

## University of Nebraska - Lincoln DigitalCommons@University of Nebraska - Lincoln

---

Uniformed Services University of the Health  
Sciences

U.S. Department of Defense

---

2014

# Risk for suicidal behaviors associated with PTSD, depression, and their comorbidity in the U.S. Army

Holly J. Ramsawh

*Uniformed Services University of the Health Sciences, [holly.ramsawh.ctr@usuhs.edu](mailto:holly.ramsawh.ctr@usuhs.edu)*

Carol S. Fullerton

*Uniformed Services University of the Health Sciences*

Holly B. Herberman Mash

*Uniformed Services University of the Health Sciences*

Tsz Hin H. Ng

*Uniformed Services University of the Health Sciences*

Ronald C. Kessler

*Harvard Medical School, [kessler@hcp.med.harvard.edu](mailto:kessler@hcp.med.harvard.edu)*

*See next page for additional authors*

Follow this and additional works at: <https://digitalcommons.unl.edu/usuhs>

---

Ramsawh, Holly J.; Fullerton, Carol S.; Herberman Mash, Holly B.; Ng, Tsz Hin H.; Kessler, Ronald C.; Stein, Murray B.; and Ursano, Robert J., "Risk for suicidal behaviors associated with PTSD, depression, and their comorbidity in the U.S. Army" (2014). *Uniformed Services University of the Health Sciences*. 161.  
<https://digitalcommons.unl.edu/usuhs/161>

This Article is brought to you for free and open access by the U.S. Department of Defense at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Uniformed Services University of the Health Sciences by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

---

**Authors**

Holly J. Ramsawh, Carol S. Fullerton, Holly B. Herberman Mash, Tsz Hin H. Ng, Ronald C. Kessler, Murray B. Stein, and Robert J. Ursano



## Research report

## Risk for suicidal behaviors associated with PTSD, depression, and their comorbidity in the U.S. Army



Holly J. Ramsawh<sup>a,\*</sup>, Carol S. Fullerton<sup>a</sup>, Holly B. Herberman Mash<sup>a</sup>, Tsz Hin H. Ng<sup>a</sup>,  
Ronald C. Kessler<sup>b</sup>, Murray B. Stein<sup>c,d</sup>, Robert J. Ursano<sup>a</sup>

<sup>a</sup> Center for the Study of Traumatic Stress, Department of Psychiatry, Uniformed Services University of the Health Sciences, Bethesda, MD, United States

<sup>b</sup> Harvard Medical School, Department of Health Care Policy, Boston, MA, United States

<sup>c</sup> University of California, San Diego, Departments of Psychiatry & Family and Preventive Medicine, San Diego, CA, United States

<sup>d</sup> Psychiatry Service, Veterans Affairs, San Diego Healthcare System, San Diego, CA, United States

## ARTICLE INFO

## Article history:

Received 25 February 2014

Accepted 7 March 2014

Available online 25 March 2014

## Keywords:

Suicidal ideation

Attempted

Military personnel

Depression

Stress disorders

Post-traumatic

## ABSTRACT

**Background:** Suicide rates have risen considerably in the United States Army in the past decade. Suicide risk is highest among those with past suicidality (suicidal ideation or attempts). The incidence of posttraumatic stress disorder (PTSD) and depressive illnesses has risen concurrently in the U.S. Army. We examined the relationship of PTSD and depression, independently and in combination, and rates of past-year suicidality in a representative sample of U.S. Army soldiers.

**Methods:** This study used the DoD Survey of Health Related Behaviors Among Active Duty Military Personnel (DoD HRB) ( $N=5927$ ). Probable PTSD and depression were assessed with the PTSD Checklist (PCL) and the 10-item short form of the Center for Epidemiologic Studies Depression Scale (CES-D), respectively. Past-year suicidality was assessed via self-report.

**Results:** Six percent of Army service members reported suicidality within the past year. PTSD and MDD were each independently associated with past-year suicidality. Soldiers with both disorders were almost three times more likely to report suicidality within the past year than those with either diagnosis alone. Population-attributable risk proportions for PTSD, depression, and both disorders together were 24%, 29%, and 45%, respectively.

**Limitations:** The current study is subject to the limitations of a cross-sectional survey design and the self-report nature of the instruments used.

**Conclusions:** PTSD and depression are each associated with suicidality independently and in combination in the active duty component of the U.S. Army. Soldiers presenting with either but especially both disorders may require additional outreach and screening to decrease suicidal ideation and attempts.

© 2014 Elsevier B.V. All rights reserved.

## 1. Introduction

Suicide rates in the United States Army have historically been lower than civilian rates (Eaton et al., 2006). With the advent of Operation Iraqi Freedom and Operation Enduring Freedom (OEF/OIF), suicide rates have increased, surpassing civilian rates for the first time (Kuehn, 2009, 2010). From 2001 to 2009, rates of suicide in the Army increased from 9 to 22 per 100,000 (Black et al., 2011), the highest Army suicide rate in nearly three decades (Alvarez, 2009). Past suicidality (i.e., suicidal ideation, intent and/or plan, and attempt) is one of the strongest risk factors for future attempts

(Mann et al., 2008, 1999) as well as completed suicide (Beck et al., 1999; Brown et al., 2000; Nordstrom et al., 1995). Suicidality is associated with psychiatric disorders in both military (Gadermann et al., 2012; Thomsen et al., 2011) and civilian populations (Kessler et al., 2005; Nock et al., 2010; Petronis et al., 1990), with approximately 80% of suicide attempters and two-thirds of ideators having a preexisting psychiatric disorder (Nock et al., 2010). The rates of posttraumatic stress disorder (PTSD) and major depressive disorder (MDD) in the military have risen considerably relative to previous estimates, with MDD rates increasing by 20% and rates of PTSD nearly doubling (Armed Forces Health Surveillance, 2012). To date, there have been no large-scale epidemiological studies of the relationship between PTSD, depression, and suicidality in the active duty component of the United States military.

PTSD has been shown to be a risk factor for suicidality in civilian (Nock et al., 2009; Sareen et al., 2007) and military samples (Bryan and Corso, 2011; Bush et al., 2011; Guerra et al., 2011; Maguen et al.,

\* Correspondence to: Uniformed Services University of the Health Sciences, Center for the Study of Traumatic Stress, 6720-B Rockledge Drive, Suite 550, Bethesda, Maryland 20817, United States. Tel.: +1 301 319 4933; fax: +1 301 319 6965.

E-mail address: [holly.ramsawh.ctr@usuhs.edu](mailto:holly.ramsawh.ctr@usuhs.edu) (H.J. Ramsawh).

2012b). A recent meta-analysis of 50 studies indicated that while PTSD was not associated with completed suicide, it was significantly associated with prior and current suicidal ideation (SI) and prior suicide attempts (Krysinska and Lester, 2010). These relationships remain after adjusting for psychiatric comorbidity (e.g., depression).

Depressive disorders are strongly associated with suicidal behaviors in the general population (Beautrais et al., 1996; Kessler et al., 2005; Nock et al., 2010; Petronis et al., 1990). Among individuals who attempt suicide, 39–62% have a depressive disorder diagnosis (Beautrais et al., 1996; Kessler et al., 2005; Petronis et al., 1990). Although there are some data available on the association between depression and suicidality in military samples (Bryan et al., 2013; Bush et al., 2011; Goodwin et al., 2013; Guerra et al., 2011), most of these studies are limited to inpatient, veteran, or other non-representative samples of the U.S. military.

PTSD and depression are highly comorbid in national surveys (Cogle et al., 2009; Kessler et al., 1995) and in military samples (Calabrese et al., 2011; Galatzer-Levy et al., 2013; Milliken et al., 2007). Among military samples, the contribution of PTSD to suicidality above and beyond that of depression has been examined in only a few studies (Bryan and Corso, 2011; Bryan et al., 2013; Griffith, 2012; Maguen et al., 2012b; Richardson et al., 2012). Among these studies, there have been conflicting findings with regard to whether there is a significant independent association between PTSD and suicidality. Furthermore, as prior studies have been conducted with small, non-representative samples of military service members or veteran samples, associations at the population level are yet unknown. The current study includes a large, representative sample of Army active duty service members, and therefore is better equipped to allow generalization of findings to the entire U.S. Army active duty population.

The purpose of the current investigation was to determine the relationships between PTSD, depression, and suicidality in Army service members so that delivery of appropriate resources to those individuals most at risk may be facilitated. In order to better understand the independent contributions of PTSD and depression to suicidality in practical terms, we also estimated the proportion of past-year suicidality attributable to PTSD and depression in the current population.

## 2. Methods

### 2.1. Participants and procedures

The target population of the 2008 Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel (DoD HRB) included all active duty service members of the United States Military with the exception of recruits, academy cadets, and those who were absent without leave or incarcerated. More detailed discussion of sampling methods can be found elsewhere (Bray et al., 2009, 2010). A two-stage sampling method was used. First, a stratified, probability proportional to size methodology was applied, with stratification by service and region of the world. The sample was then stratified by pay grade and gender, and officers and women were oversampled to account for low numbers in these groups. The survey data were weighted to represent the active duty population, and sampling and non-response differences were accounted for in the weighting. Of 40,436 active duty service members sampled worldwide, 28,546 were available and completed surveys. Among Army service members, 10,400 were sampled, with 5927 responses representative of 508,088 soldiers. To examine the association of depression and PTSD to suicidality in the active Army, an analytic sample of  $N=5472$  was used (weighted  $N=468,788$ ). About 45% of the active Army was age 17–25, 86% were male, 63% were non-Hispanic

**Table 1**  
Demographics, mental health diagnoses, and suicidality<sup>a</sup> in the U.S. Army.

Risk factors	Weighted proportion (%)	Weighted N <sup>b</sup>	Unweighted N
	100	467,925	5461
<b>Demographics</b>			
Age			
17–20	14	64,046	677
21–25	31	145,553	1692
26–34	31	143,610	1721
≥ 35	25	114,716	1371
Gender			
Male	86	403,385	3962
Female	14	64,540	1499
Race			
Non-Hispanic White	63	296,449	3054
White	37	171,476	2407
Education			
High school or Less	33	152,243	1683
Some College	45	209,620	2494
College Degree or More	23	106,062	1284
Married			
No	43	200,897	2442
Yes	57	267,028	3019
Enlisted			
No	18	84,178	1091
Yes	82	383,747	4370
<b>PTSD</b>			
No	88	409,672	4772
Yes	12	58,253	689
<b>Depression</b>			
No	66	307,710	3547
Yes	34	160,215	1914
<b>Comorbidity of PTSD &amp; Depression</b>			
Neither diagnosis	65	302,143	3484
Both PTSD & depression	11	52,686	626
Either PTSD or depression alone	24	113,096	1351
PTSD only	1	5567	63
Depression only	23	107,529	1288
<b>Suicidality<sup>a</sup></b>			
No	94	439,782	5115
Yes	6	28,143	346

<sup>a</sup> Suicidality is defined as seriously considered and/or attempted suicide within the past-year.

<sup>b</sup> Differences from totals are due to rounding.

white, 33% had a high school education or less, 43% were not married, and 82% were enlisted (Table 1). Survey respondents were apprised of the anonymous and voluntary nature of the self-report written survey. The Uniformed Services University of the Health Sciences Institutional Review Board approved this study.

### 2.2. Measures

#### 2.2.1. Suicidality

Participants responded to a series of questions that assessed suicidality in the past year. They were asked separately, "Have you

seriously considered suicide?” and “Have you ever attempted suicide?” Those who indicated that they considered suicide or attempted suicide “Within the past year” were categorized using a single dichotomous variable indicating presence or absence of past-year suicidality.

### 2.2.2. Post-traumatic stress disorder

The presence of probable PTSD was assessed with the 17-item PTSD Checklist-Civilian Version (PCL; Weathers et al., 1993). The PCL lists all symptoms of PTSD outlined in the DSM-IV-TR. The civilian version was selected so that PTSD symptoms that resulted from either military or non-military traumas could be assessed. Respondents indicated the extent to which they had been bothered by each symptom in the past month on a scale ranging from 1 (not at all) to 5 (extremely). Responses were summed to produce PTSD symptom severity scores, ranging from 17 to 85. In this study, participants were classified as positive for PTSD if they had scores of 50 or greater and also met DSM-IV-TR symptom criteria: at least one intrusion (Criterion B), three avoidance (Criterion C), and two hyperarousal (Criterion D) symptoms, each present at the level of moderate or higher intensity during the previous month (Grieger et al., 2006; Hoge et al., 2004). The PCL exhibits good internal consistency (Weathers et al., 1993) and high diagnostic accuracy as compared to structured clinical interviews (0.80–0.90), with a specificity of 0.97 using a cut-off score of 50 (Forbes et al., 2001). Standardized Cronbach's alpha in the current study was 0.97, indicating high internal consistency.

### 2.2.3. Depression

The presence of probable depression was measured with the 10-item Center for Epidemiologic Studies Depression Scale (Andresen et al., 1994), a short version of a 20-item original scale designed to measure depressive symptoms in the general population (Radloff, 1977). Respondents indicated the extent to which they had been bothered by each symptom in the past week on a scale ranging from 0 (rarely or none of the time) to 3 (most or all of the time), and total score for the 10-item scale ranges from 0 to 30. The cutoff score for probable depression is 10 or greater (Andresen et al., 1994). The 10-item scale has been validated against semi-structured diagnostic interviews, with AUC values of 0.87–0.88, sensitivity ratings of 0.76–0.90, and specificity ratings of 0.72–0.79 (McManus et al., 2005; Whooley et al., 1997). Overall test-retest reliability has been found to be adequate at 0.71 over an average test-retest interval of 22 days (Andresen et al., 1994). Standardized Cronbach's alpha in the current study was 0.82, indicating relatively high internal consistency.

### 2.3. Statistical analyses

SAS version 9.3 was used for all statistical analyses. Prevalence rates for past-year suicidality were computed for each predictor of interest, and chi-square tests were used to examine associations with suicidality. Bivariate (unadjusted) logistic regressions were conducted to examine relationships between psychiatric disorders (PTSD and depression) and suicidality. Demographic variables were included as covariates in all multivariate (adjusted) logistic regression models. In multivariate models, we examined independent risk of suicidality associated with PTSD and depression, with models run for each disorder individually as well as both disorders together. To further investigate the relationship between comorbidity and past-year suicidality, a multilevel variable was created to represent respondents with either PTSD alone, depression alone, both PTSD and depression, or neither disorder. Pairwise comparisons were conducted to examine whether risk of suicidality differed among the four diagnostic groups. Finally, we tested whether PTSD and depression each moderated the other's association with suicidality, with examination of both multiplicative and additive scales.

First, to test effect modification on a multiplicative scale, we included a PTSD  $\times$  depression interaction term in multivariate logistic regression models. In addition, to test effect modification on an additive scale using logistic regression modeling, we calculated whether the odds of suicidality were significantly greater (or less than) the sum of the odds for PTSD and depression separately by calculating a ‘synergy index’ (SI), which is derived from multivariate logistic regression coefficients (Andersson et al., 2005). If there is a significant departure from the additive model, the SI is significantly greater than (or less than) 1. Odds ratios (ORs), 95% confidence intervals (CIs), chi-square test statistics, and the corresponding p-values were reported for all analyses. All reported analyses were conducted while accounting for weighted data and the complex survey design.

The associations of suicidality with PTSD, MDD, and both diagnoses together were also assessed using population-attributable risk proportions (PARP). PARP is the proportion of observed suicidality that would not have occurred in the absence of one or more predictors, assuming that the coefficients in the model represent causal effects of the predictor (Greenland and Rothman, 1998). PARP is a simulation method that provides a sense of the population-wide impact of a predictor of interest by taking into account both the prevalence of a given predictor(s), and the strength of association between that predictor and a particular outcome variable. In the current study, PARP can be interpreted as the proportion of past-year suicidality that could be prevented if PTSD, depression, or both disorders together are causally related to suicidality. The predicted probability of suicidality for each individual was calculated twice by applying coefficients of the multivariate models with and without the predictor of interest. The PARP is equal to 1 minus the ratio of the predicted prevalence estimates in the 2 specifications. All significance tests were evaluated using 2-sided  $p < 0.05$ . The design-based Taylor series method implemented in SAS was used for variance estimation.

## 3. Results

Six percent (weighted  $N=28,143$ ) of Army service members reported past-year suicidality (see Table 1). Of the service members with past-year suicidality, 80% (weighted  $n=22,646$ ) reported past-year suicidal ideation and 31% (weighted  $n=8663$ ) reported past-year suicide attempts. Those with past-year suicidality were more likely to be unmarried ( $\chi^2=15.72$ ,  $df=1$ ,  $p < 0.001$ ), enlisted ( $\chi^2=8.79$ ,  $df=1$ ,  $p=0.003$ ), and to have a lower education level (high school or less;  $\chi^2=14.51$ ,  $df=2$ ,  $p < 0.001$ ). Thirteen percent of the sample (weighted  $N=58,732$ ) had probable PTSD, and 34% (weighted  $N=160,841$ ) had probable depression. Of the full sample, 65% (weighted  $N=302,143$ ) had neither PTSD nor depression. Eleven percent of the sample (weighted  $N=52,686$ ) had both PTSD and depression. Twenty-four percent (weighted  $N=113,096$ ) had either PTSD or depression alone. PTSD without comorbid depression was rare, with only 1% of the sample (weighted  $N=5567$ ) meeting criteria for PTSD alone. In contrast, 23% of the sample had depression without comorbid PTSD (weighted  $N=107,529$ ).

### 3.1. PTSD and suicidality

Of all service members with PTSD, 18% reported past-year suicidality (see Table 2). Adjusting for demographics, those with PTSD were 4.7 times more likely to report past-year suicidality (Wald  $\chi^2=126.80$ ,  $df=1$ ,  $p < 0.001$ , 95% CI=3.6–6.1). After adjusting for demographics and depression, there continued to be a significant association between PTSD and past-year suicidality (OR=3.1, Wald  $\chi^2=91.01$ ,  $df=1$ ,  $p < 0.001$ , 95% CI=2.5–3.9).

**Table 2**  
Association of mental health diagnoses with suicidality in the U.S. Army.<sup>a</sup>

Risk factors	Prevalence of suicidality (%)	Likelihood of suicidality <sup>b</sup>									
		Unadjusted		Adjusted <sup>c</sup>							
		OR	95% CI	PTSD		Depression		PTSD+Depression		Comorbidity of PTSD and depression	
		OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
<b>PTSD</b>											
Yes	18	<b>5.0*</b>	(3.9, 6.3)	<b>4.7*</b>	(3.6, 6.1)	–	–	<b>3.1*</b>	(2.5, 3.9)	–	–
No	4	[Reference]		–	–	–	–	–	–	–	–
<b>Depression</b>											
Yes	11	<b>3.3*</b>	(2.3, 4.8)	–	–	<b>3.2*</b>	(2.1, 4.7)	<b>2.0*</b>	(1.3, 3.2)	–	–
No	4	[Reference]		–	–	–	–	–	–	–	–
<b>Comorbidity of PTSD and Depression</b>											
Neither	3	<b>0.4*</b>	(0.3, 0.6)	–	–	–	–	–	–	<b>0.4*</b>	(0.3, 0.6)
One diagnosis	8	[Reference]		–	–	–	–	–	–	–	–
Two diagnoses	18	<b>2.7*</b>	(2.2, 3.4)	–	–	–	–	–	–	<b>2.6*</b>	(2.1, 3.2)
Neither	3	[Reference]		–	–	–	–	–	–	[Reference]	
PTSD only	17	<b>6.0*</b>	(3.0–12.1)	–	–	–	–	–	–	<b>5.8*</b>	(2.7–12.5)
Depression only	7	<b>2.3*</b>	(1.5–3.6)	–	–	–	–	–	–	<b>2.2*</b>	(1.4–3.5)
Both	18	<b>6.6*</b>	(4.5–9.7)	–	–	–	–	–	–	<b>6.2*</b>	(4.1–9.6)
Neither	3	<b>0.2*</b>	(0.1–0.3)	–	–	–	–	–	–	<b>0.2*</b>	(0.1–0.4)
PTSD only	17	[Reference]		–	–	–	–	–	–	[Reference]	
Depression only	7	<b>0.4*</b>	(0.2–0.8)	–	–	–	–	–	–	<b>0.4*</b>	(0.2–0.8)
Both	18	1.1	(0.5–2.2)	–	–	–	–	–	–	1.1	(0.5–2.3)
Neither	3	<b>0.4*</b>	(0.3–0.7)	–	–	–	–	–	–	<b>0.5*</b>	(0.3–0.7)
PTSD only	17	<b>2.6*</b>	(1.2–5.5)	–	–	–	–	–	–	<b>2.6*</b>	(1.2–5.6)
Depression only	7	[Reference]		–	–	–	–	–	–	[Reference]	
Both	18	<b>2.9*</b>	(2.3–3.7)	–	–	–	–	–	–	<b>2.8*</b>	(2.3–3.5)

–: variable not used in logistic regression model.

\*  $p < 0.05$ .

<sup>a</sup> Analyses were based on the weighted sample.

<sup>b</sup> Suicidality is defined as seriously considered and/or attempted suicide within the past-year.

<sup>c</sup> Adjusted for age, gender, race, education, marital status, and rank.

## 2.2. Depression and suicidality

Among those with depression, 11% reported past-year suicidality. Adjusting for demographics, those with depression were 3.2 times more likely to report past-year suicidality (Wald  $\chi^2 = 33.17$ ,  $df = 1$ ,  $p < 0.001$ , 95% CI = 2.1–4.7). Even after adjusting for demographics and PTSD, there continued to be a significant association between depression and past-year suicidality (OR = 2.0, Wald  $\chi^2 = 9.03$ ,  $df = 1$ ,  $p < 0.01$ , 95% CI = 1.3–3.2).

## 3.3. PTSD, depression and suicidality

Of those who had one diagnosis—either PTSD or depression—8% reported past-year suicidality. Of those with neither PTSD nor depression, 3% reported past-year suicidality. For those who had both PTSD and MDD, 18% reported past-year suicidality. Adjusting for demographics, individuals with both PTSD and depression were 2.6 times more likely to have past-year suicidality than those with either diagnosis alone (Wald  $\chi^2 = 87.56$ ,  $df = 1$ ,  $p < 0.001$ , 95% CI = 2.1–3.2).

We then tested whether the interaction of PTSD and depression was significantly associated with past 12-months suicidality. The interaction term was not significant at  $p < 0.05$  on the multiplicative scale (Wald  $\chi^2 = 3.06$ ,  $df = 1$ ,  $p = 0.08$ ). Using SI to test interaction on the additive scale, the interaction between PTSD

and depression was also nonsignificant (SI = 1.348, 95% CI = 0.775–2.347).

## 3.4. Population-level associations of PTSD and depression with past-year suicidality

Results of the PARP analysis based on our multivariate models indicate that in the active duty component of the U.S. Army, 24% of past-year suicidality is attributable to PTSD. Twenty-nine percent of past-year suicidality among U.S. Army active duty is attributable to depression. Overall, 45% of past-year suicidality in the active duty component of the U.S. Army is attributable to PTSD and depression together.

## 4. Discussion

Suicidality, including both ideation and attempts, is associated with significant costs to society in terms of medical care as well as lost productivity and wages (Palmer et al., 1998; Sinclair et al., 2006). Past suicidality is one of the most robust risk factors for future suicide ideation (Fergusson et al., 2005; Kerr et al., 2008; Reinherz et al., 2006), future attempts (Fergusson et al., 2005; Mann et al., 1999; Reinherz et al., 2006), and completed suicide

(Beck et al., 1999; Brown et al., 2000; Nordstrom et al., 1995). Therefore, past-year suicide ideation and attempts—as measured in this study—are an index of risk for future completed suicide as well as future suicide attempts. Although there is one large-scale study of predictors of suicidality in the United States Army currently underway (Gilman et al., *in press*; Kessler et al., *in press*; Nock et al., *in press*; Schoenbaum et al., *in press*), there are no nationally representative surveys of the relationship between PTSD, depression, and suicidality in the active duty component of the U.S. Army.

In the current study, 6% of service members reported past-year suicidal ideation or suicide attempts, whereas 10–12% of respondents reported lifetime or current suicidal ideation in samples of National Guard members and veterans (Calabrese et al., 2011; Guerra et al., 2011). Twelve percent of our U.S. Army sample had PTSD, comparable to previous reports of 11–20% in other military samples (Bray et al., 2010; Hankin et al., 1999; Thomas et al., 2010). Thirty-four percent had depression, which is similar to rates of 23–31% found in other military samples using a version of the CES-D (Hankin et al., 1999; Harbertson et al., 2013). Among those with PTSD, 90% had comorbid depression, compared with comorbid depression rates of 46–56% in prior military samples (Calabrese et al., 2011; Guerra et al., 2011; Maguen et al., 2012a). The rate of comorbid depression in the current study is somewhat higher than what has been previously found. This may reflect methodological differences within the studies (e.g., different samples and different measures of depression).

Among service members with PTSD, the rate of past-year suicidality (i.e., suicidal ideation or suicide attempts) in the current study was 18%. Prior studies with military samples examined suicidal ideation alone, whereas the current study examined ideation and attempts together. Rates of lifetime or current suicidal ideation previously found among those with PTSD were 33–46% (Calabrese et al., 2011; Guerra et al., 2011).

Current respondents with PTSD were five times more likely to report past-year suicidality as those without PTSD. In previous studies, similarly increased risks associated with PTSD have been reported (Calabrese et al., 2011; Guerra et al., 2011). Having PTSD was associated with three times the likelihood of reporting suicidality even after adjusting for depression, similar to prior research findings using military samples (Bush et al., 2011; Maguen et al., 2012b). Having both PTSD and depression were associated with a significantly greater risk of past-year suicidality than having either PTSD or depression alone. This finding is consistent with prior studies which have also found an increased risk associated with PTSD and comorbid psychiatric disorders, including depression, relative to PTSD alone (Calabrese et al., 2011; Cogle et al., 2009; Jakupcak et al., 2009). The interaction between PTSD and depression was not significant in the current analysis on either multiplicative or additive scales. This suggests that the association between PTSD and past-year suicidality does not vary significantly by depression. However, as the primary purpose of the DoD HRB survey was not to test the joint effects of PTSD and depression on risk of suicidality, the current study may be underpowered to test such interaction effects (Garcia-Closas and Lubin, 1999).

Finally, results of our PARP analysis—which can be interpreted as the proportion of past-year suicidality that could be prevented if PTSD, MDD, or both disorders together are causally related to suicidality—revealed that PTSD and depression each individually accounted for 24–29% of past-year suicidality in the active duty component of the U.S. Army. If both PTSD and depression were eliminated, a full 45% of past-year suicidality might be prevented. In a previous investigation of the association between traumatic events and suicidality, which involved 102,245 respondents (age 18+) from 21 countries participating in the WHO World Mental Health Surveys (Stein et al., 2010), PARP results suggested that 15.4% of all suicidal ideation and 22.1% of suicide attempts were

attributable to traumatic events. In the only prior study to examine PARPs for both PTSD and depression in association with suicidality (Bolton and Robinson, 2010), results suggested that PTSD accounted for 6.3% of all suicide attempts, while 26.6% of all suicide attempts were attributable to depression. The current findings for the active duty component of the U.S. Army are representative of this population's demographics (i.e., primarily young, male soldiers with higher base rates of the psychiatric disorders under investigation), which may explain the differing results with respect to PARP for PTSD. These results are novel and further convey the independent burden associated with PTSD and depression in the active duty component of the U.S. Army, and the elevated risk for future suicide associated with psychiatric comorbidity.

To our knowledge, no other studies have examined the independent contributions of PTSD and depression to suicidality with a representative sample of the active duty component of the U.S. Army. Prior investigations in military samples have been conducted with small, treatment-seeking samples of active duty soldiers or veterans. Among these studies, some have found an independent association of PTSD and suicidality (Bush et al., 2011; Maguen et al., 2012b), and others have not (Bryan and Corso, 2011; Bryan et al., 2013; Griffith, 2012; Richardson et al., 2012). The results of this study are similar to those of large, epidemiological studies of civilian populations (Bernal et al., 2007; Bolton and Robinson, 2010; Nock et al., 2009, 2010; Sareen et al., 2007) and underscore the importance of PTSD to future suicide risk in Army soldiers.

There are several limitations to our study. First, the self-report questions on suicidality used in the survey are relatively brief and were subject to interpretation by respondents as to the meaning of “serious considered suicide” or “attempted suicide.” Second, there was insufficient power to examine suicidal ideation and attempts separately for all subgroup analysis, and so these variables were combined for the current investigation. It is possible that results may have differed had each been analyzed separately. Third, as this is a cross-sectional survey, causality cannot be determined from the existing results. Further, we did not have data on whether psychiatric diagnoses were temporally antecedent to our outcome variable of interest, past-year suicidality. Future investigators should examine onset of PTSD and depression in relation to onset of suicidality in order to more accurately gauge the temporal relationship of psychiatric disorders to suicidal behaviors in the U.S. Army.

## 5. Conclusions

Six percent of a representative sample of Army service members reported either seriously considering or attempting suicide within the past year. Soldiers in the U.S. Army who have PTSD, MDD, or both disorders are at increased risk for past-year suicidality. Further research investigating suicide risk and other adverse outcomes should consider the hazards associated with having both disorders relative to either disorder alone, as few studies besides the current investigation have used this approach. Understanding the contribution of comorbidity to suicidality has implications for identification and treatment of those who are at risk, especially those exposed to chronic stressors of combat and deployment. In order to decrease future risk of suicidality, future investigators should consider the added utility of treatment modalities that address both disorders simultaneously.

### Role of the funding source

The opinions or assertions contained herein are the private views of the authors and are not necessarily those of the Department of Defense, the Uniformed Services University of the Health Sciences, or the Center for the Study of Traumatic

Stress. The funders had no role in study design, data collection, and analysis, decision to publish, or preparation of the manuscript.

### Conflict of interest

In the past three years, Dr. Kessler has been a consultant for Hoffman-La Roche, Inc., Johnson & Johnson Wellness and Prevention, Shire, and Sanofi-Aventis Groupe. Dr. Kessler has served on advisory boards for Plus One Health Management and the Lake Nona Institute. Dr. Kessler has had research support for his epidemiological studies from EPI-Q, Johnson & Johnson Pharmaceuticals, Sanofi-Aventis Groupe, and Walgreens Co. Dr. Kessler owns 25% share in DataStat, Inc. Dr. Stein reports that he is paid for his editorial work at *Depression and Anxiety* (Wiley), *Biological Psychiatry* (Elsevier), and UpToDate, Inc., as well as for consulting work at Care Management Technologies. All other authors report no biomedical financial interests or potential conflicts of interest.

### Acknowledgments

The authors wish to thank Deborah Probe, M.A. and Erin Beech, M.A., each of whom provided valuable assistance to the undertaking of the research summarized here.

### References

- Alvarez, L., 2009. Suicides of soldiers reach high of nearly 3 decades, *The New York Times*, New York Ed., The New York Times Company, New York.
- Andersson, T., Alfredsson, L., Kallberg, H., Zdravkovic, S., Ahlbom, A., 2005. Calculating measures of biological interaction. *Eur. J. Epidemiol.* 20, 575–579.
- Andresen, E.M., Malmgren, J.A., Carter, W.B., Patrick, D.L., 1994. Screening for depression in well older adults: evaluation of a short form of the CES-D. *Am. J. Prev. Med.* 10, 77–84.
- Armed Forces Health Surveillance, 2012. Mental Disorders and Mental Health Problems, Active Component, U.S. Armed Forces, 2000–2011. Medical Surveillance Monthly Report, vol. 19, pp. 11–17.
- Beautrais, A.L., Joyce, P.R., Mulder, R.T., Fergusson, D.M., Deavoll, B.J., Nightingale, S.K., 1996. Prevalence and comorbidity of mental disorders in persons making serious suicide attempts: a case-control study. *Am. J. Psychiatry* 153, 1009–1014.
- Beck, A.T., Brown, G.K., Steer, R.A., Dahlsgaard, K.K., Grisham, J.R., 1999. Suicide ideation at its worst point: a predictor of eventual suicide in psychiatric outpatients. *Suicide Life Threat. Behav.* 29, 1–9.
- Bernal, M., Haro, J.M., Bernert, S., Brugha, T., de Graaf, R., Bruffaerts, R., Lepine, J.P., de Girolamo, G., Vilagut, G., Gasquet, I., Torres, J.V., Kovess, V., Heider, D., Neleman, J., Kessler, R., Alonso, J., Invest, E.M., 2007. Risk factors for suicidality in Europe: results from the ESEMED study. *J. Affect. Disord.* 101, 27–34.
- Black, S.A., Galloway, S., Bell, M.R., Ritchie, E.C., 2011. Prevalence and risk factors associated with suicides of army soldiers 2001–2009. *Mil. Psychol.* 23, 433–451.
- Bolton, J.M., Robinson, J., 2010. Population-attributable fractions of Axis I and Axis II mental disorders for suicide attempts: findings from a representative sample of the adult, noninstitutionalized US population. *Am. J. Public Health* 100, 2473–2480.
- Bray, R., Pemberton, M., Hourani, L., Witt, M., Olmstead, K., Brown, J., Weimer, B., Lance, M., Marsden, M., S., 2009. 2008 Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel. Research Triangle Institute, 1. Research Triangle Park, NC.
- Bray, R.M., Pemberton, M.R., Lane, M.E., Hourani, L.L., Mattiko, M.J., Babeu, L.A., 2010. Substance use and mental health trends among US Military active duty personnel: key findings from the 2008 DoD health behavior survey. *Mil. Med.* 175, 390–399.
- Brown, G.K., Beck, A.T., Steer, R.A., Grisham, J.R., 2000. Risk factors for suicide in psychiatric outpatients: a 20-year prospective study. *J. Consult. Clin. Psychol.* 68, 371–377.
- Bryan, C.J., Corso, K.A., 2011. Depression, PTSD, and suicidal ideation among active duty veterans in an integrated primary care clinic. *Psychol. Serv.* 8, 94–103.
- Bryan, C.J., Ray-Sannerud, B., Morrow, C.E., Etienne, N., 2013. Guilt is more strongly associated with suicidal ideation among military personnel with direct combat exposure. *J. Affect. Disord.* 148, 37–41.
- Bush, N.E., Skopp, N.A., McCann, R., Luxton, D.D., 2011. Posttraumatic growth as protection against suicidal ideation after deployment and combat exposure. *Mil. Med.* 176, 1215–1222.
- Calabrese, J.R., Prescott, M., Tamburrino, M., Liberzon, I., Slembariski, R., Goldmann, E., Shirley, E., Fine, T., Goto, T., Wilson, K., Ganocy, S., Chan, P., Serrano, M.B., Sizemore, J., Galea, S., 2011. PTSD comorbidity and suicidal ideation associated with PTSD within the Ohio Army National Guard. *J. Clin. Psychiatry* 72, 1072–1078.
- Cougle, J.R., Resnick, H., Kilpatrick, D.G., 2009. PTSD, depression, and their comorbidity in relation to suicidality: Cross-sectional and prospective analyses of a national probability sample of women. *Depress. Anxiety* 26, 1151–1157.
- Eaton, K.M., Messer, S.C., Garvey Wilson, A.L., Hoge, C.W., 2006. Strengthening the validity of population-based suicide rate comparisons: an illustration using U.S. military and civilian data. *Suicide Life Threat. Behav.* 36, 182–191.
- Fergusson, D.M., Horwood, L.J., Ridder, E.M., Beautrais, A.L., 2005. Suicidal behaviour in adolescence and subsequent mental health outcomes in young adulthood. *Psychol. Med.* 35, 983–994.
- Forbes, D., Creamer, M., Biddle, D., 2001. The validity of the PTSD checklist as a measure of symptomatic change in combat-related PTSD. *Behav. Res. Therapy* 39, 977–986.
- Gadermann, A.M., Gilman, S.E., McLaughlin, K.A., Nock, M.K., Petukhova, M., Sampson, N.A., Kessler, R.C., 2012. Projected rates of psychological disorders and suicidality among soldiers based on simulations of matched general population data. *Mil. Med.* 177, 1002–1010.
- Galatzer-Levy, I.R., Nickerson, A., Litz, B.T., Marmar, C.R., 2013. Patterns of lifetime comorbidity: a latent class analysis. *Depress. Anxiety* 30, 489–496.
- Garcia-Closas, M., Lubin, J.H., 1999. Power and sample size calculations in case-control studies of gene-environment interactions: comments on different approaches. *Am. J. Epidemiol.* 149, 689–692.
- Gilman, S.E., Bromet, E.J., Cox, K.L., Colpe, L.J., Fullerton, C.S., Gruber, M.J., Heeringa, S.G., Lewandowski-Romps, L., Millikan-Bell, A.M., Naifeh, J.A., Nock, M.K., Petukhova, M.V., Sampson, N.A., Schoenbaum, M., Stein, M.B., Ursano, R.J., Wessely, S., Zaslavsky, A.M., Kessler, R.C., 2014. Socio-demographic and career history predictors of and suicide mortality in the United States Army 2004–2009. *Psychological Medicine* (in press).
- Goodwin, R.D., Prescott, M.R., Tamburrino, M., Calabrese, J.R., Liberzon, I., Galea, S., 2013. Cigarette smoking and subsequent risk of suicidal ideation among National Guard Soldiers. *J. Affect. Disord.* 145, 111–114.
- Greenland, S., Rothman, K.J., 1998. *Modern Epidemiology*. Lippincott-Raven.
- Grieger, T.A., Cozza, S.J., Ursano, R.J., Hoge, C., Martinez, P.E., Engel, C.C., Wain, H.J., 2006. Posttraumatic stress disorder and depression in battle-injured soldiers. *Am. J. Psychiatry* 163, 1777–1783.
- Griffith, J., 2012. Suicide and war: the mediating effects of negative mood, posttraumatic stress disorder symptoms, and social support among army national guard soldiers. *Suicide Life-Threat. Behav.* 42, 453–469.
- Guerra, V.S., Calhoun, P.S., 2011. Mid-Atlantic Mental Illness Research Education and Clinical Center Workgroup Examining the relation between posttraumatic stress disorder and suicidal ideation in an OEF/OIF veteran sample. *J. Anxiety Disord.* 25, 12–18.
- Hankin, C.S., Spiro, A., Miller, D.R., Kazis, L., 1999. Mental disorders and mental health treatment among US Department of Veterans Affairs outpatients: the Veterans Health Study. *Am. J. Psychiatry* 156, 1924–1930.
- Harbertson, J., Grillo, M., Zimulinda, E., Murego, C., Cronan, T., May, S., Brodine, S., Sebagabo, M., Araneta, M.R.G., Shaffer, R., 2013. Prevalence of PTSD and depression, and associated sexual risk factors, among male Rwanda defense forces military personnel. *Trop. Med. Int. Health* 18, 925–933.
- Hoge, C.W., Castro, C.A., Messer, S.C., McGurk, D., Cotting, D.J., Koffman, R.L., 2004. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *N. Engl. J. Med.* 351, 13–22.
- Jakupcak, M., Cook, J., Imel, Z., Fontana, A., Rosenheck, R., McFall, M., 2009. Posttraumatic stress disorder as a risk factor for suicidal ideation in Iraq and Afghanistan war veterans. *J. Trauma. Stress* 22, 303–306.
- Kerr, D.C., Owen, L.D., Capaldi, D.M., 2008. Suicidal ideation and its recurrence in boys and men from early adolescence to early adulthood: an event history analysis. *J. Abnorm. Psychol.* 117, 625.
- Kessler, R.C., Berglund, P., Borges, G., Nock, M., Wang, P.S., 2005. Trends in suicide ideation, plans, gestures, and attempts in the United States, 1990–1992 to 2001–2003. *J. Am. Med. Assoc.* 293, 2487–2495.
- Kessler, R.C., Heeringa, S.G., Stein, M.B., Colpe, L.J., Fullerton, C.S., Hwang, I., Naifeh, J.A., Nock, M.K., Petukhova, M., Sampson, N.A., Schoenbaum, M., Zaslavsky, A.M., Ursano, R.J., 2014. Thirty-day prevalence of DSM-IV mental disorders among non-deployed soldiers in the U.S. Army: Results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *J. Am. Med. Assoc. Psychiatry* (in press).
- Kessler, R.C., Sonnega, A., Bromet, E., Hughes, M., Nelson, C.B., 1995. Posttraumatic stress disorder in the National Comorbidity Survey. *Arch. Gen. Psychiatry* 52, 1048.
- Krynska, K., Lester, D., 2010. Post-traumatic stress disorder and suicide risk: a systematic review. *Arch. Suicide Res.* 14, 1–23.
- Kuehn, B.M., 2009. Soldier suicide rates continue to rise: military, scientists work to stem the tide. *J. Am. Med. Assoc.* 301, 1111–1113.
- Kuehn, B.M., 2010. Military probes epidemic of suicide: mental health issues remain prevalent. *J. Am. Med. Assoc.* 304, 1427–1430.
- Maguen, S., Cohen, B., Ren, L., Bosch, J., Kimerling, R., Seal, K., 2012a. Gender differences in military sexual trauma and mental health diagnoses among Iraq and Afghanistan veterans with posttraumatic stress disorder. *Women's Health Issues* 22, e61–e66.
- Maguen, S., Metzler, T.J., Bosch, J., Marmar, C.R., Knight, S.J., Neylan, T.C., 2012b. Killing in combat may be independently associated with suicidal ideation. *Depress. Anxiety* 29, 918–923.
- Mann, J.J., Ellis, S.P., Wateraux, C.M., Liu, X., Oquendo, M.A., Malone, K.M., Brodsky, B.S., Haas, G.L., Currier, D., 2008. Classification trees distinguish suicide attempters in major psychiatric disorders: a model of clinical decision making. *J. Clin. Psychiatry* 69, 23–31.
- Mann, J.J., Wateraux, C., Haas, G.L., Malone, K.M., 1999. Toward a clinical model of suicidal behavior in psychiatric patients. *Am. J. Psychiatry* 156, 181–189.
- McManus, D., Pipkin, S.S., Whooley, M.A., 2005. Screening for depression in patients with coronary heart disease (data from the heart and soul study). *Am. J. Cardiol.* 96, 1076–1081.
- Milliken, C.S., Auchterlonie, J.L., Hoge, C.W., 2007. Longitudinal assessment of mental health problems among active and reserve component soldiers returning from the Iraq war. *J. Am. Med. Assoc.* 298, 2141–2148.
- Nock, M.K., Hwang, I., Sampson, N., Kessler, R.C., Angermeyer, M., Beautrais, A., Borges, G., Bromet, E., Bruffaerts, R., de Girolamo, G., de Graaf, R., Florescu, S.,



- Gureje, W.S., Haro, J.M., Hu, C., Huang, Y., Karam, E.G., Kawakami, N., Kovess, V., Levinson, D., Posada-Villa, J., Sagar, R., Tomov, T., Viana, M.C., Williams, D.R., 2009. Cross-national analysis of the associations among mental disorders and suicidal behavior: findings from the WHO World Mental Health Surveys. *PLoS Med.* 6, e1000123.
- Nock, M.K., Hwang, I., Sampson, N.A., Kessler, R.C., 2010. Mental disorders, comorbidity and suicidal behavior: results from the National Comorbidity Survey Replication. *Mol. Psychiatry* 15, 868–876.
- Nock, M.K., Stein, M.B., Heeringa, S.G., Ursano, R.J., Colpe, L.J., Fullerton, C.S., Hwang, I., Naifeh, J.A., Sampson, N.A., Schoenbaum, M., Zaslavsky, A.M., Kessler, R.C., 2014. Prevalence and correlates of suicidal behavior among soldiers: results from the army study to assess risk and resilience in servicemembers (Army STARRS) (in press).
- Nordstrom, P., Asberg, M., Aberg-Wistedt, A., Nordin, C., 1995. Attempted suicide predicts suicide risk in mood disorders. *Acta Psychiatr. Scand.* 92, 345–350.
- Palmer, C.S., Kleinman, L., Taylor, L.A., Revicki, D.A., 1998. Pharmacoeconomics of antidepressant drug overdose. *CNS Drugs* 10, 223–231.
- Petronis, K.R., Samuels, J.F., Moscicki, E.K., Anthony, J.C., 1990. An epidemiologic investigation of potential risk factors for suicide attempts. *Soc. Psychiatry Psychiatr. Epidemiol.* 25, 193–199.
- Radloff, L.S., 1977. The CES-D scale: a self-report depression scale for research in the general population. *Appl. Psychol. Meas.* 1, 385–401.
- Reinherz, H., Tanner, J., Berger, S., Beardslee, W., Fitzmaurice, G., 2006. Adolescent suicidal ideation as predictive of psychopathology, suicidal behavior, and compromised functioning at age 30. *Am. J. Psychiatry* 163, 1226–1232.
- Richardson, J.D., St Cyr, K.C.M., McIntyre-Smith, A.M., Haslam, D., Elhai, J.D., Sareen, J., 2012. Examining the association between psychiatric illness and suicidal ideation in a sample of treatment-seeking Canadian peacekeeping and combat veterans with posttraumatic stress disorder. *Can. J. Psychiatry – Rev. Can. Psychiatr.* 57, 496–504.
- Sareen, J., Cox, B.J., Stein, M.B., Affifi, T.O., Fleet, C., Asmundson, G.J., 2007. Physical and mental comorbidity, disability, and suicidal behavior associated with posttraumatic stress disorder in a large community sample. *Psychosom. Med.* 69, 242–248.
- Schoenbaum, M., Kessler, R.C., Gilman, S.E., Colpe, L.J., Heeringa, S.G., Stein, M.B., Ursano, R.J., Cox, K.L., 2014. Predictors of Suicide and Accident Death in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS) (in press).
- Sinclair, J.M.A., Gray, A., Hawton, K., 2006. Systematic review of resource utilization in the hospital management of deliberate self-harm. *Psychol. Med.* 36, 1681–1693.
- Stein, D.J., Chiu, W.T., Hwang, I., Kessler, R.C., Sampson, N., Alonso, J., Borges, G., Bromet, E., Bruffaerts, R., de Girolamo, G., Florescu, S., Gureje, O., He, Y., Kovess-Masfety, V., Levinson, D., Matschinger, H., Mneimneh, Z., Nakamura, Y., Ormel, J., Posada-Villa, J., Sagar, R., Scott, K.M., Tomov, T., Viana, M.C., Williams, D.R., Nock, M.K., 2010. Cross-national analysis of the associations between traumatic events and suicidal behavior: findings from the WHO World Mental Health Surveys. *PLoS One* 5, e10574.
- Thomas, J.L., Wilk, J.E., Riviere, L.A., McGurk, D., Castro, C.A., Hoge, C.W., 2010. Prevalence of mental health problems and functional impairment among active component and national guard soldiers 3 and 12 months following combat in Iraq. *Arch. Gen. Psychiatry* 67, 614–623.
- Thomsen, C.J., Stander, V.A., McWhorter, S.K., Rabenhorst, M.M., Milner, J.S., 2011. Effects of combat deployment on risky and self-destructive behavior among active duty military personnel. *J. Psychiatr. Res.* 45, 1321–1331.
- Weathers, F., Litz, B., Herman, D., Huska, J., Keane, T., 1993. The PTSD checklist (PCL): reliability, validity, and diagnostic utility. In: Annual Convention of the International Society for Traumatic Stress Studies, San Antonio, TX.
- Whooley, M.A., Avins, A.L., Miranda, J., Browner, W.S., 1997. Case-finding instruments for depression – two questions are as good as many. *J. Gen. Intern. Med.* 12, 439–445.