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# Self Reported Cardiovascular Health and Health Behaviors in Women Veterans

Seth Byland

# SELF REPORTED CARDIOVASCULAR HEALTH AND HEALTH BEHAVIORS IN WOMEN VETERANS

by

Seth Byland

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Accepted by:

Abbie Lane-Cordova, Director of Thesis

Ray Thompson, Reader

Bridget McFadden, Reader

Tracey L. Weldon, Interim Vice Provost and Dean of the Graduate School

# DEDICATION

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# ABSTRACT

**Objective:** The purpose of this study is to describe self-reported cardiovascular health (CVH) and health behaviors in women veterans (WV). A cardiovascular score will be adapted from the existing American Heart Association CVH score. This score will be used to describe CVH in WV.

**Methods:** Data was collected from WV using an anonymous online survey. This survey asked questions about CVH, CVH behavior, and military specific questions. CVH scoring was determined by asking 6 questions that scored individuals for a total score from 0 to 12, with 12 being most ideal for CVH health. Scores were tallied and mean scores of WV were calculated. Mean scores of enlisted WV were compared to officer WV. Mean WV scores were also compared based on deployment status by answering "yes" or "no". Percentages of each health metrics was compared WV to non-women veterans (non-WV).

**Results:** Thirteen WV completed the survey (mean age=37.6±3.23 years of age; mean BMI=27.69±6.07 $kg/m^2$). Two WV reported a hypertension diagnosis; 2 WV reported a diabetes diagnosis. WV had higher rates of diabetes, hypertension and obesity than non-WV aged 18-44 in South Carolina. WV were more physically active and consumed more fruits and vegetables on average than non-WV. Enlisted WV had a lower CVH score than that of officer WV.

**Conclusion:** WV remain the fastest growing group of individuals in the military. With heart disease remaining the main cause of death in women, Veteran Health Care providers and civilian health care professionals should pay close attention to their WV patient's CVH to better serve them. Future research should attain a more detailed CVH score and gather objective data on blood pressure, cholesterol levels, blood glucose levels, and BMI.

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# LIST OF ABBREVIATIONS

AHA…… American Heart Association

BMI……Body Mass Index

CVD…….Cardiovascular Disease

CDC……...Center for Disease Control and Prevention

DM…….Diabetes mellitus

HEI……Healthy eating index

HEI-5…….. Five-Item Healthy Eating Score

MST…….Military Sexual Trauma

MV……...Men Veterans

NHANES……. National Health and Nutrition Examination Survey

Non-WV……Women with no Military Service

PTSD……Posttraumatic stress disorder

VA…….Veteran Affairs

VHA……Veterans Health Administration

WV…….Women Veterans

# CHAPTER 1

# INTRODUCTION

Heart disease remains the leading cause of death of women in the United States, which accounts for 21.8% of all deaths of women (Heron, 2017). Over one third (36.1%) of the women veteran (WV) population is affected by cardiovascular disease (CVD), and rates of CVD are highest (68.4%) in the age 65 or older group in WV (Frayne et al., 2018). Additionally, minority WV face higher rates of traditional CVD risk factors than white WV (Rose et al., 2013). Not only are WV exposed to traditional CVD risk factors, but they may also be exposed to military specific risk factors of CVD such as stresses of combat and/or military sexual trauma that may increase their risk (Kimerling et al., 2007; Jackson and Mishra, 2013; Lutwak & Dill, 2013; Wolff & Mills, 2016; Frayne et al., 2018; and Ebrahimi et al., 2021). Veteran status itself may contribute to the development of CVD, independent of traditional risk factors (Assari, 2014).

In 2010, the American Heart Association (AHA) updated their impact goals to include a criteria for ideal cardiovascular health (Lloyd-Jones et al., 2010). The AHA defined ideal cardiovascular health as (1) the simultaneous presence of 4 favorable health behaviors to include, abstinence from smoking within the last year, ideal body mass index (BMI), physical activity at goal, and consumption of a dietary pattern that promotes cardiovascular health; (2) the simultaneous presence of favorable health factors, which includes, untreated total cholesterol <200 mg/dL, untreated blood pressure < 120/<80 mm

Hg, and fasting blood glucose <100 mg/dL and finally (3) the absence of clinical CVD (Lloyd-Jones et al., 2010). Each of these metrics were scored based on current literature and research (Lloyd-Jones et al., 2010). The aim of this study is to describe self-reported cardiovascular health and health behaviors in WV. We hypothesize higher rates of hypertension and more advanced CVD in WV compared to women with no military service (non-WV). Using a modified scoring for cardiovascular health metrics defined by the American Heart Association and compared to representative data from statewide databases, the National Health and Nutrition Examinations Survey (NHANES), and the Center for Disease Control and Prevention (CDC), we expect less favorable levels of cardiovascular health promoting behavior in WV. A secondary aim of this study will be to relate health behavior to self-reported cardiovascular health in WV. We hypothesize WV with the most favorable levels of health behaviors, now and during their time in the military, will have the lowest odds of reporting hypertension or more advanced CVD.

# CHAPTER 2

# A REVIEW OF THE LITERATURE

## 2.1 Women and Military Service

Since the formation of the military, women have served within the military in an informal capacity. It wasn't until 1901, with the development of the Army Nurse Corps that women have been formally recognized as part of the military (National Center for Veterans Analysis and Statistics, 2017). In 1948, the Women's Armed Services Integration Act limited the proportion of women in the military to only 2% of the enlisted force and 10% of officers. This cap was lifted in 1967 and the military moved to an all-volunteer force in 1973 (National Center for Veterans Analysis and Statistics, 2017). Several policy changes throughout the 1990's led to many opportunities for women to serve in more military positions. In 1992, the Defense Authorization Act repealed combat exclusion laws that prevented women from flying combat aircraft. Two years later, in 1994, the legislation of combat exclusion that stopped women from serving on combatant ships in the Navy was lifted. In 1998, the first women flew combat aviation missions during Operation Desert Fox in Iraq (National Center for Veterans Analysis and Statistics, 2017). One of the biggest changes to gender restrictions to the military came in 2013 when the Secretary of Defense announced the repeal of the 1994 Direct Ground Combat Definition and Assignment Rule for Women followed by the first two women

graduating from the Army's Ranger School in 2015 (National Center for Veterans Analysis and Statistics, 2017). In the fiscal year of 2019, the active-duty force included 224,760 women making up 16.9% of active-duty forces (Department of Defense 2019).The Selected Reserve and National Guard components had a total of 166,386 women serving, composing 20.6% of their members (Department of Defense 2019). With the growing percentages of women making up more of the military, there will be more WV that will need care and services from the publicly funded Department of Veterans Affairs.

### 2.2 Prevalence of Women Veterans

In 2015, only 35.9% of WV were enrolled in the Veterans Health Administration (VHA) health care system. Of the 729,989 enrolled WV, 455,875 used Veteran Affairs (VA) health care in 2015. VA health care is the largest VA benefit used by WV (National Center for Veterans Analysis and Statistics, 2017). Although the proportions of WV are still relatively small compared to men veterans, the number of WV has grown rapidly. In 2000, WV only made up 6% of the veteran population. By 2015, that number grew to 9.4%, and by the end of 2040 it is expected that WV will make up nearly 16% of the veteran population (National Center for Veterans Analysis and Statistics, 2017). Thus, the number of WV utilizing VA services is also expected to grow substantially.

### 2.3 Hypertension and Women Veterans

Normal blood pressure is defined as having a systolic blood pressure of less than 120mmHg and a diastolic blood pressure of less than 80mmHg. Hypertension is defined as having a systolic blood pressure of greater than or equal to 130mmHg and/or having a

diastolic blood pressure of greater than or equal to 80mmHg (Whelton et al., 2018). Hypertension is a well-known risk factor for CVD and is the most common health condition for WV (Frayne et al., 2018). The overall prevalence of hypertension among U.S. adults 18 and older is 45.4%. Hypertension affects 27.2% of WV and prevalence is the highest (58.7%) in the 65 or older age group (Frayne et al. 2018). As people get older there is a higher chance of developing hypertension, and this holds true with WV as well. WV and non-WV see a similar pattern of increasing rates with increases in age (Frayne et al., 2018; Ostchega et al., 2020). In one study, that looked at race and hypertension of WV, black WV were 2.3 times more likely to be hypertensive than that of white WV (Rose et al., 2013). There is a higher rate of hypertension in non-WV at 39.7%, however, this statistic is adjusted for age (Ostchega et al., 2020). There may be a higher rate of hypertension in non-WV compared to WV, but from 2000 to 2015, WV rates of hypertension increased from 23.9% to 27.2% which is opposite the trend toward lower rates of hypertension for non-WV: 42% to 39.7% (Frayne et al., 2018; Ostchega et al., 2020). There is not a clear reason as to why rates of hypertension increased in WV. Self-reported data of hypertension from 2017 showed lower findings of hypertension in the U.S. population, with approximately one-third of adults reported to be hypertensive (Samanic et al., 2020). Geographically, southeast states in the U.S. tend to have the highest rates of hypertension (Samanic et al., 2020).

### 2.4 High Cholesterol and Women Veterans

Having high blood cholesterol over 240 mg/dL is a prominent risk factor for CVD (Stone et al., 2014; Benjamin et al., 2018). According to the American Heart Association (AHA), having an untreated total cholesterol level of < 200 mg/dL is one of the seven

factors for ideal cardiovascular health (Lloyd-Jones, et al. 2010). WV have a prevalence (25.2%) for lipid disorders, defined as having a high total cholesterol, high low-density lipoprotein cholesterol, or high triglycerides (Lloyd-Jones, et al. 2010; Frayne et al. 2018). Nearly half (49.3%) of all WVs aged 65 or older receiving health care from Veterans Health Administration (VHA) health care system have been diagnosed with a lipid disorder (Frayne et al. 2018). Lipid disorders were the 5$^{th}$ ranked health condition for WV and the total number of WV with lipid disorders grew from 159,810 in 2000 to 439,791 in 2015 (Frayne et al., 2018). The prevalence of lipid disorders increased in all age groups from 2000 to 2015 for WV (Frayne et al., 2018). In the U.S., 11.9% of the adult population 20 years or older had a total cholesterol score of ≥ 240 mg/dL and 13% of women at the age of 20 or older had a total cholesterol score of ≥ 240 mg/dL (Benjamin et al., 2018).

**2.5 Obesity and Women Veterans**

Normal body weight in reference to body mass index (BMI) is defined as a BMI of 18.5 to 24.9 kg/m$^2$. A BMI of 25 kg/m$^2$ to 29.9 kg/m$^2$ would classify someone as overweight. Having a BMI at or over 30 kg/m$^2$ is considered obese (Lloyd-Jones, et al. 2010). Obesity is not only an epidemic in the general population but also in the veteran population (Lloyd-Jones, et al. 2010; Breland et al., 2017; Frayne et al. 2018; Hales et al., 2020). A total of 75% of WV fall into the categories of overweight or obese, with obesity making up the majority at 44% (Breland et al., 2017). It has been reported that black WV are twice as likely to be obese when compared to white WV (Rose et al., 2013). According to the National Center for Health Statistics, 41.9% of adult females ages 20 and older in the U.S. population are obese (Hales et al., 2020). Obesity rates are

also higher in WV (44%) when one compares them to men veterans (41%) (Breland et al., 2017). The opposite holds true for the national average, where men have higher rates of obesity versus women (Hales et al. 2020).

### 2.6 Diabetes Mellitus and Women Veterans

Diabetes mellitus (DM) is a major risk factor for CVD. According to NHANES data, the age-adjusted national average for DM in the U.S. was 14.8% for adults older than 18 (Stierman et al., 2021). Nearly 25% of all veteran patients have DM (US Department of Veterans Affairs, 2017). Approximately 11% of WVs have DM compared to only 8.9% of non WVs (Frayne et al. 2018, Benjamen et al. 2018). Nearly 1 in every 4 WVs over the age of 65 have DM (Frayne et al. 2018). Race disparities also exist for WV and DM. Black WV are 2.5 times more likely to be diagnosed with DM and Hispanic WV are over 4 times more likely to be diagnosed with DM when compared to white WV (Rose et al., 2013). Nearly 5% of all WV who had a singleton birth covered from the VHA during 2000 to 2012 had gestational diabetes (Shaw et al., 2017). It has also been reported that WV are 40% more at risk of gestational diabetes compared to non-WV (Katon et al., 2014).

### 2.7 Smoking and Tobacco Usage in Women Veterans

It is well understood that smoking leads to poor cardiovascular health (CVH) and many other negative consequences in one's health, yet the use of cigarettes in the veteran population remains high (Odani et al., 2018; Centers for Disease Control and Prevention, 2020). When comparing veterans to the general population, veterans have a higher prevalence of tobacco usage (Odani et al., 2018; Centers for Disease Control and

Prevention, 2020). The percentage of veterans that use tobacco was reported to be 29.2%, which is higher than the general population which was reported to be 15.5% (Odani et al., 2018). Smoking cigarettes is the most common use of tobacco among veterans with approximately 21% of veterans reporting smoking cigarettes (Odani et al., 2018). Approximately 29.7% of WV use some form of tobacco and nearly 29% of WV smoke cigarettes (Odani et al., 2018). In contract, according to the CDC, 12.7% of women over the age of 18 in the United States reported cigarette use "every day" or "some days" at the time of the survey (2020). Former smoker WV who formerly smoked, smoked an average of 2.12 years longer than civilian former smokers. Additionally, the likelihood of WV to smoke 20 plus years was nearly five percentage points higher opposed to non-WVs (Bastian et al., 2016). The proportion of WV that smoke cigarettes (29%) is higher than that of men veterans (21%), however a greater proportion of men veterans use smokeless tobacco, thus the proportion of any tobacco products used is similar in both WV and MV (Odani et al., 2018).

### 2.8 Physical Activity and Women Veterans

The recommended amount of physical activity that adults should attain in a week is at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic activity per week (U.S. Department of Health and Human Services, 2018). Adults should also perform muscle-strengthening activities at least 2 days per week (US Department of Health and Human Services, 2008). In the 2003 Behavioral Risk Factor Surveillance System surveys of US adults that included over 34,000 veterans, 46% of veterans met physical activity guidelines. This survey included approximately 2,000 WVs, with only about 42.2% of which met physical activity guidelines (Littman, Forsberg, & Koepsell,

2009). The percentage of WV that meet the physical activity guidelines may be higher than that of non-WV at 39.1% but an eight year follow up study conducted by Washington et al. showed that the decline rate in self-reported recreational physical activity time declined faster in WVs when compared to the women civilian population (2016).

### 2.9 Healthy Diet Score and Women Veterans

A person's diet is an important factor in one's CVH and is complex with many factors and variables. Previous studies have attempted to define the quality of a person's diet with different metrics collectively known as a healthy diet score. Lloyd-Jones and colleagues with the AHA proposed five factors of a diet that would indicate an ideal score for a diet that promotes CVH (2010). These five factors include 1) Fruits and vegetables: 4.5 cups per day. 2) Fish: two 3.5-oz servings per week. 3) Fiber-rich whole grains (1.1 g of fiber per 10 g of carbohydrate): three 1-oz-equivalent servings per day. 4) Sodium: <1500 mg per day. 5) Sugar-sweetened beverages: <450 kcal (36 oz) per week. (Llyod-Jones et al., 2010). This list is meant to be used for a 2000kcal diet and the proposed numbers should be adjusted to reflect individual kcal goals. According to NHANES data collected from 2011 to 2012, less than 0.5% of U.S. adults met 4-5 components of the AHA healthy diet score (Benjamin et al., 2018). Other organizations have proposed healthy eating scores as well. The healthy eating index (HEI) scores people on a scale from 0 to 100 and measures this out of 13 factors. To score a maximum score a person must include all of the following 1) Total fruits ≥ .8 cups per 1,000 kcal. 2) Whole fruits ≥ .4 cups per 1,000 kcal. 3) Total vegetables ≥ 1.1 cups per 1,000 kcal. 4) Greens and beans ≥ .2 cups per 1,000 kcal. 5) Whole grains ≥ 1.5 ounces per 1,000 kcal.

6) Dairy ≥ 1.3 cups per 1,000 kcal. 7) Total protein foods ≥ 2.5 ounces per 1,000 kcal. 8) Seafood and plant proteins ≥ .08 ounces per 1,000 kcal. 9) Fatty acids- (PUFAs + MUFAs)/SFAs ≥2.5. 10) Refined grains ≤ 1.8 ounces per 1,000 kcal. 11) Sodium ≤ 1.1 grams per ≤ 1.8 ounce equivalent per 1,000 kca.l 12) Added sugars ≤ 6.5% of total energy 13) Saturated fats ≤ 8% of energy (U.S. Department of Agriculture, 2018). Similarly, military researchers developed the five-item Healthy Eating Score (HES-5), adapted from the HEI (Shams-White et al., 2019). The HES-5 simplifies the HEI and factors in only 5 components, which include intake of fruit, vegetables, whole grains, dairy, and fish. Even with the simplified version of the HEI, the HEI and the HES-5 have a moderate correlation strength of r = .41 (Shames-White et al., 2019). Veterans had a reported adjusted HEI score 3.7 points below the nonveterans (Dong, Stewart, and Carlson, 2019). The biggest difference was that being a veteran was associated with consuming more empty calories from added fats and sugars (Dong, Stewart, and Carlson, 2019). To our knowledge there have not been published studies on WV and a healthy diet score.

Fruit and vegetable consumption is one of the common inclusions of a diet recall survey and health diet scores. Both the HEI and the ideal cardiovascular health score use fruit and vegetable consumption as part of the scoring. For this reason, it is worthwhile to include information about national averages. In 2015 to 2018, 67.3% of adults aged 20 and over in the U.S. consumed any fruit on a given day (Ansai and Wambogo, 2021). An even higher percentage of adults (95.1%) consumed any vegetable a day (Ansai and Wambogo, 2021). Although there are high rates of adults consuming at least one type of fruit or vegetable on a given day, only about 9% of non-Hispanic (NH) whites, 7% of NH

blacks, and 6% of Mexican Americans met guidelines of ≥2 cups of fruit per day (Benjamin et al., 2018).

### 2.10 Mental Health and Women Veterans

Posttraumatic stress disorder (PTSD) can be caused by any traumatic event that involves actual or threatened death, serious injury or sexual violation (American Psychiatric Association, 2013). Both WV and MV are exposed to unusually high amounts of possible traumatic events during their time in the military and the diagnoses of PTSD in veterans is greater in both WV and MW compared to their civilian counterparts (Crum-Cianflone, et al., 2014; Lehavot, et al., 2018; Ebrahimi, et al., 2020; Kelber, et al., 2021). The diagnosis of PTSD in WV increased from 6% in 2000 to 18.4% in 2015 (Frayne et al. 2018). WV who have been diagnosed with PTSD have a 44% greater risk of developing ischemic heart disease compared to WV without PTSD (Ebrahimi et al., 2021). According to the VHA data base in 2015, which included 439,791 WV and 5,450,283 MV; WV had a slightly higher risk of being diagnosed with PTSD than MV; age adjusted odds ratio risk 1.02 (Frayne et al., 2018).

In a cohort of 10,547 females aged 47 to 52 years old who were followed up to 12 years as part of the Australian longitudinal study, having depression was associated with an increase of almost two times the risk of stroke (Jackson and Mishra, 2013). WV are nearly two times more likely than men veterans to be diagnosed with major depressive disorder (Frayne et al., 2018). An older study from 2013 that included 105,075 WV aged 45–54 years old with depression, 38% had hypertension, 40% had hyperlipidemia, 14% had diabetes, and 25% were obese (Vimalananda et al., 2013). This finding suggests that

WV who are also diagnosed with depression are more likely to have traditional risk factors of CVD.

### 2.11 Military Sexual Trauma and Women Veterans

WV faced high rates of sexual trauma while in the military (Kimerling et al., 2007; Lutwak & Dill, 2013; Wolff & Mills, 2016). Military sexual trauma (MST) is the VHA term for sexual assault or sexual harassment that happens during military service. One study looked at patient data from the VHA during the fiscal year of 2003, which showed that 22% of 185,880 WV reported MST (Kimerling et al., 2007). Positive diagnoses for MST have been shown to be strongly associated with a range of mental health conditions. Among WV, MST was most strongly related to PTSD (Kimerling et al., 2007). MST often leads to depression, which is a known risk factor for cardiovascular disease (Lutwak & Dill, 2013). High rates of homelessness for WV also brings additional risk of MST compared to housed WV (Washington et al., 2010). WV who are homeless are significantly more likely to be in fair or poor health; to have diagnosed medical conditions; and to screen positive for an anxiety disorder, PTSD, or tobacco use (Washington et al., 2010).

# CHAPTER 3

# METHODS

## 3.1 Study Design

This retrospective cohort study gathered information on self-reported cardiovascular health and health behaviors of WV living in the state of South Carolina. Data was collected using an anonymous online survey. We used a modified CVH score metric adapted from the American Heart Association's CVH metric known as Life's Simple 7 to summarize CVH in WV. Table 1 outlines the American Heart Association criteria for ideal cardiovascular health. Table 2 is our modified criteria for ideal CVH to fit the needs and simplicity of our survey data. The study was deemed non-research activity by the VA as it was completely anonymous. The University of South Carolina IRB approved the study, and all participants provided informed consent via an anonymous online process. Before the participants could enter the survey, they were prompted to an informed consent page that described the purpose of the study, types of questions asked, and explained that the survey would not ask any personal information or inquire about past traumatic events.

**Table 3.1** Definitions of Poor, Intermediate, and Ideal Cardiovascular Health Metric

| | Poor | Intermediate | Ideal |
|---|---|---|---|
| Current Smoking | Current smoker (0) | Former ≤12 months (1) | Never or quit ≥12 months (2) |
| Body Mass Index | ≥30 kg/m$^2$ (0) | 25 kg/m$^2$ to 29.9 kg/m$^2$ (1) | <25 kg/m$^2$ (2) |
| Physical Activity | None (0) | 1–149 min/wk moderate intensity or 1–74 min/wk vigorous intensity or 1–149 min/wk moderate & vigorous (1) | ≥150 min/wk moderate intensity or ≥75min/wk vigorous intensity or ≥150min/wk moderate & vigorous (2) |
| Healthy Diet Score | 0-1 components (0) | 2-3 components (1) | 4-5 components (2) |
| Total Cholesterol | ≥240 mg/d (0) | 200–239 mg/dL or treated to goal (1) | <200 mg/dL (2) |
| Blood Pressure | SBP ≥140 or DBP ≥90 mm Hg (0) | SBP 120-139 or DBP 80-89 mm Hg or treated to goal (1) | <120/80 mm Hg (2) |
| Fasting Plasma Glucose | ≥ 126 mg/dL (0) | 100-126 mg/dl (1) | <100 mg/dl (2) |

**Table Legend:** American Heart Association's cardiovascular health scoring criteria for each health factor and health behavior. Recreated from Lloyed-Jones, et al. (2010).

**Table 3.2** Women Veterans Modified Cardiovascular Health Score Criteria

| | Poor | Intermediate | Ideal |
|---|---|---|---|
| Current Smoking<br>CVH Points: | Current smoker<br>(0) | N/A | No<br>(2) |
| Body Mass Index<br><br>CVH Points: | ≥30 kg/$m^2$<br><br>(0) | 25 kg/$m^2$ to 29.9 kg/$m^2$<br>(1) | <25 kg/$m^2$<br><br>(2) |
| Physical Activity<br><br><br><br><br><br>CVH Points: | None<br><br><br><br><br><br>(0) | 1–149 min/wk moderate intensity or 1–74 min/wk vigorous intensity or 1–149 min/wk moderate & vigorous<br><br>(1) | ≥150 min/wk moderate intensity or ≥75min/wk vigorous intensity or ≥150min/wk moderate & vigorous<br>(2) |
| Fruits and Vegetable Consumption<br>CVH Points: | < 1 Servings per day<br><br>(0) | 4-1 Servings per day<br><br>(1) | ≥ 4.5 Servings per day<br>(2) |
| Blood Pressure<br><br>CVH Points: | SBP ≥140 or DBP ≥90 mm Hg<br>(0) | SBP 120-139 or DBP 80-89 mm Hg<br>(1) | <120/80 mm Hg<br><br>(2) |
| Diabetes<br>CVH Points: | Yes<br>(0) | N/A | No<br>(2) |

**Table Legend:** Modified cardiovascular scoring criteria for poor, intermediate, and ideal.

### 3.2 Women Veteran Modified Cardiovascular Health Score

Our modified CVH metric has been adapted to fit the needs of self-reported data that could be easily collected by the participant. We have only taken 6 of the 7 metrics and heavily modified other parts of the existing components of ideal CVH. Cholesterol levels were omitted from our CVH score due to the expected low accuracy of self-reporting of cholesterol. Self-reports of elevated cholesterol have been shown to have an error of 44% points lower than what was measured (Konstantinidou et al., 2014). Blood glucose was not measured in this experiment but instead we asked the simple question of if the participant had diabetes, with either a yes or no response. “Yes” 'suggests poor

influence on CVH and "No" being representative of ideal CVH. Due to this simple approach we have omitted an intermediate score for the modified blood glucose criteria. Similarly, we only asked smoking as a yes or no question, which limits the ability to have an intermediate score. Healthy diet score was reduced to only one index of fruit and vegetable consumption. Ideal ≥ 4.5 servings per day of fruits and vegetables combined. Intermediate 4-1 servings per day of fruits and vegetables combined. Poor < 1 servings per day of fruits and vegetables combined. Physical activity was modified to ask the average duration per day but did not include the intensity. Physical activity in this survey only included leisure time physical activity; a previous study showed that leisure physical activity was associated with reduced risk of major adverse cardiovascular events (Holtermann et al., 2021). BMI and blood pressure will be scored in the same manner as the originally defined CVH score. A score on this modified CVH scale can range from 0 to 12, with 0 being the poorest and 12 being the highest score. This score is not indicative of a person's actual CVH or a predictor for CV diseases but is meant to be a way to describe CVH in WV.

### 3.3 Participants

Information about WV was collected via an anonymous survey link posted at various veteran services locations including the Columbia Veterans Affair Medical Center, various Veterans of Foreign Wars locations, the University of South Carolina Veteran's Center and other non-profit Veteran support organizations. The results were interpreted and compared to non-WV data that was publicly available from America's Health Rankings United Health Foundation.

### 3.4 Survey

WV self-reported their current health and health behaviors with an anonymous survey. This survey did not ask any identifiable questions or any questions that were classified as traumatizing such as MST or past combat experiences. The focus of the survey was to gather information on ideal CVH factors and behaviors. We took a modified score of the American Heart Association's CVH health factors and behaviors. In addition to this, we asked military related questions such as years of service, military occupation, branch of service, and rank. A copy of the survey is included in Appendix A.

### 3.5 Statistical Power Analysis

Using statistical results and sample sizes from previous studies, it is expected to find large to small effect sizes in the differences of means for the modified cardiovascular health score. The largest effect size compared healthy diet scores from two separate articles. Shames-White and colleagues looked at diet scores of male and female active-duty personnel (females n=86), where Perak et al. surveyed young adults (females n= 2650) (2019 and 2020). Using the means of the two previous studies and G-power, we determined a large effect size for the difference in diet between active-duty military and civilian individuals. The smallest effect size was comparing the prevalence of diabetes for WV 11% and non-WV 9% (Han et al., 2019). Similarly, the prevalence of hypertension, obesity, and smoking rates among WV verses non-WV suggested small to moderate effect sizes. Thus, a target sample population of as few as 15 to over 1000 is needed to show statistical significance for various CVH components included in this study. Since this study will focus on CVH scores and not a single metric, a targeted

sample size was not able to be precisely calculated, but the results will be used to guide sample sizes for future studies on WV and CVH score.

### 3.6 Statistical Analysis

Demographic information of survey responses were collected and are displayed in Table 4.1. Data from America's Health Rankings United Health Foundation was used to establish the reference group of non-WV to WV. We calculated the differences in means of each survey response between WV and non-WV unadjusted and adjusted for age. We evaluated associations of CVH components and overall CVH with veteran status using linear regression for continuous variable and Poisson regression for rates of achieving ideal status for individual CVH components and overall CVH score. Stratified analyses were performed by deployment status (y/n) and service type (officer or enlisted).

# CHAPTER 4

# RESULTS

This study included a sample of 16 survey responses, 3 of which were incomplete and 13 fully completed. With very few survey responses, a comparison of responses to NHANES data was not conducted due to the broad differences of sample sizes. The results of our survey were compared to women living in South Carolina, which was collected from America's Health Ranking United Health Foundation datasets. The average age of WV who participated in this survey was 37.4 years of age, average BMI of 27.7, and an average blood pressure of 121/76mmHg. Three WV reported not knowing their blood pressure. The average years of service was approximately 3 years, and the majority of responses were from WV who served with the Army (84.6) and Air Force represented a small proportion of responses (15.4%). There were 0 WV (0%) who self-reported heart disease, 2 WV (14.3%) reported being diagnosed with diabetes, and 0 WV (0%) reported to smoking. The demographics of WV responses is outlined in Table 4.1.

When comparing to Non-WV residing in South Carolina to WV, WV self-reported lower rates of smoking and were more physically active. Nearly half (46.2%) of the WV who participated in this survey had a BMI of $\leq 24.9$ kg/m$^2$ while 23.1% and 30.7% of WV were classified as overweight or obese, respectively. WV and non-WV had similar rates of obesity around 30%. There was a higher rate of poor physical activity of

non-WV (25.4%) compared to WV (15.4%). 23.1% of WV fell in the intermediate category of physical activity and 46.1% of WV met the goal of at least 150 minutes of physical activity per week. All the WV in this survey reported to consuming at least one fruit and vegetable per day, and nearly one third of WV met the goal of at least 4 fruits and vegetables per day. There was a very low reported number of non-WV in South Carolina to meet the ideal goal for fruits and vegetables. More WV (18.2%) in this study were hypertensive than non-WV (13.5%), and WV (14.3%) also reported a higher percentage of being diagnosed with diabetes than non-WV (8.9%).

Determining the mean CVH score was calculated by summing all the individual health metric questions and finding the total score for each individual. The total scores were summed up and divided by ten. Out of the 16 survey responses, 3 were omitted for incomplete responses, and 3 others were left out since the participant answered to not knowing their blood pressure. The mean CVH score for WV in this study was 8.6 on a scale from 0 to 12, where 0 is very poor and 12 is most favorable for CVH. The mean CVH score of WV officers was 10.3, while the mean CVH score for enlisted WV was 7.8. For WV who deployed at least one time, the mean CVH score was 8 and for WV who did not deploy their mean CVH score was 9. Intermediate classifications for each variable of CVH was not reported in non-WV, as data was inaccessible on non-WV living in South Carolina. Therefore, a total CVH score was not compared between WV and non-WV. Due to low number of events (CVD and diabetes diagnoses), we were unable to perform correlation and regression analyses.

**Table 4.1** Demographics of Surveyed Women Veterans

| | | | | | |
|---|---|---|---|---|---|
| Age | 37.46 (3.23) Years of Age | | | | |
| BMI | 27.69 (6.07) kg/m$^2$ | | | | |
| Blood Pressure | 121/76 (15/10) mmHg | | | | |
| Heart Disease | 0 | | | | |
| Diabetes | 2 (14.29%) | | | | |
| Smoking Status | 0 | | | | |
| Years of Service | 3 (1.5) Years of Service | | | | |
| Branch of Service | Air Force 2 (15.4%) | Army 11 (84.6%) | Marines 0 (0%) | Navy 0 (0%) | Coast Guard 0 (0%) |

**Table Legend:** Demographics of Women Veteran Survey Responses. Data are mean ± SD or n (%).

**Table 4.2** Modified Cardiovascular Health Women Veterans and Non Women Veterans

| | **Poor** | | **Intermediate** | | **Ideal** | |
|---|---|---|---|---|---|---|
| | WV | Non-WV | WV | Non-WV | WV | Non-WV |
| **Current Smoking** | 0% | 18.3% | N/A | | 100% | 81.7% |
| **Body Mass Index** | 30.7% | 30% | 23.1% | - | 46.2% | - |
| **Physical Activity** | 15.4% | 25.4% | 61.5% | - | 23.1% | - |
| **Fruits and Vegetable Consumption** | 0% | - | 62% | - | 38% | 8.3% |
| **Blood Pressure** | 18.2% | 13.5% | 45.5% | - | 36.3% | - |
| **Diabetes** | 14.3% | 8.9% | N/A | | 85.7% | 91.1% |

**Table Legend**: Percentage of poor, intermediate, and ideal for Women Veterans and Non Women Veterans in each cardiovascular health metric. Data for non-WV in South Carolina were obtained from a publicly available database America's Health Rankings United Health Foundation.

# CHAPTER 5

# DISCUSSION

Although, the findings of this study are preliminary due to the limitations discussed herein, it was to our knowledge the first study to articulate a self-reported CVH and CVH behaviors score in WV. It is also one of the first studies to evaluate CVH differences between officers and enlisted WV as well as deployment history of WV. Future research should aim to gather information from a larger sample size of WV and survey non-WV residing in the same geographical regions. Researchers can take this study a step further and perform actual screenings for blood pressure, blood glucose levels, BMI, and cholesterol levels to eliminate the threat of self-reporting bias. Moreover, changes to the CVH modified score should be aligned to follow the established AHA ideal cardiovascular health metric.

Several findings of this study did not align with the current literature. Obesity (30.7%) and hypertension (18.2%) of WV in this study was lower than what was reported in the literature, 44% and 27.2%, respectively (Breland et al., 2017; Frayne et al. 2018). Our findings of this study may contradict the current literature for several possible reasons. The first and possibly the most obvious reason for this was our small sample size; most studies had larger sample sizes of WV or gathered data from VHA medical and diagnostic codes. Another explanation for the differences of reported rates of health

outcomes and behaviors in this study was that results were self-reported by the WV. Finally, the average age of WV that participated in this study was lower than what would be expected. The average age of WV in this study was 37 years of age, while the majority of WV that use VA benefits is reported to be 48 years of age (Frayne et al., 2018).

The low amount of survey responses left this study with a major limitation. Due to the few responses, one cannot come to any statistical conclusion regarding self-reported CVH of WV. Although recruitment flyers were placed in the Women's Clinic and other offices of the South Carolina, Columbia VA, due to COVID 19, many appointments were conducted via telehealth, which limited potential responses. Additionally, all data was self-reported, which is subjected to reporting biases. CVH health score factors based off of the AHA CVH score could not be matched one to one due the nature of having to self-report health statuses. The authors of this article thought it would be best for accuracy purposes to excluded self-reported cholesterol levels, as low accuracy in self-reporting cholesterol levels has been shown to not be accurate (Konstantinidou et al., 2014). Reporting glucose levels was also modified to exclude numeric values for this same reason. Furthermore, the survey lacked an intermediate answer for smoking status that should have matched the AHA "Former ≤12 months". Healthy eating questions were limited to asking about fruit and vegetable consumption as opposed to the AHA healthy eating 5 component questions. With several modifications to the CVH scoring metric, a mean score for WV may have been skewed to be more favorable than what was reported in this study.

This study displayed that WV who deployed may have lower CVH scores and serving as an officer in the military may present some favorable scores. Both of these conclusions should be investigated more thoroughly in future research. WV remain the fastest growing group of individuals in the military (National Center for Veterans Analysis and Statistics, 2017). With heart disease remaining the main cause of death in women, Veteran Health Care providers and civilian health care professionals should pay close attention to their WV patient's CVH to better serve this population of the veteran community.

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# APPENDIX A

## SURVEY QUESTIONS

General health questions (fillable fields)

What is your age?

How much do you weigh?

How tall are you?

Do you know your blood pressure?

What is your blood pressure?

Are you on blood pressure medication?

Have you been diagnosed with diabetes?

Have you ever had a heart attack or stroke?

Have you ever been diagnosed with heart disease, not including high blood pressure?

Health behavior questions (Radio buttons and branching logic)

How many hours of sleep do you get per night?

Less than 6 hours 6-9 hours more than 9 hours

Do you smoke?

If yes: How frequently do you smoke?

More than 6 hours between smokes 3-5 hours between smokes 2-3 hours between smokes less than 2 hours between smokes

If yes: How much do you smoke per day?

Less than ½ pack ½ to 1 pack 1 to 2 packs more than 2 packs

Do you use other tobacco products?

If yes: What types? (fillable field)

If yes: How often per day? (fillable field)

Do you drink alcohol?

If yes: How much do you drink each week?

Only on special occasions 1 - 2 drinks per week 3- 7 drinks per week more than 7 drinks per week

If yes: What types of alcohol do you drink?

Beer Wine Hard liquor More than 1 of these types of alcohol

If yes: How many drinks do you typically have per sitting?

1-2 3-4 more than 4

Do you perform aerobic exercise? For example, walking, running, biking, swimming.

If yes: How often per week?

1-2 x per week 3 -5 x per week more than 5 x per week

If yes: How long do you exercise per workout?

Less than 15 minutes 15-30 minutes 30-60 minutes more than 60 minutes

Do you perform strength training exercise? For example weight/resistance training, powerlifting.

If yes: How often per week?

1 x per week 2-3 x per week more than 3 x per week

If yes: How long per workout?

Less than 15 minutes 15-30 minutes 30-60 minutes more than 60 minutes

How many servings of vegetables do you eat per day?

0-1 2-3 3-4 more than 4

How many servings of fruits do you eat per day?

0-1 2-3 3-4 more than 4

Military Specific questions (Radio buttons and branching logic, fillable fields)

How many years did you serve in the military?

Less than 4 years 4-8 years 9-12 years 12-20 years more than 20 years

What branch did you serve with?

Air Force Army Marines Navy Coast Guard

What component?

Active Duty Reserve National Guard Air National Guard

Were you an enlisted soldier or officer?

What was your MOS/job with the military? (fillable field)

Did you deploy?

If yes: How many times?

1-2 3-4 5 or more times

If yes: On average, how long was your deployments?

0-6 months 6-9 months 9-12 months more than 12 months

If yes: What was your longest deployment?

0-6 months 6-9 months 9-12 months more than 12 months

While in the military, did you smoke?

If yes: How frequently did you smoke per day

More than 6 hours between smokes 3-5 hours between smokes 2-3 hours between smokes less than 2 hours between smokes

If yes: How much did you smoke per day?

Less than ½ pack ½ to 1 pack 1 to 2 packs more than 2 packs

Did you smoke before entering the military?

While in the military, did you use other tobacco products?

If yes: What types? (fillable field)

If yes: How often per day? (fillable field)

Did you use tobacco products before entering the military?

While in the military, did you drink?

If yes: How often per week?

Only on special occasions 1 - 2 drinks per week 3- 7 drinks per week more than 7 drinks per week

If yes: What types of alcohol did you drink?

Beer Wine Hard liquor More than 1 of these types of alcohol

If yes: How many drinks did you typically have per sitting?

1-2 3-4 more than 4

Did you drink before entering the military?

Did you perform regular physical fitness training with you assigned unit?

If yes: How often per week?

Less than 1 x per week 2-3 x per week 4-5 x per week more than 5 x per week

If yes: How long per workout?

Less than 15 minutes 15-30 minutes 30-60 minutes more than 60 minutes

Thank you for your time! Survey complete.