

# Body Mass Index Relates to Males with Posttraumatic Stress Disorder

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*Introduction:* We looked at the relationships among posttraumatic stress disorder (PTSD), body mass index (BMI) and socioeconomic status (SES) in a newly formed PTSD program at the Hunter Holmes McGuire Veterans Affairs Medical Center in Richmond, VA.

*Methods:* We reviewed 265 records and then selected only black and white male veterans (n=252) for study. Variables were: 1) age, 2) decade of life, 3) height, 4) weight, 5) sex, 6) race, and 7) SES (estimated using priority group status). Low income is an important variable determining priority group status.

*Results:* About two-thirds of the veterans were in the age range of 50–59 years (Vietnam veterans). Their mean BMI was  $30.2 \pm 5.6$  kg/m<sup>2</sup>, and this value did not separate by race. Far exceeding national numbers, 84.1% of our veterans were either overweight or obese. Veterans in the lower priority groups had greater ( $p=0.029$ ) BMIs than their counterparts in higher priority groups.

*Conclusions:* The pervasiveness of overweight and obesity in our PTSD population was profound. Our observations suggest that low SES is a likely contributor to veterans in lower priority groups having greater BMIs than veterans in higher priority groups.

**Key words:** body mass index ■ military ■ obesity ■ overweight ■ posttraumatic stress disorder

## INTRODUCTION

Early identification and treatment of posttraumatic stress disorder (PTSD) is now a high priority for active duty military personnel.<sup>1</sup> For a variety of reasons, these personnel appear more vulnerable than their military predecessors to develop this syndrome.<sup>2</sup> Thus, the Department of Veterans Affairs is likely to receive a growing number of veterans with PTSD. Iraq and Afghanistan veterans who develop PTSD are in the relatively early stages of this disorder. Looking at factors contributing to or impairing the treatment of older veterans with PTSD may lead to more successful treatments for Iraq and Afghanistan veterans with new-onset PTSD. Socioeconomic status (SES) may be one of the factors contributing to the worsening of or failure to improve for older veterans with PTSD.

## Priority Group, Income and Access to Healthcare

A history of the evolving eligibility criteria for care within the Department of Veterans Affairs medical facilities is beyond the scope of this paper.<sup>3</sup> In October 1996, Congress passed Public Law 104-262, the Veterans' Health Care Eligibility Reform Act of 1996. This law led to a Medical Benefits Package and priority groups 1–8 for Department of Veterans Affairs beneficiaries.<sup>4,5</sup> Table 1 defines priority groups 1–8.<sup>3,6</sup> Low income is one of the important variables determining priority group status.

Table 2 lists annual household income of all enrolled veterans during the 2003 VHA Survey by Priority Group.<sup>7</sup> Figure 1 shows the percent of all enrolled veterans in priority groups 1–6 in different income categories. Table 3 provides annual income for the subset of enrolled veterans<sup>7</sup> meeting DSM-IV criteria for PTSD (DSM-IV Code Number 309.81).<sup>8</sup> Figure 2 shows the percent of enrolled PTSD veterans in priority groups 1–6 in different income categories. The 2003 VHA Survey by Priority Group showed that for those enrollees who reported income, median income was in the \$21,000–25,999

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range, or approximately \$23,500. The median income for enrolled PTSD veterans according to Veterans Administration patient files was \$16,764.<sup>7</sup> That is, enrolled PTSD veterans had substantially reduced annual household income compared with all enrolled veterans.

### Socioeconomic Status and Obesity

SES is often related to obesity but in complex ways.<sup>9</sup> This relationship may differ by racial groups and among countries in different stages of the obesity epidemic. In developing countries, obesity is first found among higher-SES groups because they can afford high-energy diets.

Popular assumptions about the relationship between SES and obesity suggest that socially disadvantaged families possess little knowledge or interest in healthful diets, are poorly nourished, and have limited opportunities for physical exercise and

activities.<sup>10</sup> Alternatively, obesity may lead to a reduction in SES. Or, low SES and obesity may have similar causes, and this common causality explains the association.

In the United States, about one-third of black and Mexican-American women suffer from obesity, compared with about one-fourth of non-Hispanic white women; two-thirds of these minority women are either overweight or obese.<sup>11</sup> BMI declines with increasing education among women. The proportion of men suffering from obesity (about 20%) is similar in different racial groups—although slightly higher among Mexican-American men.

Averett and Korenman<sup>12</sup> reported that the SES effects of obesity were larger for whites than blacks. They hypothesized that cultural differences may protect black women, as opposed to whites, from loss of self-esteem associated with obesity. Self-esteem differences, however, did not explain the

**Table 1. Priority groups define enrollment priorities<sup>3,6</sup>**

Priority Group	Definition
1	Service-connected disability rated 50% or more disabling
2	Service-connected disability rated 30% or 40% disabling
3	Former POWs Purple Heart recipients Service-connected disability rated 10–20% disabling Discharged for a disability that was incurred or aggravated in the line of duty Special eligibility classification under “benefits for individuals disabled by treatment or vocational rehabilitation”
4	Veterans who are receiving aid and attendance or housebound benefits Veterans who have been determined by the VHA to be catastrophically disabled
5	Income and net worth below the VHA Means Test threshold Receiving VA pension benefits Eligible for Medicaid
6	World War I veterans Mexican Border War veterans Service-connected disability rated 0% Veterans solely seeking care for disorders associated with: <ul style="list-style-type: none"> <li>• Exposure to herbicides while serving in Vietnam</li> <li>• Exposure to ionizing radiation during atmospheric testing or during the occupation of Hiroshima or Nagasaki</li> <li>• Disorders associated with service in the Gulf War</li> <li>• Any illness associated with service in combat in a war after the Gulf War or during any period of hostility after November 11, 1998</li> </ul>
7	Veterans who agree to pay copayments with income and/or net worth above the VHA Means Test threshold and income below the HUD Geographic Means Test threshold
8 (Not currently eligible for enrollment)	Veterans who agree to pay specified copayments with income and/or net worth above the VHA Means Test threshold and the HUD Geographic Means Test threshold

effects of obesity on SES.

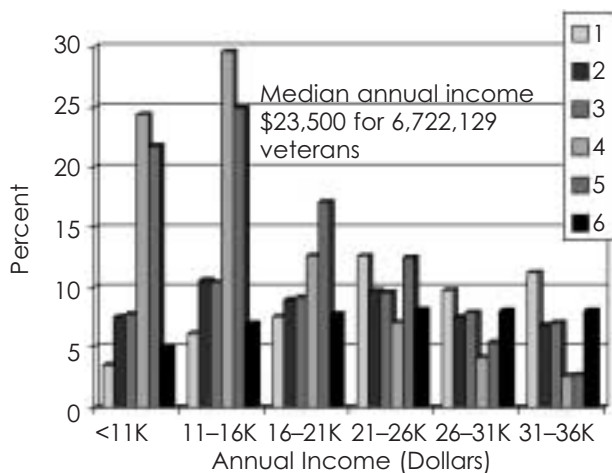
Paeratakul et al.<sup>13</sup> studied how sex, race and SES related to obesity and obesity comorbidities in a sample of U.S. adults. They found that the disease burden associated with obesity is substantial and that this

burden increases with increasing obesity severity. The authors concluded that level of obesity-related health risks may vary with sex, race and SES.

Moore et al.<sup>14</sup> studied overweight in youths over a seven-year period. Lower-SES youths independent of race or sex developed extremely large increases in general adiposity over time. These increases drove a number of obesity-related problems, including hypertension. The authors emphasized the importance or primary prevention of obesity, particularly among youths from low-SES backgrounds.

Using data from 13,113 U.S. adolescents enrolled in the National Longitudinal Study of Adolescent Health, Gordon-Larsen et al.<sup>15</sup> reported that maintaining adolescents in their same environments while changing family income and parental education little affected disparities in the prevalence of overweight. Race-SES-overweight differences were greater among females compared with males. Also, black-white disparity in overweight prevalence increased at the highest SES levels. The authors concluded that efforts to correct overweight differences among ethnic groups must look beyond income and education and

**Figure 1. The percent of all enrolled veterans (n= 6,722,129) veterans in priority groups 1–6 in different income categories<sup>7</sup>**



**Table 2. Annual household income of all enrolled veterans during the 2003 VHA Survey by Priority Group<sup>7</sup>**

Income	Priority Group 1	Priority Group 2	Priority Group 3	Priority Group 4	Priority Group 5	Priority Group 6	Priority Group 7	Priority Group 8	Total
<\$11,000	22,625	32,999	65,989	50,536	503,717	6,304	44,674	18,847	745,690
									11.09%
\$11,000–\$15,999	39,556	46,262	88,422	61,390	577,807	8,581.7	94,171	40,872	957,061
									14.24%
\$16,000–\$20,999	48,930	39,017	77,598	26,158	395,935	9,613.9	134,857	54,759	786,869
									11.71%
\$21,000–\$25,999	81,420	42,531	81,210	1,4628	289,003	10,045	172,999	63,256	755,092
									11.23%
\$26,000–\$30,999	63,097	32,902	67,001	8,580.4	124,936	9,947.8	145,634	49,505	501,602
									7.46%
\$31,000–\$35,999	72,644	29,945	59,402	5,406.6	63,238	9,997.6	106,930	94,576	442,139
									6.58%
\$36,000–\$40,999	47,667	20,059	40,024	3,209.5	32,385	8,807.3	42,980	97,678	292,809
									4.36%
\$41,000–\$45,999	31,560	23,862	38,582	1,487.7	20,827	8,954.5	21,270	100,667	247,210
									3.68%
\$46,000–\$50,999	22,703	14,595	37,987	1,124	12,140	6,045.9	3,475.4	76,550	174,621
									2.60%
\$51,000–\$55,999	17,187	16,934	26,431	888.03	5,652.7	5,335.8	728.64	77,037	150,194
									2.23%
≥\$56,000	77,822	77,917	144,561	3,231.3	39,906	25,546	0	326,265	695,248
									10.34%
Don't know	52,237	23,384	40,067	18,404	124,645	4,434.2	0	104,588	367,759
									5.47%
Refused to answer	71,158	39,132	82,990	12,139	127,722	10,777	0	261,918	605,836
									9.01%
Total	648,605	439,539	850,263	207,182	2,317,912	124,391	767,720	1,366,518	6,722,129
	9.65%	6.54%	12.65%	3.08%	34.48%	1.85%	11.42%	20.33%	100.00%

focus on such factors as environment, context, biology and sociocultural factors.

Zhang and Wang<sup>16</sup> assessed SES inequality in obesity distribution among U.S. adults aged 18–60 years. Consistent with earlier studies, they found substantive racial differences in the relationship between SES and obesity. The authors reported a lower SES inequality in obesity within minority groups. They concluded that sex, age and race are important factors in SES inequality in obesity.

Gary et al.<sup>17</sup> assessed the fruit, vegetable and fat intake in a population-based sample of blacks. They reported that women, older persons, the physically active and those with a higher SES ate more healthful foods. The authors hoped that their findings would help reverse the high rates of obesity and other chronic diseases among blacks.

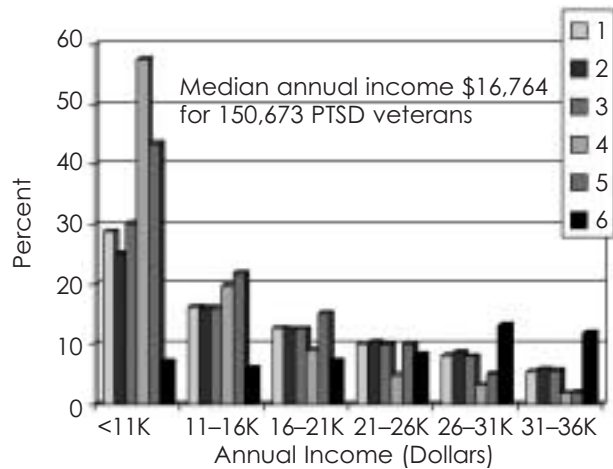
SES is a variable poorly explored among overweight and obese military veterans with PTSD and is a largely ignored determinant of the nation's health.<sup>18</sup> However, there is an emerging literature linking SES and obesity in this country. These principles may be applicable to our military veterans.

### The Richmond PTSD Program for Military Veterans

The expanding epidemic in obesity,<sup>19-21</sup> coupled with the increasing importance of PTSD among

military veterans,<sup>22,23</sup> stimulated us to use our recently developed database on PTSD to assess the potential interactions of PTSD, body mass index (BMI) and priority groups. That is, might eligibility criteria and their benefits for PTSD veterans separate along the lines of overweight and obesity? And in a sub-analysis, might BMI vary by race among military veterans?

**Figure 2. The percent of enrolled posttraumatic stress disorder veterans (n=150,673) in priority groups 1–6 in different income categories<sup>7</sup>**



**Table 3. Annual household income of enrolled posttraumatic stress disorder veterans during the 2003 VHA Survey by Priority Group<sup>7</sup>**

Income	Priority Group 1	Priority Group 2	Priority Group 3	Priority Group 4	Priority Group 5	Priority Group 6	Priority Group 7	Priority Group 8	Total
<\$11,000	18,168	4,635	4,532	4,068	14,701	392	170	370	47,036 31.22%
\$11,000–\$15,999	10,240	2,961	2,419	1,402	7,373	334	161	355	25,245 16.75%
\$16,000–\$20,999	7,994	2,314	1,886	631	5,117	406	173	381	18,902 12.55%
\$21,000–\$25,999	6,354	1,905	1,487	342	3,397	459	202	529	14,675 9.74%
\$26,000–\$30,999	5,119	1,592	1,203	218	1,676	735	329	744	11,616 7.71%
\$31,000–\$35,999	3,380	1,069	829	129	667	662	220	707	7,663 5.09%
\$36,000–\$40,999	3,053	1,003	764	94	403	645	155	647	6,764 4.49%
\$41,000–\$45,999	2,103	647	450	43	178	445	88	469	4,423 2.94%
\$46,000–\$50,999	1,805	615	386	52	117	432	43	395	3,845 2.55%
\$51,000–\$55,999	1,120	401	237	23	84	230	15	250	2,360 1.57%
≥\$56,000	3,901	1,350	890	68	164	842	32	897	8,144 5.41%
Total	63,237 41.97%	18,492 12.27%	15,083 10.01%	7,070 4.69%	33,877 22.48%	5,582 3.70%	1,588 1.05%	5,744 3.81%	150,673 100.00%

**METHODS**

To test the null hypothesis that overweight and obesity did not relate to SES among military veterans, we reviewed the database (n=265) of the recently constituted PTSD program at Hunter Holmes McGuire Veterans Affairs Medical Center in Richmond, VA. These veterans were referred with clinical features of PTSD, subsequently met DSM-IV criteria for PTSD of the American Psychiatric Association (DSM-IV Code Number 309.81)<sup>8</sup> and carried PTSD as their primary diagnosis. Due to their small numbers, we eliminated eight women and five nonblack, nonwhite male veterans to establish an all-male military veteran study population that was either black or white (n=252). Variables assessed included: 1) age, 2) decade of life, 3) height, 4) weight, 5) sex, 6) race, and 7) priority group. From the height and weight measurements, we calculated BMI.

Because this report is a result of our review of routinely collected clinical data and was not conceived as research, we did not submit this project to our institutional review board for review. We caution that our paper does not report prospectively derived data. Rather, we report a systematic review of data available to us from standard clinical assessment.

**RESULTS**

The mean age of the 252 male veterans was 55.8 ± 8.8 years (black, n=146, 54.9 ± 8.2 years and white, n=106, 56.9 ± 9.6 years; df=250, t=1.767, p=0.078). The youngest veteran was 23 years old and the oldest veteran was 85 years old.

The mean BMI of the 252 male veterans was 30.2 ± 5.6 kg/m<sup>2</sup> (black, n=146, 29.7 ± 5.7 kg/m<sup>2</sup> and white, n=106, 30.9 ± 5.3 kg/m<sup>2</sup>; df=250, t=1.807, p=0.072)—that is, BMI did not vary by race). The smallest BMI was 18.2 kg/m<sup>2</sup> and the largest BMI was 53.7 kg/m<sup>2</sup>.

Table 4 shows the mean BMI by decade of life. Using Analysis of Variance (ANOVA), BMI did not differ by decade of life (p=0.226). Most (66.3%) of our veterans were in the age range of 50–59 years

consistent with Vietnam veterans dominating our study population.

BMI was in the normal range (<25 kg/m<sup>2</sup>) for 40 veterans (15.9%). There were 95 veterans (37.7%) in the overweight range (≥25 kg/m<sup>2</sup> to <30 kg/m<sup>2</sup>), 100 veterans (39.7%) in the obese range (≥30 kg/m<sup>2</sup>), and 17 (6.7%) in the morbidly obese range (≥40 kg/m<sup>2</sup>). That is, 84.1% were overweight, obese or morbidly obese.

Table 5 shows BMI by priority group. We collapsed priority groups 1 and 2 into a single group (group A) and priority groups 3–6 into a second group (group B) to approximate two groups based on priority groups. No veterans were in groups 7 and 8. Veterans in group A (n=139, BMI 30.9 ± 6.0 kg/m<sup>2</sup>) had greater BMIs (df=250, t=2.202, p=0.029) than veterans in group B (n=113, BMI 29.3 ± 4.9 kg/m<sup>2</sup>).

**DISCUSSION**

The mean BMI (30.2 ± 5.6kg/m<sup>2</sup>) of our study population placed black and white male military veterans with PTSD in the obese category, with 84.1% of them overweight, obese or morbidly obese. This value of 84.1% exceeded the current national finding of 64.5% by about 20%.<sup>20</sup> White male PTSD veterans tended to be slightly more obese than their black counterparts, but this difference did not quite reach the level of statistical significance (p=0.072). Almost two-thirds of our study population were in the sixth decade of life (Table 4), placing them in the Vietnam era of veterans. This sixth decade is associated with the highest prevalence of obesity at a national level.<sup>24</sup>

When we divided our study population (Table 5) into two groups based on priority groups, PTSD military veterans in the lower two priority groups had greater BMIs (p=0.029) than veterans in higher priority groups. Priority groups 1 and 2 were veterans with service-connected conditions of ≥30% (priority group 1 ≥50% and priority group 2 ≥30% and <50%). The higher priority groups were judged less disabled.

**Our Observations Compared with the Literature**

In a quality-of-life survey, Arterburn et al.<sup>25</sup> analyzed cross-sectional data that included BMI esti-

**Table 4. BMI by decade of life among 252 male military veterans with posttraumatic stress disorder studied using ANOVA**

N	Decade of Life	BMI
4	Age 20–29 years	29.8 ± 3.1 kg/m <sup>2</sup>
10	Age 30–39 years	30.2 ± 4.8 kg/m <sup>2</sup>
25	Age 40–49 years	30.9 ± 6.5 kg/m <sup>2</sup>
167	Age 50–59 years	30.5 ± 5.7 kg/m <sup>2</sup>
31	Age 60–69 years	30.0 ± 5.4 kg/m <sup>2</sup>
11	Age 70–79 years	25.9 ± 3.4 kg/m <sup>2</sup>
4	Age 80–89 years	27.6 ± 2.5 kg/m <sup>2</sup>
252 total		30.2 ± 5.6 kg/m <sup>2</sup>

df: 6; F: 1.372; p: 0.226

**Table 5. BMI by priority group among 252 male military veterans with posttraumatic stress disorder**

N	Priority Group	BMI
101	1	30.8 ± 6.1 kg/m <sup>2</sup>
38	2	31.2 ± 5.8 kg/m <sup>2</sup>
35	3	29.2 ± 4.9 kg/m <sup>2</sup>
3	4	30.0 ± 8.2 kg/m <sup>2</sup>
60	5	29.3 ± 5.1 kg/m <sup>2</sup>
15	6	29.5 ± 3.8 kg/m <sup>2</sup>
252 total		30.2 ± 5.6 kg/m <sup>2</sup>

mates from 15,857 veterans enrolled in the general internal medicine clinics at seven Department of Veterans Affairs Medical Centers, including the one in Richmond. Veterans were older than our study population consistent with a larger portion of World War II veterans in their study. Using telephone-obtained height and weight, Arterburn et al.<sup>25</sup> found that 43.1% of their subjects were overweight and 28.4% were obese. The number of veterans overweight and obese in their study (71.5%) exceeded expected values (64.5%) based on current national surveys of the U.S. population.<sup>20</sup> However, these veterans did not reach the prevalence of overweight and obesity found in our study (84.1%), even though they included veterans from the Richmond catchment area. The authors did not look at the prevalence of PTSD in their veteran population.<sup>25</sup>

David et al.<sup>26</sup> assessed comorbid physical illnesses among veterans with PTSD and compared them to veterans with alcohol dependence. The mean BMI for their PTSD veterans<sup>26</sup> was  $30.1 \pm 6.6 \text{ kg/m}^2$ , with our value of  $30.2 \pm 5.6 \text{ kg/m}^2$ . Compared with our obesity (obese plus morbidly obese) prevalence of 46.4%, 36% of their veterans were obese.

### Priority Groups

Virtually all World War II and Korean War veterans have Medicare coverage.<sup>6</sup> One in 11 Vietnam-era veterans lacks non-Veterans Health Administration (VHA) health insurance. About one-half of uninsured veterans have incomes that make them currently ineligible for VHA enrollment (priority group 8).

Only six of the eight priority groups (Table 1) were represented in our study population. Specifically, priority groups 7 and 8 were absent. Priority group 7 veterans have income that places them above the VA Means Test threshold but below the applicable geographic means test threshold and agree to make appropriate copayments. For 2005, Table 6 lists means test thresholds.<sup>27</sup> The Department

of Veterans Affairs uses the Department of Housing and Urban Development's (HUD) "low-income" geographic-based income limits to determine their geographic means test thresholds.<sup>27</sup> Table 7 lists HUD's "low-income" income limits for Richmond, VA, where median family income was \$67,550 for calendar year 2005.<sup>28</sup>

Priority group 8 represents veterans not in priority groups 4, 6 or 7, who agree to pay medical care copayments. By definition, they have the financial resources that exceed those veterans in priority group 7. In January 2003, executive order halted enrollment for priority group 8 veterans.<sup>6</sup>

More than one-half of the study population was in priority groups 1 and 2. The amount of basic benefit paid ranges from \$108 to \$2,299 per month.<sup>29</sup> Additional disability payments may depend on such factors as very severe disabilities or loss of limb(s); having a spouse, child(ren) or dependent parent(s); and having a seriously disabled spouse. Earlier in this paper, we reported that PTSD veterans had annual incomes (median \$16,764) substantially below that of the typical enrolled veteran (median \$23,500). Figures 1 and 2 show graphically the preponderance of PTSD veterans both in low-income categories and low priority groups compared with the typical veteran.

Not only were PTSD veterans "poor" compared with non-PTSD veterans, but they were "poor" compared with the general U.S. population. Veterans without service-connected disability and with incomes about 80% of the median income in their geographic locations are placed in priority group 8.<sup>6</sup> Thus, the vast majority of veterans in our study population have incomes well below the national median income. This would certainly place them among lower-SES groups. We believe that low SES is the most likely explanation for our finding that overweight and obesity were so pervasive in our study population and about 20% above current National figures. This, or greater degree of disability, might explain why black and white male veterans in priori-

**Table 6. Veterans Means Test thresholds for 2005<sup>27</sup>**

Dependent Status	Means Test Thresholds (MTT)
No dependents	Below MTT \$25,842
	Above MTT \$25,843
One dependent	Below MTT \$31,013
	Above MTT \$31,014
Two dependents	Below MTT \$32,747
	Above MTT \$32,748
Three dependents	Below MTT \$34,481
	Above MTT \$34,482
Four dependents	Below MTT \$36,215
	Above MTT \$36,216
Five dependents	Below MTT \$37,949
	Above MTT \$37,950

**Table 7. HUD's "low-income" 2005 geographic-based income limit for Richmond, VA, where the median family income was \$67,550<sup>28</sup>**

Persons	Income Limits
1	\$37,850
2	\$43,250
3	\$48,650
4	\$54,100
5	\$58,400
6	\$62,750
7	\$67,050
8	\$71,400

ty groups 1 and 2 were more obese than the remaining veterans in priority groups 3–6. The failure of BMI to separate by decade of life (Table 4) argues against age as a factor explaining our finding of pervasive overweight and obesity among our black and white PTSD veterans.

## Study Limitations

Rather than using comparison groups of medically ill and/or psychiatrically ill non-PTSD veterans from our own medical center in our study, we used several reports from the literature to point out that the prevalence of overweight and obesity in our study sample greatly exceeded both current national findings and findings from other studies of veterans. Indeed, one of these reports included—but was not specific to—veterans from Richmond.<sup>25</sup> The high prevalence of black veterans in our study might have influenced our findings. If so, it was not evident from our analysis which white male veterans tended to have greater BMIs than their black counterparts.

Our study was retrospective and employed only a small fraction of the large national pool of military veterans with PTSD. In that more than one-half of our study population was black—distinctly skewing expected racial proportions among military veterans—we may have an unrepresentative sample of military veterans with PTSD.

## CONCLUSIONS

The pervasiveness of overweight and obesity in our PTSD population was a stunning finding and not previously reported. Our observations, coupled with broadly based Department of Veteran Affairs data, suggest that low SES likely contributed to obesity among PTSD military veterans. However preliminary and incomplete our study may be, our findings argue compellingly for additional studies employing much larger PTSD populations to assess the prevalence of overweight and obesity among PTSD military veterans and its association with this mental illness and SES. Such information may allow us to provide better care for Iraq and Afghanistan veterans developing PTSD.

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