

## Millennium Cohort: The 2001–2003 baseline prevalence of mental disorders in the U.S. military

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### Abstract

**Objectives:** The 12-month prevalence of common mental illnesses in the United States is estimated to be 26%, accounting for an increasing fraction of all disability in the general population. The U.S. military is a unique group involved in response and defense during times of conflicts and disasters. The mental health of service members affects organizational productivity and effectiveness and is of great importance to the health of U.S. military members and public health in general.

**Study Design and Setting:** In the present report, the authors describe the baseline prevalence of mental disorders in a large U.S. military cohort, the Millennium Cohort, established for a 22-year longitudinal study of the health effects of military service. Using crude and weighted prevalence and multivariable logistic regression, the mental health morbidity of the Millennium Cohort is reported for various demographics.

**Results:** These analyses suggest that although the cohort compares favorably to other populations, there are military subpopulations, including women, younger, less educated, single, white, short-term service, enlisted, and Army members, who are at greater odds for some mental disorders.

**Conclusion:** With ongoing U.S. involvement in combat operations around the world, these baseline data are essential to assessing long-term mental health morbidity in U.S. military service members. © 2007 Elsevier Inc. All rights reserved.

**Keywords:** Mental health; Morbidity; Military medicine; Military personnel; Cohort studies; Veterans

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### 1. Introduction

The 12-month prevalence of common mental illnesses among adults in the United States is estimated to be 26% [1]. This prevalence placed the United States highest out of 14 countries chosen from the Americas, Europe, the Middle East, and Asia. The United States also ranked highest in severe disorder prevalence (7.7%) [1]. Mental disorders accounted for nearly 11% of the disease burden worldwide in 1990, ranking these afflictions almost as harmful to public health as cardiovascular and respiratory diseases [2]. In a subsequent 2001 World Health Report focusing on mental health, the global burden of disease from

mental disorders was estimated to have increased to 12% and projected to reach 15% by 2020 [3]. This report further documented circumstances or characteristics associated with increased mental health disorders, including poverty, sex, age, major physical diseases, family or social environment, and conflicts or disasters [3].

The U.S. military is frequently called upon as the first line of response or defense in conflicts and disasters, often resulting in service members' separation from family or home life for extended periods of time. When service-related risk factors known to be associated with increased mental health morbidity are considered in conjunction with normal population risk factors, the mental health of this population becomes a topic of much concern. Hoge et al. [4] reported that 13% of all military hospitalizations and 28% of all military hospital bed days from 1990 to 1999 were due to mental disorders, and nearly half of those with a first time mental disorder hospitalization separated from military service within 6 months. Reports have suggested that personnel involved in combat operations or peacekeeping missions following combat may have increased symptoms of psychological distress [5–12], with one report recently suggesting significant risk of mental health problems after combat duty in Iraq and Afghanistan [13]. With America's dependence on a fit and healthy force for the security of this nation, maintaining sound mental health of all military personnel is one of the primary goals of military medicine.

The mental health of military service members affects organizational productivity and effectiveness and is of great importance to the U.S. military for retention, readiness, and mission capability. The military is also committed to protecting the health, both physical and mental, of all service members. In this report, the authors describe the baseline prevalence of mental disorders in a large U.S. military cohort that will be longitudinally followed until 2022.

## 2. Materials and methods

### 2.1. Study population

The methodology for the Millennium Cohort Study has been described in detail elsewhere [14]. In brief, those invited to participate in the Millennium Cohort Study came from a sample provided by the Defense Manpower Data Center (DMDC), Seaside, California, representing approximately 11.3% of the 2.2 million men and women in service as of October 1, 2000. U.S. military personnel serving in the Army, Navy, Coast Guard, Air Force, and Marine Corps were selected and oversampled for those previously deployed to Southwest Asia, Bosnia, or Kosovo during the 1998–2000 time period, U.S. Reserve and National Guard members, and female service members to ensure adequate power for statistical inferences over the 22-year follow-up period. Using a modified Dillman approach [15], Web and U.S. Postal Service-based enrollment began in July 2001. Enrollment ended on June 30, 2003, with

77,047 consenting participants, or 35.9% of the invited nondeceased, eligible, and contacted target population.

Demographic data for the Millennium Cohort Study participants were provided by DMDC and reflected status as of October 1, 2000. These data included date of birth, marital status, sex, race/ethnicity, Department of Defense primary and duty occupations, service branch (Army, Navy, Coast Guard, Air Force, and Marines), service component (active duty and Reserve/Guard), highest education level, pay grade, Unit Identification Code, beginning date of active service, date and reason for separation from service, social security number, and recent deployment to southwest Asia, Bosnia, or Kosovo (January 1, 1998 to September 1, 2000). For this study, missing demographic data for marital status, occupation, education, and pay grade were supplemented with self-reported data from the survey whenever possible. This reduced those missing data for at least one demographic characteristic from 1.8% to 0.4% of the cohort.

### 2.2. Mental health status

The Millennium Cohort Study questionnaire consists of more than 450 questions and components regarding diagnosed medical conditions, reported symptoms, psychosocial assessment, physical status, functional status, alcohol use, tobacco use, occupation, alternative medicine use, exposures, sleep patterns, and basic demographic and contact data [16]. Mental health measures for this report were based on two standardized instruments: the Primary Care Evaluation of Mental Disorders Patient Health Questionnaire (PHQ) [17–19] and the posttraumatic stress disorder (PTSD) Checklist-Civilian Version (PCL-C) [20,21]. Additionally, an aggregate measure of PTSD or one of the five PHQ measures was analyzed.

Using standardized scoring algorithms [17–19], the PHQ provides a psychosocial assessment based on scores of several health concepts. Reliability and validity of this instrument has been investigated in a study of 3,000 adult primary care patients, comparing self-administered PHQ to primary care physician diagnosis found to have a moderate level of reliability (Kappa = 0.65), high overall accuracy (85%), and high sensitivity (75%) and specificity (90%) [18]. Furthermore, sensitivity and specificity have also been reported high for two PHQ defined threshold disorders including major depressive disorder (sensitivity = 0.93; specificity = 0.89) [22] and panic disorder (sensitivity = 100%; specificity = 0.63) [23]. Measured for these analyses are threshold disorders (disorders that correspond to specific diagnoses from the *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition, DSM-IV), including major depressive syndrome (9 items) [24], panic syndrome (15 items), other anxiety syndrome (6 items), and bulimia nervosa (4 items), and subthreshold disorders (disorders for which criteria encompass fewer symptoms than are required for any specific DSM-IV diagnosis), including alcohol abuse (5 items) and binge-eating

disorders. Other anxiety syndrome makes up a generalized anxiety disorder category excluding anxiety about having a panic attack (panic disorder), being publicly embarrassed (social phobia), being contaminated (obsessive-compulsive disorder), being away from home or close relatives (separation anxiety disorder), gaining weight (anorexia nervosa), having multiple physical complaints (somatization disorder), or having a serious illness (hypochondriasis), and the anxiety and worry do not occur exclusively during PTSD. For the purposes of this report, binge-eating and bulimia nervosa disorders are combined into eating disorders. The PHQ defines alcohol abuse as an indication of at least one of five questions answered “yes” if in the past 6 months any experiences have happened more than once. Defining experiences include drinking alcohol even though a doctor suggested that you stop drinking because of a problem with your health; you drank alcohol, were high from alcohol, or hung over while you were working, going to school, or taking care of children or other responsibilities; you missed or were late for work, school, or other activities because you were drinking or hung over; you had a problem getting along with other people while you were drinking; or you drove a car after having several drinks or after drinking too much [17–19].

The PCL-C is a 17-item self-report measure of PTSD symptoms that requires respondents to rate the severity of each symptom during the past 30 days on a 5-point Likert scale (from 1 = not at all to 5 = extremely). Participants were identified as possibly having PTSD if they reported a moderate or above level of at least one intrusion symptom, three avoidance symptoms, and two hyperarousal symptoms [25], and had a total score of 50 or more on a scale of 17–85 [13,20,21,26]. Using this instrument, with a cutoff of 50 has been reported to be highly specific (specificity = 99%) in comparison to other instruments and other cutoff values with slightly lower sensitivity (60%), a positive predictive value of 75% and a negative predictive value of 97% [27].

### 2.3. Statistical analyses

Initial investigation of population characteristics included univariate analyses with chi-square tests of association to assess significant differences in the composition of the Millennium Cohort when compared with the demographic and military characteristics of the sampling frame of U.S. military in October 2000. Weighted and non-weighted (data not shown) prevalence estimates of mental disorders were calculated for demographic subgroups within the cohort. Weighting was based on the inverse of the sampling fraction for the three characteristics over-sampled: female, past deployed, and Reserve/Guard member. A multivariable exploratory model analysis was conducted to assess multicollinearity, significant associations, and possible confounding while simultaneously adjusting for all other covariates in the model. Multivariable logistic regression was used to compare the differences in

adjusted odds of mental health morbidity while controlling for possible confounders including sex, age, education, marital status, race/ethnicity, short- and long-term service, deployment status, pay grade, active-duty status, service branch, and occupation. Using SAS software (version 9.1, SAS Institute, Inc., Cary, NC, USA), prevalence, weighted prevalence, odds ratios (ORs), and 95% confidence intervals (CIs) were calculated for personnel with complete covariate data [28–30].

### 3. Results

Demographic data for this report were complete and available for 76,476 of 77,047 (99.3%) Millennium Cohort respondents. The cohort consisted of 73% men, 68% between 25 and 44 years of age, 51% with at least some college experience, 63% married, 70% white non-Hispanic, 30% recently deployed, 45% with less than 10 years of military service, 77% enlisted personnel, 57% active duty, 48% Army, and 20% combat specialists (Table 1). When compared with the U.S. military demographic and military characteristic distributions in October 2000, significant differences were observed for each population characteristic. These differences between the cohort and U.S. military population were largely due to oversampling to assure adequate representation of certain demographic groups. The cohort is composed of proportionally more service members who are older, educated, married, female, recently deployed, officer, in the Air Force, with longer time in service, and who are health care specialists.

Alcohol abuse defined by PHQ was the most prevalent mental health disorder identified in the cohort (non-weighted, 11.9% [data not shown]; weighted, 12.6% within 6 months) (Table 2). Weighted prevalence of other disorders in this cohort during the previous month was less than 4%; PTSD (2.4% within 1 month), major depressive disorder (3.2% within 2 weeks), panic syndrome (1.0% within 1 month), other anxiety syndrome (2.0% within 1 month), and eating disorders (3.1% within 3 months). The prevalence of all disorders was higher in women when compared with men except for alcohol abuse. In general, the six mental disorders were more prevalent in younger, less educated, single, nondeployed, short-term service, enlisted, and Army personnel. Weighted and nonweighted (data not shown) prevalence estimates were consistent in magnitude for the different subgroups of the cohort.

Model analyses began with investigation of multicollinearity using variance inflation factors of greater than four to establish collinearity. Length of service, age, and pay grade were modestly correlated but did not have variance inflation greater than four. These variables were carefully evaluated in the subsequent seven separate models constructed for each of the six individual mental disorders and one for any disorder.

Table 3 reports the multivariable logistic regression results. After adjusting for all variables in separate

Table 1  
 Characteristics of Millennium Cohort Study members (panel 1), June 30, 2001 to July 30, 2003, and the U.S. military in October 2000<sup>a</sup>

Variable	Cohort <i>n</i> (%), <i>N</i> = 76,476	U.S. military <sup>b</sup> <i>n</i> (%), <i>N</i> = 2,068,078	<i>P</i> value*
<b>Sex</b>			
Male	56,052 (73.3)	1,761,962 (85.2)	<0.0001
Female	20,424 (26.7)	306,116 (14.8)	
<b>Age (years)</b>			
17–24	14,466 (18.9)	672,919 (32.5)	<0.0001
25–34	26,829 (35.1)	702,523 (34.0)	
35–44	25,254 (33.0)	517,703 (25.0)	
>44	9,927 (13.0)	174,933 (8.5)	
<b>Education</b>			
No high school diploma	4,706 (6.2)	169,583 (8.2)	<0.0001
High school diploma/equivalent	32,832 (42.9)	1,110,558 (53.7)	
Some college	19,594 (25.6)	431,868 (20.9)	
Bachelor's degree	12,503 (16.4)	233,039 (11.3)	
Master's/PhD	6,841 (9.0)	121,878 (5.9)	
<b>Marital status</b>			
Single	22,914 (30.0)	855,488 (41.4)	<0.0001
Married	48,312 (63.2)	1,109,238 (53.6)	
Divorced	5,250 (6.9)	103,352 (5.0)	
<b>Race/ethnicity</b>			
White non-Hispanic	53,248 (69.6)	1,398,008 (67.6)	<0.0001
Black non-Hispanic	10,552 (13.8)	394,067 (19.1)	
Other	12,676 (16.6)	276,003 (13.4)	
<b>Recent deployment experience</b>			
No	53,536 (69.8)	1,861,270 (90.0)	<0.0001
Yes	23,182 (30.2)	206,808 (10.0)	
<b>Length of service (years)</b>			
0–4	19,714 (25.8)	774,424 (37.5)	<0.0001
5–9	14,922 (19.5)	370,773 (17.9)	
10–14	13,983 (18.3)	304,069 (14.7)	
> 14	27,857 (36.4)	618,812 (29.9)	
<b>Military pay grade</b>			
Enlisted	59,116 (77.3)	1,755,370 (84.9)	<0.0001
Commissioned officer	15,996 (20.9)	289,497 (14.0)	
Warrant officer	1,364 (1.8)	23,211 (1.1)	
<b>Service component</b>			
Reserve/Guard	32,883 (43.0)	854,087 (41.3)	<0.0001
Active duty	43,593 (57.0)	1,213,991 (58.7)	
<b>Branch of service</b>			
Army	36,357 (47.5)	961,242 (46.5)	<0.0001
Air Force	22,339 (29.2)	499,122 (24.1)	
Navy and Coast Guard	13,858 (18.1)	427,077 (20.7)	
Marines	3,922 (5.1)	180,637 (8.7)	
<b>Occupational category</b>			
Combat specialists	15,257 (20.0)	463,075 (22.4)	<0.0001
Electrical repair	6,730 (8.8)	172,152 (8.3)	
Communications/intelligence	5,390 (7.1)	148,859 (7.2)	
Health care specialists	7,906 (10.3)	169,049 (8.2)	
Other technical	1,969 (2.6)	57,377 (2.8)	
Functional support specialists	15,335 (20.1)	372,645 (18.0)	
Electrical/mechanic repair	11,353 (14.9)	325,395 (15.7)	
Craft workers	2,375 (3.1)	80,061 (3.9)	
Service support	6,659 (8.7)	200,935 (9.7)	
Students, prisoners, other	3,502 (4.6)	78,530 (3.8)	

\**P* values based on Pearson chi-square test of association.

<sup>a</sup> Only observations with complete Table 1 demographic data were used in this study.

<sup>b</sup> Demographic and military characteristics based on U.S. military service rosters for active-duty and Reserve/Guard members in sampling frame in October 2000.

Table 2  
Weighted<sup>a</sup> prevalence of PHQ and patient checklist defined mental health morbidity among Millennium Cohort participants

Variable	Any PHQ or PTSD (w%)	PTSD (w%)	Major depressive disorder (w%)	Panic syndrome (w%)	Other anxiety syndrome (w%)	Alcohol abuse (w%)	Eating disorders (w%)
Full cohort	18.3	2.4	3.2	1.0	2.0	12.6	3.1
Sex							
Male	18.4	2.2	2.8	0.9	1.7	13.4	2.9
Female	17.5	3.2	5.1	2.1	3.4	8.4	4.3
Age (years)							
17–24	29.9	3.8	5.5	1.6	3.0	22.8	3.7
25–34	17.9	2.2	2.9	0.9	1.9	12.4	3.3
35–44	14.4	2.1	2.4	1.0	1.7	9.0	2.9
>44	12.5	1.8	2.2	0.9	1.2	7.8	2.5
Education							
No high school diploma	25.0	3.8	5.1	1.8	3.1	17.9	3.6
High school diploma/equivalent	22.9	3.3	4.4	1.2	2.8	15.9	3.6
Some college	15.8	1.9	2.3	1.1	1.6	10.4	2.9
Bachelor's degree	12.8	1.1	1.5	0.6	0.8	9.2	2.3
Master's/PhD	8.8	0.6	1.0	0.4	0.6	5.3	2.7
Marital status							
Single	26.4	3.2	4.5	1.3	2.5	20.5	3.2
Married	14.6	2.0	2.5	0.9	1.7	9.1	3.1
Divorced	19.1	2.8	3.5	1.5	2.1	12.4	3.0
Race/ethnicity							
White non-Hispanic	19.3	2.2	3.0	1.1	2.0	13.7	3.3
Black non-Hispanic	15.3	2.8	4.0	1.0	2.1	9.1	2.1
Other	16.5	2.6	3.2	0.9	1.8	10.6	3.2
Recent deployment experience							
No	18.4	2.4	3.2	1.1	2.0	12.7	3.2
Yes	17.0	1.9	2.8	1.0	1.7	12.0	2.9
Length of service (years)							
0–4	25.9	3.5	4.8	1.4	2.8	19.2	3.4
5–9	18.9	2.2	3.1	1.0	2.0	13.3	3.3
10–14	15.3	1.9	2.4	0.7	1.6	10.1	3.1
>14	14.2	2.0	2.4	1.0	1.6	9.0	2.9
Military pay grade							
Enlisted	20.7	2.9	3.8	1.3	2.4	14.3	3.3
Commissioned officer	10.5	0.6	1.1	0.4	0.6	7.2	2.5
Warrant officer	11.0	1.5	1.3	0.2	1.1	7.0	2.2
Service component							
Reserve/Guard	19.1	2.2	2.7	1.0	1.6	14.1	2.7
Active duty	17.8	2.5	3.5	1.1	2.2	11.5	3.4
Branch of service							
Army	19.5	3.0	3.7	1.2	2.5	13.1	3.4
Air Force	13.0	1.2	1.8	0.9	1.2	8.8	2.3
Navy and Coast Guard	19.7	2.3	3.2	0.9	1.7	14.0	3.5
Marines	25.3	2.8	4.0	0.9	2.4	19.2	3.2
Occupational category							
Combat specialists	19.0	2.1	2.6	0.6	1.7	14.3	3.2
Electrical repair	17.7	2.2	2.9	1.0	1.6	12.4	3.1
Communications/intelligence	18.8	2.2	3.6	1.1	2.2	13.0	3.1
Health care specialists	14.8	2.2	2.8	1.2	2.0	8.7	3.6
Other technical	19.7	3.0	3.9	1.4	2.3	13.3	2.4
Functional support specialists	15.7	2.3	3.2	1.2	1.9	9.4	3.1
Electrical/mechanic repair	20.6	2.6	3.6	1.0	2.2	14.9	3.2
Craft workers	20.4	3.0	3.0	0.7	1.7	15.5	2.4
Service support	19.6	3.2	3.9	1.6	2.8	12.8	3.3
Students, prisoners, other	21.0	2.2	3.2	1.3	1.8	15.7	2.8

<sup>a</sup> Weighted for sampling differences in sex, military component, and prior deployment for those with complete demographic data.

Table 3

Adjusted odds using multiple logistic regression of PHQ and patient checklist defined mental health morbidity among Millennium Cohort subgroups

Variable	Any PHQ or PTSD		PTSD		Major depressive disorder		Panic syndrome		Other anxiety syndrome		Alcohol abuse		Eating disorders	
	OR <sup>a</sup>	CI <sup>a</sup>	OR	CI	OR	CI	OR	CI	OR	CI	OR	CI	OR	CI
	Sex													
Male <sup>b</sup>	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
Female	0.9	0.9–1.0	1.4	1.2–1.5	1.8	1.6–1.9	2.3	1.9–2.7	2.1	1.9–2.4	0.6	0.5–0.6	1.6	1.5–1.8
Age (years)														
17–24 <sup>b</sup>	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
25–34	0.7	0.7–0.8	0.9	0.8–1.0	0.8	0.7–1.0	0.8	0.6–1.0	1.0	0.8–1.2	0.6	0.6–0.7	0.9	0.8–1.0
35–44	0.6	0.6–0.7	1.2	0.9–1.4	1.0	0.8–1.2	1.1	0.8–1.6	1.1	0.9–1.4	0.5	0.5–0.6	0.8	0.7–1.0
>44	0.6	0.5–0.6	1.4	1.1–1.8	1.2	1.0–1.6	1.2	0.8–1.8	1.2	0.9–1.6	0.4	0.4–0.5	0.7	0.6–0.9
Education														
No high school diploma	1.1	1.0–1.1	1.1	0.9–1.3	1.2	1.0–1.4	1.3	1.0–1.6	1.3	1.1–1.5	1.0	0.9–1.1	1.0	0.9–1.2
High school diploma/equivalent <sup>b</sup>	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
Some college	1.0	0.9–1.0	0.9	0.7–1.0	0.8	0.7–0.9	1.0	0.8–1.2	0.9	0.8–1.0	1.0	0.9–1.0	1.1	0.9–1.2
Bachelor's degree	0.8	0.8–0.9	0.6	0.5–0.7	0.6	0.5–0.8	0.7	0.5–1.0	0.6	0.5–0.8	0.9	0.8–1.0	0.9	0.7–1.0
Master's/PhD	0.8	0.7–0.9	0.5	0.4–0.8	0.5	0.4–0.7	0.6	0.4–0.9	0.7	0.5–1.0	0.8	0.7–0.9	1.0	0.8–1.3
Marital status														
Single <sup>b</sup>	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
Married	0.7	0.7–0.8	0.9	0.8–1.0	0.9	0.8–1.0	1.0	0.8–1.2	1.0	0.9–1.2	0.6	0.6–0.6	1.1	1.0–1.2
Divorced	1.1	1.0–1.2	1.3	1.0–1.5	1.2	1.0–1.5	1.5	1.2–2.0	1.2	1.0–1.5	0.9	0.8–1.0	1.2	1.0–1.4
Race/ethnicity														
White non-Hispanic <sup>b</sup>	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
Black non-Hispanic	0.7	0.6–0.7	1.0	0.8–1.1	1.0	0.9–1.2	0.6	0.5–0.8	0.8	0.7–0.9	0.6	0.6–0.6	0.6	0.5–0.7
Other	0.9	0.8–0.9	1.2	1.1–1.4	1.1	0.9–1.2	0.9	0.8–1.1	0.9	0.8–1.1	0.8	0.8–0.9	0.9	0.8–1.0
Recent deployment experience														
No <sup>b</sup>	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
Yes	1.0	0.9–1.0	0.9	0.8–1.0	0.9	0.8–1.0	1.0	0.8–1.1	0.9	0.8–1.1	1.0	1.0–1.1	1.0	0.9–1.1
Length of service (years)														
0–4 <sup>b</sup>	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
5–9	0.9	0.9–1.0	0.8	0.7–0.9	0.8	0.7–0.9	0.9	0.7–1.1	0.9	0.7–1.0	1.0	0.9–1.0	1.0	0.9–1.2
10–14	0.9	0.8–1.0	0.7	0.6–0.9	0.8	0.7–0.9	0.8	0.6–1.0	0.8	0.6–1.0	0.9	0.8–1.0	1.0	0.9–1.2
>14	0.9	0.8–1.0	0.7	0.5–0.8	0.7	0.6–0.9	0.9	0.6–1.2	0.8	0.6–1.0	0.9	0.8–1.0	1.2	1.0–1.4
Military pay grade														
Enlisted <sup>b</sup>	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
Commissioned officer	0.6	0.6–0.7	0.4	0.3–0.5	0.5	0.4–0.6	0.5	0.3–0.6	0.4	0.3–0.5	0.7	0.6–0.8	0.7	0.6–0.9
Warrant officer	0.6	0.5–0.7	0.4	0.3–0.7	0.5	0.3–0.8	0.2	0.1–0.6	0.5	0.3–0.8	0.6	0.5–0.8	0.5	0.4–0.8
Service component														
Reserve/Guard <sup>b</sup>	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
Active duty	0.8	0.8–0.9	1.3	1.1–1.4	1.4	1.3–1.5	1.3	1.1–1.5	1.6	1.4–1.8	0.6	0.6–0.7	1.3	1.2–1.5
Branch of service														
Army <sup>b</sup>	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
Air Force	0.7	0.6–0.7	0.5	0.4–0.6	0.6	0.5–0.6	0.7	0.5–0.8	0.5	0.5–0.6	0.8	0.7–0.8	0.6	0.5–0.7
Navy and Coast Guard	1.0	1.0–1.1	0.7	0.6–0.8	0.8	0.7–0.9	0.9	0.7–1.0	0.7	0.6–0.8	1.2	1.1–1.2	0.9	0.8–1.0
Marines	1.2	1.1–1.3	0.8	0.7–1.0	0.9	0.8–1.1	0.8	0.6–1.1	0.8	0.7–1.1	1.4	1.3–1.5	0.8	0.6–1.0
Occupational category														
Combat specialists <sup>b</sup>	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—	1.0	—
Electrical repair	0.9	0.8–1.0	1.1	0.9–1.3	1.1	0.9–1.3	1.4	1.0–1.9	0.9	0.7–1.1	0.9	0.8–0.9	0.9	0.7–1.0
Communications/intelligence	0.8	0.8–0.9	0.8	0.7–1.1	1.1	0.9–1.3	1.2	0.9–1.7	0.9	0.7–1.1	0.8	0.7–0.9	0.8	0.6–0.9
Health care specialists	0.9	0.8–0.9	1.0	0.8–1.2	1.0	0.8–1.2	1.5	1.1–2.0	1.0	0.8–1.2	0.8	0.7–0.8	1.0	0.9–1.2
Other technical	0.9	0.8–1.0	1.0	0.8–1.4	1.1	0.9–1.5	1.4	0.9–2.1	0.9	0.7–1.3	0.9	0.8–1.0	0.9	0.7–1.2
Functional support specialists	0.8	0.8–0.9	0.9	0.8–1.1	1.0	0.9–1.1	1.2	1.0–1.6	0.8	0.7–1.0	0.7	0.7–0.8	0.9	0.8–1.0
Electrical/mechanic repair	0.9	0.9–1.0	1.0	0.9–1.2	1.1	0.9–1.2	1.3	1.0–1.7	1.1	0.9–1.3	0.9	0.8–1.0	0.9	0.8–1.1
Craft workers	0.9	0.8–1.0	1.3	1.0–1.7	1.0	0.8–1.3	1.0	0.6–1.6	0.9	0.6–1.2	0.9	0.8–1.0	0.7	0.6–1.0
Service support	0.9	0.9–1.0	1.2	1.0–1.4	1.1	1.0–1.3	1.8	1.4–2.4	1.2	1.0–1.5	0.8	0.8–0.9	1.0	0.8–1.1
Students, prisoners, other	0.8	0.7–0.9	0.9	0.7–1.1	0.9	0.8–1.2	1.3	0.9–1.9	0.9	0.7–1.1	0.7	0.6–0.8	1.0	0.8–1.2

<sup>a</sup> ORs and associated 95% CIs for those with complete demographic data are adjusted for sex, age, education, marital status, race/ethnicity, short- and long-term service, deployment status, pay grade, active-duty status, service branch, and occupation.

<sup>b</sup> Reference category for measure of association.



multivariable logistic models, women were at statistically significant increased adjusted odds of PTSD (OR = 1.4), major depressive disorder (OR = 1.8), panic syndrome (OR = 2.3), anxiety syndrome (OR = 2.1), and eating disorders (OR = 1.6), whereas at statistically significant decreased adjusted odds of alcohol abuse (OR = 0.6) when compared with men. Older personnel, when compared with personnel aged 17–24 years, were at significantly lower odds of any PTSD or PHQ morbidity (OR = 0.6), alcohol abuse (OR = 0.4), and eating disorders (OR = 0.7), and significantly higher odds of PTSD (OR = 1.4) and major depressive disorders (OR = 1.2). Personnel with a bachelor's degree or higher were at a significant decreased odds of any PHQ or PTSD morbidity, and specifically PTSD, major depressive disorder, panic syndrome, other anxiety syndrome, and alcohol abuse. Married personnel were at half the odds of alcohol abuse (OR = 0.6) when compared with single personnel. Black non-Hispanic personnel were at a significant decreased odds of any PHQ or PTSD (OR = 0.7), and specifically panic syndrome (OR = 0.6), other anxiety syndrome (OR = 0.8), alcohol abuse (OR = 0.6), and eating disorders (OR = 0.6) when compared with white non-Hispanics. Personnel in service for more than 14 years were at significantly lower odds of PTSD (OR = 0.7) and major depressive disorder (OR = 0.7) when compared with those in service for less than 4 years. Being an officer was strongly protective against mental health morbidity in all seven measures when compared with enlisted personnel. When compared with Reserve/Guard, active-duty personnel were significantly more likely to have symptoms of PTSD (OR = 1.3), major depressive disorder (OR = 1.4), panic syndrome (OR = 1.3), other anxiety syndrome (OR = 1.6), and eating disorders (OR = 1.3) and less likely to have symptoms of alcohol abuse (OR = 0.6). Air Force personnel were at significantly lower odds of each of the seven outcomes when compared with Army personnel, whereas Navy personnel were at lower odds of PTSD (OR = 0.7), major depressive disorder (OR = 0.8), and other anxiety syndrome (OR = 0.7), and at higher odds of alcohol abuse (OR = 1.2). Marines were at significant increased odds of alcohol abuse (OR = 1.4) when compared with Army personnel. There were no consistent statistically significant findings among occupational categories, although combat specialists appeared to be more likely to have symptoms of alcohol abuse and less likely to have symptoms of panic syndrome when compared with other occupations. Those recently deployed to southwest Asia, Bosnia, or Kosovo were not at statistically different adjusted odds of mental health morbidity when compared with those not recently deployed.

#### 4. Discussion

The worldwide prevalence of mental disorders has increased significantly during the past two decades and the

projected 15% prevalence by 2020 [3] will have far-reaching public health implications [31]. The complex nature of identifying mental disorders, coupled with multiple causal pathways and diverse populations in which these conditions present, make this a likely underestimate of the true burden of disease. The U.S. military represents the diversity of the U.S. population with varying ethnic groups, social backgrounds, occupations, and demographic characteristics. Military personnel may be less likely to seek medical evaluation and feel more alienated due to real or perceived stigma regarding mental health conditions than what might be seen in the general public. This underscores the importance of understanding the burden of mental disorders in this population, which may be underreported in medical databases. Mental health disorders in military service members have a broad impact on military readiness through diminished organizational productivity and effectiveness. The results of this report suggest that although there are subpopulations in need of further study and potential intervention, the mental health of this military cohort compares favorably to the U.S. population in general.

The prevalence of the mental disorders, other than alcohol abuse, was found to be consistent with or less common than that of other reports on military and nonmilitary populations [13,32–43]. For example, the prevalence of PTSD in the weighted military sample was 2.4% compared with 3.5% in the recent National Comorbidity Survey Replication (NCS-R) of households [44], major depressive disorder prevalence was 3.2% compared with 6.7% in the NCS-R sample, and panic syndrome was 1.0% compared with 2.7% in the NCS-R sample. These studies are not directly comparable because of different survey methodology, different population demographics, and the fact that the NCS-R study focused on 12-month prevalence rather than 1-month prevalence rates.

However, the rates that we detected are well within expected prevalence estimates from numerous studies [13,32–43]. A previous study that extrapolated Epidemiologic Catchment Area (ECA) data to a military population estimated the prevalence of panic syndrome in a military population to be 0.9% [45]. This compared with 1.0% detected in this direct survey of a military population. Major depressive disorder was estimated to have a prevalence of 3.8%, based on the extrapolated ECA data, compared with 3.2% that we detected. PTSD was not measured in the ECA study.

As reported elsewhere [46–48], populations at greater odds of mental disorders in general included women, young, and single personnel, and individuals with lower socioeconomic status as measured by education, enlisted rank, and length of service. Our finding of a significant reduction in adjusted odds among black non-Hispanics for panic syndrome, anxiety, alcohol abuse, and eating disorders when compared with white non-Hispanics has not been previously reported. Although this may be due to study population size or composition, another possible

explanation may be that these results represent the true baseline prevalence of a large subpopulation of U.S. military members and may be of significant interest for comparison to postcombat deployments in support of Operation Enduring Freedom or Operation Iraqi Freedom. Additionally, active-duty and Army personnel were at increased adjusted odds of many of these disorders when compared with Reserve/Guard and other services.

Alcohol abuse, as defined by the PHQ, was the most prevalent mental disorder in the Millennium Cohort and was consistent with or slightly more prevalent when compared with other nonmilitary populations [49–52]. After controlling for sex, age, education, marital status, race/ethnicity, short- and long-term service, deployment status, pay grade, active-duty status, service branch, and occupation in the model, personnel who were male, younger, single, less educated, enlisted, active duty, Marine, and combat specialists were at the highest adjusted odds of this disorder and should be considered for further investigation and intervention.

It is interesting that there were no significant differences in mental health morbidity due to recent deployment to southwest Asia, Bosnia, and Kosovo. In a recent report [13], PTSD symptoms consistent with PCL scoring in this report were found in 5.0% of the overall study population prior to deployment to Iraq. After returning from deployment, 6.2% of a population deployed to Afghanistan and more than 12% of population deployed to Iraq were identified as having PTSD symptoms. The baseline PTSD symptoms reported here is nearly half of the baseline reported by Hoge et al. and may be explained by differences in study population composition. Specifically, the baseline PTSD symptoms in Millennium Cohort members was 3.9% for those aged 17–24 years. However, this group makes up only 19% of the cohort, whereas those ages 18–24 years comprised the majority, with a very small proportion over 40 years of age in the previous report [13]. The Millennium Cohort consists of more highly educated personnel, more officers, and more married personnel, all of which are associated with a reduced prevalence of PTSD symptoms (Table 2). Lastly, the report by Hoge et al. focused on combat units that were engaged in direct combat, unlike the participants of this cohort who may or may not have been directly engaged in combat-related deployments.

There are notable limitations to these analyses that should be mentioned. Although the original cohort was a random weighted sample of the U.S. military, the study population consists of a self-selected group representing 35.9% of the invited and contacted personnel. Because we oversampled female, deployed, and Reserve/Guard members, and because there were proportional differences between responders and nonresponders including older, more educated, married, and officer members [14], these data may not be representative of the military population in general. It is possible that those who were in ill health may have believed that inclusion in a study of this type

might be of benefit to them, resulting in a possible overestimation of the true prevalence. Conversely, those who might be severely ill may not choose to respond or may not have the capacity to do so, which could potentially underestimate the true prevalence. Additionally, although the Millennium Cohort is a longitudinal prospective study, the cross-sectional design of these analyses did not permit us to investigate temporality at this stage. However, additional longitudinal studies of this cohort will provide us this opportunity. Furthermore, an enrollment period encompassing the tragic events of September 11, 2001, may have introduced a temporal change in mental illness because military personnel were called upon to respond to the terrorist attacks [53]. Lastly, although these mental health instruments have undergone thorough testing and are believed to correlate well with a physician's assessment of mental health [17–20,54], the use of standardized instruments for self-reported data as a surrogate for mental health diagnosis is imperfect.

Despite limitations, our study has a number of unique strengths. The large study population, along with many demographic variables, permitted robust risk estimates, allowing for considerable statistical power to detect small differences in the mental health outcomes measured. Additionally, we used multivariable modeling techniques to model the odds of disease while adjusting for many covariates. Finally, the use of standardized instruments allows for comparison to other populations, such as the U.S. population in general [18,20] or other military populations, such as the Canadian [43,55], Australian [56], or United Kingdom forces. This analysis represents a major step in the effort to establish the baseline mental health status in a large U.S. military cohort for prospective observation of trends in exposures and outcomes temporally investigated over a 22-year follow-up period.

In summary, the U.S. military represents a complex and dynamic group of Americans whose sensitivity to world events is heightened due to the personal impact on their lives. In this report, we document the baseline prevalence of mental disorders in a large U.S. military cohort. With the exception of alcohol abuse, our findings suggest a mentally healthier population than other comparison populations and should be reassuring to those serving and those who depend on the readiness of our military forces. However, the higher prevalence of alcohol abuse and the disproportionately higher burden of mental disorders among some subgroups should prompt further clinical investigation and intervention. When factors known to increase the prevalence of mental health morbidity are combined with physically and mentally demanding military occupations and lifestyle, extended periods of separation from family or home life, high operational tempo during times of war, relative lack of knowledge of mental illness symptoms or treatments, and social stigmas often associated with treatment, there is reason for concern. Further coordination between primary care providers, mental health



specialists, and researchers is necessary to identify and prioritize critical areas for research and improvement of clinical services to protect the mental health of the U.S. military. In the future, the Millennium Cohort Study [14,16] will continue to address important issues of military health through prospective long-term follow-up of individuals in the cohort.

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