and increased physical activity (4.3% and 4.1% contribution, respectively), but these were not contributing factors for Other race/ethnicity. Meanwhile, presence of current or past smoking behavior (6.7%, 9.8%, 8.9% contribution, respectively) was the largest health-detracting factor for all groups, and obese status was a health-detracting factor for non-Hispanic Whites (1.3% contribution) and Other (4.8% contribution), but was health-promoting for non-Hispanic Blacks (3.6% contribution) and Hispanics (.6% contribution).

Compared with non-Hispanic Whites, non-Hispanic Black and Hispanic individuals with prior military service tended to have higher income (69% and 134% more in highest income category, respectively), higher prevalence of physical activity within the last 30 days (7% and 15% more, respectively), higher prevalence of current and former smoking behavior (9% and 38% more current daily smokers, respectively), and lower prevalence of obesity than individuals without prior military service (7% and 1% less, respectively) (Figures 4, 5, 6, 7). Individuals of Other racial/ethnic background had income and physical activity distributions that did not differ from non-Hispanic Whites, had the highest prevalence of smoking (65% more current daily smokers), and had the highest prevalence of obesity (59% more with BMI>30). (Figures 4, 5, 6, 7).

DISCUSSION

We found that prior military service was associated with increased odds of the development of CVD, and that this association varied by race/ethnicity. Our primary findings from the analysis of racial/ethnic subgroups were threefold: 1) we found that age-adjusted CVD prevalence among non-Hispanic Whites with prior military service was higher than that of any other racial/ethnic subgroup with or without military service; 2) while prior military service was associated with higher odds of CVD for non-Hispanic Whites, Hispanics and Other race/ethnicity, this was not the case for non-Hispanic Blacks; and 3) Hispanics had the lowest overall odds of CVD, where Hispanics with military service had similar odds as non-Hispanic Whites without service, and Hispanics and Other without military service were the lowest odds groups.

These findings contribute to the body of evidence supporting differences in CVD outcomes by military service, demonstrate that this difference varies by race/ethnicity, and highlight specific socioeconomic and health behavior factors that may contribute to this difference. Our finding that prior military service overall was associated with increased odds of CVD is consistent with recent findings.[6] There is mounting evidence that military veterans have higher prevalence of CVD because military service is often accompanied by health compromising exposures, including physical, psychological and behavioral factors. For example, military service puts individuals at increased risk of traumatic injury, which has been shown to be associated with higher risk of subsequent CVD[11] and hypertension.[11,20] Increased mental health diagnoses, including depression, anxiety[21] and post-traumatic stress disorder[20,22] within military veterans has also been linked to subsequent CVD risk. Higher prevalence of obesity[23] and smoking behavior[24] have also been linked to higher risk of CVD in military veterans.

Most surprisingly, however, is the finding that non-Hispanic Whites with prior military service had higher age-adjusted CVD prevalence than non-Hispanic Blacks and Hispanics, regardless of prior service. Furthermore, in multivariable adjusted models, the odds of CVD for non-Hispanic Blacks with prior service were buffered, compared with non-Hispanic Whites, Hispanics and Other racial/ethnic background with prior service. In fact, non-Hispanic Blacks with prior service had odds of CVD that were no different than non-Hispanic Blacks with no prior service, a reversal of the pattern observed in non-Hispanic Whites, Hispanics and Other race/ethnicity.

While differential health risks have been noted in the health disparities literature, they typically work to the disadvantage of non-Hispanic Blacks compared with non-Hispanic Whites.[25] Our findings, however, point to a CVD risk advantage for non-Hispanic Blacks with prior service, compared with non-Hispanic Whites with prior service. This contrasts with other recent findings that, despite having relatively similar health upon enlistment,[26] disparities in cardiovascular risk factors, including hypertension[14,16] and obesity[16] exist among non-Hispanic Black active duty and veteran service members. Our findings
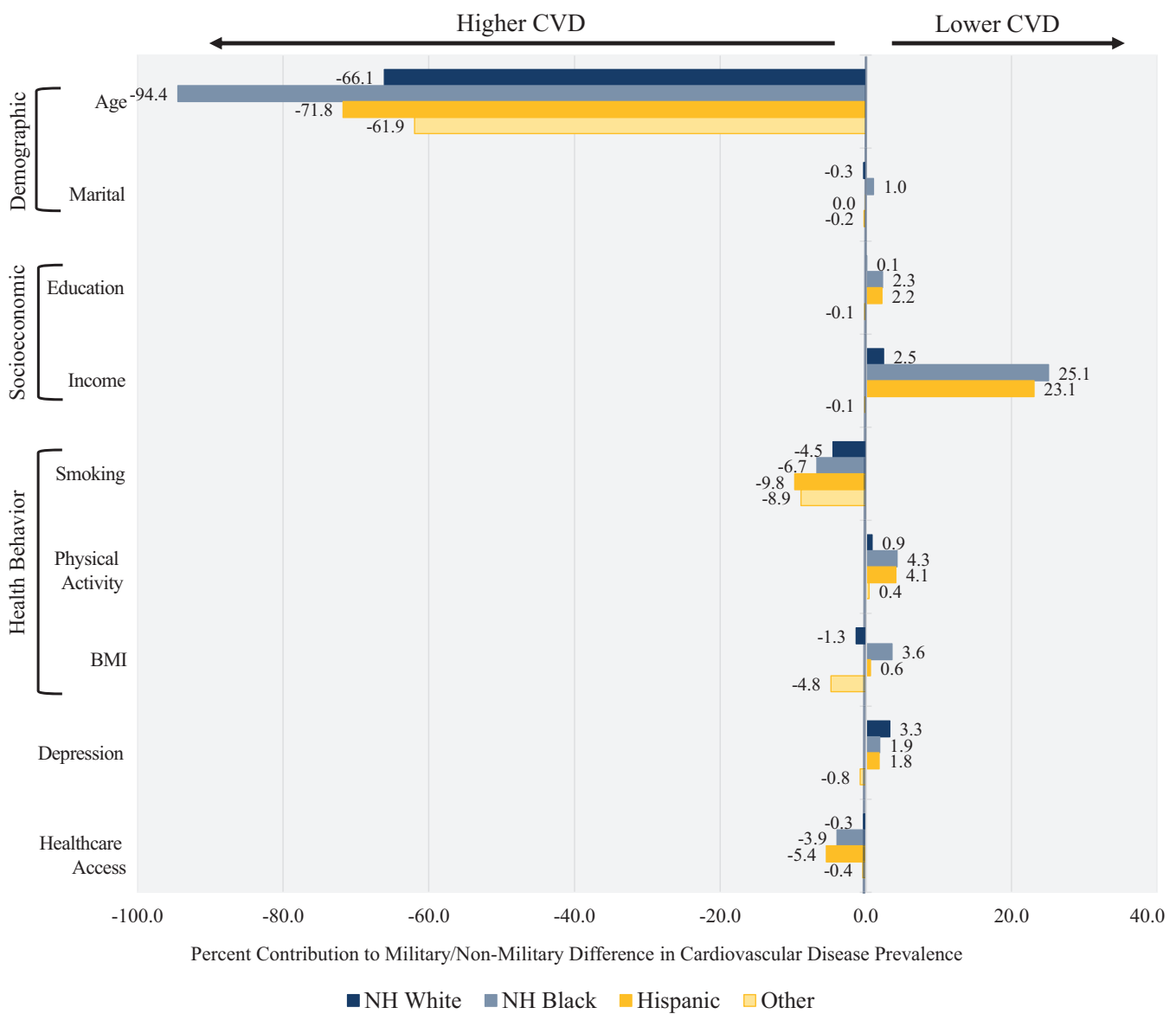
Figure 3. Decomposition percent contribution estimates for prior military versus no prior military difference in cardiovascular disease prevalence: Behavioral Risk Factor Surveillance System (BRFSS), 2011-2016

are more consistent with a recent meta-analysis of racial/ethnic mortality disparities in the Veterans Health Administration, which found that mortality among non-Hispanic Black veterans with CVD was overall either the same or lower than that of White veterans.[17]

The results of decomposition analysis further explain why the large

differences in CVD between prior service and no prior service exist for non-Hispanic Whites, but not for non-Hispanic Blacks. After age, income was the most important factor, contributing to only 2.5% of the difference in CVD between those with prior service and no prior service within non-Hispanic Whites,

but contributing 25.1% within non-Hispanic Blacks and 23.1% within Hispanics. Interestingly, income contributed effectively nothing for Other race/ethnicity (.1%). More specifically, the percentage of non-Hispanic Whites in the top income category (>$50,000) was the same for those with prior service as for no prior ser-
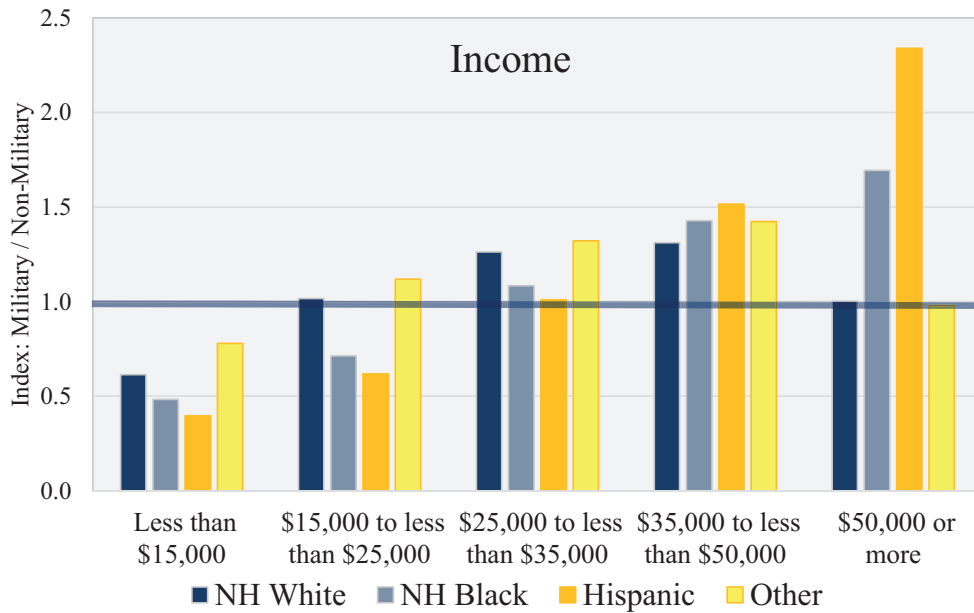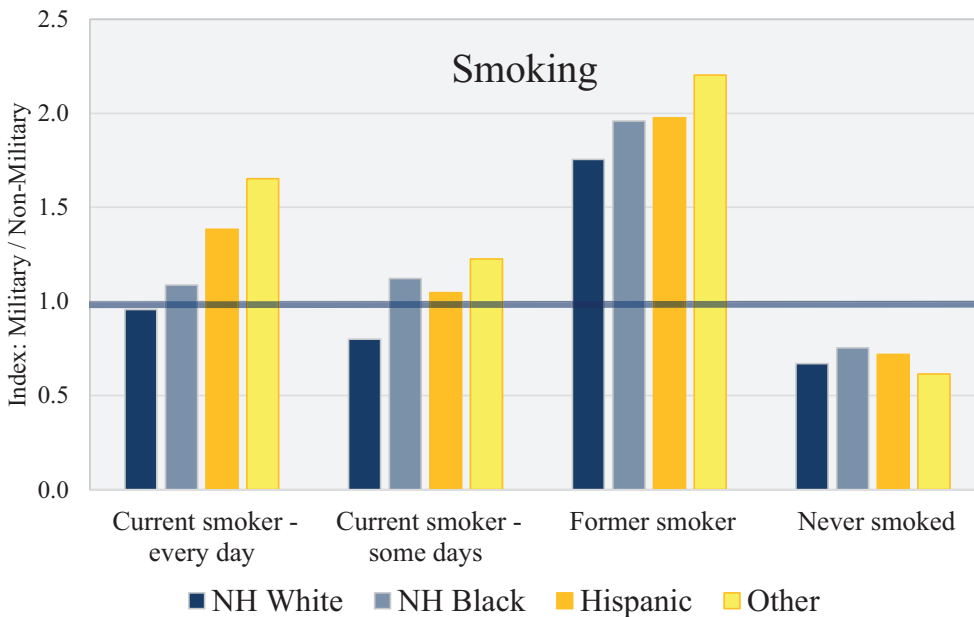
Figure 4. Index of distribution of one of top four potentially modifiable contributing factors to prior military vs no prior military difference in cardiovascular disease prevalence: Behavioral Risk Factor Surveillance System (BRFSS), 2011-2016. Graph shows the distribution of factor as an index comparing prior military with no prior military, where a value of 1, as represented by a solid blue line, means that prior military and no prior military groups have the same representation, greater than 1 means prior military is over-represented compared with no prior military, and less than 1 means prior military is under-represented compared with no prior military.
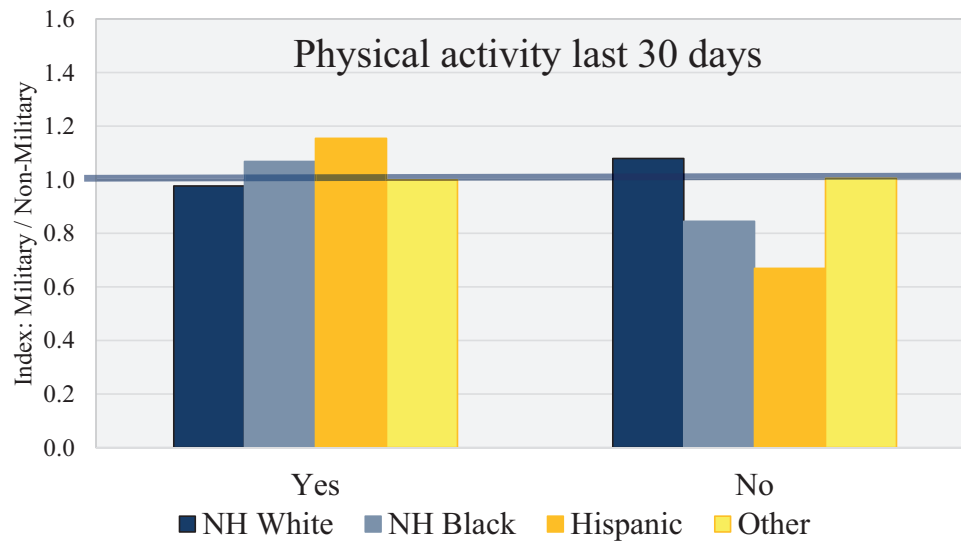

Figure 5. Index of distribution of one of top four potentially modifiable contributing factors to prior military vs no prior military difference in cardiovascular disease prevalence: Behavioral Risk Factor Surveillance System (BRFSS), 2011-2016. Graph shows the distribution of factor as an index comparing prior military with no prior military, where a value of 1, as represented by a solid blue line, means that prior military and no prior military groups have the same representation, greater than 1 means prior military is over-represented compared with no prior military, and less than 1 means prior military is under-represented compared with no prior military.
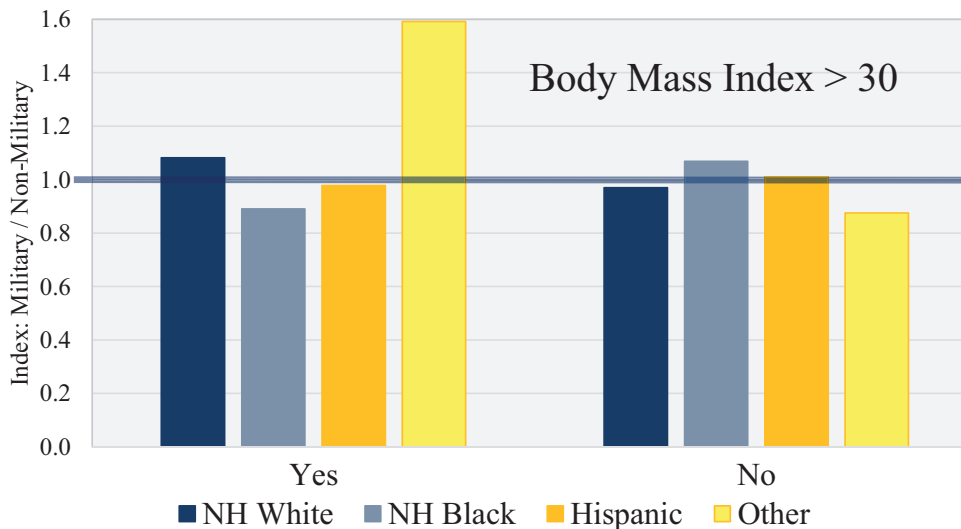
Figure 6. Index of distribution of one of top four potentially modifiable contributing factors to prior military vs no prior military difference in cardiovascular disease prevalence: Behavioral Risk Factor Surveillance System (BRFSS), 2011-2016. Graph shows the distribution of factor as an index comparing prior military with no prior military, where a value of 1, as represented by a solid blue line, means that prior military and no prior military groups have the same representation, greater than 1 means prior military is over-represented compared with no prior military, and less than 1 means prior military is under-represented compared with no prior military.

Figure 7. Index of distribution of one of top four potentially modifiable contributing factors to prior military vs no prior military difference in cardiovascular disease prevalence: Behavioral Risk Factor Surveillance System (BRFSS), 2011-2016. Graph shows the distribution of factor as an index comparing prior military with no prior military, where a value of 1, as represented by a solid blue line, means that prior military and no prior military groups have the same representation, greater than 1 means prior military is over-represented compared with no prior military, and less than 1 means prior military is under-represented compared with no prior military.

vice, but among non-Hispanic Blacks, the percentage in the top income category was 69% higher for those with prior service. Among Hispanics, the percentage of those in the top income category was 134% higher for those with prior service compared with no prior service, but was no different for Other race/ethnicity. In contrast, non-Hispanic Whites with prior service had a higher representation within the $25,000-$50,000 income range, compared with non-Hispanic Blacks and Hispanics. These findings are consistent with a previous analysis of the 2010 National Survey of Veterans, which found that racial/ethnic disparities in self-rated health and disability among veterans could be partially explained by socioeconomic factors and smoking behavior.[15]

The contribution of physical activity was 4.3% for non-Hispanic Blacks and 4.1% for Hispanics, but was only .9% for non-Hispanic Whites, and even less for Other race/ethnicity. This was largely driven by the fact that there was no difference in the percentage of non-Hispanic Whites and Other race/ethnicity with prior military service and no prior military service who engaged in physical activity in the past 30 days, while physical activity was 7% higher for non-Hispanic Black military veterans than non-veterans, and 15% higher for Hispanic military veterans than non-veterans. Previous analyses of BRFSS have also found that overall, veterans are more physically active than non-veterans.[27,28] Similarly, non-Hispanic Blacks and Hispanics with prior military service had lower prevalence of obesity status than individuals without prior military ser-

vice, but non-Hispanic Whites and Other race/ethnicity individuals with prior military service had 8% and 59% higher prevalence of obese status, respectively, than those without military service. Additionally, non-Hispanic Black, Hispanic, and Other race/ethnicity individuals with prior military service had higher percentages of current and former smoking behavior than non-Hispanic Whites.

Overall, our findings suggest that non-Hispanic Blacks and, to a lesser extent, Hispanics with prior military service have benefitted more from higher income, increased levels of physical activity, and lower obesity levels than non-Hispanic Whites and Other race/ethnicity with prior military service. These data suggest that for non-Hispanic Blacks and Hispanics, military service provides a pathway to upward mobility, leading to higher income and socioeconomic status, which translates into a protective buffer to CVD that is not realized by non-Hispanic Whites and Other race/ethnicity individuals. Why these benefits do not seem to translate for non-Hispanic Whites and Other race/ethnicity individuals is not completely clear, but could potentially be explained by differences in pathways toward upward mobility, as realized in higher incomes, with diverse selection processes that differ by race/ethnicity.[29] Higher incomes for non-Hispanic Blacks may also be correlated with lower obesity and greater physical activity than observed in non-Hispanic Whites. Thus, non-Hispanic Whites may experience a different selection process than other groups, which results in differences in socioeconomic outcomes after military service. More

research is needed to further examine critical factors in determining differences in military service selection processes, and how such differences may serve to influence subsequent socioeconomic and health outcomes.

While this study addresses individual demographic, select health behaviors, and access to care, we are unable to discuss other potential causes of health inequalities, such as biological mechanisms, environmental and social contexts, or societal factors, such as discrimination or systemic poverty.[30] We were also unable to account for military service factors, such as length of time in service, branch of service, and combat exposure, which have been identified as potential causes of racial/ethnic health disparities.[15]

Conclusions

These results from a nationally representative sample of the US population support an association between prior military service and CVD and demonstrate that this relationship varies by race/ethnicity. Higher income and physical activity were identified as health-promoting factors that contributed to lower CVD odds for non-Hispanic Blacks with prior military service than non-Hispanic Whites, while increased smoking was identified as a health-detracting behavior. Knowledge of modifiable risk factors and protective factors can be used to guide CVD treatment and prevention efforts among US veterans. Further research is needed to determine why veterans are at increased risk of CVD and to explore specific causes of how race mediates this relationship.

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