

## The Prevalence of Overweight and Obesity among U.S. Military Veterans

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**ABSTRACT** Overweight and obesity are increasingly contributing to disease burden among military populations. The purpose of this study was to calculate and examine the prevalence of overweight and obesity among the veteran population. Data were obtained from the 2004 Behavioral Risk Factor Surveillance System. Overweight (body mass index  $\geq 25$  kg/m<sup>2</sup>) prevalence in veterans was 73.3% (SE, 0.4%) for males and 53.6% (SE 1.7%) for females. Obesity (body mass index  $\geq 30$  kg/m<sup>2</sup>) prevalence in veterans was 25.3% (SE, 0.4%) for males and 21.2% (SE, 1.4%) for females. After adjusting for sociodemographics and health status, veterans were no more likely to be overweight (odds ratio, 1.05; 95% confidence interval, 0.99–1.11) or obese (odds ratio 0.99; confidence interval, 0.93–1.05) than nonveterans. Despite previous participation in a culture and environment that selects for and enforces body weight standards, veterans have a high prevalence of overweight and obesity that is similar to general population estimates.

### INTRODUCTION

Increases in the prevalence of overweight (body mass index [BMI]  $\geq 25$  kg/m<sup>2</sup>) and obesity (BMI  $\geq 30$  kg/m<sup>2</sup>) in the United States since 1960 are well known.<sup>1–3</sup> Clinical examination data from the National Health and Nutrition Examination Survey (NHANES) found the prevalence of overweight in U.S. adults increased from 45% in 1960 to 1962 to 66% in 2003 to 2004, while obesity prevalence increased from 13% in 1960 to 1962 to 32% in 2003 to 2004.<sup>1,4,5</sup> Obesity and overweight are associated with increased morbidity and mortality as well as increased economic burden to society. The mortality attributed to obesity has been estimated to be between 111,919 and 365,000 deaths annually.<sup>6–9</sup> Comorbid conditions associated with obesity include hypertension, dyslipidemia, stroke, gallbladder disease, diabetes, coronary heart disease, and osteoarthritis, as well as breast, prostate, colorectal, gall bladder, and endometrial cancer.<sup>10</sup> The economic cost of obesity exceeds \$90 billion dollars annually.<sup>11</sup>

The epidemic of obesity significantly affects the military. First, the potential pool of recruits is decreased due to the increasing proportion of young adults who do not meet military entry standards for weight, estimated at 13 to 18% of U.S. men and 17 to 43% of U.S. women in the general population.<sup>12</sup> Retention of active military personnel is also decreased secondary to the disease burden, with 1,419 per-

sonnel discharged in 2002 due to failing the body weight standard.<sup>13</sup> Lastly, overweight and obesity add to health care costs for the Department of Defense, whose total health care budget is currently estimated at \$36 billion with projected costs in 5 years to be \$61 billion annually.<sup>14</sup>

The high prevalence of overweight and obesity has been observed in U.S. military active duty populations.<sup>13</sup> The prevalence of overweight based on self-reported height and weight of the ~1.4 million<sup>15</sup> active duty personnel in 2002 was 62% in males, 32% in females, and 57% overall.<sup>16</sup> These numbers are surprising given physical fitness and body fat standards required of military service members. One explanation may be the inability of BMI, which is a proxy for adiposity, to distinguish “overfat” individuals from very athletic and heavily muscled individuals in the BMI range of 25 to 29.9 kg/m<sup>2</sup>. The prevalence of obesity among active duty during this same time period was 10% in males, 4% in females, and 9% overall.<sup>17</sup> These data, which show that most of the overweight prevalence was in the BMI range of 25 to 29.9 kg/m<sup>2</sup>, suggest that muscle mass might be contributing to the high number of overweight active duty members.

Multiple studies have established overweight and obesity prevalence in the veteran population. The prevalence of overweight for the over 5 million veterans who use outpatient Veterans Health Administration (VHA) facilities was 73% among men and 68% among women in 2000, based on measured heights and weights in the medical record.<sup>18</sup> Obesity prevalence in this sample was 33% among men and 37% among women. Additionally, the overweight and obesity prevalence of VHA users was determined to be 69 and 25%, respectively, using Behavioral Risk Factor Surveillance System (BRFSS) 2000 data.<sup>19</sup> Lastly, the prevalence of overweight and obesity based on a 1996 cross-sectional survey of VHA outpatient clinics found an overweight prevalence of 75% overweight and an obesity prevalence of 34%.<sup>20</sup>

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The prevalence of overweight and obesity cannot be used as an estimate for the entire veteran population because VHA users are generally older, have poorer health status, and have lower income than the overall veteran population.<sup>21</sup> A recent study of BRFSS data from 2003 demonstrated that veterans who did not use VHA facilities had an overall overweight prevalence of 72% and an overall obesity prevalence of 24%.<sup>22</sup> Although this study was the first to address disease burden in veterans who did not use VHA facilities, it did not report an overall prevalence of disease burden in the entire veteran population or report prevalence by gender.

In another study, 38- to 64-year-old military health care-eligible individuals comprised of retirees and their spouses were surveyed to determine their prevalence of overweight.<sup>23</sup> This prevalence was 80% in males, 60% in females, and 70% overall. In this study, the majority of males were retirees, while the females were predominately spouses of the retirees. The limitations of not knowing whether respondents were veterans or spouses of veterans and of sampling only respondents ages 38 to 64 prohibits drawing definitive conclusions regarding all veterans, but it does suggest that a high percentage of retired veterans are overweight.

Estimates of the prevalence of overweight and obesity for the overall U.S. military veteran population, which numbers 26.4 million—or 12.7% of the U.S. population 18 or older<sup>24</sup>—are unknown. Determination of overweight and obesity prevalence for all U.S. veterans is needed for several reasons. First, knowledge of overweight and obesity prevalence has implications for primary preventive efforts during the active duty period as a means to prevent subsequent morbidity. Next, the prevalence could serve as a benchmark comparison for VHA and military retiree planners as well as other policy makers who are examining smaller subsets of the veteran population. Lastly, as veterans may re-enlist or be recalled to duty, they constitute a valuable potential resource for the nation's defense and knowledge of their disease burden would inform military preparedness. The aims of this study were: (1) to determine the overall prevalence of overweight and obesity among all U.S. veterans by gender and age groups using self-reported BMI data from the 2004 BRFSS and (2) to compare the prevalence of overweight and obesity between the veteran and nonveteran population.

## METHODS

### Data Source and Study Population

Data used were from the 2004 BRFSS, a monthly conducted, annually aggregated and reported, state-based, cross-sectional, random digit-dialed telephone survey, conducted by state health departments with assistance from the Behavioral Surveillance Branch of the Centers for Disease Control and Prevention (further information on BRFSS methodology exists at their web site: [www.cdc.gov/brfss/technical\\_infodata/surveydata/2004.htm](http://www.cdc.gov/brfss/technical_infodata/surveydata/2004.htm)). The BRFSS is the largest continuously conducted telephone health survey in the world. The BRFSS's annually revised questionnaire is designed to measure behavioral risk factors

in a representative sample of U.S. noninstitutionalized individuals ages 18 and over. Information is collected by all 50 state health departments using a disproportionate stratified sampling design. Data are weighted to represent population estimates for each state. The BRFSS questionnaire includes core questions that are asked by every state, in addition to module questions that are used at each state's discretion.

### Measures

Those who answered affirmatively to ever serving on active duty in the U.S. Armed Forces, either in the regular military or in a National Guard or military reserve unit and who indicated that they were retired, medically discharged, or discharged from military services were considered to be "veterans" for this analysis. All other respondents were considered nonveterans. This classification is consistent with the U.S. census definition of a veteran. Self-reported height and weight were used to calculate BMI (weight in pounds/(height in inches)<sup>2</sup>)  $\times$  (703). Overweight and obesity prevalence determined by BMI classification was the primary outcome measure. BMI was classified as (1) normal or underweight (BMI <25 kg/m<sup>2</sup>), or (2) overweight but not obese, (BMI  $\geq$ 25 kg/m<sup>2</sup> but <30 kg/m<sup>2</sup>), or (3) obese (BMI  $\geq$ 30 kg/m<sup>2</sup>), or (4) overweight (BMI  $\geq$ 25 kg/m<sup>2</sup>). These classifications for overweight and obesity are according to the guidelines published by the National Heart, Lung, and Blood Institute.<sup>25</sup>

Other BRFSS variables were considered as possible confounders of the relationship between veteran status and overweight or obesity status. The variables included gender, age, race/ethnicity (Caucasian, African American, Hispanic, or multiracial and not Hispanic), marital status, education (did not graduate high school, graduated high school, attended college or technical school, graduated college or technical school), annual household income (five levels), self-reported health status (dichotomized as good to excellent and fair to poor), and smoking status (never, former, or current).

### Analysis

The analysis included only respondents who answered both the veteran status questions and the self-reported height and weight questions (287,467 respondents of the total 303,882 surveyed). STATA 9.0 (StataCorp LP, College Station, Texas) survey commands were used in all analyses to account for BRFSS's complex multistage cluster sampling survey design. Frequencies were calculated for various demographics of both the veteran and nonveteran populations. Crude prevalence of overweight but not obese (BMI  $\geq$ 25 kg/m<sup>2</sup> and <30 kg/m<sup>2</sup>), obese (BMI  $\geq$ 30 kg/m<sup>2</sup>), and overweight (BMI  $\geq$ 25 kg/m<sup>2</sup>) were determined for veterans and nonveterans using proportion estimation commands for these weight categories. These results were further stratified by age and gender.

To further examine the relationship between veteran status and overweight and obesity, two logistic regression models were used to calculate adjusted prevalence odds ratios (ORs). In the first model, the dependent outcome was overweight,



categorized as BMI  $\geq 25$  kg/m<sup>2</sup> or  $< 25$  kg/m<sup>2</sup>. In the second model, the dependent outcome was obesity, categorized as BMI  $\geq 30$  kg/m<sup>2</sup> or  $< 30$  kg/m<sup>2</sup>. Covariates that have been demonstrated in previous studies to be related to either veteran status and/or to obesity were entered in the model, as were covariates that in exploratory analysis suggested possible confounding. Interaction between veteran status and gender was assessed for inclusion in the models using the Wald test. Variables that were not found to confound the relationship between veteran status and overweight and obesity were removed to arrive at a final model for the relationship between (1) veteran status and overweight and (2) veteran status and obesity. This study was determined to be exempt from review by the University of North Carolina School of Public Health Institutional Review Board.

## RESULTS

Subjects included 287,467 respondents who replied to height, weight, and veteran status questions; of these, 39,627 (13.8%) indicated that they were veterans. Table I displays population estimates for various characteristics of veterans and nonveterans based on this sample. The veteran population was primarily male (94%), married (72%), older than 35 years (92%), and Caucasian (81%). More than 93% of veterans had at least a high school education, and >43% of veterans reported incomes of >\$50,000 dollars per year. Also, >80% rated their health as good, very good, or excellent. More veterans reported former smoking (43%) than never smoking (36%). The nonveteran population included a larger percentage of females, non-Caucasians, and younger age groups than the veteran population.

### Prevalence of Overweight and Obesity

Table II describes prevalence of overweight but not obese, obese, and overweight in veterans and nonveterans by gender. Among veterans, prevalence of overweight but not obese was higher in males (48%) than females (32%); however, the prevalence of obesity was similar (25% in males, 21% in females). Because of the difficulty in distinguishing between body fat and muscle tissue for BMIs in the 25 to 29.9 range, further investigation was limited to obesity alone.

The prevalence of obesity stratified by age and gender is displayed in Figure 1. The prevalence of obesity by age group and gender followed a similar trend in both veterans and nonveterans with increasing prevalence as age increases up to age  $\geq 65$  where prevalence then declines. The prevalence of obesity among male veteran ages 35 to 54 was slightly higher than in nonveterans in this age group. Similar prevalence was found in all other age groups. The prevalence of obesity among male veteran obesity prevalence was highest in the age group 45 to 54; among male nonveterans, the prevalence of obesity was highest in the 55 to 64 age group.

Due to smaller sample sizes, particularly in the older age categories, the prevalence of obesity in female veterans by

**TABLE I.** Population Estimates of Selected Characteristics for Veterans and Nonveterans

Characteristic	Sample No. <sup>a</sup>	Veterans <sup>b</sup> Percent (% SE)	Nonveterans <sup>c</sup> Percent (% SE)
Gender	287,467		
Male		94.1 (0.2)	43.0 (0.2)
Female		5.9 (0.2)	57.0 (0.2)
Age (in groups)	287,467		
18–24		1.4 (0.1)	14.9 (0.2)
25–34		7.0 (0.3)	19.8 (0.2)
35–44		12.1 (0.3)	21.5 (0.2)
45–54		16.4 (0.4)	19.0 (0.2)
55–64		23.9 (0.4)	11.3 (0.1)
$\geq 65$		39.0 (0.5)	13.4 (0.1)
Marital status	286,767		
Married		71.5 (0.4)	57.0 (0.2)
Not married		28.5 (0.4)	43.0 (0.2)
Race	285,031		
Caucasian		81.2 (0.5)	69.0 (0.2)
African American		8.6 (0.3)	10.0 (0.1)
Hispanic		5.5 (0.3)	14.9 (0.2)
Multiracial and non-Hispanic		4.8 (0.3)	6.2 (0.1)
Education	284,043		
Did not graduate high school		6.4 (0.2)	12.4 (0.2)
Graduated high school		29.4 (0.4)	29.9 (0.2)
Attended college or technical		29.9 (0.5)	26.0 (0.2)
Graduated college or technical		34.2 (0.5)	31.7 (0.2)
Annual household income	252,127		
<\$15,000		6.8 (0.3)	12.3 (0.2)
\$15,000–\$25,000		16.2 (0.4)	17.8 (0.2)
\$25,000–<\$35,000		14.0 (0.4)	13.2 (0.2)
\$35,000–<\$50,000		19.3 (0.4)	16.1 (0.2)
\$50,000 or more		43.6 (0.5)	40.7 (0.2)
Self-reported health status	286,600		
Good, very good, or excellent		80.2 (0.4)	84.5 (0.2)
Fair or poor		19.8 (0.4)	15.5 (0.2)
Smoking status	286,618		
Never smoked		36.3 (0.5)	58.3 (0.2)
Former smoker		43.2 (0.5)	20.6 (0.2)
Current smoker		20.4 (0.4)	21.1 (0.2)

Data from the 2004 Behavioral Risk Factor Surveillance System.

<sup>a</sup> The sample population (*N*) varies according to number of respondents who answered each question.

<sup>b</sup> *N* = 39,627.

<sup>c</sup> *N* = 247,840.

age groups was characterized by larger SEs. The prevalence of obesity in female veterans ranged from a low of 6% in the 18 to 24 age group to a high of 34% in the 55 to 64 age group. This range was wider than in nonveterans (15–30% in the same age groups). Obesity prevalence among female veterans and nonveterans showed increasing trends with increasing age, just as was seen in males.

**TABLE II.** Prevalence of Overweight but not Obese, Obese, and Overweight by Veteran Status and Gender

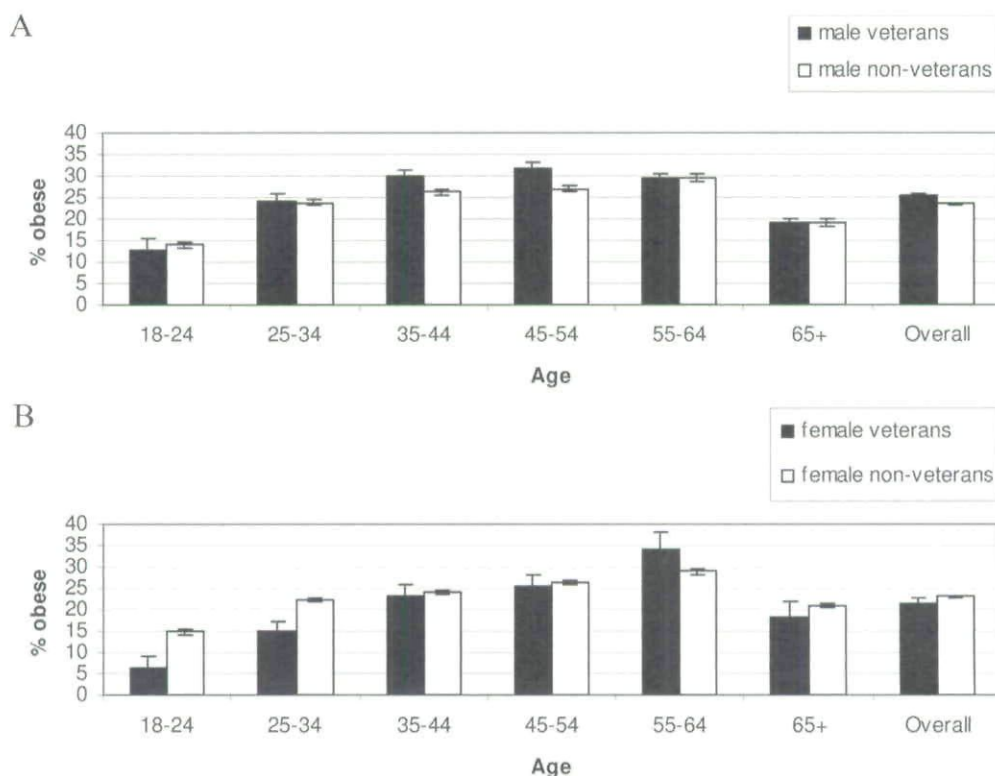
	% Overweight but not Obese <sup>a</sup> (% SE)		% Obese <sup>b</sup> (% SE)		% Overweight <sup>c</sup> (% SE)	
	Veteran	Nonveteran	Veteran	Nonveteran	Veteran	Nonveteran
Males (N = 114,805)	48.0 (0.5)	42.8 (0.4)	25.3 (0.4)	23.5 (0.3)	73.3 (0.4)	66.4 (0.3)
Females (N = 172,662)	32.4 (1.6)	29.4 (0.2)	21.2 (1.4)	23.0 (0.2)	53.6 (1.7)	52.4 (0.2)
Overall (N = 287,467)	47.1 (0.5)	35.2 (0.2)	25.1 (0.4)	23.3 (0.2)	72.2 (0.4)	58.4 (0.2)

Data from 2004 Behavioral Risk Factor Surveillance System.

<sup>a</sup> BMI  $\geq 25$  kg/m<sup>2</sup> and  $< 30$  kg/m<sup>2</sup>.

<sup>b</sup> BMI  $\geq 30$  kg/m<sup>2</sup>.

<sup>c</sup> BMI  $\geq 25$  kg/m<sup>2</sup>.



**FIGURE 1.** Obesity prevalence (and SE) by veteran status and gender: data from the 2004 Behavioral Risk Factor Surveillance System. (A) Data for males. (B) Data for females.

### Multivariate Analysis

Two separate logistic regression models were used to examine the associations between (1) veteran status and overweight and (2) veteran status and obesity. These models included veteran status as the independent outcome and either overweight or obesity as the dependent outcome. Interaction between gender and veteran status was assessed using the Wald test in both the overweight and obesity models and no significant interactions were found. The following covariates remained in both models: age, gender, marital status, race, education level, income level, smoking history, and self-rated health status. Using these models, veterans were as likely as

nonveterans to be overweight (adjusted OR, 1.05; 95% confidence interval, 0.99, 1.11) or obese (adjusted OR, 0.99; 95% confidence interval, 0.93, 1.05).

### DISCUSSION

This study is the first to report the prevalence of overweight and obesity, based on self-reported height and weights, for the entire U.S. military veteran population (regardless of VHA user status) and is the first to examine disease burden in a nationally representative veteran population by gender and age. Despite military entry standards for body weight and previous participation in a culture that emphasized and en-



forced physical fitness, we found that the prevalence of overweight and obesity is high in the veteran population and that veterans were just as likely as nonveterans to be overweight or obese. The military experience might be thought to convey some long-lasting protective benefit against becoming overweight or obese; however, this study does not support that hypothesis.

Previous findings of overweight and obesity prevalence in VHA users are interesting to contrast to this study.<sup>18</sup> Both this study and the 2000 study using measured heights and weights of VHA users found 73% of males to be overweight or obese. However, a greater percentage of veteran males who used the VHA for medical care were obese (33%) than the overall veteran male population in our analysis (25%). This is consistent with previous observations that veteran VHA users have a higher disease burden than veteran non-VHA users.<sup>21</sup> Female veterans in our analysis had markedly lower prevalence of overweight (54%) and obesity (21%) than previously reported veteran females who used the VHA for medical care (68 and 33%, respectively), suggesting that female users of VHA may be different from female veterans who do not obtain health care in the VHA.

This study has several limitations. The BRFSS is a self-reported telephone survey: this type of sampling may not fully represent the general U.S. population. Also, the tendency to underreport weight and overreport height has been documented.<sup>26</sup> Thus, self-reported BRFSS data tends to underestimate the prevalence of overweight and obesity compared to NHANES data, which uses measured heights and weights. In a study of BRFSS data from 1999 to 2000, this underestimation was 5.7% for overweight and 9.5% for obesity.<sup>27</sup> Understanding this underestimation is useful when comparing data from BRFSS, NHANES, and other sources.

Additional research could further delineate the trajectory of overweight and obesity and also suggest appropriate age groups to approach with primary intervention programs. Our study's finding of similar disease prevalence between veterans and nonveterans underscores the need for effective primary preventive efforts for active duty members. The period of active military service is a unique opportunity to study primary prevention programs in a coordinated health care system. Providing active service members with life skills during their service could prevent future obesity and comorbidities associated with obesity, reducing the burden of disease for the Department of Veterans Affairs, the military health care system, and the overall U.S. medical system. Furthermore, it might ensure a more fit and militarily-ready pool of individuals in the event of a national emergency that results in a recall to duty.

Baseline data on the prevalence of overweight and obesity after discharge are essential to describing the overweight and obesity trajectory of veterans once they have transitioned from active service to the civilian sector. A longitudinal study of active duty military members, titled the Millennium Cohort study, is currently underway.<sup>28</sup> This study, which is

collecting self-reported height and weight at various time intervals, could further define the trajectory of disease burden in the military population. Understanding this trajectory may inform not only the development of military primary preventive efforts but also nonmilitary behavioral modification programs. Further research might also evaluate veteran comorbidities associated with overweight and obesity, including hyperlipidemia, hypercholesterolemia, and diabetes and the extent to which war-related injury or immobility, and mental health conditions impact the development of overweight and obesity.

The military experience includes enforcement of a body weight standard and physical fitness testing with mandatory minimum physical fitness scores and decreased advancement opportunities for those who fail to meet them. The association of increased abnormal eating behaviors with the current physical fitness assessment cycle is well known.<sup>29-32</sup> This current cyclical system, with predictable biannual weigh-ins, does not encourage year-round weight standards, nor does it produce veterans who are any better equipped than their civilian counterparts to maintain a healthy weight. Other researchers have suggested more frequent assessment of weight and fitness to decrease unhealthy eating behavior resulting from the current system.<sup>29</sup> An alternative solution could be to alter the assessment protocol to resemble the current military policy for drug screening.<sup>33</sup> Weigh-ins could change from the current cyclical process to become random and unannounced.

It may be unrealistic to expect veterans to switch easily from the military's primarily external motivation to maintain a healthy weight to an internal motivation once the military's expectations are removed when the member transitions to civilian life. A randomly enforced weight standard might decrease unhealthy eating behaviors and lead to lifelong habits that a military member could continue after discharge from active duty. This approach could emphasize internal motivation through individual concerns and responsibility and would place emphasis on year-round maintenance of a consistent healthy weight instead of on passing or failing a weight standard on a biannual, predictable schedule. This area deserves further study.

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