ORIGINAL RESEARCH

The Obesity Epidemic in the Veterans Health Administration: Prevalence Among Key Populations of Women and Men Veterans

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BACKGROUND: Most US adults are overweight or obese. Understanding differences in obesity prevalence across subpopulations could facilitate the development and dissemination of weight management services.

OBJECTIVES: To inform Veterans Health Administration (VHA) weight management initiatives, we describe obesity prevalence among subpopulations of VHA patients.

DESIGN: Cross-sectional descriptive analyses of fiscal year 2014 (FY2014) national VHA administrative and clinical data, stratified by gender. Differences ≥5% higher than the population mean were considered clinically significant.

PARTICIPANTS: Veteran VHA primary care patients with a valid weight within ±365 days of their first FY2014 primary care visit, and a valid height (98% of primary care patients).

MAIN MEASURES: We used VHA vital signs data to ascertain height and weight and calculate body mass index, and VHA outpatient, inpatient, and fee basis data to identify sociodemographic- and comorbidity-based subpopulations.

KEY RESULTS: Among nearly five million primary care patients (347,112 women, 4,567,096 men), obesity prevalence was 41% (women 44%, men 41%), and overweight prevalence was 37% (women 31%, men 38%). Across the VHA's 140 facilities, obesity prevalence ranged from 28% to 49%. Among gender-stratified subpopulations, obesity prevalence was high among veterans under age 65 (age 18-44: women 40%, men 46%; age 45-64: women 49%, men 48%). Obesity prevalence varied across racial/ethnic and comorbidity subpopulations, with high obesity prevalence among black women (51%), women with schizophrenia (56%), and women and men with diabetes (68%, 56%).

CONCLUSIONS: Overweight and obesity are common among veterans served by the VHA. VHA's weight management initiatives have the potential to avert long-term morbidity arising from obesity-related conditions. High-risk groups—such as black women veterans, women veterans with schizophrenia, younger veterans, and Native Hawaiian/Other Pacific Islander and American Indian/Alaska Native veterans—may require particular attention to ensure that systems improvement efforts at the population level do not inadvertently increase health disparities.

KEY WORDS: veterans; obesity; health disparities; population health; women.
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INTRODUCTION

A population health approach to preventing and treating obesity demands, as a first step, a sketch of the population served and its key subpopulations. High obesity prevalence is well-established in the general US population,[1] as is obesity's association with numerous health risks,[2] including high all-cause mortality.[3] Behavioral weight loss programs, medication, and surgery effectively treat obesity.[2] However, to ensure that treatments are successfully implemented at the population level, descriptive epidemiological information is needed to identify those most in need of weight management and to inform the development of outreach programs. This is particularly important given known disparities in obesity prevalence, including the high prevalence among black and Hispanic women in the general US population.[1]

Compared to many US subpopulations,[1] veterans using the Veterans Health Administration (VHA) have high rates of obesity.[4] However, no recent analyses have leveraged the full capabilities of the VHA's administrative and clinical data to characterize obesity among the veterans it serves. Therefore, this paper describes obesity prevalence among almost five million women and men VHA veteran primary care patients,

overall and across key subpopulations defined by gender, age, race/ethnicity, service-connected disability status, urban/rural residence, and period of military service, and among subpopulations with one of several physical or mental health conditions. Epidemiological findings from these rich national data will inform VHA weight management services and can be used to generate hypotheses regarding obesity and weight management in the general US population.

METHODS

Data Sources and Cohort. Using the Women's Health Evaluation Initiative (WHEI) Master Database (which includes outpatient, inpatient, and community care [fee basis] records,[5] and VHA Vital Signs data for all women and men VHA patients), we identified all veteran patients nationally with at least one VHA primary care visit in fiscal year 2014 (FY2014). We included the 98% of these patients with non-missing body mass index (BMI) data. (Information on veterans with missing BMI is in Online Appendix 1.) This program evaluation activity for VHA Women's Health Services and the VHA Office of Health Equity (OHE) received an official non-research determination from the national VA office of Women's Health Services, and therefore did not require review by the institutional review board.

BMI. To ascertain BMI, we developed an algorithm influenced by past work.[6] In brief, we identified the closest non-missing weight taken within ±365 days of a veteran's first FY2014 primary care visit and the veteran's modal height between October 1999 and July 2016. We then created seven BMI categories: 1) underweight (BMI <18.5 kg/m^2); 2) normal weight (18.5 $kg/m^2 \leq$ BMI < 25 kg/m^2); 3) overweight (25 $kg/m^2 \leq$ BMI < 30 kg/m^2); 4) obesity–any (BMI ≥ 30 kg/m^2); 5) obesity class I (30 $kg/m^2 \leq$ BMI < 35 kg/m^2); 6) obesity class II (35 $kg/m^2 \leq$ BMI < 40 kg/m^2); and 7) obesity class III (BMI ≥ 40 kg/m^2). See Online Appendix 2 for additional detail.

Key Subpopulations. We identified key subpopulations described in the VHA's Health Equity Action Plan,[7] defined below, and, unless otherwise noted, assessed in FY2014 and based on WHEI and OHE algorithms, which are freely available online.[5, 8]

Gender. Assessed as women or men.

Age on first day of FY2014. We included three age categories: 18-44 years, 45-64 years, and 65+ years.

Race/ethnicity. We included the following groups: white, black/African American, Hispanic, Asian, Native Hawaiian/other Pacific Islander, American Indian/Alaska Native, multiracial, or unknown/declined to state.

Service-connected disability status. If an injury or illness is determined to have been incurred or aggravated during military service, it is considered service-connected; the Veterans Benefits Administration uses a multi-step process to rate its severity from 0 to 100%. We used four categories: none, 0-49%, 50-99%, and 100% (based on veterans' last ratings in FY2014).

Rural/urban residence. Veterans' last known addresses in FY2014 were used to define four categories: 1) highly urban (a metropolitan statistical area with 500,000+ residents), 2) urban (50,000+ people in the urban nucleus and at least 1000 residents per square mile in the urban core), 3) highly rural (county with <7 residents per square mile), and 4) rural (any other non-urban area).

Period of service. We grouped veterans based on their most recent period of military service, which is highly correlated with age: 1) Operation Enduring Freedom (OEF)/Operation Iraqi Freedom (OIF)/Operation New Dawn (OND), 2) Gulf War I/pre-OEF/OIF/OND, 3) post-Vietnam War/pre-Gulf War, 4) Vietnam War, 5) post-Korean War/pre-Vietnam War, 6) Korean War, 7) post-World War II, 8) World War II or earlier, or 9) unclassified. Years spanning eras can be found in Washington et al.[9] A graphical representation is also available.[10]

Facility. We assessed obesity prevalence at each of the VHA's 140 facilities.

Comorbid physical and mental health conditions. Based on the presence of at least one instance of an ICD-9 diagnosis code in FY2014 outpatient or inpatient VHA or community care (fee-basis) data, we identified veterans with sleep apnea, diabetes, hypertension, lipid disorders, coronary artery disease, lumbosacral spine disorders, lower extremity joint disorders, major depressive disorder, bipolar disorder, post-traumatic stress disorder (PTSD), anxiety disorder, drug use disorder, alcohol use disorder, and/or schizophrenia. Conditions were chosen based on their strong association with obesity[2] and/or high prevalence among veteran populations.[5]

Analyses. We calculated frequencies across BMI categories within each subpopulation. We then repeated analyses, stratified by gender. This stratification was planned a priori because of known differences in obesity prevalence between women and men[11, 12] and because, among VHA patients, women veterans tend to be younger, have greater racial/ethnic diversity, and have a higher burden of mental health comorbidity than men veterans.[5] As in other OHE work,[8] we highlight clinically relevant differences in the results, defined as ≥5% higher than the population mean, rather than reporting statistical tests of difference, which given our large sample could highlight small, clinically irrelevant differences. We used SAS Enterprise Guide 7.1 and SAS 9.2 software (SAS Institute Inc., Cary, NC) for UNIX and Linux.

RESULTS

The cohort included 4,914,208 VHA primary care patients (347,112 women, 4,567,096 men). Most veterans were either

overweight or obese. Overweight prevalence was 37% (women 31%, men 38%) and obesity prevalence was 41% (women 44%, men 41%; see Fig. 1). Across the VHA's 140 facilities, obesity prevalence ranged from 28% to 49% (see Online Appendix 3 for facility-level obesity prevalence by region). Below, we highlight key findings for obesity prevalence among subpopulations overall and stratified by gender (Table 1). See Online Appendix 4 for information on all BMI categories.

Overall Prevalence. Obesity prevalence was ≥5% higher than the population mean in some sociodemographic groups: veterans 45-64 years old (48%), Native Hawaiian/other Pacific Islander veterans (46%), American Indian/Alaska Native veterans (47%), veterans with 50–99% or 100% service-connected disability status (49%, 47%), and those who served in the Gulf War I/pre-OEF/OIF/OND (51%) or just prior to the Gulf War (48%) eras. Unsurprisingly, obesity prevalence was high among veterans with obesity-related conditions, and was highest among veterans with sleep apnea (72%), diabetes (57%), or lower extremity joint disorders (50%). Obesity prevalence was also high among veterans with mental health conditions, particularly major depressive disorder (48%), bipolar disorder (47%), and PTSD (47%), and among veterans with three or more conditions (50%). In general, we saw similar findings across obesity classes (see Online Appendix 4).

Gender-Stratified Results. Obesity prevalence differed across age groups for women and men. Prevalence was highest among the middle age group (women 49%, men 48%), but there was a notable difference in obesity prevalence between women and men veterans age 18–44 (40% vs. 46%). The prevalence of obesity was also notably high among black women (51%), American Indian/Alaska Native men (47%), and men veterans of unknown race/ethnicity (47%). High obesity prevalence was also notable among women and men who served in the Gulf War I/pre-OEF/OIF/OND and post-Vietnam War/pre-Gulf War eras, and women Vietnam War veterans (Table 1).

With regard to physical health conditions, obesity prevalence was ≥5% higher among women than men for veterans with diabetes (68% vs. 56%), hypertension (56% vs. 46%), and lipid disorders (52% vs. 45%). Gender differences in obesity prevalence among veterans with mental health conditions were modest, with the exception of schizophrenia, in which obesity prevalence was 15 percentage points higher among women than men (56% vs. 41%). There were also gender differences among veterans with three or more conditions (women 54%; men 49%).

DISCUSSION

Among the almost five million VHA primary care patients in FY2014, 41% were obese and 37% were overweight, collectively accounting for most veterans seen in VHA primary care. Obesity prevalence was high compared to that of the general US population or military personnel, among whom obesity prevalence is estimated at 38% and 13%, respectively.[1, 13] However, comparisons must be interpreted with the understanding that VHA data reflect a treatment-seeking population, who may be older and sicker than the general population.[14–18] Furthermore, while findings reflect the universe of veterans using VHA, they may not apply to veterans outside the VHA, who tend to be in better health.[19, 20] Nonetheless, high obesity prevalence, even among the youngest veterans served by the VHA, could partially explain why veterans who may be fit when leaving the military go on to develop more chronic conditions and poorer health than the general US population.[14–18]

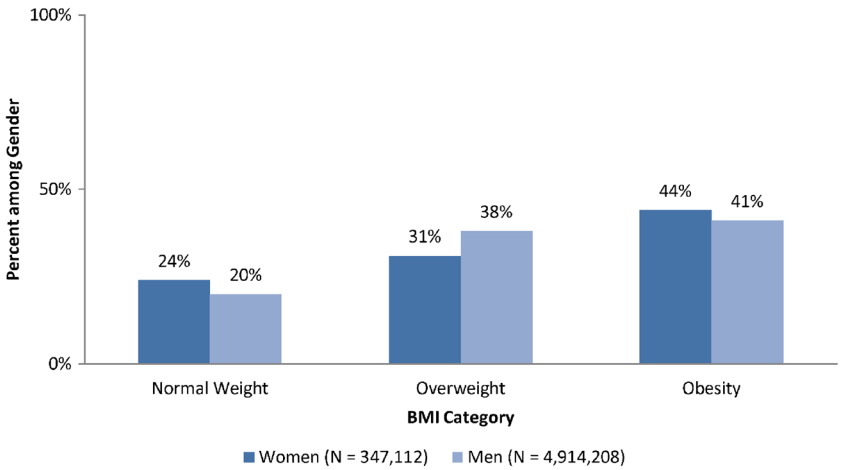

Figure 1 BMI distribution among women and men veteran VHA primary care patients in fiscal year 2014. BMI: body mass index; VHA: Veterans Health Administration; normal weight (18.5 kg/m^2 ≤ BMI < 25 kg/m^2); overweight (25 kg/m^2 ≤ BMI < 30 kg/m^2); obesity (BMI ≥ 30 kg/m^2).

Table 1 Prevalence of Obesity Among FY2014 Veteran VHA Primary Care Patients Nationally and by Subpopulations

	Row N	Obesity prevalence		
	Total sample	Total sample	Women*	Men*
		N = 4,914,208	N = 347,112	N = 4,567,096
Total	4,914,208	41%	44%	41%
Age (years)				
18-44	738,416	44%	40%	**46%**
45-64	1,766,767	**48%**	**49%**	**48%**
65+	2,409,014	36%	37%	36%
Race/ethnicity				
White	3,592,109	41%	41%	41%
Black or African American	777,692	44%	**51%**	43%
Hispanic	279,647	43%	39%	43%
Asian	40,621	24%	21%	25%
Native Hawaiian/ other Pacific Islander	30,718	**46%**	**47%**	**46%**
American Indian/ Alaska Native	28,533	**47%**	45%	**47%**
Multiracial	39,080	43%	43%	43%
Unknown/ declined to state	125,808	**46%**	43%	**47%**
Service-connected disability status†				
None	2,421,446	37%	41%	36%
0-49%	1,122,173	43%	43%	43%
50-99%	1,005,790	**49%**	**46%**	**49%**
100%	363,559	**47%**	**48%**	**47%**
Rural/urban residence				
Highly urban	2,280,998	40%	43%	40%
Urban	866,899	41%	44%	41%
Rural	1,682,082	43%	45%	43%
Highly rural	70,756	43%	42%	43%
Period of service				
OEF/OIF/OND	523,874	44%	36%	45%
Gulf War I/pre-OEF/OIF/ OND	598,070	**51%**	**47%**	**52%**
Post-Vietnam War/pre-Gulf War	556,486	**48%**	**49%**	**48%**
Vietnam War	2,151,491	44%	**49%**	44%
Post-Korean War/pre-Vietnam War	266,078	34%	39%	34%
Korean War	435,782	26%	28%	26%
Post-World War II	14,191	21%	22%	21%
World War II or earlier	269,542	15%	13%	15%
Unclassified	22,533	44%	43%	45%
Physical health conditions				
Sleep apnea	540,753	**72%**	**74%**	**72%**
Diabetes	1,325,087	**57%**	**68%**	**56%**
Hypertension	2,826,651	**46%**	**56%**	**46%**
Lipid disorder	2,597,602	45%	**52%**	45%
Coronary artery disease	862,749	42%	**47%**	42%
Lumbosacral spine disorder	1,050,310	**46%**	**47%**	45%
Lower extremity joint disorder	933,441	**50%**	**51%**	**50%**
Mental health conditions				
Major depressive disorder	340,976	**48%**	**49%**	**48%**
Bipolar disorder	123,252	**47%**	**49%**	**46%**
PTSD	675,921	**47%**	**46%**	**47%**
Anxiety disorder	528,765	42%	42%	42%
Schizophrenia	77,747	42%	**56%**	41%
Drug use disorder	232,876	33%	36%	33%
Alcohol use disorder	377,873	34%	35%	34%
3+ Conditions‡	2,348,005	**50%**	**54%**	**49%**

(continued on next column)

Table 1. (continued)

Boldface font in an obesity prevalence column indicates subgroup prevalence ≥5% above overall obesity prevalence for the total cohort (41%).

Obesity: BMI ≥30+ kg/m^2; FY2014: fiscal year 2014; VHA: Veterans Health Administration; OEF/OIF/OND: Operation Enduring Freedom/ Operation Iraqi Freedom/Operation New Dawn; PTSD: post-traumatic stress disorder.

**Represents proportion among only that gender.*

†Designates presence and rating of an injury or illness incurred or aggravated during military service, rated from 0 to 100%.

‡Includes physical and/or mental health conditions

Given the high obesity prevalence among VHA primary care patients, a population health approach to weight management is warranted. However, while overall obesity prevalence is high in the VHA, it does not affect all equally: obesity prevalence among several veteran subpopulations was higher than mean obesity prevalence by at least 5% (which has been used as a clinically meaningful threshold[8]). Therefore, in its efforts to reduce obesity within the overall population, the VHA must remain vigilant to avoid unintentionally increasing disparities. This may require approaches such as determining whether subpopulations with the highest obesity prevalence use weight management programs at rates commensurate with their risk. Existing work offers some information; for example, veterans with serious mental illness or depressive disorders,[21] veterans with higher service-connected disability status,[22, 23] and veterans with more health conditions[23, 24] are more likely to use MOVE!, one of the VHA's weight management programs.[24, 25] Conversely, despite high obesity prevalence among younger veterans, they have low MOVE! use.[23, 24] Additional work is needed, as black women veterans and women veterans with schizophrenia have high obesity prevalence, but analyses of weight loss treatment use are rarely stratified by gender. Moreover, there are few data on disparities in the use of VHA programs other than MOVE!.

Other subpopulations with excess obesity prevalence also merit attention, including Native Hawaiian/other Pacific Islander and American Indian/Alaska Native veterans. These groups have not historically been the focus of health-related

research,[26] despite the fact that American Indian/Alaska Native veterans served in the military post-9/11 at higher rates than other racial/ethnic groups.[27] In addition, obesity was very common among men veterans age 18–44. It is notable that obesity was far more common among these men than among men age 20–39 in the general US population (46% vs. 32%[1]). Given their long horizon for VHA care, the benefits of behavioral interventions (e.g., MOVE! use is associated with decreased diabetes incidence[28]), and the fact that men veterans are less likely to use MOVE! than women veterans,[23, 24] understanding and increasing weight loss treatment engagement in this group could prevent the onset of costly and debilitating chronic conditions later in life.

Future Research. While tailoring weight loss treatments to populations with the highest obesity prevalence could help the VHA prevent health disparities, it is a complex undertaking. Approaches may appear promising in one setting, but not in another: a weight management program tailored for patients with serious mental illness at Kaiser Permanente was associated with more weight loss than was usual care,[29] whereas a trial investigating VHA's MOVE! program tailored for veterans with serious mental illness had null results.[30] In addition, work on cultural tailoring can be limited by a lack of clear methods for operationalizing the tailoring so that interventions can be optimally and empirically tested.[31]

In light of these complexities, well-designed VHA research in this area could have a broad impact. For example, the VHA, with its mostly male patient population, represents an excellent setting in which to conduct weight management research among men, a population that may benefit from tailored approaches (e.g., individual as opposed to group treatment), but that is underrepresented in existing work.[32–34] With its diverse patient population, the VHA is also well-positioned to move beyond unidimensional analyses of disparities, and instead examine disparities among patients at the intersection of historically disadvantaged groups.[35]

Several other intriguing areas for future work emerge from our findings, for example, understanding why Asian veterans using the VHA have such high obesity prevalence compared to other Asian Americans (24% vs. 13%[1]). In addition, given the correlation between some mental health conditions and excess weight,[36–39] it is worth investigating whether the high prevalence of mental health conditions among VHA patients[5] contributes to the higher rate of obesity in the VHA compared to the general US population. Considering the high need and associated high costs of patients with multimorbid conditions,[40] the relationship between obesity and multimorbidity also merits further research, particularly because conditions in the present analyses were selected based on their associations with obesity and/or high prevalence among VHA-using veterans.

Limitations. This paper did not attempt to explore mechanisms for observed differences in obesity prevalence between groups. For example, we did not assess veterans' bariatric surgery history, their use of medications that facilitate weight loss (directly or as a side effect), or their use of medications that promote weight gain (including many psychiatric medications, relevant to the large group with comorbid mental health conditions). Any of these factors could have contributed to between-group differences if there was differential use across subpopulations. Nor did we have information on income or education, which could also be drivers of some observed differences. Further, with cross-sectional data, we cannot draw causal conclusions (e.g., whether musculoskeletal conditions cause obesity, or the reverse).

Other limitations include the fact that, at the individual level, BMI is an imperfect measure of future health risk,[41] particularly when comparing across race and ethnicity[42] or when examining older patients who may have lower than average muscle mass.[43] In addition, our use of a wide date range for assessing height could have led to an underestimation of BMI among some older veterans, given declines in height with advancing age.[44] Our method of identifying comorbid conditions means that, for patients who joined the VHA late in FY2014, there may have been less opportunity for the detection of a medical condition that was present. Additionally, findings may not be generalizable to the 10% of veteran VHA patients not using primary care,[5] or to the ~15 million veterans not using the VHA.[45]

Strengths. Despite these limitations, our methods have several strengths. For example, they allowed us to include 98% of all VHA primary care patients in analyses, minimizing potential selection bias. The large-scale and national scope of this work is particularly valuable, given known geographic variability in obesity prevalence.[46] Furthermore, since the bulk of prior weight management research has focused on women (especially white women[32, 33]), our ability to examine obesity in several populations that previously received little attention adds to the general scientific literature in this field. An additional strength is that obesity case-finding in this paper relied on BMI values calculated using height and weight from the VHA national electronic health record rather than ICD-9 diagnoses. Finally, while BMI cannot perfectly measure health, it is consistently associated with adverse outcomes,[3] and is therefore a valid way to assess the population at risk for obesity-related health conditions within the VHA.

Conclusions. The high prevalence of overweight and obesity in our cohort supports the VHA's continued investment in deploying effective weight management programs, as losing just 4–7 pounds can improve health outcomes.[2] Efforts should focus on increasing engagement in the variety of weight

management treatments offered by the VHA, including in-person treatments (e.g., MOVE!), telephone coaching, weight loss medications, and bariatric surgery. Options that allow for flexible scheduling may have particular value, due to the high prevalence of obesity among veterans of working age, who may need after-hours care.

Given the high obesity prevalence among the general US population, the results of such efforts could have a broad impact, especially in light of calls for an increased focus on population health management in the United States.[47–49] For veterans, the VHA's weight management initiatives have the potential to avert long-term morbidity arising from obesity-related conditions. High-risk groups in the VHA—such as black women veterans, women veterans with schizophrenia, younger veterans, Native Hawaiian/other Pacific Islander veterans, and American Indian/Alaska Native veterans—as well as high-risk groups in the general US population, may require particular attention to ensure that systems improvement efforts at the population level do not inadvertently increase health disparities.

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