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Heart Matters: Gender and Racial Differences Cardiovascular Disease Risk Factor Control Among Veterans

Karen M. Goldstein, MD, MPSH [a,b,c,*], S. Dee Melnyk, PharmD, MHS [a,b,d], Leah L. Zullig, PhD, MPH [a,e], Karen M. Stechuchak, MS [a], Eugene Oddone, MD, MHSc [a,b,c], Lori A. Bastian, MD, MPH [f,g], Susan Rakley, MD [b], Maren K. Olsen, PhD [a,h], Hayden B. Bosworth, PhD [a,c,i]

[a] Center of Excellence for Health Services Research in Primary Care, Durham Veterans Affairs Medical Center, Durham, North Carolina
[b] Ambulatory Care Services, Durham Veterans Affairs Medical Center, Durham, North Carolina
[c] Division of General Internal Medicine, Duke University, Durham, North Carolina
[d] University of North Carolina Eshelman School of Pharmacy, Chapel Hill, North Carolina
[e] Department of Health Policy and Management, University of North Carolina, Chapel Hill, North Carolina
[f] VA Connecticut Healthcare System, Newington, Connecticut
[g] University of Connecticut Health Center, Farmington, Connecticut
[h] Department of Biostatistics and Bioinformatics, Duke University Medical Center, Durham, North Carolina
[i] Departments of Psychiatry and School of Nursing, Duke University, Durham, North Carolina

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A B S T R A C T

Background: Cardiovascular disease (CVD) is the leading cause of mortality for U.S. women. Racial minorities are a particularly vulnerable population. The increasing female veteran population has an higher prevalence of certain cardiovascular risk factors compared with non-veteran women; however, little is known about gender and racial differences in cardiovascular risk factor control among veterans.
Methods: We used analysis of variance, adjusting for age, to compare gender and racial differences in three risk factors that predispose to CVD (diabetes, hypertension, and hyperlipidemia) in a cohort of high-risk veterans eligible for enrollment in a clinical trial, including 23,955 men and 1,010 women.
Findings: Low-density lipoprotein (LDL) values were higher in women veterans than men with age-adjusted estimated mean values of 111.7 versus 97.6 mg/dL ($p < .01$). Blood pressures (BPs) were higher among African-American than White female veterans with age-adjusted estimated mean systolic BPs of 136.3 versus 133.5 mmHg, respectively ($p < .01$), and diastolic BPs of 82.4 versus 78.9 mmHg ($p < .01$). African-American veterans with diabetes had worse BP, LDL values, and hemoglobin A1c levels, although the differences were only significant among men.
Conclusions: Female veterans have higher LDL cholesterol levels than male veterans and African-American veterans have higher BP, LDL cholesterol, and A1c levels than Whites after adjusting for age. Further examination of CVD gender and racial disparities in this population may help to develop targeted treatments and strategies applicable to the general population.

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Cardiovascular disease (CVD) remains the leading cause of mortality for women in the United States (Roger et al., 2011). Over the last few decades, efforts to treat relevant risk factors and the increased use of effective medical therapies have led to measurable reductions in overall deaths from CVD among both genders (Ford et al., 2007). However, these reductions have stagnated in recent years. Of particular concern is the recognition that CVD related deaths are rising in women aged 35 to 44 years (Ford & Capewell, 2007). Inadequate awareness among women about the significance of CVD risk persists (Biswas, Calhoun, Bosworth, & Bastian, 2002; Mosca, Mochari-Greenberger, Dolor, Newby, & Robb, 2010), including within the female veteran population (Canter, Atkins, McNeal, & Bush, 2009). We are at

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* Correspondence to: Karen M. Goldstein, MD, MSPH, Durham VMAC, 508 Fulton Street, Durham, NC 27705. Phone: 919.286.0411x7764; fax: 919.416.5835.
E-mail address: karen.goldstein@va.gov (K.M. Goldstein).

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a critical juncture for modifying risk factors and preventing CVD in women.

Evidence of gender disparities in CVD is emerging. Recent studies show that women are more likely to have delayed care for emergent cardiac illness (Concannon et al., 2009), have higher in-hospital mortality post-myocardial infarction for women younger than 50 (Zhang et al., 2012), and receive less guideline concordant care post-stroke (Tuhrim et al., 2008). Gender disparities in CVD prevention have also been recognized among female veterans. For example, female veterans are less likely to receive nicotine replacement therapy for smoking cessation (Sherman, Fu, Joseph, Lanto, & Yano, 2005) and are more likely to have inadequate control of cholesterol compared with male veterans (Sambamoorthi, Mitra, Findley, & Pugach, 2012; Tseng et al., 2006a, 2006b; Vimalananda, Miller, Palnati, Christiansen, & Fincke, 2011).

In addition to gender disparities in CVD morbidity and mortality, there is also evidence of racial/ethnic group disparities. In the United States, the gender gap in CVD mortality between men and women is greater among Whites than African Americans. However, African-American women have higher rates of CVD mortality than White women and the time lag in CVD mortality between men and women is 5 to 10 years shorter in the African-American U.S. population than the White population (Ho, Paultre & Mosca, 2005). Also notable are higher mortality rates for coronary heart disease and stroke among African-American women compared with White women (Roger et al., 2011). Racial disparities among veterans has been previously demonstrated in the context of blood pressure (BP), (Axon, Gebregziabher, Echols, Msph, & Egede, 2011; Bosworth et al., 2008), diabetes (Egede, Mueller, Echols, & Gebregziabher, 2010), and cardiovascular interventions (Saha et al., 2008). Recently, Rose, Farmer, Yano, and Washington (2013) found that African-American women veterans were more likely to have a diagnosis of hypertension, diabetes, and obesity compared with White women veterans. Understanding and reducing racial disparities in the control of diseases like hypertension would make a significant contribution to erasing the racial disparities in death owing to CVD (Fiscella & Holt, 2008).

Female veterans are at high risk for developing CVD. Female veterans utilizing Veterans Administration (VA) health care have an increased frequency of chronic medical conditions, mental health disorders and health risk behaviors in addition to poorer health status overall compared with the civilian population (Frayne et al., 2006; Lehavot, Hoerster, Nelson, Jakupcak, & Simpson, 2012). Vimalananda and colleagues (2013a) recently described the high prevalence of hypertension, hyperlipidemia, and diabetes in female veterans at 42%, 39% and 18%, respectively, in women aged 55 to 64. In addition, higher rates of certain risk factors such as smoking (Farmer, Rose, Riopelle, Lanto, & Yano, 2011; Sherman et al., 2005) and obesity (Das et al., 2005) add to an elevated risk for CVD in female veterans relative to non-veteran women. Moreover, racial/ethnic minority female veterans remain at a higher risk for CVD compared with White women veterans, a finding most pronounced among African-American women (Rose et al., 2013). High rates of CVD risk factors are particularly concerning, because female veterans tend to be younger on average than male veterans and are thus susceptible to significant long-term morbidity. Developing a better understanding of gender and racial disparities in CVD risk among female veterans will inform effective prevention and treatment approaches, not only for this population, but also in other high-risk groups.

In this paper, we examine disease control among key conditions in a population of veterans at high risk for CVD as defined as having hypertension, hyperlipidemia, or both. Specifically, we aim to answer the following questions: 1) Is there a significant difference in CVD risk factor control between men and women veterans at high risk for CVD as defined by BP (mmHg), hemoglobin A1c (HbA1c), and low-density lipoprotein (LDL) cholesterol (mg/dL)? and 2) Is there a significant difference in CVD risk factor control between African-American and White veterans by gender as defined by BP (mmHg), HbA1c, and LDL cholesterol (mg/dL)?

Methods

Design

We examined CVD risk factors in a cohort of high-risk veterans who were potentially eligible for the Cardiovascular Intervention Improvement Telemedicine Study (CITIES). CITIES has been described elsewhere in detail (Melnyk et al., 2013; Zullig et al., 2014). In brief, this study is a 12-month clinical pharmacist specialist–delivered medication and behavioral management telephone intervention administered to veterans with poorly controlled hypertension and/or hyperlipidemia. A study team member identified eligible participants to be included in the sample by conducting a data pull from Veterans Health Information System/Computerized Patient Record System based on ICD-9 codes (Jackson et al., 2011). The Durham VA Medical Center (VAMC) Institutional Review Board approved the study.

Patients

Our study included all patients who were eligible for the CITIES study if they 1) lived in North Carolina or Virginia 2) were 40 years of age or older, 3) were enrolled in one of three primary care clinics affiliated with the Durham VAMC and had at least one visit with a primary care provider in the past year, and 4) had an outpatient diagnosis code of hypertension (ICD-9 codes of 401.0, 401.1, and 401.9) and/or hyperlipidemia (ICD-9 codes of 272.xx). Based on these criteria, 24,965 potentially eligible male and female patients were identified in 2011. There were 9,585 men and 275 women in this sample who had a diagnosis of diabetes. Patients were ineligible for the study if they had a diagnosis of active psychosis and/or dementia.

Data Analysis

LDL, HbA1c, and outpatient values for BP were obtained from the electronic medical record for the year prior the data pull. Mean LDL, HbA1c, and BP values were calculated for each patient from available data.

Patients were identified as having diabetes if they had the ICD-9 code 250.xx. Age, race, and gender were determined as identified in the electronic medical record. Four racial categories were created: White, Black or African American, and other (composed of American Indian or Alaskan Native, Asian, Asian or Pacific Islander, Native Hawaiian or Pacific Islander, Hispanic—Black, and Hispanic—White), and unknown (composed of unknown or declined to answer).

For each outcome variable, we report findings in all high-risk patients together ("Overall") and then break down by gender and into White and African-American patients only owing to the low

Table 1
Characteristics of Veterans at High Risk for Cardiovascular Disease by Diagnosis, Gender, and Age Range

Race[†]	Women, *n* (%)[*]			Men, *n* (%)		
	Overall, *n* = 1,010 (4.0)	African American, *n* = 553 (54.8)	White, *n* = 397 (39.3)	Overall, *n* = 23,955 (96.0)	African American, *n* = 8,128 (33.9)	White, *n* = 12,940 (54.0)
Age (y), mean (SD)	55.9 (9.2)	53.6 (6.9)	58.9 (10.7)	65.2 (10.7)	61.3 (9.9)	67.0 (10.3)
By decade[‡]						
40–49	240 (23.8)	155 (28.0)	67 (16.9)	1,784 (7.4)	927 (11.4)	667 (5.2)
50–59	498 (49.3)	302 (54.6)	176 (44.3)	4,556 (19.0)	2,440 (30.0)	1,675 (12.9)
60–69	196 (19.4)	86 (15.6)	98 (24.7)	10,583 (44.2)	3,460 (42.6)	6,084 (47.0)
≥70	76 (7.5)	10 (1.8)	56 (14.1)	7,031 (29.4)	1,300 (16.0)	4,514 (34.9)
Comorbidity						
HTN (no HL)	409 (40.5)	288 (52.1)	98 (24.7)	7,265 (30.3)	3,275 (40.3)	3,198 (24.7)
HL (no HTN)	176 (17.4)	52 (9.4)	116 (29.2)	3,429 (14.3)	697 (8.6)	2,273 (17.6)
HTN and HL	425 (42.1)	213 (38.5)	183 (46.1)	13,261 (55.4)	4,156 (51.1)	7,469 (57.7)
DM	280 (27.7)	161 (29.1)	108 (27.2)	9,740 (40.7)	3,730 (45.9)	5,015 (38.8)

Abbreviations: DM, diabetes; HL, hyperlipidemia; HTN, hypertension; SD, standard deviation.
[*] Except where noted otherwise.
[†] For women, there were 13 who identified as "Other race" and 47 as "Unknown." For men, there were 316 who identified as "Other race" and 2,571 as "Unknown."
[‡] One African-American man only had year of birth available and was unable to be classified by decade.

numbers in the other two categories, unknown and other. We used analysis of variance (ANOVA) to examine gender differences in the following outcome variables: BP, LDL levels, and HbA1c. Gender differences in BP were examined in patients with hypertension; differences in LDL levels were examined in patients with hyperlipidemia. Additionally, gender differences in BP, LDL levels, and HbA1c were examined in patients with diabetes. In each ANOVA model, gender was the main explanatory variable of interest, and age was included as a covariate. We further examined racial differences in the outcome variables between African-American and White veterans by gender. In separate ANOVA models for men and women, race was the main explanatory variable of interest, and age was included as a covariate. To account for the exploratory nature of this analysis, we only considered measurement differences to be significant when $p < .01$. A lower threshold for significance was chosen to lessen the possibility of identifying small and potentially clinically insignificant differences. Results are given as estimated age-adjusted means to clarify that means provided were estimated from the ANOVA models, which took into consideration the age of the participants. All data analyses for this paper were completed using SAS software version 9.2 (SAS Institute, Inc., Cary, NC).

Results

Control in Target Diseases (Hypertension, Hyperlipidemia, and Diabetes)

This analysis included 1,010 women and 23,955 men. For women, the breakdown by race/ethnic group was 54.8% African American, 39.3% White, 1.3% other, and 4.7% unknown (Table 1). For men, it was 33.9% African American, 54.0% White, 1.3% other, and 10.7% unknown. The mean age was 55.9 (SD 9.2) for women and 65.2 (SD 10.7) for men. To be included in the study, patients had to have hypertension and/or hyperlipidemia. More men had both hypertension and hyperlipidemia than women in this cohort (55.4% vs. 42.1%, respectively). Additionally, diabetes rates in this sample were higher in male veterans (40.7%) than female veterans (27.7%).

With respect to disease control, hypertensive women and men were generally well-controlled with an age-adjusted estimated mean BP of 135.5/76.8 and 135.3/79.0 mmHg, respectively (Table 2). The difference between genders for diastolic BP was significant ($p < .0001$). Both adjusted mean systolic and diastolic BPs were significantly higher among African-American veterans of both genders. Women had significantly higher LDL levels than male veterans with age-adjusted estimated mean LDL levels of 111.7 and 97.6 mg/dL, respectively ($p < .0001$; Table 3). There was no difference in LDL values between African-American and White women, although LDL levels were greater among African-American men than White men with age-adjusted estimated means of 99.6 versus 95.8 mg/dL, respectively ($p < .0001$).

Among patients with diabetes, there was no difference in HbA1c level or systolic BP between genders, although diastolic BP continued to be higher among men (Table 4). Similar to the finding in patients with hyperlipidemia noted, female veterans with diabetes had higher age-adjusted estimated mean LDL values compared with men (100.0 versus 88.0 mg/dL; $p < .0001$). In African-American male veterans with diabetes, there was a pattern of worse disease control for all three conditions (hypertension, hyperlipidemia, and diabetes) compared with White male veterans ($p < .0001$). Although there were disparities among African-American and White women with diabetes in all

Table 2
Blood Pressure Levels in Patients with Hypertension by Gender and Race

	n[*]	Age-Adjusted Mean SBP (SE)	*p* Value	Age-Adjusted Mean DBP (SE)	*p* Value
Gender			.6894		<.0001
Women	826	135.5 (0.5)		76.8 (0.3)	
Men	20,150	135.3 (0.1)		79.0 (0.1)	
Race					
Women			.0085		<.0001
African American	495	136.3 (0.6)		82.4 (0.4)	
White	279	133.5 (0.8)		78.9 (0.6)	
Men			<.0001		<.0001
African American	7,330	136.8 (0.2)		81.0 (0.1)	
White	10,464	134.3 (0.1)		77.7 (0.1)	

Abbreviations: DBP, diastolic blood pressure (mmHg); SBP, systolic blood pressure (mmHg); SE, standard error.
Note. Age-adjusted means, standard errors, and *p* values are estimated from analysis of variance models adjusting for age.
[*] Eight out of 834 women and 274 out of 20,526 men had a diagnosis of hypertension but did not have a usable blood pressure measurement in the year prior to data acquisition. Additionally, two men were not included in the analysis of variance models owing to not having an exact date of birth for age calculation.

Table 3
LDL Cholesterol Levels in Patients with Hyperlipidemia by Gender and Race

	n^*	Adjusted Mean LDL (SE)	p Value
Gender			<.0001
Women	481	111.7 (1.6)	
Men	12,537	97.6 (0.3)	
Race			
Women			.8132
African American	226	117.5 (2.6)	
White	230	118.4 (2.6)	
Men			<.0001
African American	3,907	99.6 (0.5)	
White	7,278	95.8 (0.4)	

Abbreviations: LDL, low-density lipoprotein (mg/dL); SE, standard error.
Note. Adjusted means, standard errors, and p-values are estimated from analysis of variance models adjusting for age.
* One hundred twenty out of 601 women and 4,151 out of 12,539 men had a diagnosis of hyperlipidemia, but did not have a usable LDL measurement in the year before data acquisition. Additionally, two men were not included in the analysis of variance models owing to not having an exact date of birth for age calculation.

three conditions as well, the differences were only significant for diastolic BP (80.3 versus 76.0 mmHg; $p < .01$). Of note, the age-adjusted estimated mean HbA1c levels for all groups of veterans with diabetes were above the American Diabetes Association goal of ≤7.0 (American Diabetes Association, 2013) with the highest being among African-American women at 7.6.

CVD Risk Factors for Patients without Target Diseases

In this study, patients had to have either hypertension or hyperlipidemia to be included, but even those without a formal disease diagnosis had signs of elevated risk (e.g., a patient may have had a diagnosis of hyperlipidemia and not hypertension, but have elevated BPs meeting the threshold for pre-hypertension). The mean systolic BP in those women and men without a diagnosis of hypertension was similar at 124.9 (SD 10.7) and 127.3 (SD 12.1) mmHg, respectively. Similarly, for those patients who did not have a diagnosis of diabetes, but who did have a HbA1c measured, the mean HbA1c was 5.8 (SD 0.4) in women and 5.9 (SD 0.5) in men.

Discussion

Among this veteran population at high risk for CVD, we found that female veterans had worse control of hyperlipidemia than male veterans. This difference was observed despite the fact that female veterans in this cohort on average were almost 10 years younger than male veterans. In addition, we found that African-American women had worse BP control than White women, and that African-American veterans with diabetes had worse control of BP, LDL, and HbA1c levels, a difference only significant among men. These disparities occur despite a health care system that has fewer barriers to care than most U.S. health care systems. This is particularly important in light of recent findings demonstrating that African-American women veterans have an higher prevalence of hypertension and diabetes compared with White women veterans (Rose et al., 2013). More generally, racial disparities among veterans have been attributed to differences in information sources, lack of trust and less active participation in care (Saha et al., 2008). Less has been previously described about gender disparities by race within the veteran population.

Our findings of worse lipid control in women than in men supports previous work on gender disparities in the veteran population. Sambamoorthi and colleagues (2012) similarly found that female veterans have worse LDL control, part of which was explained by differences in depression and lower use of lipid-lowering medications among women. The authors found a total difference of lipid control of 10.4% between genders. Another study in veterans with diabetes (Vimalananda et al., 2011) discovered that women had higher LDLs and were less likely to be receiving lipid therapy or to be initiated on such therapy. The largest difference was in younger women (age <45). Also concerning are recent findings that older female veterans and those with ischemic heart disease are treated less aggressively for hyperlipidemia than their male counterparts (Vimalananda et al., 2013b). Gender disparities in lipid control have been seen in other studies among veterans (Womens Veterans Health Strategic Health Care Group, 2012; Tseng et al., 2006a, 2006b) and recognized in the general U.S. population (Chou et al., 2007).

Certain characteristics of the female veteran population increase their risk for CVD. A recent study comparing female

Table 4
Blood Pressure, LDL Cholesterol, and HbA1c Levels in Patients with Diabetes by Gender and Race*

	Blood Pressure					LDL			HbA1c		
	n^*	Adjusted Mean SBP (SE)	p Value	Adjusted Mean DBP (SE)	p Value	n^*	Adjusted Mean LDL (SE)	p Value	n^*	Adjusted Mean HgbA1c % (SE)	p Value
Gender			.5142		.0082			<.0001			.0138
Women	275	134.5 (0.9)		74.8 (0.6)		235	100.0 (2.0)		243	7.1 (0.1)	
Men	9,585	134.0 (0.1)		76.4 (0.1)		7,694	88.0 (0.4)		7,962	7.4 (0.02)	
Race											
Women			.0165		.0003			.6819			.0460
African American	158	135.8 (1.1)		80.3 (0.7)		135	105.1 (3.2)		142	7.6 (0.1)	
White	106	131.6 (1.3)		76.0 (0.9)		90	103.0 (3.9)		91	7.1 (0.2)	
Men			<.0001		<.0001			<.0001			<.0001
African American	3,691	135.7 (0.2)		78.5 (0.2)		3,117	90.3 (0.6)		3,236	7.5 (0.03)	
White	4,929	132.6 (0.2)		74.9 (0.1)		3,911	85.7 (0.5)		4,051	7.3 (0.02)	

Abbreviations: DBP, diastolic blood pressure (mmHg); HgbA1c, hemoglobin A1c; LDL, low-density lipoprotein (mg/dL); SE, standard error; SBP, systolic blood pressure (mmHg).
Adjusted means, standard errors, and p values are from analysis of variance models adjusting for age.
* Out of 280 women with a diagnosis of diabetes, 5 did not have a usable blood pressure reading in the year before data acquisition, 45 did not have a usable LDL measurement, and 37 did not have a HgbA1c. Out of 9,740 men with a diagnosis of diabetes, 155 did not have a usable blood pressure reading, 2,046 did not have a usable LDL measurement, and 1,778 did not have a HgBA1c.

veterans, active duty women, and civilians determined that female veterans had greater risk for chronic health conditions and health risk behaviors (Lehavot et al., 2012). Although female and male veterans treated in the VA health care system have a similarly high disease burden and morbidity (Frayne et al., 2006), female veterans are more likely to experience poor health-related quality of life compared with non-veteran women (Shen & Sambamoorthi, 2012). Female veterans have lower awareness of their CVD risk (Biswas et al., 2002; Canter et al., 2009) as well as lower levels of social support than their male counterparts (Frayne et al., 2006). Higher rates of mental health disorders in women veterans than civilians (Lehavot et al., 2012) may be a contributing factor. Comorbid depression in female veterans with complex chronic illnesses such as diabetes or CVD is common (Shen, Findley, Banerjea, & Sambamoorthi, 2010), which may complicate care. Female veterans also have higher rates of intimate partner violence than non-veteran women that is, in turn, associated with increased risk factors associated with CVD including smoking, depression, and heavy drinking (Dichter, Cerulli, & Bossarte, 2011). Although the female veteran population has higher prevalence of certain predisposing and exacerbating factors for CVD development as noted, these conditions (e.g., depression, social isolation, personal experience of violence) are not unique to the veteran population. Lessons learned from an examination of female veterans health patterns can help us to understand the dynamics of health in other vulnerable populations.

Our analysis has limitations. First, we examined a cohort with patients 40 years and older receiving care in the Durham, NC, Veterans Affairs Medical Center and these results may not generalize to younger veterans living elsewhere or non-veterans of the same age. Second, we based our racial disparities analysis information from the medical record, which may contain inaccuracies. Race/ethnicity designations with the Veterans Health Administration electronic medical record have been previously found to have up to 15% inaccuracies compared with self-reported race/ethnicity (Hamilton, Edelman, Weinberger, & Jackson, 2009); however, for White and African-American veterans, agreement in VHA administrative data is greater than 90% compared with self-report (Kressin, Chang, Hendricks, & Kazis, 2003). Missing race/ethnicity data within administrative records is also common (Long, Bamba, Ling, & Shea, 2006). Given a generally acceptable level of missing race/ethnicity data of 5% to 6% (Long et al., 2006), our data had slightly higher levels of missing data for male veterans but within this range for female veterans. Therefore, results could under- or overestimate racial disparities if the administrative designation of missing or unknown racial/ethnic information included significant numbers of White or African-American veterans. Multiple changes in national guidelines for the disease states examined in this paper have changed in the last few years spanning the time from which this data originated (Stone et al, 2013; Department of Veteran Affairs, 2004). In addition, this dataset does not include other risk factors for the development of CVD, such as smoking status or family history. Furthermore, we were unable to include visit frequency in this analysis to account for the impact of multiple visits on disease diagnosis and disease management. Finally, the number of women examined for this analysis is relatively small and a larger sample might yield larger numbers of other racial groups. To this end, efforts to examine disease control in larger cohorts of female veterans across multiple VA centers may be helpful.

Implications for Practice and/or Policy

This article adds to the existing literature of gender and racial differences in CVD by exploring disease control in key conditions, signaling larger disparities among African-American veterans in general and female African-American veterans in particular. The veteran population can be viewed as an at-risk population and findings such as these can have implications for both clinical practice and future research in the general population. Raising awareness among clinicians about the importance of CVD and risk factor control in women, especially minority women, is one important step to ending gender disparities. Future research in this area to better understand the contributing factors to these disparities among all women, and veteran women in particular, will be critical. Women's representation in randomized controlled trials for CVD prevention has improved, but still lags in proportion to the disease prevalence (Mosca et al., 2010). A recent assessment of the state of women's health research in the veteran population specifically notes few interventional studies (Bean-Mayberry et al., 2011) and there have been calls for more intervention studies (Rohrer, Gierisch, Fish, Blakeney, & Bastian, 2011) and a focus on prevention of CVD and reduction of gender disparities in health care delivery to female veterans (Yano et al., 2011). Additionally, further exploration of racial differences in gender disparities among the veteran population could help to identify contributing factors and highlight areas of importance for future intervention development.

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Conflicts of Interest: There were no conflicts of interest for the authors of this paper.

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Author Descriptions

Karen M. Goldstein, MD, MSPH, is a general internist and a health services researcher at the Durham VAMC. Her research interests include women's health, primary care delivery, and, cardiovascular risk reduction.

S. Dee Melnyk, PharmD, MHS, is a clinical pharmacist whose research interests include innovative methods of clinical pharmacist interventions to decrease cardiovascular risk, improve diabetes management, and medication adherence through medication and behavioral management.

Leah L. Zullig, PhD, MPH, is a health services researcher. She earned her doctorate from the University of North Carolina at Chapel Hill in Health Policy and Management. Her research interests include quality of care, cancer care, chronic disease management, and women's health.

Karen M. Stechuchak, MS, a statistician in the Durham VAMC Health Services Research Biostatistics Unit. Her research activities focus on collaborative statistical methodology within the field of health services research.

Eugene Oddone, MD, MHSc, is the director of the Center for Health Services Research in Primary Care at the Durham VAMC. He is a general internist and health service researcher whose research interest includes access and provision of high quality primary care.

Lori A. Bastian, MD, MPH, is a Senior Research Associate at VA Connecticut Healthcare System and Chief of Division of General Medicine at the University of Connecticut. Her clinical and research interests include women's health, cancer prevention and primary care.

Susan Rakley, MD, is a primary care internist. She was the Associate Chief of Staff-Ambulatory Care at the Durham VA Medical Center at the time this work was completed and is Assistant Professor Medicine, Duke University School of Medicine.

Maren K. Olsen, PhD, is a statistician and the director of the Durham VAMC Health Services Research Biostatistics Unit. Her research activities focus on collaborative statistical methodology within the field of health services research.

Hayden B. Bosworth, PhD, is the Associate Director of the Center for Health Services Research in Primary Care at the Durham VAMC. Dr. Bosworth has expertise in developing interventions to improve health behaviors and medication adherence related to chronic diseases.