



## Original Contribution

# Longitudinal Associations Among Posttraumatic Stress Disorder, Disordered Eating, and Weight Gain in Military Men and Women

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Obesity is a major health problem in the United States and a growing concern among members of the military. Posttraumatic stress disorder (PTSD) has been associated with overweight and obesity and may increase the risk of those conditions among military service members. Disordered eating behaviors have also been associated with PTSD and weight gain. However, eating disorders remain understudied in military samples. We investigated longitudinal associations among PTSD, disordered eating, and weight gain in the Millennium Cohort Study, which includes a nationally representative sample of male ( $n = 27,741$ ) and female ( $n = 6,196$ ) service members. PTSD at baseline (time 1; 2001–2003) was associated with disordered eating behaviors at time 2 (2004–2006), as well as weight change from time 2 to time 3 (2007–2008). Structural equation modeling results revealed that the association between PTSD and weight change from time 2 to time 3 was mediated by disordered eating symptoms. The association between PTSD and weight gain resulting from compensatory behaviors (vomiting, laxative use, fasting, over-exercise) was significant for white participants only and for men but not women. PTSD was both directly and indirectly (through disordered eating) associated with weight change. These results highlight potentially important demographic differences in these associations and emphasize the need for further investigation of eating disorders in military service members.

binge eating; eating disorders; military; obesity

Abbreviations: PTSD, posttraumatic stress disorder; SEM, structural equation model.

Obesity is major health problem and a leading cause of death in the United States (1). Currently, 69% of adults in the United States are overweight or obese (2) and therefore are at increased risk of developing hypertension, type 2 diabetes, certain cancers, and cardiovascular disease (1). Annual obesity-related medical costs in the United States were approximately \$147 billion in 2008 (3) and are projected to increase by \$48–\$66 billion by 2030 (4).

Military populations are typically healthier than the general population because they must meet physical and mental fitness requirements (5). However, evidence has suggested that increasing numbers of recruits are overweight, partly because of the rising rates of overweight and obesity in the general population (6, 7). Specifically, the prevalence of overweight and obesity was 60.5% in a nationally representative sample of military service men and women; in contrast

to what is seen among civilians, men were more likely than women to be overweight or obese (8). Further, after separation from service, veterans may be at increased risk of overweight and/or obesity (9, 10). There are several potential explanations for these higher rates, including the physiological effects of prolonged exposure to stress (11). Posttraumatic stress disorder (PTSD), which affects as many as 45% of veterans (12, 13), has high rates of medical comorbid conditions, including asthma, stroke, and obesity, as well as psychiatric comorbid conditions, such as depression, anxiety, and substance use disorders (14, 15).

In addition, women and men with eating disorders, particularly those characterized by bingeing and/or purging, have been found to have high rates of PTSD (16–19). For example, in the National Women's Study, 37% of participants with bulimia nervosa and 22% with binge eating disorder met criteria

for lifetime PTSD (16, 20). Although eating disorders, particularly anorexia nervosa and bulimia nervosa, are more common among women, men experience higher rates than previously believed (21). There have been few studies in which researchers have investigated PTSD among men with eating disorders, but Mitchell et al. (19) found that 67% of men with bulimia nervosa and 24% of men with binge eating disorder in the National Comorbidity Survey Replication had lifetime PTSD. This association was seen in a cross-sectional study, so the temporal order is unknown.

To date, there have been relatively few investigations of eating disorders among military populations. However, the prevalence of eating disorders appears to be at least as high in military samples as in civilian samples; for example, the weighted prevalence of eating disorders in the nationally representative Millennium Cohort Study was 3.1% (22). In addition, extant evidence suggests that the incidence of newly diagnosed eating disorders among military personnel increased between 1998 and 2006, from 2.3 to 4.1 cases per 1,000 service members (23). New-onset eating disorders in the Millennium Cohort Study were associated with a history of a mental health disorder, being on a special diet for weight loss, and combat exposure among women. Among men, new-onset eating disorders were associated with history of a mental disorder and being on a diet (24). Thus, strict weight and physical fitness requirements, as well as higher rates of trauma, PTSD, and depression (13), might increase the risk of disordered eating among service men and women. Further, a recent investigation in the Millennium Cohort Study found that PTSD was associated with weight gain and the development of obesity over a 3-year period (25).

The exact mechanisms that link PTSD with increased weight are unknown and likely involve interplay among a variety of biological and psychological factors. Development of disordered eating may be 1 such pathway. For some individuals with PTSD, eating disorder symptoms may be used as a means to distract from or cope with negative affect and reminders of the trauma (18, 26). Binge eating disorder, which has been found to be associated with PTSD (19), is more common among overweight or obese adults. As many as 30%–90% of individuals who are overweight engage in binge eating (27). There have been a limited number of studies in which researchers have investigated the prospective association between binge eating and weight gain. Research conducted among children, adolescents, and adults suggests that binge eating with a loss of control and the inability to control eating (hereafter referred to as loss-of-control eating) are predictive of greater weight gain (28–30). Taken together, these findings underscore the public health significance of binge eating and the importance of addressing the comorbidity of PTSD and disordered eating.

However, there have been relatively few large longitudinal studies of the long-term effects of binge eating, and the majority of the study samples were composed of middle-class European Americans (28, 29, 31, 32). Thus, it is unclear whether the results generalize to racial/ethnic minorities or populations with lower overall socioeconomic status. Associations among binge eating, PTSD, and weight gain remain understudied in men (19) and populations of diverse racial/ethnic backgrounds.

The Millennium Cohort Study offers a unique opportunity to investigate these important associations in a large, racially diverse sample of men and women (33, 34). The Millennium Cohort Study enrolled a nationally representative sample of US military service members in 2001 with the goal of following them through and beyond their service, for up to 21 years (34). In the present study, we hypothesized that male and female military service members with PTSD at baseline (time 1; 2001–2003) would have higher rates of disordered eating behaviors at time 2 (2004–2006) and greater weight change from time 2 to time 3 (2007–2008) than would service members without PTSD. We also tested a longitudinal structural equation model of PTSD, disordered eating behaviors, and weight gain in order to test our hypothesis that disordered eating at time 2 would mediate the relation between PTSD at time 1 and weight change from time 2 to time 3.

## METHODS

### Study population

In 2000, a population-based sample was randomly selected from all active military rosters. A total of 77,047 personnel enrolled in the first panel of the Millennium Cohort Study and completed the baseline survey (2001–2003); 55,021 of these individuals completed a follow-up questionnaire (2004–2006), and 54,790 completed a second follow-up questionnaire (2007–2008). Because our aim in the present study was to examine a longitudinal sequence of PTSD, new-onset binge disordered eating, and subsequent weight gain, only participants with all 3 data points were included in these analyses. Women who reported on any 1 of the 3 questionnaires that they were pregnant or had given birth within the previous 3 years were excluded from analyses. Participants who reported disordered eating behaviors at time 1 were excluded from analyses. The final analysis sample included 6,196 women and 27,741 men (total  $n = 33,937$ ). The Naval Health Research Center Institutional Review Board approved this study.

### Measures

Demographic information, including sex, birth date, race/ethnicity, educational level, marital status, branch of service, service component, rank, military occupation, and deployment, was obtained from the Defense Manpower Data Center. Participants completed paper or online questionnaires that assessed demographic, military, and health information, including PTSD, eating disorder symptoms, height, and current weight. The questions on eating disorder items included 8 from the Patient Health Questionnaire (35) that are used to assess symptoms of bulimia nervosa and binge eating disorder. These items have been validated as a screening measure for bulimia nervosa and binge eating disorder (36). Loss-of-control eating was identified by asking the question, “Do you often feel that you can’t control what or how much you eat?” Binge eating was determined using the question, “Do you often eat, within any 2-hour period, what most people would regard as an unusually large amount of food?” Compensatory behaviors are those performed in order to avoid

gaining weight any time over the last 3 months and were identified by the sum of “yes” responses to any of the questions about engaging in 4 compensatory behaviors listed on the survey (self-induced vomiting, use of laxatives, fasting, or overexercising). Eating disorder symptoms were assessed at baseline (time 1), the first follow-up (time 2), and the second follow-up (time 3). Binge eating, loss of control, and compensatory behaviors from time 2 were included as measured variables in the structural equation models, as described below.

The 17-item PTSD Checklist-Civilian version (37), which corresponds to criteria in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (38), was used to evaluate PTSD symptoms. The PTSD Checklist is used to assess symptoms experienced within the past month and has been validated as a screening measure of PTSD. PTSD Checklist data at time 1 were included in the present analyses. A positive screen for PTSD was identified by applying the sensitive criteria, which are based on the definition of PTSD in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision*, that is, endorsement of 1 intrusion item, 3 avoidance items, and 2 hyperarousal symptoms (38). This dichotomous PTSD variable was used in descriptive analyses to compare rates of disordered eating and weight gain in individuals with and without PTSD. In the structural equation models, 3 parcels were created by summing PTSD Checklist items assessing the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* symptom clusters re-experiencing, hyperarousal, and avoidance/numbing (38); these served as indicators of the latent PTSD variable.

Weight change between times 2 and 3 was parameterized for descriptive statistics as 1) did not gain more than 5% of time-2 weight, 2) gained 5%–10% of time-2 weight, or 3) gained more than 10% of time-2 weight. Continuous weight change from time 2 to time 3 was included in structural equation models, which were controlled for body mass index at time 1.

Psychiatric comorbidity was assessed with the Patient Health Questionnaire (35), which measured depression, panic, and anxiety. Alcohol use was assessed using the CAGE questionnaire (named after questions focused on cutting down, annoyance by criticism, guilty feeling, and eye-openers) (39), with a score of 1 or more indicating problematic drinking. Status as a nonsmoker, past smoker, or current smoker was determined using self-reported lifetime smoking status and previous success of cessation attempts. Participants were asked whether they had ever personally experienced sexual and/or violent physical assault, and the answers were coded as yes or no for descriptive analyses. Demographic characteristics, including sex, race, birth year, service branch, service component (active duty vs. Reserve/National Guard), rank (enlisted vs. officer), separation status, educational level, marital status, and occupation were also assessed.

### Statistical analyses

To evaluate whether the hypothesized relationships were supported by the data, we first examined each bivariate association.  $\chi^2$  tests were used to describe associations among PTSD, psychiatric variables, and demographic variables at time 1 and eating disorder symptoms at time 2, as well as

associations among PTSD, psychiatric variables, and demographic variables at time 1 and categories representing weight change between time 2 and time 3. Demographic variables were included in later models as covariates, as described below.

To address the primary objectives, a series of structural equation models (SEMs) assessing associations among PTSD, disordered eating, and weight change were estimated using Mplus, version 5.2 (40). SEM has the advantage of simultaneously estimating paths among multiple constructs while modeling measurement error. Mean- and variance-adjusted weighted least squares estimation was used because some endogenous variables in the model were categorical. The comparative fit index, the Tucker–Lewis index, and root mean square error of approximation were used to assess model fit. The  $\chi^2$  difference test was used to compare “nested” models, with and without a direct path from PTSD, to weight change. A significant  $\chi^2$  indicates that dropping a path significantly degrades model fit and that the path should be retained.

SEMs were estimated in the total sample and also were stratified by sex, race, and service branch. Multigroup SEMs, which determine whether paths differ significantly across groups, were not estimated because of the widely varying sample sizes across groups.

All procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. This research was conducted in compliance with all applicable federal regulations governing the protection of human subjects (ProtocolNHRC.2000.0007).

## RESULTS

### Descriptives

Of the 77,047 participants recruited into the initial panel, 30,610 did not respond at time 2 or time 3. An additional 8,713 participants reported binge eating symptoms at time 1; 2,783 female participants reported having recently given birth or being pregnant on at least 1 of the 3 surveys; and 1,004 provided insufficient data, yielding a final sample of 33,937. These participants were largely male (82%), non-Hispanic white (72%), in the Army (46%), and enlisted (70%), with an average age at selection into the cohort of 36.0 (standard deviation, 8.9) years.

Tables 1–4 include associations among PTSD, psychiatric variables, and demographic variables at time 1 and binge eating at time 2 (Table 1), loss-of-control eating at time 2 (Table 2), compensatory behaviors at time 2 (Table 3), and weight status at time 3 (Table 4). PTSD was associated with binge eating symptoms at time 2; rates of time-1 PTSD were higher among women (6.6%) and men (5.0%) who reported binge eating at time 2 than among women (2.3%) and men (2.1%) who did not report binge eating at time 2 (all  $P < 0.001$ ). Further, PTSD also was associated with loss-of-control eating at time 2; 4.6% of women and 5.0% of men who reported loss-of-control eating at time 2 also reported PTSD at time 1, compared with 2.3% of women and 2.0% of men who had not reported loss-of-control

**Table 1.** Characteristics of Cohort Participants by Sex and Binge Eating Symptoms at Time 2, Millennium Cohort Study, United States, 2004–2006<sup>a</sup>

Characteristic	Women				Men			
	No Binge Eating (n = 5,969)		Binge Eating (n = 227)		No Binge Eating (n = 26,416)		Binge Eating (n = 1,325)	
	No.	%	No.	%	No.	%	No.	%
Baseline characteristics								
PTSD status <sup>b,c</sup>								
Negative screen	5,829	97.7	212	93.4	25,858	97.9	1,259	95.0
Positive screen	140	2.3	15	6.6	558	2.1	66	5.0
Birth year <sup>b,c</sup>								
Before 1960	1,911	32.0	61	26.9	7,254	27.5	265	20.0
1960–1969	2,420	40.5	83	36.6	11,398	43.1	550	41.5
1970–1979	1,367	22.9	67	29.5	7,174	27.2	451	34.0
1980 or later	271	4.5	16	7.0	590	2.2	59	4.5
Race/ethnicity <sup>c</sup>								
White/non-Hispanic white	3,921	65.7	152	67.0	19,498	73.8	1,021	77.1
Black/non-Hispanic white	1,117	18.7	33	14.5	2,344	8.9	94	7.1
Other	922	15.4	42	18.5	4,556	17.2	210	15.8
Marital status <sup>c</sup>								
Married	2,855	47.8	102	44.9	19,612	74.2	897	67.7
Never married	2,153	36.1	90	39.6	5,463	20.7	367	27.7
Divorced, separated, or widowed	961	16.1	35	15.4	1,341	5.1	61	4.6
Educational level								
Some college or less	3,794	63.6	152	67.0	17,752	67.2	916	69.1
Bachelor's degree or higher	2,175	36.4	75	33.0	8,662	32.8	409	30.9
Body mass index <sup>c</sup>								
Underweight (<18.5)	133	2.2	5	2.2	95	0.4	4	0.3
Healthy (18.5–24.9)	3,787	63.4	130	57.3	7,478	28.3	295	22.3
Overweight (25.0–29.9)	1,705	28.6	78	34.4	15,973	60.5	779	58.8
Obese (≥30.0)	245	4.1	13	5.7	2,596	9.8	228	17.2
Service branch <sup>c</sup>								
Army	2,910	48.8	114	50.2	11,965	45.3	639	48.2
Navy/Coast Guard	1,076	18.0	36	15.9	4,769	18.1	257	19.4
Marine Corps	113	1.9	4	1.8	1,231	4.7	73	5.5
Air Force	1,870	31.3	73	32.2	8,451	32.0	356	26.9
Military rank <sup>c</sup>								
Enlisted	4,050	67.9	152	67.0	18,424	69.7	968	73.1
Officer	1,919	32.1	75	33.0	7,992	30.3	357	26.9
Service component <sup>c</sup>								
Active duty	2,717	45.5	109	48.0	14,995	56.8	790	59.6
Reserve/National Guard	3,252	54.5	118	52.0	11,421	43.2	535	40.4
Occupation								
Combat specialist	362	6.1	18	7.9	6,896	26.1	357	26.9
Health care	1,495	25.0	64	28.2	1,852	7.0	110	8.3
Other	4,111	68.9	145	63.9	17,665	66.9	858	64.8
Problem drinker defined by CAGE questionnaire score <sup>c</sup>								
No	5,231	87.6	190	83.7	21,470	81.3	980	74.0
Yes	712	11.9	37	16.3	4,843	18.3	337	25.4

Table continues

Table 1. Continued

Characteristic	Women				Men			
	No Binge Eating (n = 5,969)		Binge Eating (n = 227)		No Binge Eating (n = 26,416)		Binge Eating (n = 1,325)	
	No.	%	No.	%	No.	%	No.	%
Smoking status <sup>c</sup>								
Nonsmoker	3,643	61.0	122	53.7	15,139	57.3	703	53.1
Past smoker	1,255	21.0	59	26.0	6,504	24.6	359	27.1
Current smoker	869	14.6	36	15.9	3,860	14.6	208	15.7
Prior trauma/assault <sup>c</sup>								
No	4,505	75.5	163	71.8	24,466	92.6	1,183	89.3
Yes	1,433	24.0	63	27.8	1,833	6.9	135	10.2
Depression status <sup>b,c</sup>								
Negative screen	5,834	97.7	209	92.1	25,987	98.4	1,271	95.9
Positive screen	115	1.9	16	7.0	328	1.2	48	3.6
Panic syndrome status								
Negative screen	5,853	98.1	222	97.8	26,049	98.6	1,300	98.1
Positive screen	76	1.3	4	1.8	141	0.5	11	0.8
Anxiety syndrome status <sup>b,c</sup>								
Negative screen	5,843	97.9	215	94.7	26,124	98.9	1,292	97.5
Positive screen	87	1.5	11	4.8	207	0.8	28	2.1
Follow-up characteristics								
Deployment experience <sup>c,d</sup>								
Nondeployed	4,806	80.5	183	80.6	18,004	68.2	939	70.9
Deployed without combat	666	11.2	20	8.8	4,230	16.0	178	13.4
Deployed with combat	497	8.3	24	10.6	4,182	15.8	208	15.7
Separation status <sup>b,c,e</sup>								
Not separated	5,426	90.9	201	88.5	24,113	91.3	1,166	88.0
Separated <1 year	192	3.2	15	6.6	811	3.1	51	3.8
Separated ≥1 year	351	5.9	11	4.8	1,492	5.6	108	8.2
Follow-up time between surveys, years <sup>f</sup>								
Baseline to first follow-up	2.70 (0.51)		2.71 (0.52)		2.65 (0.53)		2.68 (0.52)	
First follow-up to second follow-up	2.93 (0.40)		2.91 (0.47)		2.91 (0.41)		2.90 (0.43)	

Abbreviations: CAGE, cutting down, annoyance by criticism, guilty feeling, and eye-openers; PTSD, posttraumatic stress disorder.

<sup>a</sup> Persons with missing data for independent variables were not included.

<sup>b</sup> Significant  $\chi^2$  test ( $P < 0.05$ ) for women.

<sup>c</sup> Significant  $\chi^2$  test ( $P < 0.05$ ) for men.

<sup>d</sup> Deployment experience was measured between baseline and the first follow-up survey participants. Participants were classified as having combat experience if they reported exposure to death due to war, disaster, or tragic event or witnessing instances of physical abuse, dead and/or decomposing bodies, maimed soldiers or civilians, or prisoners of war or refugees at follow-up.

<sup>e</sup> Separation status reflects whether participants left military service between their baseline and first follow-up survey.

<sup>f</sup> Values are expressed as mean (standard deviation).

eating at time 2 (all  $P < 0.05$ ). Depression and anxiety at time 1 were associated with binge eating and loss-of-control eating at time 2 among both women; history of trauma at time 1 was associated with binge eating and loss-of-control eating at time 2 among men and with loss-of-control eating among women at time 2 (all  $P < 0.05$ ). PTSD, problematic alcohol use, smoking, trauma history, depression, panic,

and anxiety at time 1 were associated with use of compensatory behaviors at time 2 for both women and men (all  $P < 0.05$ ).

PTSD, smoking, depression, panic, and anxiety at baseline were associated with weight change from time 2 to time 3 for both men and women (all  $P < 0.05$ ). Endorsement of at least 1 type of compensatory behavior at time 2 also was associated

**Table 2.** Characteristics of Millennium Cohort Participants by Sex and Loss of Control at Time 2, United States, 2004–2006<sup>a</sup>

Characteristic	Women				Men			
	No Loss of Control (n = 5,584)		Loss of Control (n = 612)		No Loss of Control (n = 26,013)		Loss of Control (n = 1,728)	
	No.	%	No.	%	No.	%	No.	%
Baseline characteristics								
PTSD status <sup>b,c</sup>								
Negative screen	5,457	97.7	584	95.4	25,476	97.9	1,641	95.0
Positive screen	127	2.3	28	4.6	537	2.1	87	5.0
Birth year <sup>c</sup>								
Before 1960	1,766	31.6	206	33.7	7,051	27.1	468	27.1
1960–1969	2,273	40.7	230	37.6	11,207	43.1	741	42.9
1970–1979	1,287	23.0	147	24.0	7,146	27.5	479	27.7
1980 or later	258	4.6	29	4.7	609	2.3	40	2.3
Race/ethnicity <sup>c</sup>								
White/non-Hispanic white	3,672	65.8	401	65.5	19,294	74.2	1,225	70.9
Black/non-Hispanic white	1,046	18.7	104	17.0	2,306	8.9	132	7.6
Other	858	15.4	106	17.3	4,396	16.9	370	21.4
Marital status <sup>b</sup>								
Married	2,695	48.3	262	42.8	19,261	74.0	1,248	72.2
Never married	2,015	36.1	228	37.3	5,430	20.9	400	23.1
Divorced, separated, or widowed	874	15.7	122	19.9	1,322	5.1	80	4.6
Educational level <sup>b,c</sup>								
Some college or less	3,523	63.1	423	69.1	17,410	66.9	1,258	72.8
Bachelor's degree or higher	2,061	36.9	189	30.9	8,601	33.1	470	27.2
Body mass index <sup>b,c</sup>								
Underweight (<18.5)	128	2.3	10	1.6	93	0.4	6	0.3
Healthy (18.5–24.9)	3,610	64.6	307	50.2	7,558	29.1	215	12.4
Overweight (25.0–29.9)	1,541	27.6	242	39.5	15,621	60.1	1,131	65.5
Obese (≥30.0)	214	3.8	44	7.2	2,471	9.5	353	20.4
Service branch <sup>c</sup>								
Army	2,715	48.6	309	50.5	11,770	45.2	834	48.3
Navy/Coast Guard	998	17.9	114	18.6	4,693	18.0	333	19.3
Marine Corps	111	2.0	6	1.0	1,216	4.7	88	5.1
Air Force	1,760	31.5	183	29.9	8,334	32.0	473	27.4
Military rank <sup>b,c</sup>								
Enlisted	3,754	67.2	448	73.2	18,081	69.5	1,311	75.9
Officer	1,830	32.8	164	26.8	7,932	30.5	417	24.1
Service component								
Active duty	2,555	45.8	341	55.7	14,791	56.9	994	57.5
Reserve/National Guard	3,029	54.2	271	44.3	11,222	43.1	734	42.5
Occupation								
Combat specialist	342	6.1	38	6.2	6,833	26.3	420	24.3
Health care	1,400	25.1	159	26.0	17,338	66.7	1,185	68.6
Other	3,842	68.8	414	67.6	1,839	7.1	123	7.1
Problem drinker defined by CAGE questionnaire score <sup>c</sup>								
No	4,900	87.8	521	85.1	21,127	81.2	1,323	76.6
Yes	660	11.8	89	14.5	4,784	18.4	396	22.9

Table continues

Table 2. Continued

Characteristic	Women				Men			
	No Loss of Control (n = 5,584)		Loss of Control (n = 612)		No Loss of Control (n = 26,013)		Loss of Control (n = 1,728)	
	No.	%	No.	%	No.	%	No.	%
Smoking status <sup>b</sup>								
Nonsmoker	3,415	61.2	350	57.2	14,900	57.3	942	54.5
Past smoker	1,160	20.8	154	25.2	6,404	24.6	459	26.6
Current smoker	821	14.7	84	13.7	3,829	14.7	239	13.8
Prior trauma/assault <sup>b,c</sup>								
No	4,241	75.9	427	69.8	24,096	92.6	1,553	89.9
Yes	1,315	23.5	181	29.6	1,802	6.9	166	9.6
Depression status <sup>b,c</sup>								
Negative screen	5,460	97.8	583	95.3	25,607	98.4	1,651	95.5
Positive screen	105	1.9	26	4.2	308	1.2	68	3.9
Panic syndrome status <sup>b</sup>								
Negative screen	5,482	98.2	593	96.9	25,650	98.6	1,699	98.3
Positive screen	65	1.2	15	2.5	138	0.5	14	0.8
Anxiety syndrome status <sup>b,c</sup>								
Negative screen	5,471	98.0	587	95.9	25,726	98.9	1,690	97.8
Positive screen	75	1.3	23	3.8	206	0.8	29	1.7
Follow-up characteristics								
Deployment experience <sup>d</sup>								
Nondeployed	4,488	80.4	501	81.9	17,745	68.2	1,198	69.3
Deployed without combat	628	11.2	58	9.5	4,152	16.0	256	14.8
Deployed with combat	468	8.4	53	8.7	4,116	15.8	274	15.9
Separation status <sup>b,c,e</sup>								
Not separated	5,096	91.3	531	86.8	23,739	91.3	1,540	89.1
Separated <1 year	170	3.0	37	6.0	794	3.1	68	3.9
Separated ≥1 year	318	5.7	44	7.2	1,480	5.7	120	6.9
Follow-up time between surveys, years <sup>f</sup>								
Baseline to first follow-up	2.69 (0.51)		2.74 (0.52)		2.65 (0.53)		2.66 (0.52)	
First follow-up to second follow-up	2.93 (0.39)		2.91 (0.44)		2.91 (0.41)		2.91 (0.42)	

Abbreviations: CAGE, cutting down, annoyance by criticism, guilty feeling, and eye-openers; PTSD, posttraumatic stress disorder.

<sup>a</sup> Persons with missing data for independent variables were not included.

<sup>b</sup> Significant  $\chi^2$  test ( $P < 0.05$ ) for women.

<sup>c</sup> Significant  $\chi^2$  test ( $P < 0.05$ ) for men.

<sup>d</sup> Deployment experience was measured between baseline and the first follow-up survey participants. Participants were classified as having combat experience if they reported exposure to death due to war, disaster, or tragic event or witnessing instances of physical abuse, dead and/or decomposing bodies, maimed soldiers or civilians, or prisoners of war or refugees at follow-up.

<sup>e</sup> Separation status reflects whether participants left military service between their baseline and first follow-up survey.

<sup>f</sup> Values are expressed as mean (standard deviation).

with weight change from time 2 to time 3 for men ( $P < 0.001$ ) and women ( $P < 0.05$ ).

### Structural equation model results

All models provided acceptable fit to the data (fit statistics are presented in Table 5). For the unconditional model

(model 1), in the total sample, PTSD at time 1 was positively associated with loss-of-control eating, binge eating, and compensatory behaviors at time 2 (path coefficients are presented in Figure 1). Only compensatory behaviors were related to subsequent weight change between times 2 and 3. In addition, there were significant total (95% confidence interval (CI): 0.03, 0.06) associations between PTSD and weight

**Table 3.** Characteristics of Cohort Participants by Compensatory Behaviors at Time 2, Millennium Cohort Study, United States, 2004–2006<sup>a</sup>

Characteristic	Women <sup>b</sup>				Men <sup>b</sup>			
	No Compensatory Behaviors (n = 5,804)		Compensatory Behaviors (n = 369)		No Compensatory Behaviors (n = 26,460)		Compensatory Behaviors (n = 1,043)	
	No.	%	No.	%	No.	%	No.	%
Baseline characteristics								
PTSD status <sup>c,d</sup>								
Negative screen	5,674	97.8	345	93.5	26,107	98.0	954	91.5
Positive screen	130	2.2	24	6.5	533	2.0	89	8.5
Birth year <sup>d</sup>								
Before 1960	1,877	32.3	83	22.5	7,245	27.2	252	24.2
1960–1969	2,334	40.2	161	43.6	11,474	43.1	456	43.7
1970–1979	1,326	22.8	105	28.5	7,306	27.4	303	29.1
1980 or later	267	4.6	20	5.4	615	2.3	32	3.1
Race/ethnicity <sup>c,d</sup>								
White/non-Hispanic white	3,860	66.5	197	53.4	19,830	74.4	644	61.7
Black/non-Hispanic white	1,031	17.8	116	31.4	2,283	8.6	150	14.4
Other	904	15.6	56	15.2	4,510	16.9	249	23.9
Marital status <sup>c,d</sup>								
Married	2,795	48.2	153	41.5	19,730	74.1	737	70.7
Never married	2,092	36.0	144	39.0	5,571	20.9	248	23.8
Divorced, separated, or widowed	917	15.8	72	19.5	1,339	5.0	58	5.6
Educational level <sup>c,d</sup>								
Some college or less	3,652	62.9	282	76.4	17,875	67.1	746	71.5
Bachelor's degree or higher	2,152	37.1	87	23.6	8,763	32.9	297	28.5
Body mass index <sup>c,d</sup>								
Underweight (<18.5)	130	2.2	8	2.2	98	0.4	1	0.1
Healthy (18.5–24.9)	3,702	63.8	202	54.7	7,602	28.5	157	15.1
Overweight (25.0–29.9)	1,647	28.4	128	34.7	16,019	60.1	700	67.1
Obese (≥30.0)	233	4.0	25	6.8	2,646	9.9	169	16.2
Service branch <sup>c,d</sup>								
Army	2,781	47.9	231	62.6	11,970	44.9	603	57.8
Navy/Coast Guard	1,049	18.1	58	15.7	4,850	18.2	167	16.0
Marine Corps	107	1.8	10	2.7	1,243	4.7	58	5.6
Air Force	1,867	32.2	70	19.0	8,577	32.2	215	20.6
Rank <sup>c,d</sup>								
Enlisted	3,882	66.9	304	82.4	18,546	69.6	799	76.6
Officer	1,922	33.1	65	17.6	8,094	30.4	244	23.4
Service component <sup>d</sup>								
Active duty	2,628	45.3	192	52.0	15,157	56.9	603	57.8
Reserve/National Guard	3,176	54.7	177	48.0	11,483	43.1	440	42.2
Occupation <sup>c</sup>								
Combat specialist	359	6.2	21	5.7	7,002	26.3	244	23.4
Health care	1,479	25.5	74	20.1	1,893	7.1	65	6.2
Other	3,965	68.3	274	74.3	17,742	66.6	734	70.4

Table continues

Table 3. Continued

Characteristic	Women <sup>b</sup>				Men <sup>b</sup>			
	No Compensatory Behaviors (n = 5,804)		Compensatory Behaviors (n = 369)		No Compensatory Behaviors (n = 26,460)		Compensatory Behaviors (n = 1,043)	
	No.	%	No.	%	No.	%	No.	%
Problem drinker defined by CAGE questionnaire score <sup>c,d</sup>								
No	5,102	87.9	299	81.0	21,620	81.2	781	74.9
Yes	677	11.7	69	18.7	4,919	18.5	252	24.2
Smoking status <sup>c,d</sup>								
Nonsmoker	3,543	61.0	207	56.1	15,266	57.3	551	52.8
Past smoker	1,238	21.3	73	19.8	6,596	24.8	250	24.0
Current smoker	830	14.3	73	19.8	3,874	14.5	181	17.4
Prior trauma/assault <sup>c,d</sup>								
No	4,410	76.0	241	65.3	24,697	92.7	897	86.0
Yes	1,365	23.5	125	33.9	1,831	6.9	134	12.8
Depression status <sup>c,d</sup>								
Negative screen	5,672	97.7	350	94.9	26,218	98.4	983	94.2
Positive screen	111	1.9	19	5.1	322	1.2	54	5.2
Panic syndrome status <sup>c,d</sup>								
Negative screen	5,698	98.2	355	96.2	26,280	98.6	1,012	97.0
Positive screen	68	1.2	11	3.0	135	0.5	16	1.5
Anxiety syndrome status <sup>c,d</sup>								
Negative screen	5,688	98.0	348	94.3	26,345	98.9	1,013	97.1
Positive screen	81	1.4	16	4.3	213	0.8	22	2.1
Follow-up characteristics								
Deployment experience <sup>c,e</sup>								
Nondeployed	4,682	80.7	288	78.0	18,211	68.4	691	66.3
Deployed without combat	644	11.1	40	10.8	4,271	16.0	125	12.0
Deployed with combat	478	8.2	41	11.1	4,158	15.6	227	21.8
Separation status <sup>d,f</sup>								
Not separated	5,279	91.0	329	89.2	24,268	91.1	953	91.4
Separated <1 year	183	3.2	21	5.7	835	3.1	27	2.6
Separated ≥1 year	342	5.9	19	5.1	1,537	5.8	63	6.0
Follow-up time between surveys, years <sup>g</sup>								
Baseline to first follow-up	2.70 (0.51)		2.66 (0.55)		2.66 (0.53)		2.64 (0.54)	
First follow-up to second follow-up	2.92 (0.40)		2.94 (0.41)		2.91 (0.41)		2.92 (0.42)	

Abbreviations: CAGE, cutting down, annoyance by criticism, guilty feeling, and eye-openers; PTSD, posttraumatic stress disorder.

<sup>a</sup> Persons with missing data for independent variables were not included. Compensatory behaviors were defined as exhibiting at least 1 symptom (self-induced vomiting, use of laxatives, fasting, or overexercise).

<sup>b</sup> Eighty-one participants were missing data on compensatory behaviors.

<sup>c</sup> Significant  $\chi^2$  test ( $P < 0.05$ ) for men.

<sup>d</sup> Significant  $\chi^2$  test ( $P < 0.05$ ) for women.

<sup>e</sup> Deployment experience was measured between baseline and the first follow-up survey participants. Participants were classified as having combat experience if they reported exposure to death due to war, disaster, or tragic event or witnessing instances of physical abuse, dead and/or decomposing bodies, maimed soldiers or civilians, or prisoners of war or refugees at follow-up.

<sup>f</sup> Separation status reflects whether participants left military service between their baseline and first follow-up survey.

<sup>g</sup> Values are expressed as mean (standard deviation).

**Table 4.** Characteristics of Cohort Participants Enrolled in 2001 by Sex and Weight Gain Status at Time 3, Millennium Cohort Study, United States, 2007–2008<sup>a</sup>

Characteristic	Women						Men					
	<5% Gain (n = 3,836)		5%–10% Gain (n = 1,083)		>10% Gain (n = 790)		<5% Gain (n = 18,805)		5%–10% Gain (n = 4,786)		>10% Gain (n = 2,109)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Baseline characteristics												
PTSD status <sup>b,c</sup>												
Negative screen	3,757	97.9	1,057	97.6	748	94.7	18,395	97.8	4,671	97.6	2,028	96.2
Positive screen	79	2.1	26	2.4	42	5.3	410	2.2	115	2.4	81	3.8
New-onset binge eating at wave 2												
No	3,758	98.0	1,058	97.7	773	97.8	18,474	98.2	4,698	98.2	2,060	97.7
Yes	78	2.0	25	2.3	17	2.2	331	1.8	88	1.8	49	2.3
Any compensatory behaviors <sup>b,c</sup>												
No	3,599	93.8	1,020	94.3	722	91.9	18,088	96.2	4,588	95.9	1,980	93.9
Yes	220	5.7	62	5.7	64	8.1	674	3.6	186	3.9	129	6.1
Birth year <sup>b,c</sup>												
Before 1960	1,317	34.3	329	30.4	190	24.1	5,518	29.3	1,131	23.6	404	19.2
1960–1969	1,538	40.1	455	42.0	319	40.4	8,118	43.2	2,055	42.9	851	40.4
1970–1979	829	21.6	253	23.4	220	27.8	4,823	25.6	1,458	30.5	730	34.6
1980 or later	152	4.0	46	4.2	61	7.7	346	1.8	142	3.0	124	5.9
Race/ethnicity <sup>b,c</sup>												
White/non-Hispanic white	2,546	66.4	682	63.0	505	63.9	13,797	73.4	3,547	74.1	1,618	76.7
Black/non-Hispanic white	665	17.3	231	21.3	176	22.3	1,680	8.9	420	8.8	189	9.0
Other	617	16.1	169	15.6	109	13.8	3,316	17.6	815	17.0	300	14.2
Marital status <sup>b,c</sup>												
Married	1,869	48.7	504	46.5	344	43.5	14,097	75.0	3,467	72.4	1,387	65.8
Never married	1,348	35.1	397	36.7	324	41.0	3,754	20.0	1,086	22.7	612	29.0
Divorced, separated, or widowed	619	16.1	182	16.8	122	15.4	954	5.1	233	4.9	110	5.2
Educational level <sup>b,c</sup>												
Some college or less	2,358	61.5	682	63.0	597	75.6	12,317	65.5	3,376	70.5	1,716	81.4
Bachelor's degree or higher	1,478	38.5	401	37.0	193	24.4	6,486	34.5	1,410	29.5	393	18.6
Body mass index <sup>b,c</sup>												
Underweight (<18.5)	82	2.1	18	1.7	24	3.0	62	0.3	20	0.4	10	0.5
Healthy (18.5–24.9)	2,492	65.0	674	62.2	436	55.2	5,366	28.5	1,281	26.8	584	27.7
Overweight (25.0–29.9)	1,053	27.5	340	31.4	268	33.9	11,316	60.2	2,940	61.4	1,210	57.4
Obese (≥30.0)	148	3.9	32	3.0	53	6.7	1,865	9.9	497	10.4	293	13.9
Service branch <sup>b,c</sup>												
Army	1,874	48.9	567	52.4	391	49.5	8,425	44.8	2,307	48.2	1,129	53.5
Navy/Coast Guard	741	19.3	162	15.0	144	18.2	3,619	19.2	860	18.0	352	16.7
Marine Corps	61	1.6	25	2.3	16	2.0	858	4.6	239	5.0	102	4.8
Air Force	1,160	30.2	329	30.4	239	30.3	5,903	31.4	1,380	28.8	526	24.9
Rank <sup>b,c</sup>												
Enlisted	2,516	65.6	741	68.4	622	78.7	12,823	68.2	3,497	73.1	1,750	83.0
Officer	1,320	34.4	342	31.6	168	21.3	5,982	31.8	1,289	26.9	359	17.0
Service component <sup>b,c</sup>												
Active duty	1,670	43.5	491	45.3	397	50.3	10,328	54.9	2,871	60.0	1,287	61.0
Reserve/National Guard	2,166	56.5	592	54.7	393	49.7	8,477	45.1	1,915	40.0	822	39.0

Table continues

Table 4. Continued

Characteristic	Women						Men					
	<5% Gain (n = 3,836)		5%–10% Gain (n = 1,083)		>10% Gain (n = 790)		<5% Gain (n = 18,805)		5%–10% Gain (n = 4,786)		>10% Gain (n = 2,109)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Occupation <sup>b,c</sup>												
Combat specialist	230	6.0	77	7.1	45	5.7	5,016	26.7	1,220	25.5	478	22.7
Health care	994	25.9	283	26.1	169	21.4	1,390	7.4	303	6.3	123	5.8
Other	2,612	68.1	722	66.7	576	72.9	12,398	65.9	3,263	68.2	1,507	71.5
Problem drinker defined by CAGE questionnaire score <sup>b</sup>												
No	3,360	87.6	944	87.2	689	87.2	15,244	81.1	3,843	80.3	1,647	78.1
Yes	458	11.9	136	12.6	96	12.2	3,491	18.6	923	19.3	450	21.3
Smoking status <sup>b,c</sup>												
Nonsmoker	2,376	61.9	642	59.3	448	56.7	10,996	58.5	2,614	54.6	1,021	48.4
Past smoker	817	21.3	239	22.1	173	21.9	4,599	24.5	1,232	25.7	561	26.6
Current smoker	504	13.1	171	15.8	143	18.1	2,551	13.6	769	16.1	464	22.0
Prior trauma/assault												
No	2,897	75.5	818	75.5	566	71.6	17,405	92.6	4,416	92.3	1,922	91.1
Yes	919	24.0	261	24.1	219	27.7	1,314	7.0	356	7.4	176	8.3
Depression status <sup>b,c</sup>												
Negative screen	3,754	97.9	1,049	96.9	759	96.1	18,514	98.5	4,692	98.0	2,030	96.3
Positive screen	69	1.8	30	2.8	27	3.4	221	1.2	77	1.6	64	3.0
Panic syndrome status <sup>b,c</sup>												
Negative screen	3,767	98.2	1,066	98.4	762	96.5	18,556	98.7	4,707	98.3	2,070	98.2
Positive screen	45	1.2	14	1.3	20	2.5	100	0.5	26	0.5	21	1.0
Anxiety syndrome status <sup>b,c</sup>												
Negative screen	3,760	98.0	1,057	97.6	763	96.6	18,603	98.9	4,722	98.7	2,067	98.0
Positive screen	55	1.4	19	1.8	21	2.7	142	0.8	47	1.0	36	1.7
Follow-up characteristics												
Deployment experience <sup>b,c,d</sup>												
Nondeployed	3,117	81.3	884	81.6	604	76.5	13,075	69.5	3,188	66.6	1,320	62.6
Deployed without combat	391	10.2	128	11.8	97	12.3	2,931	15.6	757	15.8	334	15.8
Deployed with combat	328	8.6	71	6.6	89	11.3	2,799	14.9	841	17.6	455	21.6
Separation status <sup>e</sup>												
Not separated	3,476	90.6	986	91.0	703	89.0	17,061	90.7	4,370	91.3	1,902	90.2
Separated <1 year	123	3.2	36	3.3	42	5.3	603	3.2	132	2.8	86	4.1
Separated ≥1 year	237	6.2	61	5.6	45	5.7	1,141	6.1	284	5.9	121	5.7
Follow-up time between surveys, years <sup>f</sup>												
Baseline to first follow-up	2.72 (0.52)		2.71 (0.50)		2.67 (0.52)		2.68 (0.53)		2.62 (0.52)		2.62 (0.54)	
First follow-up to second follow-up	2.90 (0.40)		2.94 (0.40)		2.98 (0.42)		2.88 (0.41)		2.94 (0.42)		3.00 (0.43)	

Abbreviations: CAGE, cutting down, annoyance by criticism, guilty feeling, and eye-openers; PTSD, posttraumatic stress disorder.

<sup>a</sup> Persons with missing data for independent variables were not included.

<sup>b</sup> Significant  $\chi^2$  test ( $P < 0.05$ ) for men.

<sup>c</sup> Significant  $\chi^2$  test ( $P < 0.05$ ) for women.

<sup>d</sup> Deployment experience was measured between baseline and the first follow-up survey participants. Participants were classified as having combat experience if they reported exposure to death due to war, disaster, or tragic event or witnessing instances of physical abuse, dead and/or decomposing bodies, maimed soldiers or civilians, or prisoners of war or refugees at follow-up.

<sup>e</sup> Separation status reflects whether participants left military service between their baseline and first follow-up survey.

<sup>f</sup> Values are expressed as mean (standard deviation).

**Table 5.** Fit Statistics for Structural Models, Millennium Cohort Study, United States, 2001–2008

Model	$\chi^2$	df	CFI	TLI	RMSEA
Model 1 <sup>a</sup>	419.01	6	0.99	0.98	0.045
Model 2 <sup>b</sup>	508.18	7	0.99	0.98	0.046
Model 3 <sup>c</sup>	7,124.04	248	0.93	0.92	0.029
Model 1 stratified by groups					
Sex					
Male	466.92	6	0.99	0.97	0.053
Female	111.21	7	0.99	0.98	0.049
Race/ethnicity					
White/non-Hispanic white	293.88	6	0.99	0.98	0.044
Black/non-Hispanic black	60.81	6	0.99	0.97	0.051
Other race	99.11	6	0.99	0.98	0.052
Service branch					
Air Force	128.39	7	0.99	0.99	0.040
Army	212.70	6	0.99	0.98	0.047
Marine Corps	21.82	7	0.99	0.98	0.039
Navy/Coast Guard	103.51	6	0.99	0.98	0.052

Abbreviations: CFI, comparative fit index; df, degrees of freedom; PTSD, posttraumatic stress disorder; RMSEA, root mean square error of approximation; TLI, Tucker–Lewis Index.

<sup>a</sup> Theoretical model unadjusted for covariates.

<sup>b</sup> Theoretical model without the direct path from PTSD to weight change.

<sup>c</sup> Theoretical model with covariates.

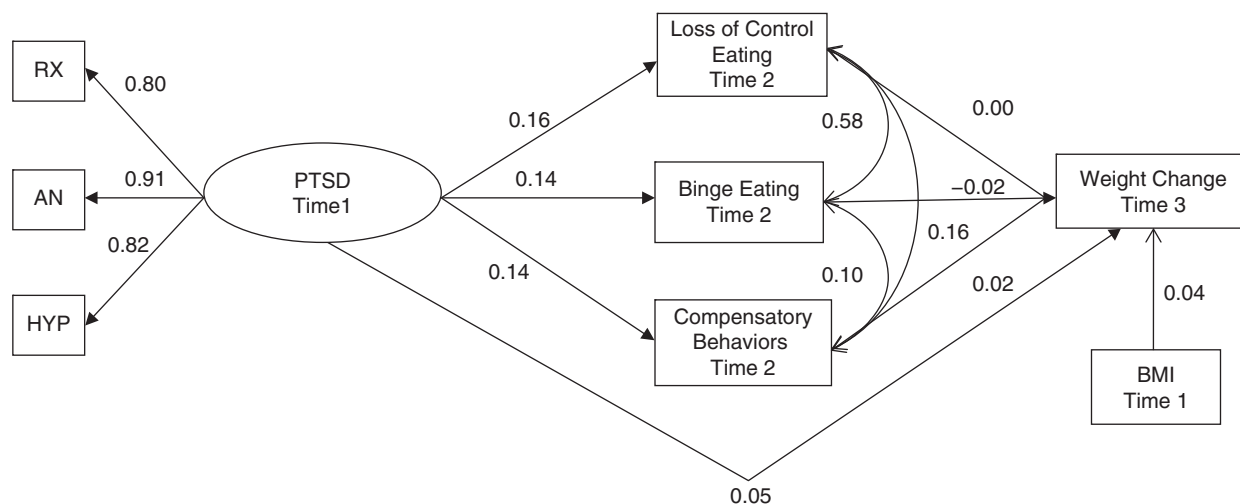
change, such that higher levels of PTSD symptoms at time 1 were related to greater weight change between time 2 and time 3. In order to determine whether the direct path from PTSD to weight change contributed significantly to the fit

of the model, we estimated model 2 without this path. The results revealed that excluding the direct path from PTSD to weight change significantly degraded the fit of the model ( $\Delta\chi^2 = 82.75$ ;  $\Delta df = 1$ ;  $P < 0.001$ ).

We re-estimated model 1, controlling for all potential covariates (model 3): sex, race, birth year, service branch, service component, rank, separation status, educational level, military occupation, alcohol misuse, smoking status, history of trauma, deployment history, and screens for panic disorder, anxiety, and major depression. Because of misfit, correlations were added between the 4 mental health disorders (PTSD, anxiety, major depression, and panic disorder). The pattern of significance did not change. Because of the relatively negligible changes in model results due to the addition of the covariates, the more parsimonious model 1 was retained for further analysis.

In secondary analyses, model 1 was then stratified by sex, race, and service branch (see Web Table 1, available at <http://aje.oxfordjournals.org/>). There were few differences in the patterns of significance for men and women, with the exception of the path from compensatory behaviors to weight change, which was significant for men ( $P = 0.03$ ) but not women ( $P = 0.29$ ). In addition, the indirect association of PTSD and weight change was significant only via compensatory behaviors in men (95% CI: 0.001, 0.017) but not women (95% CI: -0.002, 0.007).

Similarly, when models were stratified by race, the pattern of significance was comparable for whites, blacks, and persons of other races/ethnicities. However, the path from compensatory behaviors was significant only for white participants ( $P < 0.001$ ), as was the indirect association of PTSD and weight change through compensatory behaviors (95% CI: 0.002, 0.013). The direct path from PTSD to weight change was significant for white participants ( $P < 0.001$ ) and participants of other races/ethnicities ( $P = 0.01$ ) but not for black participants ( $P = 0.10$ ).



**Figure 1.** Path coefficients in model 1 (unconditional model), which included the total sample, Millennium Cohort Study, United States, 2000–2008. *P* values for all coefficients except 0.00 and -0.02 were  $< 0.05$ . AN, avoidance/numbing; BMI, body mass index; HYP, hyperarousal; PTSD, posttraumatic stress disorder; RX, re-experiencing.

In models stratified by service branch, the paths from PTSD to binge eating and PTSD to compensatory behaviors were significant for Army, Navy, and Air Force members (all  $P < 0.001$ ), but not for Marines ( $P = 0.53$  and  $0.06$ ). The association between compensatory behaviors and weight change was marginally significant only for participants in the Navy ( $P = 0.045$ ). The direct association between PTSD and weight change was significant only for members of the Army ( $P < 0.001$ ) and Air Force ( $P = 0.01$ ).

## DISCUSSION

We found that PTSD was both directly and indirectly (through the use of compensatory behaviors) associated with weight change in a nationally representative sample of male and female service members. Contrary to expectations, binge eating and loss of control were not associated with subsequent weight change. These findings align with those of previous studies which have shown positive associations between PTSD and body mass index and/or obesity in military and civilian populations (25, 41). In addition, the present results corroborate extant findings demonstrating higher rates of PTSD among individuals with eating disorders (18, 19, 24) and linking disordered eating with weight gain over time (28–30). Further, because PTSD preceded the onset of disordered eating symptoms within the SEM, the present results suggest there was temporal precedence of PTSD to disordered eating in this sample.

Eating disorders remain understudied among men in general, as well as among both male and female military and veteran samples. The association between compensatory behaviors and weight gain was significant and positive for both men and women. However, we found that the path from PTSD to compensatory behaviors and the indirect path from PTSD to weight change via compensatory behaviors were significant among men but not among women. These findings suggest that although PTSD is associated with eating disorders and body mass index among both men and women (19, 25), there may be important sex differences in the pathways responsible for the associations among these constructs. Similarly, the indirect association between PTSD and weight change via compensatory behaviors was significant for white participants and participants of other races but not for black participants, which highlights the potential racial differences in the mechanisms by which PTSD may impact weight change over time.

Because the majority of the sample was white and male and a large proportion had served in the Army, conducting multigroup SEMs to statistically compare subgroups was not recommended (42). The present study was further limited by the use of the relatively brief self-report survey, which was necessary in an epidemiologic study of this size. In addition, our creation of a sum score representing compensatory behaviors, although consistent with previous research demonstrating that engaging in multiple behaviors is associated with more psychopathology relative to endorsement of only 1 behavior (43), is limited in that it weights all behaviors equally. Further, the magnitudes of paths among PTSD, disordered eating, and weight change were relatively small, suggesting that variables not included in the model explain much

of the variance in weight gain over time. This is not surprising, given the complexity of weight change and the many potential factors that contribute to weight gain. We demonstrated that PTSD predisposes individuals to disordered eating symptoms, but the reverse path—disordered eating predicting new-onset PTSD—was not tested and may also occur. Further, as is the case in the vast majority of statistical analyses, the proposed causal relationships cannot be conclusively determined because of the possibility of a third unmeasured variable causing the associations despite support from the model.

Nonetheless, the present study has many strengths. We used a large, nationally representative sample of military service members who participated in up to 3 waves of data collection. Moreover, our sample had a sizable number of non-whites and included more participants of lower socioeconomic status than did previous longitudinal studies of binge eating. Eating disorders have been investigated previously in only 2 nationally representative samples of military members, including the Millennium Cohort Study (23, 24), which underscores the need for further epidemiologic study of these pernicious constructs in underserved groups.

Our findings highlight the complexity of relationships among PTSD, disordered eating, and weight change among both women and men. Given the high rates of overweight and obesity in the United States (2), it appears to be increasingly difficult for recruits to meet strict military weight and physical fitness requirements (6, 7). The early phase of military life may be a particularly vulnerable time for development of an eating disorder, given associations between being on a weight loss diet and development of eating disorders in this population (24). High rates of trauma and PTSD may serve to further heighten the vulnerability of military members to disordered eating. Finally, recent findings have suggested that the incidence of eating disorders has increased over time in the military (23), further emphasizing the need for research and treatment efforts in both male and female service members.

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**14. ABSTRACT**  
Obesity is a major health problem in the United States and a growing concern among members of the military. Posttraumatic stress disorder (PTSD) has been associated with overweight and obesity and may increase the risk of those conditions among military service members. Disordered eating behaviors have also been associated with PTSD and weight gain. However, eating disorders remain understudied in military samples. We investigated longitudinal associations among PTSD, disordered eating, and weight gain in the Millennium Cohort Study, which includes a nationally representative sample of male (n = 27,741) and female (n = 6,196) service members. PTSD at baseline (time 1; 2001–2003) was associated with disordered eating behaviors at time 2 (2004–2006), as well as weight change from time 2 to time 3 (2007–2008). Structural equation modeling results revealed that the association between PTSD and weight change from time 2 to time 3 was mediated by disordered eating symptoms. The association between PTSD and weight gain resulting from compensatory behaviors (vomiting, laxative use, fasting, overexercise) was significant for white participants only and for men but not women. PTSD was both directly and indirectly (through disordered eating) associated with weight change. These results highlight potentially important demographic differences in these associations and emphasize the need for further investigation of eating disorders in military service members.

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