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Posttraumatic Stress Disorder Diagnosis and Gender are Associated with Accelerated Weight Gain Trajectories in Veterans during the Post-deployment Period

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Abstract

Background—Veterans are disproportionately affected by overweight/obesity and growing evidence suggests that post-deployment is a critical period of accelerated weight gain.

Objective—We explored the relationship between posttraumatic stress disorder (PTSD) diagnosis, gender, and post-deployment weight trajectories among U.S. Operations Iraqi Freedom, Enduring Freedom, and New Dawn veterans.

Design—We used Veterans Affairs electronic health record data from 248,089 veterans (87% men) who, after their last deployment, had at least one medical visit between October 2001 and January 2009 and more than one BMI recorded through September 2010. We analyzed repeated BMI measurements using linear mixed models, with demographics, PTSD and other relevant psychiatric diagnoses as predictors.

Results—At the first recorded BMI, veterans' median age was 29, and 59% of women and 77% of men were overweight/obese. They had a median of 6 BMI measurements during a median follow-up of 2.4 years. Controlling for potential confounders, women with a PTSD diagnosis had a yearly BMI growth rate of 0.11 kg/m² (95% CI 0.09 to 0.13, $p < .001$) higher than women without PTSD. For men, the corresponding PTSD effect was also significant, but slightly lower: 0.07 kg/m² (95% CI 0.05 to 0.09, $p < .001$); women-men difference: 0.03 (95% CI 0.01 to 0.06) kg/m², $p = 0.006$.

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Conclusions—The post-deployment period is critical for weight gain, particularly for veterans diagnosed with PTSD and women veterans with PTSD. Efforts are needed to engage post-deployment veterans in weight management services, and to determine whether tailored recruitment/treatment interventions will reduce disparities for veterans with PTSD.

Keywords

BMI trajectory; veterans; PTSD; gender differences

INTRODUCTION

Obesity is prevalent among military veterans with a higher obesity rate reported among Veterans Affairs (VA) health care users (28%) compared to veteran non-users of VA (24%) and non-veterans (23%); in addition, 45% of veteran VA users and 48% of veteran VA non-users were reported to be overweight, compared to 35% of nonveterans. In a sample of Operations Iraqi Freedom and Enduring Freedom (OEF/OIF) veterans using VA healthcare services, the majority of men (66%) and almost half of women (47%) were reported to be overweight or obese at their first VA visit (Rosenberger, Ning, Brandt, Allore, & Haskell, 2011). These rates of overweight and obesity are of serious concern because patients with obesity have been shown to have a higher risk of developing conditions such as type 2 diabetes, hypertension, cardiovascular disease, stroke, and osteoarthritis (Bray, 2004; Khaothiar, McCowen, & Blackburn, 1999). The post-deployment period in particular appears to be a vulnerable time of accelerated weight gain in veterans (Rosenberger, et al., 2011).

A number of cross-sectional (Dobie, et al., 2004; Vieweg, et al., 2007) and longitudinal (LeardMann, et al., 2015; Maguen, et al., 2013) studies have reported an association between obesity and Posttraumatic Stress Disorder (PTSD) in veterans, and a recent systematic review and meta-analysis suggests this association is present in non-veterans as well (Bartoli, et al., 2015). Interestingly, the post-deployment period appears to be a time of increased incidence or identification of PTSD as well as obesity. PTSD is the most common psychiatric disorder among American military veterans, particularly among veterans returning from OEF/OIF of whom it is estimated that 14% meet probable criteria for the diagnosis (Tanielian & Jaycox, 2008). PTSD has considerable public health and quality of life implications with impairment and suicide risk similar to other mental disorders such as major depression and panic disorder (Kessler, 2000; Nepon, Belik, Bolton, & Sareen, 2010; Wilcox, Storr, & Breslau, 2009). Among US service members and veterans in the Millennium Cohort Study, PTSD was independently associated with a higher risk of weight gain (LeardMann, et al., 2015). In a longitudinal study of latent BMI trajectories from Operation Enduring Freedom, Iraqi Freedom and New Dawn (OEF/OIF/OND) veterans post-deployment, veterans with PTSD had increased odds of being in the highest risk (heaviest) BMI classes (Maguen, et al., 2013).

Few studies have specifically looked at gender differences in the association between PTSD and obesity, and those that have report mixed results. LeardMann et al. (LeardMann, et al., 2015) found no evidence of gender modifying the association between PTSD and weight

gain in the Millennium Cohort Study. Similarly, a US cross-sectional survey did not find differences in past year PTSD and associations with obesity by gender (Pagoto, et al., 2012). Maguen et al. (Maguen, et al., 2013) found that the association between PTSD and latent BMI classes in veterans was similar across genders. However, these differences were not adjusted for some factors that may be important confounders of this association (e.g. there is growing evidence of depression being positively associated with odds of developing obesity (Luppino, et al., 2010) and PTSD (Campbell, et al., 2007)). On the other hand, in a longitudinal study of German adolescents and young adults, obesity was associated with PTSD in women but not men (Perkonig, Ohashi, Stein, Kirschbaum, & Wittchen, 2009).

Collectively, these findings suggest that more attention is needed to understand whether the differences in weight trajectories post-deployment between those with and without a PTSD diagnosis vary by gender. The goal of this study is to replicate and extend the previous longitudinal veteran studies by examining whether PTSD status is associated with the rate of change in BMI in a cohort of OEF/OIF/OND veterans using VA health care services, and to examine the extent to which the association between PTSD and BMI trajectory differs by gender.

METHODS

Study population

We considered OEF/OIF/OND military veterans listed in the VA Roster file (provided by Defense Manpower Data Center—Contingency Tracking System Deployment File) who, after the end of their last military deployment, used the VA healthcare system for at least one medical visit between October 1, 2001 and January 1, 2009 (total of 395,698 participants). Military deployment involves the performance of military duties in support of the operation either in the theater of operation (overseas) or within the United States. For each participant, we used VA electronic health record (EHR) data to obtain all International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnoses and BMI measurements available from the date of their first medical visit through September 30, 2010. Because we were interested in BMI change over time, we excluded participants who had no or only one BMI measurement available (260,193 participants left). Further exclusion of 4.7% participants with unknown race/ethnicity led to a final sample size of 248,089 veterans. Overall, those included in the analytic sample were slightly more likely to be Black (18% vs. 14%) given their race was known, less likely to have more than a high school education (20% vs. 26%) and slightly younger at last deployment (median 26.9 vs. 28.1 years) than those excluded.

Study variables

The **outcome** of interest was BMI, which was assessed repeatedly over time. BMI was computed based on height and weight data routinely collected and recorded in EHR records during VA clinical visits. We removed from analyses a small percentage (0.03%) of biologically implausible BMI values (BMI<11 or BMI>70).

Our main **predictor** variables were PTSD and gender. PTSD diagnoses were identified from VA electronic records using the ICD-9-CM diagnosis code 309.81. PTSD was considered present if a participant's records contained at least one inpatient or two outpatient PTSD codes (Mattocks, et al., 2010) and the date of the first code was taken to be the diagnosis date. We required at least two outpatient diagnosis codes or one inpatient code to classify a participant as having PTSD based on evidence in the literature that this algorithm performs better for identifying psychiatric disorders and HIV in administrative data than an algorithm based on at least 1 outpatient and 1 inpatient code (Fultz, et al., 2006; Lurie, Popkin, Dysken, Moscovice, & Finch, 1992; Walkup, Wei, Sambamoorthi, & Crystal, 2004). Gender was obtained from the VA roster.

Covariates—The VA roster also provided information on other socio-demographic variables, including date of birth (from which we derived age at first BMI measurement (baseline)), race/ethnicity (Black, Hispanic, Other, White), education (binary indicator of having more than a high school education vs. high school or less) and time in years since the end date of last deployment to baseline. The psychiatric comorbidities major depression and substance use disorder (SUD) [defined as alcohol/drug abuse or dependence] were identified in a similar manner to PTSD (ICD-9-CM codes used available in Table 1). Smoking data came from the VA Health Factors data (that is, data collected when providers are periodically prompted via computerized clinical reminders to ask patients about their tobacco use) (McGinnis, et al., 2011).

Statistical analysis

We used linear mixed effects models (hierarchical models) for longitudinal data to analyze the association of a PTSD diagnosis with BMI trajectory. In all models, the outcome variables were the repeated measures of BMI and the time scale used was time in years since first available (baseline) BMI for each participant. We looked at differences in rate of change in BMI between two groups representing participants' PTSD status during the study:

1. participants ever diagnosed with PTSD during the study (PTSD group)
2. those never diagnosed with PTSD during the study (no PTSD group)

We started with a simple model (Model 1) including as predictors time (continuous), PTSD status and the PTSD*time interaction, and then further adjusted our model (Model 2) for the following potential confounders: baseline age (centered at 30, linear and quadratic terms), race/ethnicity (Black, Hispanic, Other, White), smoking (ever recorded as currently smoking during study vs. not), education, time in years from last deployment to first BMI (divided into quartiles: [0, 0.4], (0.4, 1.2], (1.2, 2.3], >2.3 years)), depression (ever/never diagnosed during study), SUD (ever/never diagnosed during study), and their two-way interactions with time. To allow for gender differences in the effect of all predictors on BMI, the two models also controlled for gender and the interaction of all predictors listed above with gender. For example, in Model 1 BMI was modeled as a function of the three-way interaction time*PTSD*gender and all the lower level terms (time, PTSD, gender, time*PTSD, time*gender, gender*PTSD). All models used random effects for BMI intercepts and slopes to account for correlation between repeated measurements within a participant and the between-participant variability in baseline BMI and rate of BMI change.

To examine the effect of taking into account the timing of diagnosis relative to baseline BMI, we conducted a sensitivity analysis that repeated the analysis in Model 2 with three PTSD categories that: 1) no PTSD during follow-up; 2) PTSD diagnosed before or on the day of baseline; 3) PTSD diagnosed after baseline. For consistency, we also created similar 3 categories for depression and SUD diagnoses. We also conducted an analysis to check whether there was any evidence of a within-participant change in BMI slope at the time of the PTSD diagnosis. For this purpose, we introduced a fixed time-term (and an associated random effect) into Model 2 representing time after PTSD diagnosis (with a value of 0 before diagnosis) --- this amounts to a piecewise linear model connected at the time of diagnosis for the BMI trajectory of those diagnosed with PTSD. The coefficient corresponding to this term represents how much the BMI slope increased on average from before to after diagnosis in those who were diagnosed with PTSD during follow-up.

To assess the potential impact of pregnancies on the results, we repeated analyses after removing all BMI measurements in a window around the dates with a pregnancy diagnostic code (specifically, for each participant, we removed all BMIs within 6 months before and 12 months after the dates with pregnancy codes (Maguen, et al., 2013)).

All models were fitted using maximum likelihood estimation in the lme4 package of the statistical software R (v. 2.15.2).

RESULTS

Baseline characteristics

Table 2 contains a summary of participant characteristics by gender. The participants had a median age at first BMI measurement of 27.6 years for women and 28.9 for men. The sample proportion of Whites was 49% and 66% among women and men, respectively. The median baseline BMI was in the overweight category for both women (26.0) and men (28.1), with 23% of women and 34% of men classified as obese ($BMI \geq 30$), and 36% of women and 43% of men classified as overweight ($BMI \geq 25$ and < 30). The median length of time between first and last BMI measurement was 2.4 years (IQR 1.3—3.9) overall (2.6 years for women and 2.4 years for men). Women had a median (average) of 8 (11) BMI measurements recorded during the study period, while men had a median (average) of 6 (8) measurements. In both women and men, the median time from last deployment to first BMI measurement was 1.2 years. During the study, PTSD was diagnosed less frequently in women (29%) than men (39%). Major depression was more frequently diagnosed among women (16%) than men (11%), while SUD was less frequently diagnosed (7% vs. 15%).

Changes in BMI by PTSD group and gender

Table 3 presents the results from Model 1 (model unadjusted for covariates). The estimates under “Intercept” represent the association between predictors (in this case, PTSD) and the intercept, while estimates under “Slope” represent the association between predictors and the slope (rate of change) of BMI. The unadjusted model showed evidence of a statistically significant association between PTSD and the slope of BMI growth for both women and men. Women diagnosed with PTSD had faster *unadjusted* rates of BMI growth than those

without PTSD (0.45 kg/m² per year vs. 0.33 kg/m² per year, difference of 0.12 kg/m² (SE=0.01) per year, $p<.001$). Among men, the unadjusted model suggested a similar effect of PTSD on BMI growth ($p=.07$ for gender difference), with a faster increase in BMI over the duration of the study in men diagnosed with PTSD than in those without PTSD (0.36 units increase per year vs. 0.26 units increase per year, difference of 0.10 units (SE=0.004) per year, $p<.001$).

Table 4 presents the results obtained from Model 2 which adjusts for the other demographic and clinical covariates, separately by gender. Participants with PTSD had higher BMI at baseline than those with no PTSD: adjusted difference of .26 kg/m² (SE=.06, $p<.001$) for women and .45 kg/m² (SE=0.02, $p<.001$) for men. The adjusted PTSD effect on the slope of BMI was slightly lower than the corresponding unadjusted effect from Table 3. The adjusted difference in slopes between the PTSD and non-PTSD groups was estimated to be 0.11 kg/m² per year (95% CI 0.09 to 0.13, $p<.001$) for women and slightly lower, 0.07 kg/m² (95% CI 0.05 to 0.09, $p<.001$) per year, for men (Figure 1). The women vs. men difference in effect of PTSD on trajectory of BMI was estimated to be 0.03 (95% CI 0.01 to 0.06) kg/m², $p=0.006$. Age and race were also significant predictors of the rate of BMI change in both men and women. Among women and men alike, Hispanic participants had a slightly slower rate of BMI growth than non-Hispanic White participants (p for gender difference=.70). There was evidence that those with major depression had increases in BMI that were .07 units higher ($p<.001$) than those without the condition in both men and women (p for gender difference=.76). The rate of BMI gain was higher for veterans recently returned from deployment.

Among women diagnosed with PTSD, 87% had their PTSD diagnosed after baseline, while among men with PTSD, 84% had their PTSD diagnosed after baseline. The results (not shown) from the analysis that grouped PTSD into three categories (no PTSD during the study, PTSD diagnosed before/ at baseline, PTSD diagnosed after baseline) indicated no significant difference in slopes between those diagnosed before/at baseline and those diagnosed after baseline ($p=0.82$ for women, $p=0.16$ for men).

The model that investigated within-participant changes in BMI slopes from pre- to post-PTSD diagnosis showed no evidence of a gender difference in slope change from pre to post-diagnosis ($p=0.46$): the difference in BMI slopes post-pre diagnosis was estimated as 0.02 (SE=0.020), $p=0.37$, for women and 0.03 (SE=0.007), $p<0.001$, for men.

Results remained substantively the same after removing 3% (1063/33181) of women and a total of 1% (24880/2145053) of all BMI measurements from the analysis due to pregnancies.

DISCUSSION

In this sample of almost 250,000 OEF/OIF/OND veterans followed over a median of approximately two and a half years while using VA health care, we found that a majority (77% of men and 59% of women) were overweight or obese at the time of their first BMI measurement in the VA. Also, we found that, while mean BMI increased over time in the

whole study population, a PTSD diagnosis was associated with higher rates of BMI growth in women and men alike, with a slightly stronger association in women. This finding strengthens and expands the evidence base regarding the association between PTSD and BMI trajectories. According to our analysis, among women of average height in our cohort (1.65 meters), those with a PTSD diagnosis would gain on average 0.30 kg more per year than those without PTSD. Similarly, among men of average height in our cohort (1.78 meters), those with a PTSD diagnosis would gain on average 0.22 kg more per year than those without PTSD. Although the differences per year are modest, they could add up if sustained over extended periods of time. Interestingly, the estimated magnitude of the impact of PTSD on the yearly rate of BMI gain in our study (0.11 kg/m² for women, 0.07 for men) is similar or greater than that obtained from the longitudinal Nurses' Health Study II (Kubzansky, et al., 2014), where women with at least four PTSD symptoms saw increases in BMI higher by 0.06 kg/m² per year than women with neither trauma nor PTSD symptoms. While the BMI-PTSD association held for both men and women, we found a slight gender difference in the PTSD effect, which is in contrast to some previous studies that found no evidence of a gender difference (Maguen, et al., 2013; Pagoto, et al., 2012). We note that this finding may be entirely due to the large sample size, which renders almost all differences, no matter how small, statistically significant.

Major depression was also associated with increased BMI growth rate, with the magnitude of association (0.07 kg/m² per year in both men and women) similar to that corresponding to PTSD. This is especially concerning given the high rates of comorbidity between PTSD and depression. Further research that takes into consideration the onset time of both PTSD and depression is needed to understand the interplay between these two conditions and weight gain.

While we found evidence of a between-participant effect of PTSD on BMI, with those ever diagnosed with PTSD during the study having higher rates of BMI gain than those with no PTSD during the study, when looking at the within participant effect of a PTSD diagnosis on the progression of BMI gain (difference in BMI slope from pre- to post-diagnosis), we found no or very low effect. The pre-post diagnosis differences may have been attenuated by the likely presence of some veterans in our sample who developed PTSD during the military so that for these participants the disease onset (and its effects on BMI) may precede the available diagnosis time. Only data on diagnosis time was available, so we could not pinpoint the exact timing of disease onset for an individual or whether PTSD was ever resolved. Also, among those diagnosed with PTSD, not much data on BMI were available before PTSD diagnosis since the median [IQR] time from baseline BMI to diagnosis was relatively short, 0.3 [0.04—1.4] years.

Our study has the advantage of a large longitudinal dataset---large in terms of number of both men and women and covariate information available at the individual level---that allowed us to examine the role of PTSD diagnosis on BMI growth rate after adjusting for a wide array of potentially confounding variables (including depression and substance use disorder). The outcome (BMI) was objectively measured during VA medical encounters so, although still prone to measurement error, it was free of the biases specific to self-reported BMI.

There are a number of limitations to keep in mind when interpreting the results of our study. Although the study found PTSD to be associated with an increased rate of BMI gain over time, the observational nature of the data precludes any conclusion on causality. In addition, if PTSD is in fact causally related to weight gain, the potential mechanisms such as increases in risky health behaviors (Zen, Whooley, Zhao, & Cohen, 2012) or biological mechanisms (Adam & Epel, 2007; Dallman, et al., 2003; Torres & Nowson, 2007) remain unknown. One health behavior that might mediate the relationship between PTSD and weight gain is disordered eating behavior (Mitchell, Porter, Boyko, & Field, 2016). Other health behaviors such as binge eating and sleep disorders have been proposed and used as covariates in models examining the relationship between PTSD and weight gain (LeardMann, et al., 2015), but more research is needed to examine these factors as potential mediators. One biological mechanism for the association between PTSD and weight may be the over-activation of stress hormones (VanItallie, 2002). There are also limitations concerning the generalizability of results: the cohort of OEF/OIF/OND veterans that we examined are all users of VA health care and may not be representative of the general OEF/OIF/OND veteran population (about 55% of eligible OEF/OIF/OND veterans used VA health care between 2002 and 2010 (Lee, et al., 2015)). Veterans who use VA health care have higher rates of obesity than veterans who do not use VA health care (Nelson, 2006). Thus, the BMI growth rate in our sample, which was limited to OEF/OIF/OND VA patients, may have been more accelerated than the rate in veterans who did not use VA health care. Also, the identification of diseases (PTSD, depression, substance use disorder) was based solely on electronic health records and may be subject to error: for example, some participants with a diagnosis code for PTSD may not have the condition, or, in a participant suffering from PTSD, the condition may go undiagnosed or diagnosed outside VA. This misclassification of exposure may have biased the estimates of the association between PTSD and weight gain.

Clearly, the post-deployment period is a critical period for weight gain, particularly among veterans with PTSD and especially women veterans with PTSD. Efforts are needed to engage post-deployment veterans in weight management services in general. Findings from this study suggest that interventions are needed to determine whether tailored recruitment or treatment strategies will reduce disparities for veterans with PTSD.

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Highlights

- We investigated the association between PTSD and change in BMI over time in U.S. military veterans during the post-deployment period.
- In particular, we examined the role of gender relative to the PTSD-BMI association.
- PTSD was associated with accelerated weight gain in both men and women, with a slightly stronger association seen in women.

Figure 1.

Estimated average body mass index (BMI, in kg/m^2) over time by gender and posttraumatic stress disorder (PTSD) status. The values plotted were derived from the mixed model in Table 4 and correspond to subjects of age 30 at baseline (first BMI), white, with education of high school or less, not smoking, with no major depression and no substance use disorder, and with time from last deployment to baseline ≤ 0.4 years.

Table 1

International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes

Condition		Corresponding ICD-9-CM codes
Posttraumatic stress disorder (PTSD)		309.81
Major depression		296.20, 296.21, 296.22, 296.23, 296.24, 296.25, 296.26, 296.3x
Substance use disorder	Alcohol abuse/dependence	291, 291.0, 291.1, 291.2x, 291.3, 291.4, 291.5, 291.8, 291.81, 291.89, 291.9, 303, 303.0, 303.00, 303.01, 303.02, 303.03, 303.9, 303.90, 303.91, 303.92, 303.93, 305.0, 305.00, 305.01, 305.02, 305.03, 790.3, 980, 980.8, 980.9, E860.0, E860.1, E860.8, E860.9, 357.5, 425.5, 535.3, 571.0, 571.1, 571.2, 571.3, V11.3
	Drug abuse/dependence	292, 292.0, 292.1, 292.11, 292.12, 292.2, 304, 304.00, 304.01, 304.02, 304.03, 304.09, 304.1, 304.11, 304.12, 304.13, 304.20, 304.21, 304.22, 304.23, 304.30, 304.31, 304.32, 304.33, 304.40, 304.41, 304.42, 304.43, 304.50, 304.51, 304.52, 304.53, 304.6, 304.60, 304.61, 304.62, 304.63, 304.7, 304.70, 304.71, 304.72, 304.73, 304.8, 304.80, 304.81, 304.82, 304.83, 304.9, 304.90, 304.91, 304.92, 304.93, 305.20, 305.21, 305.22, 305.23, 305.29, 305.30, 305.31, 305.32, 305.33, 305.40, 305.41, 305.42, 305.43, 305.50, 305.51, 305.52, 305.53, 305.60, 305.61, 305.62, 305.63, 305.70, 305.71, 305.72, 305.73, 305.80, 305.81, 305.82, 305.83, 305.90, 305.9, 305.91, 305.92, 305.93

Table 2

Characteristics of OEF/OIF/OND veteran study sample (years 2001–2009), by gender

	Women (N=33181, 13%)	Men (N = 214908, 87%)
Variable	Median [IQR] or Percent (Frequency)	Median [IQR] or Percent (Frequency)
Baseline age (years)	27.6 [24.4; 35.8]	28.9 [24.7; 39.7]
Race		
Black	31% (10358)	16% (34184)
Hispanic	11% (3802)	12% (26415)
Other	8% (2707)	6% (12211)
White	49% (16314)	66% (142098)
Baseline BMI (kg/m ²)	26.0 [23.2; 29.6]	28.1 [25.3; 31.3]
Baseline BMI class		
Normal weight <25	41% (13723)	23% (49408)
Overweight >=25 and <30	36% (11947)	43% (93143)
Obese>=30	23% (7511)	34% (72357)
Education: more than high school	24% (8020)	19% (40471)
Smoking anytime during the study	33% (11059)	48% (102333)
Length of follow-up (time in years from first to last BMI)	2.6 [1.4; 4.1]	2.4 [1.3; 3.8]
Number of BMI measures per subject	8 [4; 14]	6 [3; 10]
Time in years from end of last deployment to baseline BMI	1.2 [0.4; 2.4]	1.2 [0.4; 2.3]
PTSD *	29% (9459)	39% (82944)
Major depression *	16 % (5307)	11% (22779)
SUD *	7% (2240)	15% (32756)

* ICD-9-CM diagnosis code during one inpatient or two or more outpatient encounters. Note: OEF/OIF/OND, Operation Enduring Freedom, Iraqi Freedom and New Dawn; IQR, interquartile range; BMI, body mass index; PTSD, posttraumatic stress disorder; SUD, substance use disorder.

Table 3
Association between PTSD and BMI by gender, unadjusted for other covariates (N=248,089 subjects)

Variable	Women			Men			Gender difference	
	Estimate	SE	p-value	Estimate	SE	p-value	p-value	
Intercept								
No PTSD	26.64	0.03	<0.001	28.5	0.01	<0.001		<0.001
PTSD vs. no PTSD	0.35	0.06	<0.001	0.08	0.02	<0.001		<0.001
Slope (per year)								
No PTSD	0.33	0.01	<0.001	0.26	0.00	<0.001		<0.001
PTSD vs. no PTSD	0.12	0.01	<0.001	0.10	0.004	<0.001		0.07

Note: PTSD, posttraumatic stress disorder; BMI, body mass index; SE, standard error. The estimates are from a mixed model of BMI as a function of the time*PTSD*gender interaction and all lower level terms (main effects and two-way interactions) (Model 1). The estimates under “Intercept” represent the association between PTSD and BMI intercept, while the estimates under “Slope” represent the association between PTSD and BMI rate of change over time.

Table 4
Association between PTSD and BMI by gender, adjusted for other covariates (N=248,089 subjects)

Variable	Women			Men			Gender difference
	Estimate	SE	p-value	Estimate	SE	p-value	
Intercept							
Ref.	26.1	0.07	<0.001	28.38	0.03	<0.001	<0.001
PTSD vs. no PTSD	0.26	0.06	<0.001	0.45	0.02	<0.001	0.004
(age - 30)	0.16	0.00	<0.001	0.18	0.00	<0.001	<0.001
(age - 30) ^2	0.00	0.00	<0.001	-0.01	0.00	<0.001	<0.001
Race (vs. White)							
Black	1.16	0.06	<0.001	0.46	0.03	<0.001	<0.001
Hispanic	0.18	0.08	0.03	0.65	0.03	<0.001	<0.001
Other	-0.21	0.09	0.03	-0.26	0.04	<0.001	0.65
Education >HS vs. ≤HS	-0.81	0.06	<0.001	-0.27	0.03	<0.001	<0.001
Smoking	0.09	0.05	0.1	-0.38	0.02	<0.001	<0.001
Major depression	0.36	0.07	<0.001	0.09	0.03	0.01	0.001
Substance use disorder	-0.59	0.10	<0.001	-0.81	0.03	<0.001	0.04
Time from last deployment to first BMI (vs. [0,0.4] years)							
(0.4,1.2] years	0.30	0.07	<0.001	0.27	0.03	<0.001	0.71
(1.2,2.3] years	0.62	0.07	<0.001	0.44	0.03	<0.001	0.02
(2.3,9] years	1.24	0.07	<0.001	0.65	0.03	<0.001	<0.001
Slope (per year)							
Ref.	0.41	0.01	<0.001	0.35	0.01	<0.001	<0.001
PTSD vs. no PTSD	0.11	0.01	<0.001	0.07	0.01	<0.001	0.006
(age - 30)	0.00	0.00	0.47	-0.01	0.00	<0.001	<0.001
(age - 30) ^2	0.00	0.00	<0.001	0.00	0.00	0.76	<0.001
Race (vs. White)							
Black	0.03	0.01	0.01	-0.03	0.01	<0.001	<0.001
Hispanic	-0.04	0.02	0.02	-0.03	0.01	<0.001	0.70

Variable	Women			Men			Gender difference	
	Estimate	SE	p-value	Estimate	SE	p-value	p-value	p-value
Other	0.02	0.02	0.26	0.00	0.01	0.9	0.29	0.01
Education >HS vs. ≤HS	−0.05	0.01	<0.001	−0.01	0.01	0.12	0.01	0.07
Smoking vs. not	−0.03	0.01	0.002	−0.01	0.00	0.004	0.07	0.76
Major depression	0.07	0.01	<0.001	0.07	0.01	<0.001	0.76	0.56
Substance use disorder	−0.02	0.02	0.31	−0.01	0.01	0.17	0.56	
Time from last deployment to first BMI (vs. [0,0.4] years)								
(0.4,1.2] years	−0.08	0.01	<0.001	−0.07	0.01	<0.001	0.64	0.22
(1.2,2.3] years	−0.06	0.01	<0.001	−0.08	0.01	<0.001	0.22	0.90
(2.3,9] years	−0.04	0.01	0.02	−0.03	0.01	<0.001	0.90	

Note: PTSD, posttraumatic stress disorder; BMI, body mass index; SE, standard error; HS, high-school. The estimates are from a mixed model of BMI as a function of all predictors in the first column and their interaction with gender (Model 2). The estimates under “Intercept” represent the association between predictors (including PTSD) and BMI intercept, while the estimates under “Slope” represent the association between predictors and BMI rate of change over time. “Ref.” refers to a reference group of subjects: subjects with no PTSD, aged 30 at baseline, White, education ≤ HS, not smoking, with no major depression, no substance use disorder, and time from last deployment to first BMI ≤ 0.4 years.