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PRINCIPAL INVESTIGATOR: Shira Maguen

CONTRACTING ORGANIZATION: Northern California Institute for Research and Education (NCIRE)
San Francisco, CA

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Shira Maguen

E-Mail: Shira.Maguen@va.gov

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14. ABSTRACT The goal of this study is to determine the prevalence of eating disorders (EDs) among military personnel and examine risk factors for their onset and recurrence, especially military-specific exposures. We also described patterns of comorbidity between EDs and other mental health conditions (e.g. PTSD, depression, and problem drinking), particularly regarding order of onset. Finally, the study explores whether certain family system stressors as well as individual or relationship factors, are associated with EDs in military spouses. In the second year of the study, nearly all subtasks were completed on schedule, with finalization of all tasks imminent within the next two months. The prevalence of EDs using medical record and survey data ranged from <1% to 1.4% for Bulimia Nervosa (BN) and <1% to 5.4% for Binge Eating Disorder (BED; Table 2). Mental health disorders, lack of social support and stressful life events were strongly and consistently associated with the development of EDs (Table 4). Further, although evidence of bidirectionality emerged between BED and 3 of the 4 mental health outcomes (Depression, Anxiety, Problem Drinking), mental health was consistently a stronger predictor of subsequent BED. Finally, spouses who screened positive for PTSD, experienced an adverse childhood event, or were former smokers were more likely to develop BED. These findings have implications for the assessment and treatment of military personnel and spouses with eating disorders.

15. SUBJECT TERMS
Eating Disorders, Bulimia, Binge Eating Disorder, Anorexia Nervosa, Service Members, Military, Veterans, Mental Health, Family, Spouses, Stressors, Prevalence

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1. INTRODUCTION:

The prevalence of eating disorders (EDs) is higher in military personnel than in civilians. Despite the prevalence rates, estimates are inconsistent, risk factors for both military personnel and their families are not fully understood, and temporal patterns of comorbidity remain unclear. This research will determine the prevalence of EDs among military personnel and examine risk factors for their onset and recurrence, especially military-specific exposures. It will additionally describe the patterns of comorbidity between EDs and other mental health conditions (e.g. PTSD, depression, and problem drinking), particularly regarding order of onset. Finally, it will explore whether certain family system stressors, individual or relationship factors, are associated with EDs in military spouses. This study will provide important information for the future development of prevention and treatment of eating disorders that will be helpful for military leadership and commands as well as mental health clinicians who care for military personnel and their families.

2. KEYWORDS:

Eating Disorders, Bulimia, Binge Eating Disorder, Anorexia Nervosa, Service Members, Military, Veterans, Mental Health, Family, Spouses, Stressors, Prevalence

3. ACCOMPLISHMENTS:

What were the major goals of the project?

The main goal of this proposal is to use a longitudinal cohort design to better understand prevalence rates, risk factors, and associated comorbidities in military personnel.

The project work has been divided into 7 main tasks:

1. Complete and submit study proposal to Millennium Cohort's Scientific Committee for review and approval … 100% completed, completed year one
2. Build analytic dataset using all panels and waves of available data (N = ~202,00) … 100% completed, completed year one
3. Conduct analyses to determine prevalence and risk factors for BN, BED, and OSFED ... 75 percent completed, pending additional analyses using OSFED
4. Conduct analyses to determine relationship between eating disorders and comorbid conditions ... 80 percent completed, need to do code checking and finalize models
5. Create analytic dataset (N = ~9800) … 100% completed, completed year one
6. Perform analyses on risk and protective factors for BED and OSFED in military spouses … 100 percent completed, completed year two
7. Prepare reports and manuscripts to disseminate research findings to appropriate end users ... Expected Year 3

Progress on subtasks is described in detail in the following section.

What was accomplished under these goals?

SOW Major Task 3: Conduct analyses to determine prevalence and risk factors for BN, BED, and OSFED

Subtask 1: Calculate prevalence of BN, BED, and OSFED at each survey time point and prepare graphical data displays

Sample
The samples for prevalence estimates for EDs were derived from survey data and medical records. Estimates for survey data were calculated using the sample of participants who responded at a given survey wave (see Table 1 notes for specific sample sizes). Estimates from medical record data were calculated using the sample of enrolled Millennium Cohort members who had at least one health care encounter (either inpatient or outpatient) during the same period as each survey cycle (see Table 1 notes for specific sample sizes). Specifically, health care encounters were examined from the first day of each survey cycle through the day before the start of the next survey cycle.

Measures
Survey measures for EDs were from the Patient Health Questionnaire (Spitzer et al., 1999).

Bulimia nervosa (BN), identified using survey data, was defined as follows: endorsement of a loss of control over eating and consuming unusually large amounts of food as often as twice a week for the last 3 months; endorsement of at least 1 compensatory behavior such as vomiting or fasting and having answered "yes" to the question asking if this behavior occurred, on average, as often as twice a week for the last 3 months; and being "bothered a little" or "bothered a lot" by their weight or how they look. It should be noted that the survey items asking about compensatory behaviors required to identify BN cases were removed from the survey for the 2014-2016 cycle, so participants could only be followed through the 2011-2013 survey cycle, allowing for a maximum of three follow-up data points.

Binge eating disorder (BED), identified using survey data, was defined as follows: endorsement of a loss of control when eating and consuming unusually large amounts of food as often as twice a week for the last 3 months, and no endorsement of compensatory behaviors.

Other specified feeding or eating disorders (OSFED), using survey data, were defined as follows: meet the criteria for BN, but the compensatory behaviors do not have to occur as often as twice a week for the last 3 months (on average) OR those who meet the criteria for BED, but the binging episodes do not have to occur as often as twice a week for the last 3 months (on average).

Our criterion for identifying cases of eating disorders in the medical records were based on the criterion outlined in the June 2018 report from the Medical Surveillance Monthly Report by Williams, et al. titled "Diagnoses of eating disorders, active component service members, U.S. Armed Forces, 2013–2017." ED cases were identified if an ICD-9 or 10 diagnostic code was present in the first or second diagnostic position for inpatient data, and in the first diagnostic position for outpatient data. See Table 1 for the codes that were used for these analyses.

Table 1. ICD9 and ICD10 codes for Eating Disorders

	ICD-9 Codes	ICD-10 Codes
Eating disorders	307.1 Anorexia nervosa 307.50 Eating disorder, unspecified 307.51 BN 307.53 Rumination disorder 307.54 Psychogenic vomiting 307.59 Other feeding disorder/loss of appetite	F50.00 Anorexia nervosa, unspecified F50.01 Anorexia nervosa, restricting type F50.02 Anorexia nervosa, binge eating/purging type F50.2 BN F50.8 Other Eating disorders F50.81 BED F50.82 avoidant restrictive food intake disorder F50.89 Other specified eating disorder F50.9 Eating disorder, unspecified

Analyses

For Subtask 1, prevalence estimates were calculated using the number of cases during a survey period as the numerator, and the number of responders (for survey data) or cohort members with at least one health care encounter (for medical record data). Weighted prevalence estimates were calculated using the total responder population for survey data and using the entire active-duty military population with at least one health care encounter during a survey period for the medical record data. Estimates were weighted on age, sex, race/ethnicity and service branch.

Results

Table 1 shows both weighted and unweighted prevalence estimates for Bulimia Nervosa (BN) and Binge Eating Disorder (BED). Estimates for Anorexia Nervosa (AN) from the DoD Medical Record data are also provided. Survey data results indicate that the prevalence of BED is at least twice as high as that of BN, while the prevalence estimates from the medical records of these two conditions are similar. Survey data results also indicate an increase in prevalence of BED over time, barring a slight dip observed at the 2011 cycle, with the highest estimates of over 5% in 2014. Results for the OSFED analyses are still forthcoming, and will be evaluated using survey data only, given that OSFED was not a diagnosed condition until the DSM-5 emerged in 2013. Since OSFED includes subthreshold levels of the compensatory behaviors required for a full BN diagnosis, as well as subthreshold levels of binging episodes required for a full BED diagnosis, we expect these prevalence estimates to be substantially higher. Medical record data results show low prevalence estimates for all conditions, with AN being the lowest. These data highlight the importance of screening for unhealthy eating behaviors in a primary care setting or another nonclinical setting (e.g. deployment preparation or training) since service members may be hesitant to seek care due to potential career-limiting or career-ending consequences. Screening for eating disorders, especially binge eating, is a critical step towards identifying service members who may need care or counseling.

Table 2. Weighted and Unweighted Prevalence Estimates for Eating Disorders: Survey and Medical Record Data 2001-2014

	2001 n (%)	2001 weighted %	2004 n (%)	2004 weighted %	2007 n (%)	2007 weighted %	2011 n (%)	2011 weighted %	2014 n (%)	2014 weighted %
Survey Data										
Bulimia Nervosa	365 (0.89)	0.98	379 (0.86)	0.94	458 (0.77)	0.87	649 (1.09)	1.35	--	--
Bing Eating Disorder*	808 (1.97)	2.05	917 (2.08)	2.12	1117 (1.89)	1.94	1291 (2.16)	2.09	1320 (5.02)	5.38
Medical Record Data (MDR)										
Bulimia Nervosa	25 (0.06)	0.08	37 (0.07)	0.09	77 (0.11)	0.13	86 (0.11)	0.12	45 (0.09)	0.13
Bing Eating Disorder	36 (0.09)	0.11	40 (0.08)	0.10	83 (0.12)	0.13	99 (0.13)	0.14	41 (0.08)	0.12
Anorexia Nervosa	10 (0.03)	0.04	6 (0.01)	0.02	33 (0.05)	0.05	29 (0.04)	0.04	20 (0.04)	0.06

* Probable BED for 2014 due to unavailable data on compensatory behaviors.

cycle totals:

2001: survey n = 41,002; MDR n = 39,216

2004: survey n = 44,172; MDR n = 51,297

2007: survey n = 59,148; MDR n= 67,809

2011: survey n = 59,718; MDR n = 74,980

2014: survey n = 26,313; MDR n = 48,743

Figure 1. Weighted Prevalence Estimates for Bulimia Nervosa and Binge Eating Disorder using Survey Data
Note. Data on compensatory behaviors were not available in 2014, so estimates for Bulimia Nervosa could not be calculated

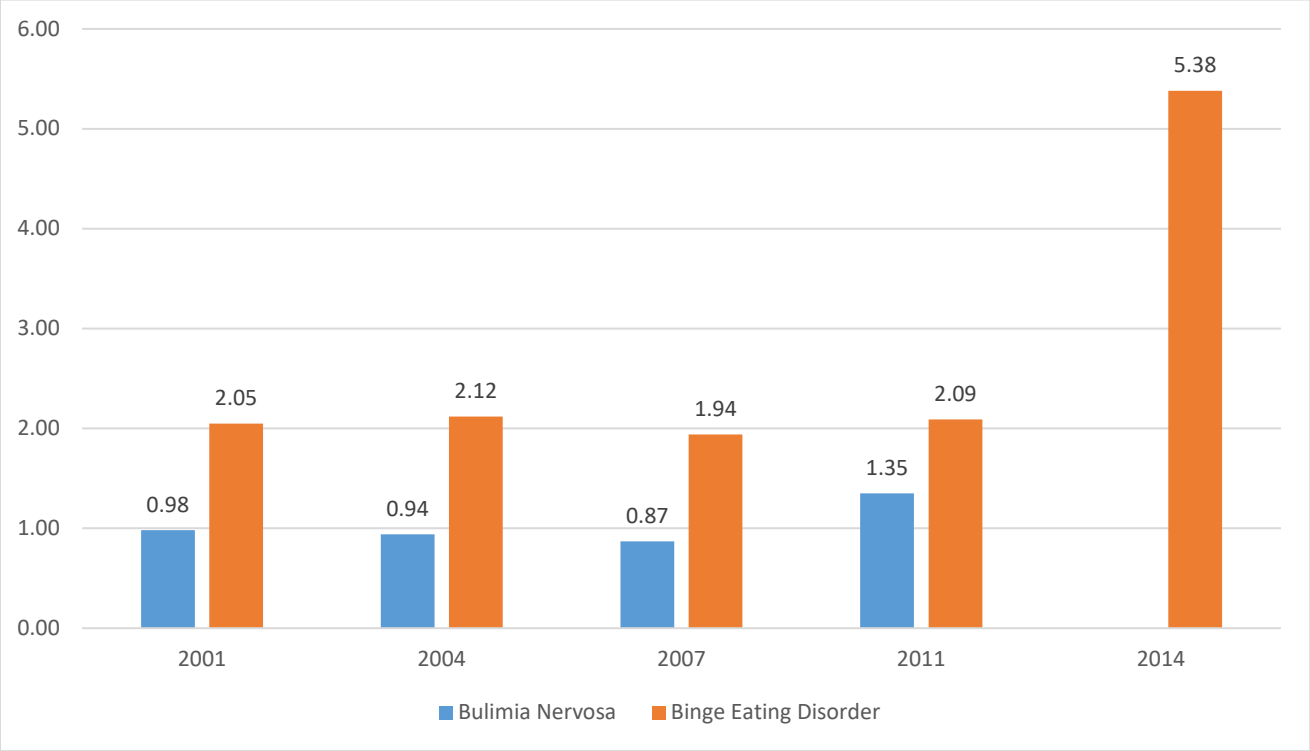
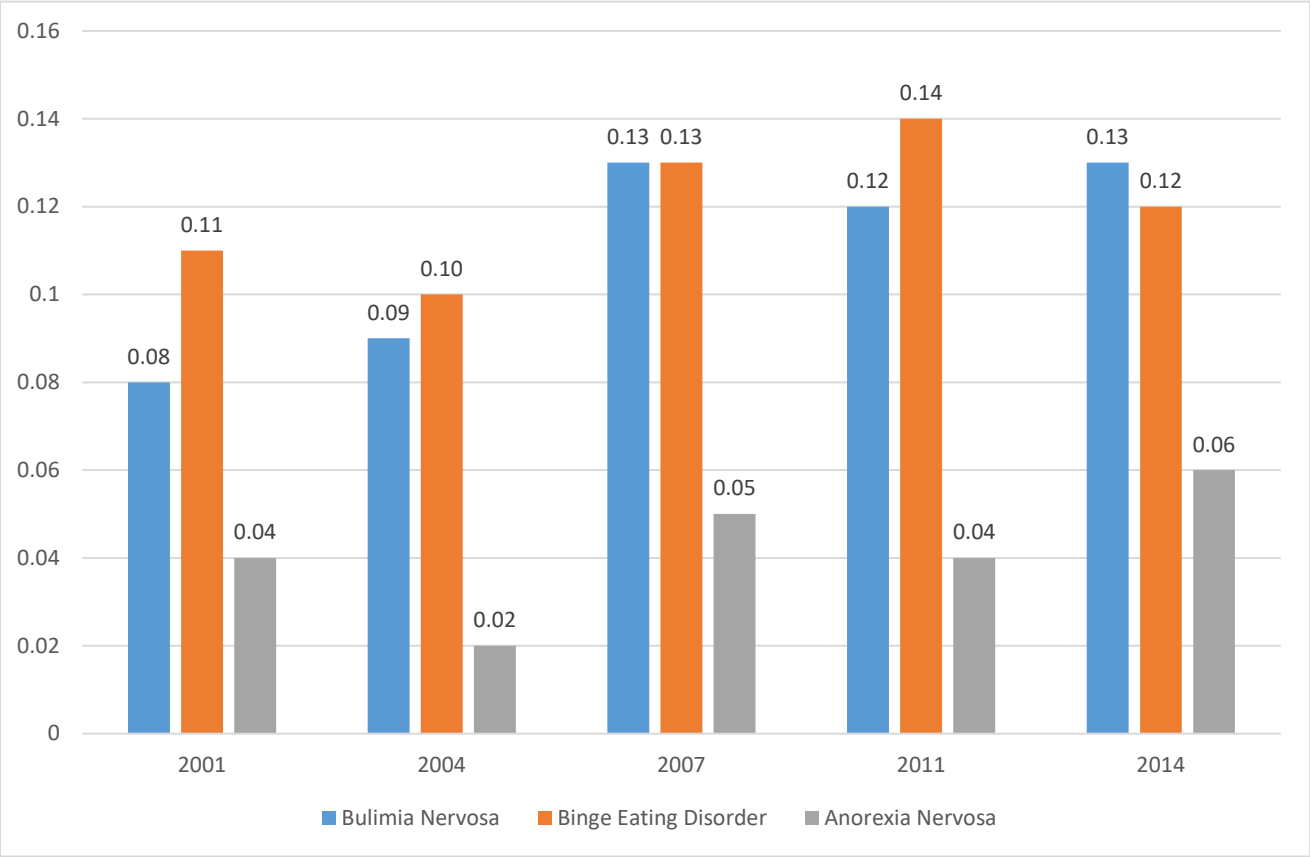


Figure 2. Weighted Prevalence Estimates for Bulimia Nervosa, Binge Eating Disorder, and Anorexia Nervosa using DoD Medical Record Data



Subtask 2: Run complementary log-log models to determine significant risk and protective factors for the development and recurrence of ED

Sample
The sample for examining Subtask 2 for the development of EDs was drawn from Millennium Cohort members who completed a survey at two or more time points (baseline and at least one follow-up survey). These members must have also been on active service at the time of their baseline survey and had a negative screen for the ED of interest for the analyses (BN, or BED). Participants included in the BN analyses had a maximum of three follow-up data points since BN could not be evaluated at the 2014 cycle (explained above in Measures section for Subtask 1). The final sample for the BN initiation analyses was 96,245. Participants included in the BED analyses has a maximum of four follow-up data points. The final sample for the BED initiation analyses was 113,733. Participants for both the BN and BED analyses were followed until they screened positive for the outcome, or until their last follow-up survey.

The samples for recurrence of EDs was drawn from Millennium Cohort members who completed at least three surveys; specifically baseline and at least two follow-up surveys. Three surveys were needed to identify those who initially screened positive for an ED, then screened negative (recovered) at the next subsequent follow-up survey and were finally evaluated for recurrence of the ED at the next subsequent follow-up survey. Participants were followed until they experienced recurrence of the ED or until their last follow-up survey. The sample size for the analysis of recurrence of BN was 452, and the sample size for the recurrence of BED was 1335.

Measures
BN and BED outcomes were defined using survey data as previously described under Subtask 1.

Analyses
For Subtask 2, descriptive analyses were completed to examine the number of participants in each subgroup by their status of initiation or recurrence of an ED. Factors of interest in these analyses included demographic (e.g. sex, age), military (e.g. service branch, deployment status) and behavioral factors (e.g. sexual assault and mental health; see Tables 3-6 for a variable list). Next, bivariate complementary log-log models were run to examine the associations between each factor of interest in relation to each ED outcome. While these models were not adjusted for any other factors of interest, they were adjusted for time between each survey cycle. Finally, multivariable models were run that adjusted for time as well as all factors of interest together. Unadjusted and adjusted associations are presented. Note that for the recurrence of BN analyses, the sample size was insufficient to achieve model convergence for the complementary log-log models, so a regular logistic regression model was used. This model also included all variables of interest and adjusted for the time between the recovery time point and the time point where the outcome was observed, or until the study ended. All models will be final pending analytic code checking.

Results
Table 3 shows the prevalence of initiation of EDs by each factor of interest. Just over 1% of the population developed BN during the follow-up period from 2001-2013, while just over 6% of the population developed BED during the follow-up period from 2001-2016. Numerous factors were associated with the development of both BN and BED in adjusted models, many of which were

shared across the two outcomes. Factors associated with an increased risk for developing either BN or BED were younger age (odds increased as age decreased); serving in the Army, Marine Corps, or Navy/Coast Guard compared with the Air Force; Active Duty compared with Reserve/Guard; Enlisted compared with Officer; deployment with combat experience; screening positive for PTSD, and/or depression; experiencing sexual assault; engaging in problem drinking; feeling bothered by a lack of social support; and experiencing any number of stressful life events.

The BN analyses revealed that participants of minority race/ethnicity were at higher risk for developing BN, as were never married participants. Those less likely to develop BN were those who separated from service during the follow-up period, and members of 3rd enrollment panel.

The BED analyses revealed that participants in a health care occupation, those who separated from service during follow-up, past smokers, and members of the 2nd, 3rd, or 4th enrollment panels, enrolled between 2004 and 2006, 2007 and 2008, and 2011 and 2013 respectively, were at higher risk for developing BED. Those less likely to develop BED were of Black non-Hispanic race/ethnicity, never married, and current smokers.

Regarding recurrence analyses, the number of participants who screened positive for an ED at baseline and recovered at the next subsequent survey cycle was relatively small (n=425 for recurrence of BN and n=1335 for recurrence of BED) in relation to the samples for the initiation analyses and should be interpreted with caution. Preliminary results indicate that nearly 14% of those who recovered from BN experienced recurrence of this ED during follow-up, while just over 29% of those who recovered from BED experienced recurrence.

Results from adjusted BN recurrence analyses suggest that females compared with males, divorced participants compared with married, members who separated from service compared with those who remained on active service, and participants enrolled in Panel 2 compared with Panel 1 were less likely to experience recurrence of BN, while participants who experience sexual assault were more likely to experience recurrence of BN compared with those without sexual assault.

Results from adjusted BED recurrence analyses suggest that participants who are younger compared with those born in 1960 or earlier, those feeling bothered by lack of social support compared with those not bothered, those experiencing combat deployment, those screening positive for depression and those enrolled in Panel 3 were more likely to experience recurrence of BED.

Taken together, these results revealed numerous factors associated with the development and recurrence of EDs in a large, military cohort. Factors that were strongly and consistently associated with both BN and BED were mental health disorders and feeling bothered by a lack of social support. Since service members are hesitant to seek care for EDs and other mental disorders, and social support is not routinely assessed, these findings suggest that unhealthy eating and other warning signs for mental disorders should be screened for in primary care settings, so they can be identified for services in other settings. These findings also underscore the importance of Major Task 4 of this grant, where the temporal sequence between the onset of EDs vs. the onset of other mental health disorders is elucidated, given we found that mental health disorders are risk factors for EDs. Furthermore, the military should continue to promote the availability and accessibility of services for social support in environments where military service members may feel isolated.

Table 3. Population Characteristics (Column Percentages) by Eating Disorder Status

Characteristics	Bulimia Nervosa					Binge Eating Disorder				
	Total sample N = 96,245	No Bulimia Nervosa N = 95,201		Bulimia Nervosa N = 1,044		Total Sample N = 113,733	No Binge Eating Disorder N = 106,657		Binge Eating Disorder N = 7,076	
Demographic factors										
Sex										
Male	(69.6)	66,321	(69.7)	631	(60.4)	(69.9)	74,661	(70.0)	4,852	(68.6)
Female	(30.4)	28,880	(30.3)	413	(39.6)	(30.1)	31,996	(30.0)	2,224	(31.4)
Birth year										
Before 1960	(13.1)	12,573	(13.2)	82	(7.9)	(11.2)	11,988	(11.2)	694	(10.0)
1960-1969	(25.6)	24,401	(25.6)	256	(24.5)	(22.1)	23,602	(22.1)	1,587	(23.1)
1970-1979	(29.2)	27,727	(29.1)	352	(33.7)	(26.7)	28,339	(26.6)	2,064	(30.0)
1980 and beyond	(32.1)	30,500	(32.0)	354	(33.9)	(40.0)	42,728	(40.1)	2,731	(36.9)
Race/ethnicity										
White non-Hispanic	(74.8)	71,298	(74.9)	669	(64.1)	(74.9)	79,788	(74.8)	5,431	(76.8)
Black non-Hispanic	(11.9)	11,261	(11.8)	167	(16.0)	(11.3)	12,252	(11.5)	548	(8.3)
Hispanic	(7.0)	6,652	(7.0)	127	(12.2)	(7.2)	7,578	(7.1)	615	(8.7)
Other	(6.3)	5,990	(6.3)	81	(7.8)	(6.6)	7,039	(6.6)	446	(6.3)
Education										
High school or less	(18.4)	17,459	(18.3)	203	(19.4)	(17.7)	18,839	(17.7)	1,334	(18.9)
Some college or Associates	(51.6)	49,005	(51.5)	619	(59.3)	(51.5)	54,685	(51.3)	3,861	(54.6)
Bachelor's or higher	(30.1)	28,737	(30.2)	222	(21.3)	(30.8)	33,133	(31.1)	1,881	(26.6)
Marital Status										
Never Married	(31.9)	30,325	(31.9)	347	(33.2)	(31.8)	33,853	(31.7)	2,294	(32.4)
Married	(57.1)	54,405	(57.1)	553	(53.0)	(57.3)	61,249	(57.4)	3,893	(55.0)
Divorced, widowed or separated	(11.0)	10,471	(11.0)	144	(13.8)	(10.9)	11,555	(10.8)	889	(12.6)
Military Factors										
Service Component										
Reserve/National Guard	(37.8)	36,092	(37.9)	330	(31.6)	(36.3)	38,788	(36.4)	2,505	(35.4)
Active Duty	(62.2)	59,109	(62.1)	714	(68.4)	(63.7)	67,869	(63.6)	4,571	(64.6)
Service Branch										
Air Force	(30.0)	28,704	(30.2)	158	(15.1)	(30.0)	32,705	(30.7)	1,424	(20.1)
Army	(44.8)	42,524	(44.7)	615	(58.9)	(44.8)	47,263	(44.3)	3,702	(52.3)
Marines	(7.0)	6,621	(7.0)	101	(9.7)	(7.1)	7,436	(7.0)	619	(8.7)
Navy & Coast Guard	(18.2)	17,352	(18.2)	170	(16.3)	(18.1)	19,253	(18.1)	1,331	(18.8)

Military Occupation										
Health Care	(11.7)	11,166	(11.7)	142	(13.6)	(11.9)	12,580	(11.8)	927	(13.1)
Combat	(17.9)	17,036	(17.9)	174	(16.7)	(17.8)	18,936	(17.8)	1,252	(17.7)
All other occupations	(70.4)	66,999	(70.4)	728	(69.7)	(70.4)	75,141	(70.5)	4,897	(69.2)
Paygrade										
Officer	(21.4)	20,440	(21.5)	132	(12.6)	(21.7)	23,520	(22.1)	1,202	(17.0)
Enlisted	(78.6)	74,761	(78.5)	912	(87.4)	(78.3)	83,137	(77.9)	5,874	(83.0)
Combat Deployment Status (ever during follow-up)										
Not deployed	(45.0)	42,856	(45.0)	422	(40.4)	(48.5)	51,692	(48.5)	3,506	(49.5)
Deployed without combat	(28.5)	27,246	(28.6)	214	(20.5)	(27.5)	29,750	(27.9)	1,573	(22.2)
Deployed with combat	(26.5)	25,099	(26.4)	408	(39.1)	(23.9)	25,215	(23.6)	1,997	(28.2)
Service status (during follow-up)										
Actively serving	(32.1)	30,658	(32.2)	267	(25.6)	(38.5)	41,907	(39.3)	1,884	(26.6)
Separated from service	(67.9)	64,543	(67.8)	777	(74.4)	(61.5)	64,750	(60.7)	5,192	(73.4)
Enrollment Panel										
Panel 1	(58.5)	55,697	(58.5)	601	(57.6)	(49.7)	52,847	(49.5)	3,686	(52.1)
Panel 2	(18.0)	17,137	(18.0)	235	(22.5)	(15.1)	15,985	(15.0)	1,177	(16.6)
Panel 3	(23.5)	22,367	(23.5)	208	(19.9)	(19.6)	20,949	(19.6)	1,316	(18.6)
Panel 4	Not available for BN analyses					(15.6)	16,876	(15.8)	897	(12.7)
Behavioral health factors										
PTSD										
No	(95.2)	90,810	(95.4)	841	(80.6)	(94.8)	101,596	(95.3)	6,215	(87.8)
Yes	(4.8)	4,391	(4.6)	203	(19.4)	(5.2)	5,061	(4.7)	861	(12.2)
Major depressive disorder										
No	(96.7)	92,147	(96.8)	912	(87.4)	(96.6)	103,411	(97.0)	6,473	(91.5)
Yes	(3.3)	3,054	(3.2)	132	(12.6)	(3.4)	3,246	(3.0)	603	(8.5)
Anxiety disorder										
No	(97.8)	93,165	(97.9)	962	(92.1)	(97.6)	104,322	(97.8)	6,673	(94.3)
Yes	(2.2)	2,036	(2.1)	82	(7.9)	(2.4)	2,335	(2.2)	403	(5.7)
Sexual assault										
No	(92.7)	88,374	(92.8)	880	(84.3)	(92.8)	99,212	(93.0)	6,342	(89.6)
Yes	(7.3)	6,827	(7.2)	164	(15.7)	(7.2)	7,445	(7.0)	734	(10.4)
Problem drinking										
No	(87.6)	83,418	(87.6)	856	(82.0)	(87.7)	94,007	(88.1)	5,779	(81.7)
Yes	(12.4)	11,783	(12.4)	188	(18.0)	(12.3)	12,650	(11.9)	1,297	(18.3)
Smoking status										
Nonsmoker	(59.1)	56,308	(59.1)	575	(55.1)	(59.6)	63,953	(60.0)	3,810	(53.8)

Past smoker	(22.8)	21,634	(22.7)	282	(27.0)	(22.8)	24,058	(22.6)	1,879	(26.6)
Current smoker	(18.1)	17,259	(18.1)	187	(17.9)	(17.6)	18,646	(17.5)	1,387	(19.6)
Social support										
Feels supported	(81.4)	77,672	(81.6)	629	(60.2)	(81.5)	87,768	(82.3)	4,896	(69.2)
Does not feel supported	(18.6)	17,529	(18.4)	415	(39.8)	(18.5)	18,889	(17.7)	2,180	(30.8)
Stressful life events										
None	(58.6)	55,935	(58.8)	490	(46.9)	(59.8)	64,326	(60.3)	3,663	(51.8)
1 event	(28.1)	26,732	(28.1)	318	(30.5)	(27.4)	29,027	(27.2)	2,119	(29.9)
2 events	(9.9)	9,387	(9.9)	152	(14.6)	(9.6)	9,989	(9.4)	892	(12.6)
3 or more events	(3.4)	3,147	(3.3)	84	(8.0)	(3.3)	3,315	(3.1)	402	(5.7)

Table 4. Unadjusted and Adjusted Odds Ratios for the Development of Eating Disorders, 2001-2016

Characteristics	Bulimia Nervosa, N= 96,245						Binge Eating Disorder, N = 113,733					
	Unadjusted			Adjusted			Unadjusted			Adjusted		
	Odds Ratio	95% CI lower	95% CI upper	Odds Ratio	95% CI lower	95% CI upper	Odds Ratio	95% CI lower	95% CI upper	Odds Ratio	95% CI lower	95% CI upper
Demographic Factors												
Sex												
Male	1.00			1.00			1.00			1.00		
Female	**1.54**	**(1.36,**	**1.75)**	**1.33**	**(1.14,**	**1.54)**	**1.14**	**(1.08,**	**1.20)**	1.00	(0.94,	1.06)
Birth year												
Before 1960	1.00			1.00			1.00			1.00		
1960-1969	**1.70**	**(1.32,**	**2.17)**	**1.29**	**(1.00,**	**1.67)**	**1.28**	**(1.17,**	**1.40)**	**1.31**	**(1.19,**	**1.43)**
1970-1979	**2.27**	**(1.79,**	**2.89)**	**1.34**	**(1.03,**	**1.74)**	**1.74**	**(1.60,**	**1.90)**	**1.58**	**(1.43,**	**1.74)**
1980 and beyond	**2.44**	**(1.92,**	**3.11)**	**1.40**	**(1.01,**	**1.92)**	**2.41**	**(2.22,**	**2.62)**	**1.66**	**(1.48,**	**1.87)**
Race/ethnicity												
White non-Hispanic	1.00			1.00			1.00			1.00		
Black non-Hispanic	**1.68**	**(1.42,**	**1.99)**	**1.34**	**(1.12,**	**1.60)**	**0.73**	**(0.67,**	**0.79)**	**0.72**	**(0.66,**	**0.79)**
Hispanic	**2.13**	**(1.76,**	**2.57)**	**1.64**	**(1.35,**	**1.99)**	**1.29**	**(1.19,**	**1.40)**	1.07	(0.98,	1.17)
Other	**1.53**	**(1.21,**	**1.92)**	**1.37**	**(1.08,**	**1.72)**	1.05	(0.95,	1.15)	0.98	(0.89,	1.08)
Education												
High school or less	1.00			1.00			1.00			1.00		
Some college or Associates	1.01	(0.86,	1.18)	1.16	(0.98,	1.37)	**0.91**	**(0.86,**	**0.97)**	1.05	(0.98,	1.12)
Bachelor's or higher	**0.55**	**(0.45,**	**0.66)**	1.00	(0.78,	1.29)	**0.63**	**(0.59,**	**0.68)**	1.06	(0.96,	1.16)
Marital Status												
Married	1.00			1.00			1.00			1.00		
Never married	**1.46**	**(1.27,**	**1.68)**	**1.18**	**(1.01,**	**1.37)**	**1.21**	**(1.15,**	**1.28)**	**0.91**	**(0.86,**	**0.97)**
Divorced	**1.43**	**(1.20,**	**1.70)**	0.86	(0.71,	1.05)	**1.28**	**(1.20,**	**1.37)**	0.94	(0.87,	1.01)
Military Factors												
Service Component												
Reserve/National Guard	1.00			1.00			1.00			1.00		
Active Duty	**1.43**	**(1.26,**	**1.63)**	**1.38**	**(1.20,**	**1.60)**	**1.23**	**(1.17,**	**1.29)**	**1.08**	**(1.02,**	**1.14)**
Service Branch												
Air Force	1.00			1.00			1.00			1.00		
Army	**2.64**	**(2.21,**	**3.14)**	**2.06**	**(1.71,**	**2.47)**	**1.78**	**(1.68,**	**1.90)**	**1.42**	**(1.33,**	**1.52)**
Marines	**3.06**	**(2.39,**	**3.93)**	**2.59**	**(1.99,**	**3.37)**	**2.21**	**(2.01,**	**2.43)**	**1.41**	**(1.28,**	**1.56)**

Navy & Coast Guard	**1.80**	**(1.45,**	**2.24)**	**1.58**	**(1.26,**	**1.96)**	**1.57**	**(1.46,**	**1.69)**	**1.35**	**(1.25,**	**1.45)**
Military Occupation												
All other occupations	1.00			1.00			1.00			1.00		
Combat	0.97	(0.82,	1.14)	1.09	(0.92,	1.30)	0.97	(0.91,	1.03)	0.98	(0.92,	1.05)
Health Care	**1.13**	**(0.94,**	**1.35)**	1.09	(0.92,	1.30)	**1.09**	**(1.02,**	**1.17)**	**1.14**	**(1.06,**	**1.22)**
Paygrade												
Officer	1.00			1.00			1.00			1.00		
Enlisted	**1.98**	**(1.67,**	**2.34)**	**1.42**	**(1.12,**	**1.80)**	**1.64**	**(1.54,**	**1.74)**	**1.24**	**(1.14,**	**1.35)**
Combat Deployment Status (ever during follow-up)												
Not deployed	1.00			1.00			1.00			1.00		
Deployed without combat (change to this ref)	0.95	(0.80,	1.13)	1.05	(0.87,	1.27)	**0.72**	**(0.67,**	**0.78)**	0.97	(0.90,	1.05)
Deployed with combat	**1.63**	**(1.42,**	**1.86)**	**1.44**	**(1.24,**	**1.66)**	**1.09**	**(1.03,**	**1.15)**	**1.21**	**(1.14,**	**1.28)**
Service status (during follow-up)												
Actively serving	1.00			1.00			1.00			1.00		
Separated from service	0.89	(0.78,	1.01)	**0.72**	**(0.62,**	**0.83)**	**1.82**	**(1.73,**	**1.91)**	**1.73**	**(1.64,**	**1.82)**
Enrollment Panel												
Panel 1	1.00			1.00			1.00			1.00		
Panel 2	**1.42**	**(1.22,**	**1.66)**	0.95	(0.79,	1.15)	**1.56**	**(1.46,**	**1.66)**	**1.19**	**(1.10,**	**1.29)**
Panel 3	1.15	(0.98,	1.36)	**0.78**	**(0.62,**	**0.97)**	**1.73**	**(1.62,**	**1.85)**	**1.42**	**(1.30,**	**1.55)**
Panel 4	Not available for BN analyses						**2.34**	**(2.18,**	**2.52)**	**2.05**	**(1.86,**	**2.26)**
Behavioral health factors												
PTSD												
No	1.00			1.00			1.00			1.00		
Yes	**4.38**	**(3.81,**	**5.05)**	**2.04**	**(1.68,**	**2.48)**	**3.56**	**(3.36,**	**3.76)**	**1.58**	**(1.46,**	**1.71)**
Major depressive disorder												
No	1.00			1.00			1.00			1.00		
Yes	**3.82**	**(3.23,**	**4.50)**	**1.25**	**(1.00,**	**1.56)**	**3.56**	**(3.33,**	**3.80)**	**1.38**	**(1.26,**	**1.51)**
Anxiety disorder												
No	1.00			1.00			1.00			1.00		
Yes	**3.39**	**(2.79,**	**4.12)**	1.02	(0.80,	1.30)	**3.29**	**(3.05,**	**3.54)**	1.10	(1.00,	1.21)
Sexual assault												
No	1.00			1.00			1.00			1.00		
Yes	**2.38**	**(2.02,**	**2.81)**	**1.34**	**(1.11,**	**1.62)**	**1.61**	**(1.49,**	**1.73)**	**1.09**	**(1.00,**	**1.19)**
Problem drinking												
No	1.00			1.00			1.00			1.00		

Yes	**1.69**	**(1.47,**	**1.95)**	**1.18**	**(1.01,**	**1.37)**	**1.79**	**(1.70,**	**1.89)**	**1.24**	**(1.17,**	**1.31)**
Smoking status												
Nonsmoker	1.00			1.00			1.00			1.00		
Past smoker	**1.20**	**(1.04,**	**1.38)**	1.07	(0.93,	1.25)	**1.37**	**(1.30,**	**1.45)**	**1.15**	**(1.08,**	**1.21)**
Current smoker	**1.23**	**(1.04,**	**1.45)**	0.88	(0.74,	1.05)	**1.30**	**(1.22,**	**1.39)**	**0.90**	**(0.84,**	**0.97)**
Social support												
Feels supported	1.00			1.00			1.00			1.00		
Does not feel supported	**3.16**	**(2.80,**	**3.58)**	**1.86**	**(1.61,**	**2.15)**	**2.48**	**(2.36,**	**2.60)**	**1.54**	**(1.50,**	**1.68)**
Stressful life events												
0	1.00			1.00			1.00			1.00		
1	**1.49**	**(1.29,**	**1.72)**	1.16	(0.99,	1.35)	**1.49**	**(1.41,**	**1.57)**	**1.20**	**(1.13,**	**1.27)**
2	**2.27**	**(1.86,**	**2.77)**	**1.43**	**(1.15,**	**1.77)**	**1.75**	**(1.61,**	**1.90)**	**1.15**	**(1.05,**	**1.26)**
3 or more	**4.14**	**(3.20,**	**5.36)**	**2.01**	**(1.51,**	**2.69)**	**2.49**	**(2.20,**	**2.82)**	**1.26**	**(1.10,**	**1.44)**

Table 5. Population Characteristics (Column Percentages) by Recurrence of Eating Disorders

Characteristics	Bulimia Nervosa (BN)					Binge Eating Disorder (BED)				
	Total sample N = 425	No recurrence of BN n = 367		Recurrence of BN n = 58		Total Sample N = 1335	No recurrence of BED, n = 942		Recurrence of BED N = 393	
Demographic factors										
Sex										
Male	(59.3)	211	(57.5)	41	(70.7)	(66.0)	617	(65.5)	264	(67.2)
Female	(40.7)	156	(42.5)	17	(29.3)	(34.0)	325	(34.5)	129	(32.8)
Birth year										
Before 1960	(15.3)	53	(14.4)	12	(20.7)	(15.4)	143	(15.2)	62	(15.8)
1960-1969	(32.9)	121	(33.0)	19	(32.8)	(28.2)	253	(26.9)	124	(31.6)
1970-1979	(32.5)	121	(33.0)	17	(29.3)	(30.6)	300	(31.8)	109	(27.7)
1980 and beyond	(19.3)	72	(19.6)	10	(17.2)	(25.8)	246	(26.1)	98	(24.9)
Race/ethnicity										
White non-Hispanic	(71.1)	264	(71.9)	38	(65.5)	(80.8)	749	(79.5)	330	(84.0)
Black non-Hispanic	(12.5)	46	(12.5)	7	(12.1)	(7.0)	69	(7.3)	25	(6.4)
Hispanic	(9.4)	33	(9.0)	7	(12.1)	(6.8)	70	(7.4)	21	(5.3)
Other	(7.1)	24	(6.5)	6	(10.3)	(5.3)	54	(5.7)	17	(4.3)
Education										
High school or less	(15.3)	55	(15.0)	10	(17.2)	(15.6)	153	(16.2)	55	(14.0)
Some college/Associates	(59.5)	223	(60.8)	30	(51.7)	(55.2)	529	(56.2)	208	(52.9)
Bachelors or higher	(25.2)	89	(24.3)	18	(31.0)	(29.2)	260	(27.6)	130	(33.1)
Marital Status										
Never Married	(18.1)	66	(18.0)	11	(19.0)	(17.4)	168	(17.8)	64	(16.3)
Married	(60.9)	217	(59.1)	42	(72.4)	(65.5)	616	(65.4)	259	(65.9)
Divorced, widowed, separated	(20.9)	84	(22.9)	5	(8.6)	(17.1)	158	(16.8)	70	(17.8)
Military Factors										
Service Component										
Reserve/National Guard	(37.4)	139	(37.9)	20	(34.5)	(38.7)	357	(37.9)	160	(40.7)
Active Duty	(62.6)	228	(62.1)	38	(65.5)	(61.3)	585	(62.1)	233	(59.3)
Service Branch										
Air Force	(15.3)	57	(15.5)	8	(13.8)	(23.9)	239	(25.4)	80	(20.4)
Army	(62.6)	232	(63.2)	34	(58.6)	(49.5)	462	(49.0)	199	(50.6)
Marines	(5.6)	19	(5.2)	5	(8.6)	(6.1)	55	(5.8)	26	(6.6)
Navy & Coast Guard	(16.5)	59	(16.1)	11	(19.0)	(20.5)	186	(19.7)	88	(22.4)
Military Occupation										

Health Care	(12.7)	46	(12.5)	8	(13.8)	(14.4)	129	(13.7)	63	(16.0)
Combat	(18.4)	69	(18.8)	9	(15.5)	(17.6)	168	(17.8)	67	(17.0)
All other occupations	(68.9)	252	(68.7)	41	(70.7)	(68.0)	645	(68.5)	263	(66.9)
Paygrade										
Officer	(16.9)	60	(16.3)	12	(20.7)	(22.4)	206	(21.9)	93	(23.7)
Enlisted	(83.1)	307	(83.7)	46	(79.3)	(77.6)	736	(78.1)	300	(76.3)
Combat Deployment Status (ever during follow-up)										
Not deployed	(62.8)	233	(63.5)	34	(58.6)	(65.9)	623	(66.1)	257	(65.4)
Deployed without combat	(5.2)	20	(5.5)	2	(3.5)	(7.0)	70	(7.4)	24	(6.1)
Deployed with combat	(32.0)	114	(37.9)	22	(37.9)	(27.0)	249	(26.4)	112	(28.5)
Service status (during follow-up)										
Actively serving	(31.8)	106	(28.9)	29	(50.0)	(32.0)	327	(34.7)	100	(25.4)
Separated from service	(68.2)	261	(71.1)	29	(50.0)	(68.0)	615	(65.3)	293	(74.6)
Enrollment Panel										
Panel 1	(76.7)	275	(74.9)	51	(87.9)	(67.3)	629	(66.8)	269	(68.4)
Panel 2	(23.3)	92	(25.1)	7	(12.1)	(17.8)	170	(18.0)	67	(17.0)
Panel 3	Not enough follow-up time for BN recurrence analyses					(15.0)	143	(15.2)	57	(14.5)
Behavioral health factors										
PTSD										
No	(60.9)	224	(61.0)	35	(60.3)	(75.1)	712	(75.6)	290	(73.8)
Yes	(39.1)	143	(39.0)	23	(39.7)	(24.9)	230	(24.4)	103	(26.2)
Major depressive disorder										
No	(70.8)	261	(71.1)	40	(69.0)	(79.9)	765	(81.2)	302	(76.8)
Yes	(29.2)	106	(28.9)	18	(31.0)	(20.1)	177	(18.8)	91	(23.2)
Anxiety disorder										
No	(78.1)	288	(78.5)	44	(75.9)	(86.5)	823	(87.4)	332	(84.5)
Yes	(21.9)	79	(21.5)	14	(24.1)	(13.5)	119	(12.6)	61	(15.5)
Sexual assault										
No	(83.5)	308	(83.9)	47	(81.0)	(85.8)	812	(86.2)	334	(85.0)
Yes	(16.5)	59	(16.1)	11	(19.0)	(14.2)	130	(13.8)	59	(15.0)
Problem drinking										
No	(69.2)	249	(67.8)	45	(77.6)	(71.6)	663	(70.4)	293	(74.6)
Yes	(30.8)	118	(32.2)	13	(22.4)	(28.4)	279	(29.6)	100	(25.4)
Smoking status										
Nonsmoker	(51.1)	187	(51.0)	30	(51.7)	(51.4)	484	(51.4)	202	(51.4)
Past smoker	(30.4)	110	(30.0)	19	(32.8)	(34.0)	311	(33.0)	143	(36.4)
Current smoker	(18.6)	70	(19.1)	9	(15.5)	(14.6)	147	(15.6)	48	(12.2)

Social support										
Feels supported	(55.8)	210	(57.2)	27	(46.6)	(66.7)	653	(69.3)	238	(60.6)
Does not feel supported	(44.2)	157	(42.8)	31	(53.4)	(33.3)	289	(30.7)	155	(39.4)
Stressful life events										
None	(59.5)	216	(58.9)	37	(63.7)	(69.1)	657	(69.7)	265	(67.4)
1 event	(26.1)	101	(27.5)	10	(17.2)	(21.3)	199	(21.1)	85	(21.6)
2 events	(12.2)	44	(12.0)	8	(15.4)	(7.8)	67	(7.1)	37	(9.4)
3 or more events	(2.1)	6	(1.6)	3	(5.2)	(1.9)	19	(2.0)	6	(1.5)

Table 6. Unadjusted and Adjusted Odds Ratios for the Reoccurrence of Eating Disorders, 2001-2015

Characteristics	Bulimia Nervosa Total N= 425 Recurrence of Bulimia Nervosa n = 58						Binge Eating Disorder Total N = 1335 Recurrence of Binge Eating Disorder n = 393					
	Unadjusted			Adjusted			Unadjusted			Adjusted		
	Odds Ratio	95% CI lower	95% CI upper	Odds Ratio	95% CI lower	95% CI upper	Odds Ratio	95% CI lower	95% CI upper	Odds Ratio	95% CI lower	95% CI upper
Demographic Factors												
Sex												
Male	1.00			1.00			1.00			1.00		
Female	0.54	(0.29,	1.00)	**0.32**	**(0.13,**	**0.80)**	0.87	(0.71,	1.07)	0.77	(0.59,	1.00)
Birth year												
Before 1960	1.00			1.00			1.00			1.00		
1960-1969	0.60	(0.26,	1.38)	0.40	(0.15,	1.07)	1.28	(1.14,	0.86)	**1.52**	**(1.31,**	**0.97)**
1970-1979	0.53	(0.23,	1.23)	0.46	(0.15,	1.36)	1.74	(1.00,	0.75)	**1.35**	**(1.21,**	**0.86)**
1980 and beyond	0.47	(0.18,	1.22)	1.34	(0.30,	6.01)	2.41	(1.40,	1.03)	**1.91**	**(1.42,**	**0.88)**
Race/ethnicity												
White non-Hispanic	1.00			1.00			1.00			1.00		
Black non-Hispanic	1.05	(0.43,	2.57)	1.76	(0.62,	5.02)	0.88	(0.60,	1.28)	0.81	(0.54,	1.21)
Hispanic	1.36	(0.54,	3.40)	1.92	(0.64,	5.79)	0.83	(0.54,	1.27)	0.81	(0.52,	1.25)
Other	1.55	(0.57,	4.20)	1.98	(0.60,	6.52)	0.97	(0.62,	1.52)	0.93	(0.58,	1.47)
Education												
High school or less	1.00			1.00			1.00			1.00		
Some college or Associates	0.72	(0.32,	1.62)	0.71	(0.26,	1.94)	0.92	(0.69,	1.22)	0.95	(0.70,	1.28)
Bachelor's or higher	1.12	(0.47,	2.70)	0.92	(0.24,	3.58)	1.02	(0.76,	1.38)	1.25	(0.84,	1.86)
Marital Status												
Married	1.00			1.00			1.00			1.00		
Never married	0.93	(0.44,	1.97)	0.75	(0.33,	1.66)	1.10	(0.85,	1.42)	1.12	(0.85,	1.48)
Divorced	**0.27**	**(0.10,**	**0.71)**	**0.15**	**(0.05,**	**0.53)**	1.03	(0.80,	1.34)	1.03	(0.77,	1.38)
Military Factors												
Service Component												
Reserve/National Guard	1.00			1.00			1.00			1.00		
Active Duty	1.10	(0.61,	2.02)	1.04	(0.47,	2.33)	0.99	(0.82,	1.20)	0.85	(0.68,	1.05)
Service Branch												
Air Force	1.00			1.00			1.00			1.00		
Army	0.96	(0.41,	2.26)	1.25	(0.47,	3.35)	1.23	(0.96,	1.58)	1.16	(0.89,	1.51)

Marines	1.39	(0.38,	5.09)	3.09	(0.67,	14.59)	**1.70**	**(1.12,**	**2.59**)	1.43	(0.91,	2.25)
Navy & Coast Guard	1.42	(0.51,	3.95)	1.80	(0.56,	5.77)	1.28	(0.96,	1.71)	1.26	(0.93,	1.70)
Military Occupation												
All other occupations	1.00			1.00			1.00			1.00		
Combat	0.75	(0.34,	1.66)	0.61	(0.24,	1.53)	0.96	(0.74,	1.24)	0.88	(0.67,	1.15)
Health Care	0.88	(0.38,	2.06)	1.16	(0.42,	3.19)	1.09	(0.84,	1.42	1.11	(0.84,	1.48)
Paygrade												
Officer	1.00			1.00			1.00			1.00		
Enlisted	0.72	(0.35,	1.48)	0.79	(0.25,	2.51)	1.00	(0.80,	1.24)	1.03	(0.75,	1.44)
Combat Deployment Status[a] (ever during follow-up)												
Not deployed	1.00			1.00			1.00			1.00		
Deployed without combat[a]							0.78	(0.55,	1.13)	1.12	(0.76,	1.66)
Deployed with combat	1.36	(0.76,	2.46)	0.80	(0.37,	1.73)	1.10	(0.89,	1.36)	**1.34**	**(1.06,**	**1.69)**
Service status (during follow-up)												
Actively serving	1.00			1.00			1.00			1.00		
Separated from service	**0.52**	**(0.29,**	**0.94)**	**0.31**	**(0.14,**	**0.69)**	**1.63**	**(1.32,**	**2.02)**	**1.79**	**(1.40,**	**2.28)**
Enrollment Panel												
Panel 1	1.00			1.00			1.00			1.00		
Panel 2[b]	**0.36**	**(0.15,**	**0.84)**	**0.20**	**(0.05,**	**0.74)**	1.14	(0.87,	1.49)	1.04	(0.73,	1.48)
Panel 3							**1.89**	**(1.40,**	**2.54)**	**1.70**	**(1.14,**	**2.56)**
Behavioral health factors												
PTSD												
No	1.00			1.00			1.00			1.00		
Yes	0.91	(0.51,	1.65)	0.73	(0.28,	1.88)	1.11	(0.89,	1.38)	0.81	(0.61,	1.08)
Major depressive disorder												
No	1.00			1.00			1.00			1.00		
Yes	1.07	(0.57,	1.99)	1.30	(0.48,	3.57)	**1.40**	**(1.12,**	**1.76)**	**1.45**	**(1.06,**	**1.97)**
Anxiety disorder												
No	1.00			1.00			1.00			1.00		
Yes	1.09	(0.55,	2.14)	1.10	(0.45,	2.70)	1.27	(0.97,	1.65)	0.97	(0.69,	1.37)
Sexual assault												
No	1.00			1.00			1.00			1.00		
Yes	1.31	(0.62,	2.75)	**3.02**	**(1.10,**	**8.34)**	1.06	(0.82,	1.38)	1.22	(0.89,	1.67)
Problem drinking												
No	1.00			1.00			1.00			1.00		
Yes	0.58	(0.30,	1.15)	0.52	(0.23,	1.17)	0.96	(0.77,	1.18)	0.84	(0.66,	1.05)

Smoking status												
Nonsmoker	1.00			1.00			1.00			1.00		
Past smoker	1.04	(0.54,	1.97)	1.42	(0.66,	3.02)	1.06	(0.86,	1.30)	1.06	(0.85,	1.31)
Current smoker	0.80	(0.35,	1.81)	0.92	(0.34,	2.52)	0.84	(0.62,	1.13)	0.73	(0.53,	1.00)
Social support												
Feels supported	1.00			1.00			1.00			1.00		
Does not feel supported	1.45	(0.82,	2.59)	1.99	(0.95,	4.18)	**1.32**	**(1.09,**	**1.61)**	**1.35**	**(1.09,**	**1.68)**
Stressful life events												
0	1.00			1.00			1.00			1.00		
1	0.46	(0.22,	1.00)	0.85	(0.34,	2.11)	1.12	(0.88,	1.41)	1.08	(0.84,	1.39)
2[c]	1.01	(0.46,	2.19)	2.04	(0.69,	6.04)	1.36	(0.97,	1.89)	1.14	(0.78,	1.66)
3 or more							0.81	(0.36,	1.82)	0.54	(0.23,	1.28

a. The deployment categories of deployed without combat and deployed with combat were collapsed into a single category of "deployed" since there were only 2 participants who experience recurrence of Bulimia Nervosa who deployed without combat (see Table 5).

b. Panel 3 were not used in the recurrence of Bulimia Nervosa analyses since these participants only had 2 survey time points, and 3 time points were required for these analyses.

c. The stressful life events categories of 2 and 3 or more were collapsed into "2 or more" for the recurrence of Bulimia Nervosa analyses since there were only 3 participants with recurrence of Bulimia Nervosa who experienced 3 or more stressful life events.

SOW Major Task 4: Conduct analyses to determine relationship between eating disorders and comorbid conditions

Subtask 1: Use non-linear mixed models to estimate prevalence of BN, BED, and OSFED conditional on the presence of comorbid conditions

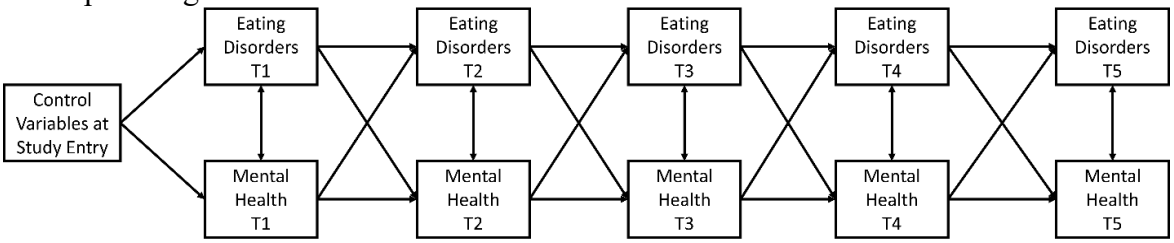
Subtask 2: Use complementary log-log models to determine whether unique temporal patterns exist between the development of BN, BED, or OSFED and comorbid conditions

Sample
Of the 201,619 Millennium Cohort Participants, 124,268 participants who were active duty at study entry and had at least two survey time points (baseline and at least one follow-up survey) were included in the eligible analytic sample.

Measures
EDs were defined using survey data as previously described under SOW major task 3. Posttraumatic stress disorder was defined using the PTSD Checklist for DSM-IV (PCL) and DSM-IV criteria given that these data were from 2001-2014. Depression, anxiety disorder and problem drinking were measured using the Patient Health Questionnaire (PHQ) screening tool.

Analyses
Cross-lagged panel models were used to assess the bidirectional associations between EDs and mental health outcomes (see Conceptual Figure). Separate analyses were conducted for all mental health outcome variables (i.e., Probable Depression, Probable PTSD, Probable Anxiety, and Problem Drinking) and eating disorders (Binge Eating Disorder, Bulimia Nervosa). Consistent with prior recommendations (Martens & Haase, 2006) and research in veteran populations (Cowlishaw et al., 2021; Kartal et al., 2021), a sequential series of models were used to assess the relationship between eating disorders and mental health: (a) an autoregressive model with no cross-lagged pathways, (b) a unidirectional model with autoregressive effects and unidirectional paths from eating disorders to mental health, (c) an alternative unidirectional model with paths from mental health to eating disorders, and (d) a fully cross-lagged model with autoregressive effects and simultaneous bidirectional pathways between eating disorders and mental health outcomes. Model fit was compared across the nested models to determine the final model.

Conceptual Figure.



Results
Preliminary analyses were conducted examining associations between Binge Eating Disorder and mental health outcomes (PTSD, Depression, Anxiety, Problem Drinking). Models examining bidirectional associations between Bulimia Nervosa and mental health outcomes are currently

underway. All models controlled for enrollment panel, birthyear, sex, race, ethnicity, education, marital status, service branch, military occupation, paygrade, combat/deployment experience, smoking status, and life stressors at study entry.

In brief, although evidence of bidirectionality emerged between BED and three of the four mental health outcomes (Depression, Anxiety, Problem Drinking), mental health was consistently a stronger predictor of subsequent BED. Specifically, compared with those who did not screen positive, those with depression had increased risk of subsequent BED (unstandardized estimate = .11, SE = .01, $p < .001$). Screening positive for BED was associated with increased risk of screening positive for depression (unstandardized estimate = .03, SE = .01, $p = .009$). Compared with those who did not screen positive, those who screened positive for problem drinking had increased risk of screening positive for subsequent BED (unstandardized estimate = .06, SE = .01, $p < .001$). Additionally, those who screened positive for BED had increased risk of screening positive for subsequent problem drinking (unstandardized estimate = .07, SE = .09, $p < .001$). Compared with those who did not screen positive, those who screened positive for anxiety had increased risk of screening positive for subsequent BED (unstandardized estimate = .12, SE = .01, $p < .001$). Binge eating disorder was also a significant prospective predictor of anxiety (unstandardized estimate = .06, SE = .01, $p <.001$)

In models examining PTSD-BED associations, no evidence of bidirectionality emerged. Specifically, PTSD was a significant predictor of BED (unstandardized estimate = .10, SE = .01, $p < .001$) but BED did not predict subsequent PTSD.

SOW Major Task 6: Perform analyses on risk and protective factors for BED and OSFED in military spouses

Subtask 1: Use logistic regression models to determine significant risk and protective factors for BED or OSFED among Family Study participants

Sample
The service members' spouses were initially recruited between 2011 and 2013 to complete the baseline assessment (n = 9,872) and participants were contacted again in 2014 and 2015 for the follow-up assessment (n = 6,618). For purposes of this study, we excluded spouses who were divorced or separated at baseline (n=63), paper survey responders (n=772) and those with missing outcomes at follow-up (n=238). The final analytic sample for this aim included 5,545 military spouses with data across the two time points.

Measures
All spouse and service member measures were derived from self-reported survey data. Binge-eating was identified when the participant endorsed twice-weekly loss of control over eating and eating unusually large amounts of food (Spitzer et al., 1999). Risk and protective factors were assessed using baseline measures conceptualized as 1) individual factors - body-mass index, military status, PTSD, major depression, problem drinking, smoking, history of assault, and adverse childhood events, 2) group- and family level factors - social support, social isolation, number of children under 5, financial problems, 3) relationship factors - service member PTSD, major depression, problem drinking, and 4) military-stress factors - service member deployment, work-family conflict, military

life stress. The following baseline demographics were used as covariates in our analyses: sex, race/ethnicity, age, educational attainment, and service member branch, rank, and component.

Analyses
We used simple descriptive methods to characterize the sample at baseline. To identify factors associated with new onset binge eating disorder (BED), we regressed spouse BED at follow-up on these baseline factors, controlling for baseline BED to capture the change in BED status from baseline to follow-up.

Results
In order to examine baseline risk and protective factors that may contribute to new onset BED, we conducted simultaneous multiple regression (see Table below). Multivariable models indicated that a probable BED classification was more likely among spouses who: 1) had probable PTSD, relative to those who did not; 2) had one adverse childhood experience, relative to none; and 3) were former smokers, relative to non-smokers. A probable BED classification was less likely among spouses who were: 1) 44 years of age or older, relative to 17-24 years; and 2) married to a service member with a recent non-combat deployment, relative to no deployment.

Results highlight the need for interventions to improve coping skills among military spouses. This may help prevent the onset of adverse behavioral outcomes (e.g., BED) once other coping mechanisms have ceased (e.g., smoking). Interventions may also help spouses cope with military-family stressors, thus contributing to family functioning and service member deployment readiness.

Binary Logistic Regression Predicting Probable Binge Eating Disorder at Time 2

	Bivariate			Multivariable		
Variable	OR	LLCI	ULCI	OR	LLCI	ULCI
Sex						
Men	–	–	–	–	–	–
Women	1.13	0.75	1.69	1.46	0.60	3.51
Race/Ethnicity						
Person of color	–	–	–	–	–	–
White	0.82	0.61	1.10	0.70	0.40	1.21
Age						
17-24 years	–	–	–	–	–	–
25-34 years	0.67**	0.50	0.90	0.81	0.48	1.37
35-44 years	0.46*	0.24	0.88	0.43	0.17	1.09
Greater than 44 years	0.55	0.17	1.75	0.04**	0.01	0.35
Educational Attainment						
High school diploma or less	–	–	–	–	–	–
Some college/Associate's degree	0.99	0.68	1.43	1.46	0.71	3.00
Bachelor's degree or higher	0.50**	0.32	0.78	1.11	0.50	2.44
Military Status						
No military experience	–	–	–	–	–	–
Veteran	1.63*	1.10	2.42	1.28	0.59	2.78
Dual-military	0.55	0.30	1.01	0.87	0.34	2.24
Posttraumatic Stress						
No	–	–	–	–	–	–
Yes	3.62***	2.61	5.02	2.77*	1.21	6.35
Major Depression						
No	–	–	–	–	–	–
Yes	3.56***	2.44	5.20	0.76	0.31	1.91
Problematic Drinking						
No	–	–	–	–	–	–
Yes	1.74**	1.15	2.63	0.82	0.35	1.93
History of Assault						
None	–	–	–	–	–	–
Sexual assault only	0.76	0.41	1.40	0.65	0.30	1.41
Sexual harassment only	0.69	0.29	1.65	0.65	0.18	2.41
Physical assault only	1.18	0.47	2.98	0.81	0.17	3.98
More than one type	1.05	0.64	1.70	0.54	0.24	1.22
Adverse Childhood Experiences						
None	–	–	–	–	–	–
One experience	2.17***	1.50	3.12	1.88*	1.01	3.51
Two or more experiences	2.25***	1.62	3.13	1.65	0.92	2.98
Smoking Status						
Non-smoker	–	–	–	–	–	–
Former smoker	1.91***	1.32	2.77	2.23*	1.20	4.15
Current smoker	1.78***	1.29	2.46	1.70	0.92	3.14

High Social Support						
No	–	–	–	–	–	–
Yes	0.40***	0.30	0.53	0.85	0.50	1.44
Social Isolation						
No	–	–	–	–	–	–
Yes	2.68***	2.04	3.52	1.40	0.80	2.43
Number of Children Under Five						
None	–	–	–	–	–	–
One	0.92	0.67	1.27	1.00	0.58	1.70
Two or more	1.35	0.97	1.89	1.31	0.70	2.44
Work-Family Conflict						
Low work-family conflict	–	–	–	–	–	–
High work-family conflict	1.97***	1.44	2.69	1.50	0.81	2.80
Bothered by Financial Problems						
No	–	–	–	–	–	–
Yes	2.79***	2.02	3.84	1.49	0.85	2.63
Military-Life Stress						
No	–	–	–	–	–	–
Yes	1.66***	1.24	2.22	1.22	0.75	1.97
SM Deployment						
No deployment	–	–	–	–	–	–
Deployed; no combat exposure	0.52*	0.30	0.90	0.36*	0.15	0.87
Deployed; combat exposure	0.82	0.52	1.31	1.27	0.67	2.43
SM Posttraumatic Stress						
No	–	–	–	–	–	–
Yes	1.70**	1.19	2.43	1.35	0.60	3.02
SM Major Depression						
No	–	–	–	–	–	–
Yes	0.70	0.36	1.35	0.58	0.19	1.76
SM Problematic Drinking						
No	–	–	–	–	–	–
Yes	1.28	0.86	1.92	1.28	0.65	2.53
SM Rank						
Enlisted	–	–	–	–	–	–
Officer	0.46*	0.25	0.85	0.91	0.51	1.61
SM Branch						
Army	–	–	–	–	–	–
Navy or Coast Guard	1.00	0.68	1.47	1.20	0.66	2.19
Marine Corps	1.12	0.76	1.62	1.13	0.52	2.48
Air Force	0.91	0.62	1.34	1.62	0.87	3.03
SM Component						
Reserve or National Guard	–	–	–	–	–	–
Active-duty	0.81	0.60	1.11	0.75	0.40	1.40

Note. *p<.05, ** p<.01, *** p<.001

What opportunities for training and professional development has the project provided?

Dr. Neika Sharifian attended a four-day Statistical Horizons workshop on Categorical Structural Equation Modeling in June 2022 taught by Dr. Kevin J. Grimm focusing on best practices and strategies for handling categorical dependent variables within a structural equation modeling framework. Structural equation modeling is a beneficial framework for analyzing complex, longitudinal datasets, however, a majority of resources often discuss the use of structural equation modeling using normally distributed outcomes and limited resources are available that outline appropriate strategies for handling non-normal models. This workshop allowed Dr. Sharifian to utilize a more robust analytic strategy (e.g., cross-lagged panel models) to test the potential bi-directional associations between eating disorders and mental health.

How were the results disseminated to communities of interest?

Nothing to Report (not yet at dissemination phase).

What do you plan to do during the next reporting period to accomplish the goals?

In the next reporting period, as stated in the SOW, we plan to finish up existing tasks and complete major task 7, which is to prepare reports and manuscripts to disseminate research findings. Subtask 1 will be to prepare for DoD and other scientific conference presentations. Subtask 2 will be to draft any reports and publications for publication in the peer-review literature. Paper topics will include: 1) Prevalence and Risk Factors for the Development and Recurrence of BN and BED in a large US Military Cohort, 2) Examination of Temporal Patterns of Eating Disorders and Comorbid Conditions among US Military Service Members, and 3) Prevalence and Risk Factors for the Development of BED in Military Spouses. Finally, we will disseminate findings through significant item research reports and the research transition office to ensure appropriate end users in the DoD and VA are aware of findings. Upon completion of these tasks all funded grant work will be completed, and all findings will have been disseminated.

4. IMPACT:

What was the impact on the development of the principal discipline(s) of the project?

Nothing to report.

What was the impact on other disciplines?

Nothing to report.

What was the impact on technology transfer?

Nothing to report.

What was the impact on society beyond science and technology?

Nothing to report.

5. CHANGES/PROBLEMS:

Changes in approach and reasons for change

Minor changes to the analytic approach were made for SOW Major Task 4. We aimed to describe the patterns of comorbidity between eating disorders (EDs) and other mental health conditions, particularly regarding order of onset. Therefore, it was determined that the use of cross-lagged panel models (CLPMs) were a more robust analytic strategy to test these prospective associations. Specifically, CLPMs are commonly used to test the temporal sequence between two variables in longitudinal research. This design examines both pathways of interest (e.g., eating disorders → mental health, mental health → eating disorders) simultaneously, while controlling for all potential relationships among the variables (Martens & Haase, 2006). This method is also considered more conservative than a regression analysis as both dependent variables are entered into the model and allowed to covary, thereby reducing multicollinearity and variance in the dependent variables to be explained by independent variables. This approach also allows for the combination of subtask 1 and subtask 2, since the prevalence of the EDs conditional on the presence of mental health disorders can be identified through this approach.

Actual or anticipated problems or delays and actions or plans to resolve them

Nothing to report. Minor delays in finalizing analyses will be resolved in the coming months, and all aims are expected to be completed in the final year of funding.

Changes that had a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use of biohazards and/or select agents

Nothing to report.

6. PRODUCTS:

- **Publications, conference papers, and presentations**

Journal publications.

Nothing to report.

Books or other non-periodical, one-time publications.

Nothing to report.

Other publications, conference papers and presentations.

Ray, T.N., McMaster, H.S., Esquivel, A., Jacobson, I.G., & Maguen, S. (2022, September). Predictors of probable binge eating disorder among active duty military spouses. Poster accepted for presentation at the Military Health System Research Symposium 2022 Annual Meeting, Kissimmee, Florida.

- **Website(s) or other Internet site(s)**

  Nothing to report.

- **Technologies or techniques**

  Nothing to report.

- **Inventions, patent applications, and/or licenses**

  Nothing to report.

- **Other Products**

  Nothing to report.

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

Name: Shira Maguen
Project Role: Principal Investigator, San Francisco VAMC
Nearest person month worked: 2.3
Contribution to Project: Dr. Maguen has provided coordination, oversight, and management of all tasks outlined in the research plan, working closely with her co-investigators.

Name: Rudy Rull
Project Role: Principal Investigator of the Millennium Cohort Study, Naval Health Research Center
Nearest person month worked: 1.8

Contribution to Project: As PI of the Millennium Cohort Study, Dr. Rull is responsible implementation and compliance, ensuring that all NHRC personnel are properly trained and qualified, data interpretation, and the publication and dissemination of study findings.

Name: Isabel Jacobson
Project Role: Co-Investigator
Nearest person month worked: 3.6
Contribution to Project: Ms. Jacobson is responsible for assisting with the design of the study, data interpretation, and scientific manuscript preparation, as well as assisting with the statistical analyses.

Name: Hope McMaster
Project Role: Co-Investigator
Nearest person month worked: 1.8
Contribution to Project: Dr. McMaster is responsible for overseeing the execution of the exploratory aim for this project, consisting of evaluating risk factors for the development of binge eating disorders in military spouses. In addition, she will be integral in drafting the manuscript related to the Family Study exploratory aim.

Name: Travis Ray
Project Role: Data Analyst
Nearest person month worked: 3
Contribution to Project: Mr. Ray provides analytic and writing support.

Name: Neika Sharifian
Project Role: Co-Investigator
Nearest person month worked: 2
Contribution to Project: Dr. Sharifian is responsible for analyses specific to examining the temporal sequence of eating disorders in relation to other mental health disorders. She is also responsible for checking code of other analysts on the project, and writing reports and scientific manuscripts for peer-reviewed professional journals and presentations.

Name: Toni Rose Geronimo-Hara
Project Role: Data Analyst
Nearest person month worked: 6
Contribution to Project: Ms. Geronimo-Hara provides statistical and analytical support, assists in processing and maintenance of research databases; and will assist in writing of reports and scientific manuscripts for peer-reviewed professional journals and presentations.

Name: Alex Esquivel
Project Role: Data Analyst
Nearest person month worked: 4.2
Contribution to Project: Mr. Esquivel provides statistical and analytical support, assists in processing and maintenance of research databases; and assists in writing of reports and scientific manuscripts for peer-reviewed professional journals and presentations.

Name: Gia Gumbs
Project Role: Data Analyst/Study Coordinator
Nearest person month worked: 1.2
Contribution to Project: Ms. Gumbs is responsible for assisting with coordinating data management. In addition, she is responsible for arranging meetings, teleconferences, and other communication necessary for the project. She also assists with filing of documents and other files related to manuscript planning, writing, and submission.

Name: Haley Mehlman
Project Role: Study Coordinator
Nearest person month worked: 6
Contribution to Project: Ms. Mehlman is responsible for multiple administrative aspects of the project. She is responsible for arranging meetings, teleconferences, and other communication necessary for the project. She also assists with maintaining the IRB, assisting with reports, and tracking important project deadlines.

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

Nothing to report.

What other organizations were involved as partners?

Nothing to report.

8. SPECIAL REPORTING REQUIREMENTS

AWARD CHARTS:

Please see attachments.

9. APPENDICES:

Not applicable/Nothing to report.