

Combat-Related Posttraumatic Stress Disorder and Comorbid Major Depression in U.S. Veterans: The Role of Deployment Cycle Adversity and Social Support

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Posttraumatic stress disorder (PTSD) and major depressive disorder (MDD) commonly co-occur in combat veterans, and this comorbidity has been associated with higher levels of distress and more social and economic costs compared to one disorder alone. In a secondary analysis of a multisite randomized controlled trial of a sample of veterans with combat-related PTSD, we examined the associations among pre-, peri-, and postdeployment adversity, social support, and clinician-diagnosed comorbid MDD. Participants completed the Deployment Risk and Resilience Inventory and the Beck Depression Inventory–II as well as structured clinical interviews for diagnostic status. Among 223 U.S. veterans of the military operations in Iraq and Afghanistan (86.9% male) with primary combat-related PTSD, 69.5% had current comorbid MDD. After adjustment for sex, a linear regression model indicated that more concerns about family disruptions during deployment, $f^2 = 0.065$; more harassment during deployment, $f^2 = 0.020$; and lower ratings of postdeployment social support, $f^2 = 0.154$, were associated with more severe self-reported depression symptoms. Interventions that enhance social support as well as societal efforts to foster successful postdeployment reintegration are critical for reducing the mental health burden associated with this highly prevalent comorbidity in veterans with combat-related PTSD.

In military populations, posttraumatic stress disorder (PTSD) and major depressive disorder (MDD) frequently

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co-occur as they do in civilian populations. In one large sample of U.S. National Guard soldiers who were clinically evaluated after deployment to Iraq, 70% of individuals with PTSD also had comorbid MDD (Kehle et al., 2011). In another large sample of treatment-seeking U.S. veterans of the military operations in Iraq and Afghanistan, 60% of participants with probable PTSD also had probable depression (Vaughan, Schell, Tanielian, Jaycox, & Marshall, 2014). This comorbidity has been associated with higher levels of psychological distress and greater use of mental health services (Kramer, Booth, Han, & Williams, 2005).

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Although they frequently co-occur (Hurlocker, Vidaurri, Cuccurullo, Maieritsch, & Franklin, 2018), little is known about why PTSD and depression are so highly comorbid in military populations and which psychological, environmental, or biological factors specifically contribute to this comorbid presentation (see Stander, Thomsen, & Highfill-McRoy, 2014). Evidence suggests that combat exposure alone does not account for this comorbidity (Grieger et al., 2006), and three general hypotheses have been proposed as possible explanations: (a) PTSD may incur causal risk for MDD; (b) PTSD and MDD are independent but interacting conditions that occur after trauma exposure, due to common risk and vulnerability factors; and/or (c) comorbidity is a consequence of symptom overlap (see Stander et al., 2014, for a review). Evidence to date has been most compelling for the hypotheses concerning causal and interacting conditions. As such, more research is needed to identify modifiable risks and vulnerabilities among military populations to assist with intervention efforts. In particular, it would be useful to better understand the potential role of adverse social and interpersonal events that may incur risk for developing comorbid depression and to consider their timeframe of occurrence in relation to the deployment cycle. Such factors can be relatively easily studied and are potentially malleable, making them possible targets for prevention and early intervention.

A variety of predeployment factors may increase the likelihood an individual will develop postdeployment PTSD and comorbid MDD (e.g., Spinhoven, Penninx, van Hemert, de Rooij, & Elzinga, 2014). Across populations with various types of trauma exposure, childhood adversity and abuse have been repeatedly identified as risk factors for both PTSD and MDD (e.g., see Gilbert et al., 2009; Clancy et al., 2006; Youssef et al., 2013). Factors that occur during deployment may also play a role in the development of postdeployment PTSD comorbid MDD. Given the interpersonal nature of depression (e.g., Gotlib & Colby, 1987; Joiner & Timmons, 2002), the role of social support and relationships while deployed may be particularly important. Unit cohesion has been the most widely studied perideployment factor that may affect the development of PTSD and MDD. Unit cohesion, which is defined as the extent to which an individual perceives their military unit, including peers and leadership, to be supportive, trustworthy, reliable, and cooperative (L. King, King, Vogt, Knight, & Saper, 2006), mitigates stressful deployment experiences (e.g., Rona et al., 2009) and protects against the psychological impact of traumatic events experienced during deployment, thus mitigating both PTSD (Goldmann et al., 2012; Han et al., 2014; Jones et al., 2012), and depression symptoms following combat exposure (Pietrzak et al., 2009; Pietrzak, Johnson, et al., 2010; Southwick, Vythilingam, & Charney, 2005). However, more research is needed to understand the relation between unit cohesion during deployment and the presence and severity of clinician-diagnosed comorbid MDD in combat veterans with postdeployment PTSD.

General harassment, or nonsexual, intentional, challenging or harmful behavior from the unit or superiors, has been strongly

associated with postdeployment PTSD, depression, and anxiety (L. King et al., 2006; Street, Gradus, Giasson, Vogt, & Resick, 2013). In a study of female veterans, researchers found general harassment to be significantly associated with both PTSD and MDD symptom severity (Kearns et al., 2016), suggesting a possible shared risk profile. However, no study to date has examined how general harassment impacts the presence and severity of comorbid MDD in male combat veterans with postdeployment PTSD. Perideployment sexual harassment and assault, often referred to as military sexual trauma (MST), has also been shown to be strongly related to postdeployment mental health outcomes (Suris & Lind, 2008, for a review). Military sexual trauma has been associated with depression symptoms and, in turn, suicidal ideation in men (Gradus, Street, Suvak, & Resick 2013) as well as increased odds of developing PTSD (Street et al., 2013). Moreover, in a study of veterans, researchers found a larger association between sexual harassment and depression and anxiety, but not PTSD symptoms in men compared to women (Vogt, Pless, King & King, 2005).

It is important to note that support systems during deployment extend beyond those established with fellow unit members and include family and friends back home. Although research remains sparse, concerns about family can impact postdeployment mental health (e.g., Vaughn-Coaxum, Smith, Iverson, & Vogt, 2015; Vogt et al., 2005). Perideployment concerns about family appear to be strongly associated with postdeployment PTSD symptoms and status, above and beyond combat exposure itself (Renshaw, 2010; Vasterling et al., 2010; Vogt et al., 2011). Concerns about home life have also demonstrated moderate associations with postdeployment depression symptoms (L. King et al., 2006; Vogt, Macdonald, & Blount, 2016) but have not yet been examined with respect to predicting MDD.

Postdeployment factors may also contribute to the presence of comorbid MDD and PTSD among combat veterans. A robust body of literature has demonstrated the impact the protective nature postdeployment social support and the negative impact of perceived negative social support can have on postdeployment mental health. Postdeployment social support refers to the support provided by an individual's broader social system, which includes friends, family members, coworkers, and society, following deployment (L. King et al., 2006). It has been well established that social support attenuates stress responses in the face of stressful life events (Cohen & McKay, 1984). Further, a high level of social support has been shown to be protective against MDD (e.g., Southwick et al., 2005) and has been associated with psychological resilience after trauma exposure (Bonanno, Galea, Bucciarelli, & Vlahov, 2007). Among combat veterans, a low level of postdeployment social support is one of the strongest negative predictors of PTSD (e.g., Goldmann et al., 2012); higher perceived postdeployment social support has been associated with less severe self-reported PTSD (Han et al., 2014) and depression (Pietrzak, Goldstein, et al., 2010). Some researchers have argued that postdeployment social support mediates the associations among self-reported PTSD, depression symptoms, and psychosocial functioning (Pietrzak,

Johnson, et al., 2010). Still, the question remains as to whether factors such as postdeployment social support and adversity may be associated with the presence and severity of clinician-diagnosed comorbid MDD, as opposed to self-reported depression symptoms, among veterans with PTSD. It is likely that social support and mental health issues iteratively impact each other in either positive or negative directions.

Despite this growing literature, some gaps remain. Although factors such as adverse childhood events, unit cohesion, and postdeployment social support have been independently associated with PTSD and depression, most studies have depended on self-report of symptoms rather than structured clinical interviews to determine diagnoses. It is important to note that no study, to our knowledge, has examined the relations between each of these factors simultaneously to determine their independent contribution to postdeployment PTSD and MDD comorbidity. The current study aimed to better understand the role of pre-, peri-, and postdeployment adversity and social support and their simultaneous associations with clinician-diagnosed comorbid MDD and self-reported depression severity in veterans with a primary diagnosis of combat-related PTSD. We hypothesized that childhood adversity, low unit cohesion, interpersonal strain experienced during deployment, low perceived postdeployment social support, and postdeployment stress exposure would predict the presence and severity of comorbid MDD.

Method

Participants and Procedure

Data were collected prior to treatment initiation during a multisite randomized clinical trial that compared the efficacy of prolonged exposure (PE) therapy, sertraline, and combined treatment for PTSD in U.S. veterans of recent military operations in Iraq and Afghanistan; detailed methods have been published elsewhere (Rauch et al., 2018). Briefly, participation criteria included that participants be a veteran or active duty service member who served in Iraq or Afghanistan and had combat-related PTSD for at least 3 months, with significant impairment as measured by a Clinician-Administered of PTSD Scale (CAPS) score of 50 or higher. Exclusion criteria included current psychosis, mania or hypomania; alcohol or substance dependence in the past 8 weeks, per criteria in the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)*; current imminent suicide risk; or significantly impairing cognitive deficits. Other exclusions were related to study-specific treatment history or contraindications (Rauch et al., 2018). Participants were 223 veterans with primary PTSD (86.9% male). The mean participant age was 34.20 years ($SD = 8.26$), and the sample was 57.8% White and 15.7% Hispanic. Close to half of the participants were married (49.3%, $n = 222$). The mean educational attainment was 13.75 years ($SD = 1.98$), and 51.1% of participants were currently employed full-time.

Participants were recruited between 2011 and 2016 from clinics and PTSD specialty programs at four sites: Massachusetts General Hospital (MGH), Ralph H. Johnson Veterans Administration (VA) Medical Center (RHJVAMC), VA Ann Arbor Healthcare System (VAAHS), and VA San Diego Healthcare System (VASDHS). Participants were administered a clinical interview with a trained independent evaluator (IE) as well as self-report study measures. The study received approval from the institutional review board of the respective healthcare systems.

Measures

PTSD diagnosis and symptom severity. The Clinician-Administered PTSD Scale (CAPS-IV; Blake, Weathers, Nagy, Kaloupek, Gusman, Charney, & Keane, 1995) is a structured diagnostic interview that has demonstrated excellent reliability and validity. It is used to determine PTSD diagnosis and severity by assessing the frequency and severity of PTSD symptoms. The CAPS was administered by IEs who were trained and required to achieve 90% agreement with trainers on all CAPS items during sample evaluations.

The Posttraumatic Stress Disorder Checklist-Specific version (PCL-S; Weathers, Litz, Herman, Huska, & Keane, 1993), which assesses the 17 *DSM-IV* symptoms of PTSD anchored to a specific traumatic event, was used to assess past-month PTSD symptoms related to the primary combat trauma. The PCL has demonstrated good test-retest reliability and construct validity (Adkins, Weathers, McDevitt-Murphy, & Daniels, 2008; Pratt, Brief, & Keane, 2006). In the present study, internal consistency was good, Cronbach's $\alpha = .87$.

Psychiatric disorders. The M.I.N.I. International Neuropsychiatric Interview (M.I.N.I.; Sheehan et al., 1998) is a structured diagnostic interview used to determine current *DSM-IV* diagnoses. The M.I.N.I. was conducted by certified IEs, who coded criterion as either present (*yes*) or absent (*no*) and were required to achieve 100% agreement with trainers on diagnoses and 90% agreement on all symptoms during sample evaluations.

Depression symptoms. The Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) is a 21-item measure of depression symptoms, with a total score that ranges from 0 to 63; higher scores indicate more severe depression symptoms. The BDI-II has demonstrated excellent internal consistency, validity, and test-retest reliability (Beck, Steer, Ball, & Ranjeri, 1996; Dozois, Dobson, & Ahnberg, 1998). In the present study, internal consistency was excellent, Cronbach's $\alpha = .91$.

Deployment-related factors. The Deployment Risk and Resilience Inventory (DRRI; L. King et al., 2006) is a widely used measure that assesses pre-, peri-, and postdeployment-related risk and resilience factors among war veterans. The DRRI consists of 14 subscales; for the current study and for parsimony, we chose to examine scales with the most

theoretical support in the literature. Thus, we were interested in eight subscales: Prior Stressors (DRRI-A) and Childhood Family Environment (DRRI-B), which concern predeployment factors; Concerns about Life and Family Disruptions (DRRI-E), Deployment Social Support (DRRI-F), General Harassment (DRRI-G1), Sexual Harassment (DRRI-G2), which concern perideployment factors; and Postdeployment Social Support (DRRI-L) and Postdeployment Stressors (DRRI-M), which concern postdeployment factors. Subscales that were theoretically related to trauma exposure severity rather than depression (e.g., combat experiences, perceived threat, aftermath of battle, preparedness) and subscales that were theoretically unrelated to the primary research question (e.g., exposures to biological weapons, difficult day-to-day living conditions in war zone) were excluded. The DRRI-A subscale includes 15 dichotomous items (0 = *no*, 1 = *yes*), with total scores ranging from 0 to 17. The DRRI-B subscale is a 15-item scale, with items rated on a 5-point Likert scale ranging from 1 (*almost none of the time*) to 5 (*almost all of the time*); scores range from 15 to 75. The DRRI-E subscale (14 items) includes items that are rated on a 4-point Likert scale ranging from 1 (*not at all*) to 4 (*a great deal*), with an additional option of 0 for *not applicable*. Scores can range between 14 and 56 (if no items receive a 0 rating). The DRRI-F subscale includes 12 items that are rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*); total scores range from 12 to 60. Both the DRRI-G1 and G2 subscales include seven items each, which are scored on 4-point Likert scales that indicate frequency of exposure using ratings of 1 (*never*) to 4 (*many times*); scores range from 7 to 28. The DRRI-L subscale includes 15 items that are rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*); scores range from 15 to 75. Finally, the DRRI-M subscale (17 items) consists of dichotomous questions (0 for *no*; 1 for *yes*). Scores range from 0 to 17. For all subscales, higher scores indicate greater presence of the construct. In the current study, internal reliability values were acceptable for DRRI-A, Cronbach's $\alpha = .77$; and DRRI-M, Cronbach's $\alpha = .70$. and good or excellent for the remaining subscales: DRRI-B, Cronbach's $\alpha = .92$; DRRI-E, Cronbach's $\alpha = .85$; DRRI-F, Cronbach's $\alpha = .92$; DRRI-G1, Cronbach's $\alpha = .92$; DRRI-G2, Cronbach's $\alpha = .87$; DRRI-I, Cronbach's $\alpha = .84$; DRRI-L, Cronbach's $\alpha = .82$.

Data Analysis

We first calculated descriptive statistics as means and standard deviations for continuous variables and as percentages and frequencies for categorical variables. Pearson correlations between self-reported depression severity (BDI-II) and each subscale of the DRRI were then calculated. We used a multiple logistic regression analysis to examine whether the eight DRRI subscales were associated with the presence or absence of MDD after adjusting for sex as a covariate. The decision to adjust for sex was made a priori given reported differences in rates of depression between male and female veterans (Haskell,

Gordon, Mattocks, Duggal, Erdos, Justice, & Brandt, 2010). An analogous multiple linear regression analysis was then used to examine whether DRRI subscales were associated with depression severity, which was based on BDI-II score. For the multiple regression models of BDI-II scores, we calculated Cohen's f^2 as an estimate of the local effect size for specific variables in the context of the multivariate regression models (Sly, Rose, Dierker, Hedeker, & Mermelstein, 2012), where f^2 [predictor] = $(r^2$ [full model] - r^2 [model without predictor]) / $(1 - r^2$ [full model]); each r^2 was calculated as r^2 [model] = $(\text{var}[\text{null model}] - \text{var}[\text{model}]) / \text{var}[\text{null model}]$. Cohen's f^2 values of 0.02 or greater, 0.15 or greater, and 0.35 or greater indicate small, medium, and large effects, respectively (Cohen, 1988). Statistical significance was determined at a two-tailed alpha less than 0.05. Data were analyzed using SAS (Version 9.4).

Results

The mean assessment scores for the sample were 77.27 ($SD = 14.30$) for the CAPS, 57.18 ($SD = 10.59$) for the PCL-S, and 24.73 ($SD = 10.87$) for the BDI-II. Of participants, 69.5% met the criteria for current MDD. As expected, individuals with current MDD had more severe self-reported depression symptoms, $p < .001$, as well as significantly higher levels of self-reported and clinician-rated PTSD symptom severity, $ps < .001$, than those without MDD, but demographic characteristics did not vary between the two groups (see Table 1).

Pearson correlations between self-reported depression (BDI-II score) and deployment risk and resilience factors are reported in Table 2. Higher self-reported depression ratings were associated with more concerns about family disruptions during deployment, $r = .26$, $p < .001$; general harassment from unit members and/or leadership while deployed, $r = .16$, $p = .021$; lower levels of perceived postdeployment social support, $r = -.37$, $p < .001$; and higher exposure to postdeployment stressors, $r = .20$, $p = .003$.

In the full logistic regression model that examined the presence of comorbid MDD and included all selected DRRI subscales and sex, no single subscale emerged as a significant predictor of MDD presence, overall model c statistic = 0.66 (Table 3). The full linear multiple regression model that examined potential pre-, peri-, and postdeployment predictors of current depression symptom severity was significant, $F(9,198) = 6.89$, $p < .001$ and explained approximately 20% of the variance of depression severity scores. The full model indicated that more concerns about life and family disruptions (i.e., DRRI-E), $p < .001$, as well as more general harassment (i.e., DRRI-G1), $p = .048$, during deployment were significant predictors of depression severity, with small effect sizes. Lower perceived postdeployment social support (i.e., DRRI-L), $p < .001$, emerged as a predictor with a medium effect size (Table 3). All variance inflation factors were between 1.15 and 1.70, suggesting no substantive multicollinearity among predictors.

Table 1
Demographic Variables

Variable	N	No MDD (n = 68)			MDD (n = 155)				Statistical Test	p	
		n	%	M	SD	n	%	M			SD
Male sex	223	62	91.2			132	85.2			$\chi^2(1, N = 223) = 1.51$.219
Age (years)	223			33.88	8.53			34.34	8.16	$t(221) = -0.38$.703
Non-White race	223	22	32.4			72	46.5			$\chi^2(1, N = 223) = 5.01$.082
Hispanic ethnicity	223	8	11.8			24	15.5			$\chi^2(1, N = 223) = 1.95$.377
Married	222	34	50.8			80	51.6			$\chi^2(1, N = 223) = 0.11$.948
Educational attainment, (years)	223			13.96	2.26			13.65	1.85	$t(221) = 1.08$.281
Employed full time	223	39	57.4			75	48.4			$\chi^2(1, N = 223) = 2.87$.238
Number of deployments	219			2.54	1.82			2.50	2.66	$t(217) = 0.10$.917
CAPS score	223			70.34	12.26			80.31	14.10	$t(221) = -5.05$	< .001
PCL-S score	221			52.69	10.00			59.13	10.27	$t(219) = -4.32$	< .001
BDI-II score	220			19.09	9.38			27.20	10.58	$t(218) = -5.41$	< .001

Note. CAPS = Clinician-Administered PTSD Scale; PCL-S = Posttraumatic Stress Disorder Checklist-Specific version; BDI-II = Beck Depression Inventory-II.

Discussion

In the current study, we sought to examine which pre, peri-, and postdeployment risk and resilience factors were associated with the presence of comorbid MDD and depression symptom severity across a treatment-seeking sample of veterans with combat-related PTSD. Over two-thirds of our sample reported having had a current comorbid major depressive episode, which contributes to the evidence showing that this comorbidity is highly prevalent. In addition, concerns about life and family disruptions during deployment and social support after deployment were associated with the severity of major depression symptoms. A less robust finding was that general harassment during deployment was also independently and positively associated with depression symptom severity.

Consistent with multiple prior reports, the results of the present study demonstrated that MDD is a common comorbid

condition among combat veterans with PTSD (e.g., Kehle et al., 2011). Our cross-sectional study design did not enable conclusions about the temporal aspects of this association, and evidence from several prior studies suggests that this relation is likely bidirectional. For instance, in a sample of Vietnam war veterans, depression predicted greater PTSD chronicity (Koenen, Stellman, Stellman, & Sommer, 2003). However, in a 20-year longitudinal study of combat-exposed war veterans, the authors found that self-reported PTSD symptom severity predicted depression symptoms at future assessment points but the reverse was not true (Ginzburg, Ein-Dor, & Solomon, 2010). In an extensive review, Stander and colleagues (2014) concluded that evidence from several studies of combat-exposed military samples provided a more convincing argument for PTSD as a risk for the subsequent development of MDD rather than the other way around.

Table 2
Correlations Between Deployment Risk and Resilience Inventory Subscales and Depression Symptom Severity

Variables	1	2	3	4	5	6	7	8	9	n	M	SD
1. BDI-II	—	.03	.06	.26*	-.13	.16*	.09	-.37*	.20*	220	24.73	10.87
2. Predeployment Life Events		—	-.34*	.27*	-.11	.25*	.09	-.08	.39*	209	3.17	2.89
3. Childhood Experiences			—	.06	.14*	-.23*	-.01	.17*	-.14	210	54.92	11.16
4. Life and Family Disruptions During Deployment				—	-.19*	.14*	.01	-.04	.13	210	23.42	10.31
5. Deployment Unit Social Support					—	-.57*	-.12	.32*	-.09	210	42.18	11.01
6. General Harassment						—	.23*	-.14*	.23*	210	14.00	5.83
7. Sexual Harassment							—	-.13	.19*	209	7.84	2.46
8. Postdeployment Social Support								—	-.24*	210	50.75	9.18
9. Postdeployment Stressors									—	209	3.95	2.75

Note. BDI-II = Beck Depression Inventory.

*p < .05.

Table 3

Results of Regression Models Examining Risk and Resilience Factors Predicting the Presence of Comorbid Current Major Depressive Disorder and Self-Reported Depression Severity

Predictor	Logistic regression results			Linear regression results			Cohen's f^2	VIF
	OR	95% CI	<i>p</i>	<i>B</i>	95% CI	<i>p</i>		
Predeployment life events	1.00	[0.88, 1.13]	.952	−0.35	[−0.90, 0.20]	.214	0.01	1.45
Childhood experiences	1.01	[0.98, 1.04]	.746	0.11	[−0.03, 0.24]	.114	0.01	1.23
Life and family disruptions during deployment	1.03	[0.99, 1.06]	.121	0.25*	[0.11, 0.39]	< .001	0.07	1.15
Deployment unit social support	0.99	[0.95, 1.02]	.411	0.12	[−0.04, 0.27]	.148	0.01	1.69
General harassment	0.98	[0.91, 1.04]	.458	0.30*	[0.00, 0.59]	.048	0.02	1.69
Sexual harassment	0.91	[0.78, 1.05]	.193	−0.01	[−0.64, 0.62]	.971	0.00	1.39
Postdeployment social support	0.97	[0.93, 1.00]	.066	−0.44*	[−0.60, −0.29]	< .001	0.15	1.22
Postdeployment stressors	1.12	[0.98, 1.29]	.095	0.42	[−0.13, 0.96]	.134	0.01	1.30
Sex	2.11	[0.66, 6.81]	.210	0.87	[−5.48, 3.74]	.710	0.00	1.29
	Overall model <i>c</i> statistic = 0.66			Overall model adjusted R^2 = .20				

Note. OR = odds ratio; VIF = variance inflation factor (used to assess multicollinearity between predictors).

* $p < .05$.

In concert with Vogt et al. (2016), who found that both objective (i.e., events) and subjective (i.e., concerns) family stressors during deployment were associated with postdeployment PTSD and depression symptom severity, we found that life and family disruptions during deployment were positively correlated with MDD symptom severity in the present sample. During deployment, worries about one's family and household may worsen mood and rumination, resulting in increased negative cognitions, which are characteristic of MDD.

Consistent with the extant literature, postdeployment social support was also negatively associated with depression severity. One possible interpretation of this finding is that ongoing interpersonal strain, including family relationship strain, during deployment continues to negatively impact veterans upon returning home, increasing their risk for depression via such potential pathways as inadequate support and/or increased stress. Another hypothesis is that factors associated with MDD, such as rumination, social withdrawal, render service members at risk for both increased family problems during deployment and social difficulties upon their return home. Regardless of the direction, future research could study the effect of interventions designed to optimize social and family support, especially for at-risk families.

Of note, in our model that included all factors simultaneously, unit support during deployment was not associated with MDD status or symptom severity. However, higher ratings of general harassment within the unit were related to a higher level of depression symptom severity. Although it has not been extensively studied, general harassment has been associated with suicidal ideation (Lemaire & Graham, 2011), alcohol use (Schultz, Glickman, & Eisen, 2014), and physical health symptoms (Nillni et al., 2014) in U.S. veterans of the conflicts in

Iraq and Afghanistan. The present study expands on these prior findings by highlighting the association between MDD severity and general harassment within the unit. This finding is consistent with a study of female veterans, which also found general harassment to predict depression severity but not diagnostic status (Kearns et al., 2016). Unit harassment may, therefore, have detrimental effects on mental health, akin to those of stress, and, along with other perideployment stressors such as combat exposure, ultimately contribute to overall cumulative risk for depression. Harassment from within one's unit or perpetrated by one's superiors may cause significant stress when it is viewed as a violation of traditional military values, such as loyalty (Nillni et al., 2014), or because of the unexpected nature of having a threat occur from people previously deemed safe. As a consequence, service members may be less able to use interpersonal regulation strategies (Hofmann, 2014) to cope with the stressors of being deployed and, in turn, experience increased levels of isolation. This finding also highlights the differential impact of the role of perideployment risk (harassment) versus resilience (unit support) factors on postdeployment depression severity and suggests that when considered together, harassment may pose a greater psychological risk than cohesion necessarily confers psychological protection. It may thus be important to inquire about experiences of general harassment as part of a comprehensive deployment assessment. Notably, our finding that low postdeployment social support, but not unit support during deployment, was associated with higher levels of depression severity is somewhat similar to findings from a prior study that showed postdeployment social support, rather than unit support, to be more strongly negatively associated with PTSD symptom severity (Han et al., 2014).

The present findings must be considered in light of both strengths and limitations. The study's strengths included a relatively large and ethnically diverse sample of veterans who were recruited from four different sites. Additionally, participants were diagnosed using standardized, structured, evidence-based assessments carried out by trained clinical raters. Despite these strengths, there were several limitations. First, data were cross-sectional, and we relied on retrospective report of deployment risk and resilience factors. We were unable to draw conclusions about the causal directions between risk and resilience factors, depression diagnosis, and depression symptom severity. Moreover, there is overlap between the symptoms of depression and PTSD; cross-sectional analyses made it impossible to examine the dynamic interplay between these symptoms over time. Some evidence suggests that anxiety symptoms are more stable and lead to depression symptoms, whereas the reverse is not necessarily true (Wetherell, Gatz, & Pedersen, 2001). Additionally, the present study was not designed to test competing explanations for PTSD and depression comorbidity. Future studies that use longitudinal designs are needed to better understand both the association between deployment-related risk and resilience factors and depression, including the study of how perideployment interpersonal factors influence postdeployment interpersonal factors, and the relation between PTSD and depression symptoms. Second, we did not limit our examination of comorbidity to new-onset MDD; our sample reflects a population of veterans with both new-onset and preexisting MDD. Third, we did not have a control group that contained individuals with primary MDD and no PTSD. Fourth, this study was conducted prior to the release of the updated DRRI-2 (Vogt et al., 2013), which has been revised to include more contemporary issues related to family and social struggles among veterans. Finally, the current sample included treatment-seeking combat-exposed veterans and excluded those with severe mental illness and recent substance dependence. Caution should be used when generalizing results to non-treatment-seeking veterans and those with severe mental illness. The sample was also predominantly composed of male veterans. The impact of some stressors, such as military sexual harassment and social support, may have a differential effect on female veterans, who are at higher risk for MST (Barth et al., 2016) and may experience a stronger protective benefit from social support (e.g., Smith et al., 2013).

Collectively, the present findings suggest that MDD is highly prevalent in U.S. veterans of the military conflicts in Iraq and Afghanistan who have combat-related PTSD. Peri- and postdeployment interpersonal strain are critical factors associated with comorbid major depression severity. Extensive and repeated deployment absences may also erode family relationships and increase family-related stress; thus, veterans may benefit from pre- and perideployment family programs to provide support and education (Laser & Stephens, 2011). Additionally, family members of military personnel may benefit from educational programs that provide information about deployment experiences. Increased stress from home life may also be compounded by harassment-related stress within a service member's unit,

and research is needed to further explore the relation between these perideployment interpersonal risk factors. Finally, given the impact of postdeployment social support on depression, enhancing social support in the aftermath of deployment, perhaps through peer support initiatives, community integration efforts, psychosocial treatments, and group therapy may offer benefits for this population.

References

- Adkins, J. W., Weathers, F. W., McDevitt-Murphy, M., & Daniels, J. B. (2008). Psychometric properties of seven self-report measures of posttraumatic stress disorder in college students with mixed civilian trauma exposure. *Journal of Anxiety Disorders, 22*, 1393–1402. <https://doi.org/10.1016/j.janxdis.2008.02.002>
- Barth, S. K., Kimerling, R. E., Pavao, J., McCutcheon, S. J., Batten, S. V., Dursa, E., Peterson, M. R., & Schneiderman, A. I. (2016). Military sexual trauma among recent veterans. *American Journal of Preventive Medicine, 50*, 77–86. <https://doi.org/10.1016/j.amepre.2015.06.012>
- Beck, A. T., Steer, R. A., Ball, R., & Ranieri, W. (1996). Comparison of Beck Depression Inventories–IA and –II in psychiatric outpatients. *Journal of Personality Assessment, 67*, 588–597. https://doi.org/10.1207/s15327752jpa6703_13
- Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory-II* (Vol. 1). San Antonio, TX: Psychological Corporation.
- Blake, D. D., Weathers, F. W., Nagy, L. M., Kaloupek, D. G., Gusman, F. D., Charney, D. S., & Keane, T. M. (1995). The development of a clinician-administered PTSD scale. *Journal of Traumatic Stress, 8*, 75–90.
- Bonanno, G. A., Galea, S., Bucchiarelli, A., & Vlahov, D. (2007). What predicts psychological resilience after disaster? The role of demographics, resources, and life stress. *Journal of Consulting and Clinical Psychology, 75*, 671–682. <https://doi.org/10.1037/0022-006X.75.5.671>
- Clancy, C. P., Graybeal, A., Thompson, W. P., Badgett, K. S., Feldman, M. E., Calhoun, P. S., . . . Beckham, J. C. (2006). Lifetime trauma exposure in veterans with military-related posttraumatic stress disorder: Association with current symptomatology. *Journal of Clinical Psychiatry, 67*, 1346–1353. <https://doi.org/10.4088/jcp.v67n0904>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
- Cohen, S., & McKay, G. (1984). Social support, stress and the buffering hypothesis: A theoretical analysis. In A. Baum, S. E. Taylor, & J. E. Singer (Eds.), *Handbook of psychology and health* (pp. 253–267). Hillsdale, NJ: Erlbaum.
- Dozois, D. J. A., Dobson, K. S., & Ahnberg, J. L. (1998). A psychometric evaluation of the Beck Depression Inventory–II. *Psychological Assessment, 10*, 83–89. <https://doi.org/10.1037/1040-3590.10.2.83>
- Gilbert, R., Spatz Widom C., Browne, K., Fergusson, D., Webb, E., & Jansan, S. (2009). Burden and consequences of child maltreatment in high-income countries. *Lancet, 373*, 68–81. [https://doi.org/10.1016/S0140-6736\(08\)61706-7](https://doi.org/10.1016/S0140-6736(08)61706-7)
- Ginzburg, K., Ein-Dor, T., & Solomon, Z. (2010). Comorbidity of post-traumatic stress disorder, anxiety and depression: A 20-year longitudinal study of war veterans. *Journal of Affective Disorders, 123*, 249–257. <https://doi.org/10.1016/j.jad.2009.08.006>
- Goldmann, E., Calabrese, J. R., Prescott, M. R., Tamburrino, M., Liberzon, I., Slembariski, R., . . . & Galea, S. (2012). Potentially modifiable pre-, peri-, and postdeployment characteristics associated with deployment-related posttraumatic stress disorder among Ohio

- Army National Guard soldiers. *Annals of Epidemiology*, 22, 71–78. <https://doi.org/10.1016/j.annepidem.2011.11.003>
- Gotlib, I. H., & Colby, C. A. (1987). *Treatment of depression: An interpersonal systems approach*. Elmsford, NY: Pergamon Press.
- Gradus, J. L., Street, A. E., Suvak, M. K., & Resick, P. A. (2013). Predictors of suicidal ideation in a gender-stratified sample of OEF/OIF veterans. *Suicide & Life-Threatening Behavior*, 45, 574–588. <https://doi.org/10.1111/sltb.12040>
- 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. *American Journal of Psychiatry*, 163, 1777–1783. <https://doi.org/10.1176/ajp.2006.163.10.1777>
- Han, S. C., Castro, F., Lee, L. O., Charney, M. E., Marx, B. P., Brailey, K., . . . Vasterling, J. J. (2014). Military unit support, postdeployment social support, and PTSD symptoms among active duty and National Guard soldiers deployed to Iraq. *Journal of Anxiety Disorders*, 28, 446–453. <https://doi.org/10.1016/j.janxdis.2014.04.004>
- Haskell, S. G., Gordon, K. S., Mattocks, K., Duggal, M., Erdos, J., Justice, A., & Brandt, C. A. (2010). Gender differences in rates of depression, PTSD, pain, obesity, and military sexual trauma among Connecticut war veterans of Iraq and Afghanistan. *Journal of Women's Health*, 19, 267–271. <https://doi.org/10.1089/jwh.2008.1262>
- Hofmann, S. (2014). Interpersonal emotion regulation model of mood and anxiety disorders. *Cognitive Therapy Research*, 38, 482–492. <https://doi.org/10.1007/s10608-014-9620-1>
- Hurlocker, M. C., Vidaurri, D. N., Cucurullo, L. J., Maieritsch, K., & Franklin, C. L. (2018). Examining the latent structure mechanisms for comorbid post-traumatic stress disorder and major depressive disorder. *Journal of Affective Disorders*, 229, 477–482. <https://doi.org/10.1016/j.jad.2017.12.076>
- Joiner, T. E., & Timmons, K. A. (2002). Depression in its interpersonal context. In I. H. Gotlib, & C. L. Hammen (Eds.), *Handbook of depression* (2nd ed.; pp. 322–339). New York, NY: Guilford Press.
- Jones, N., Seddon, R., Fear, N. T., McAllister, P., Wessely, S., & Greenberg, N. (2012). Leadership, cohesion, morale, and the mental health of UK Armed Forces in Afghanistan. *Psychiatry: Interpersonal and Biological Processes*, 75, 49–59. <https://doi.org/10.1521/psyc.2012.75.1.49>
- Kearns, J. C., Gorman, K. R., Bovin, M. J., Green, J. D., Rosen, R. C., Keane, T. M., & Marx, B. P. (2016). The effect of military sexual assault, combat exposure, postbattle experiences, and general harassment on the development of PTSD and MDD in female OEF/OIF veterans. *Translational Issues in Psychological Science*, 2, 418–428. <https://doi.org/10.1037/tps0000098>
- Kehle, S. M., Reddy, M. K., Ferrier-Auerbach, A. G., Erbes, C. R., Arbis, P. A., & Polusny, M. A. (2011). Psychiatric diagnoses, comorbidity, and functioning in National Guard troops deployed to Iraq. *Journal of Psychiatric Research*, 45, 126–132. <https://doi.org/10.1016/j.jpsychires.2010.05.013>
- King, L. A., King, D. W., Vogt, D. S., Knight, J., & Samper, R. E. (2006). Deployment Risk and Resilience Inventory: A collection of measures for studying deployment-related experiences of military personnel and veterans. *Military Psychology*, 18, 89–120. https://doi.org/10.1207/s15327876mp1802_1
- Koenen, K. C., Stellman, J. M., Stellman, S. D., & Sommer, J. F. (2003). Risk factors for course of posttraumatic stress disorder among Vietnam veterans: A 14-year follow-up of American Legionnaires. *Journal of Consulting and Clinical Psychology*, 71, 980–986. <https://doi.org/10.1037/0022-006X.71.6.980>
- Kramer, T. L., Booth, B. M., Han, X., & Williams, D. K. (2005). Service utilization and outcomes in medically ill veterans with posttraumatic stress and depressive disorders. *Journal of Traumatic Stress*, 16, 211–219. <https://doi.org/10.1023/A:1023783705062>
- Laser, J. A., & Stephens, P. M. (2011). Working with military families through deployment and beyond. *Clinical Social Work Journal*, 39, 28–38. <https://doi.org/10.1007/s10615-010-0310-5>
- Lemaire, C. M., & Graham, D. P. (2011). Factors associated with suicidal ideation in OEF/OIF veterans. *Journal of Affective Disorders*, 130, 231–238. <https://doi.org/10.1016/j.jad.2010.10.021>
- Nillni, Y. I., Gradus, J. L., Gutner, C. A., Luciano, M. T., Shipherd, J. C., & Street, A. E. (2014). Deployment stressors and physical health among OEF/OIF veterans: The role of PTSD. *Health Psychology*, 33, 1281–1287. <https://doi.org/10.1037/hea0000084>
- Pietrzak, R. H., Goldstein, M. B., Malley, J. C., Rivers, A. J., Johnson, D. C., & Southwick, S. M. (2010). Risk and protective factors associated with suicidal ideation in veterans of Operations Enduring Freedom and Iraqi Freedom. *Journal of Affective Disorders*, 123, 102–107. <https://doi.org/10.1016/j.jad.2009.08.001>
- Pietrzak, R. H., Johnson, D. C., Goldstein, M. B., Malley, J. C., Rivers, A. J., Morgan, C. A., & Southwick, S. M. (2010). Psychosocial buffers of traumatic stress, depressive symptoms, and psychosocial difficulties in veterans of Operations Enduring Freedom and Iraqi Freedom: The role of resilience, unit support, and postdeployment social support. *Journal of Affective Disorders*, 120, 188–192. <https://doi.org/10.1016/j.jad.2009.04.015>
- Pietrzak, R. H., Johnson, D. C., Goldstein, M. B., Malley, J. C., & Southwick, S. M. (2009). Psychological resilience and postdeployment social support protect against traumatic stress and depressive symptoms in soldiers returning from Operations Enduring Freedom and Iraqi Freedom. *Depression and Anxiety*, 26, 745–751. <https://doi.org/10.1002/da.20558>
- Pratt, E. M., Brief, D. J., & Keane, T. M. (2006). Recent advances in psychological assessment of adults with posttraumatic stress disorder. In V. M. Follette & J. I. Ruzek (Eds.), *Cognitive-behavioral therapies for trauma* (pp. 34–61). New York, NY: Guilford Press.
- Rauch, S. A. M., Simon, N. M., Kim, H. M., Acierno, R., King, A. P., Norman, S. B., . . . Hoge, C. W. (2018). Integrating biological treatment mechanisms into randomized clinical trials: Design of PROGRESS (PROlonged ExpoSure and Sertraline Trial). *Contemporary Clinical Trials*, 64, 128–138. <https://doi.org/10.1016/j.cct.2017.10.013>
- Renshaw, K. D. (2010). Deployment experiences and postdeployment PTSD symptoms in National Guard/Reserve service members serving in operations Enduring Freedom and Iraqi Freedom. *Journal of Traumatic Stress*, 23, 815–818. <https://doi.org/10.1002/jts.20575>
- Rona, R. J., Jones, M., Iversen, A., Hull, L., Greenberg, N., Fear, N. T., . . . Wessely, S. (2009). The impact of posttraumatic stress disorder on impairment in the UK military at the time of the Iraq war. *Journal of Psychiatric Research*, 43, 649–655. <https://doi.org/10.1016/j.jpsychires.2008.09.006>
- Schultz, M., Glickman, M. E., & Eisen, S. V. (2014). Predictors of decline in overall mental health, PTSD, and alcohol use in OEF/OIF veterans. *Comprehensive Psychiatry*, 55, 1654–1664. <https://doi.org/10.1016/j.comppsy.2014.06.003>
- Selya, A. S., Rose, J. S., Dierker, L. C., Hedeker, D., & Mermelstein, R. J. (2012). A practical guide to calculating Cohen's f^2 , a measure of local effect size, from PROC MIXED. *Frontiers in Psychology*, 3, 111. <https://doi.org/10.3389/fpsyg.2012.00111>
- Smith, B. N., Vaughn, R. A., Vogt, D., King, D. W., King, L. A., & Shipherd, J. C. (2013). Main and interactive effects of social support in predicting mental health symptoms in men and women following military stressor exposure. *Anxiety Stress and Coping*, 26, 52–69. <https://doi.org/10.1080/10615806.2011.634001>
- Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., . . . Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured

- diagnostic psychiatric interview for *DSM-IV* and *ICD-10*. *Journal of Clinical Psychiatry*, *59*, 22–33.
- Southwick, S. M., Vythilingam, M., & Charney, D. S. (2005). The psychobiology of depression and resilience to stress: Implications for prevention and treatment. *Annual Review of Clinical Psychology*, *1*, 255–291. <https://doi.org/10.1146/annurev.clinpsy.1.102803.143948>
- Spinhoven, P., Penninx, B. W., van Hemert, A. M., de Rooij, M., & Elzinga, B. M. (2014). Comorbidity of PTSD in anxiety and depressive disorders: Prevalence and shared risk factors. *Child Abuse and Neglect*, *38*, 1320–1330. <https://doi.org/10.1016/j.chiabu.2014.01.017>
- Stander, V. A., Thomsen, C. J., & Highfill-McRoy, R. M. (2014). Etiology of depression comorbidity in combat-related PTSD: A review of the literature. *Clinical Psychologist Reviews*, *34*, 87–98. <https://doi.org/10.1016/j.cpr.2013.12.002>
- Street, A. E., Gradus, J. L., Vogt, D., Giasson, H. L., & Resick, P. A. (2013). Gender differences among veterans deployed in support of the wars in Afghanistan and Iraq. *Journal of General Internal Medicine*, *28*, 556–562. <https://doi.org/10.1007/s11606-013-2333-4>
- Suris, A., & Lind, L. (2008). Military sexual trauma: A review of prevalence and associated health consequences in veterans. *Trauma, Violence, & Abuse*, *9*, 250–269. <https://doi.org/10.1177/1524838008324419>
- Vasterling, J. J., Proctor, S. P., Friedman, M. J., Hoge, C. W., Heeren, T., King, L. A., & King, D. W. (2010). PTSD symptom increases in Iraq-deployed soldiers: comparison with nondeployed soldiers and associations with baseline symptoms, deployment experiences, and postdeployment stress. *Journal of Traumatic Stress*, *23*, 41–51. <https://doi.org/10.1002/jts.20487>
- Vaughan, C. A., Schell, T. L., Tanielian, T., Jaycox, L. H., & Marshall, G. N. (2014). Prevalence of mental health problems among Iraq and Afghanistan veterans who have and have not received VA services. *Psychiatric Services*, *65*, 833–835. <https://doi.org/10.1176/appi.ps.201300111>
- Vaughn-Coaxum, R., Smith, B. N., Iverson, K. M., & Vogt, D. (2015). Family stressors and postdeployment mental health in single versus partnered parents deployed in support of the wars in Afghanistan and Iraq. *Psychological Services*, *12*, 241–249. <https://doi.org/10.1037/ser0000026>
- Vogt, D. S., Macdonald, A., & Blount, T. (2016). Family-related experiences during deployment and their role in the postdeployment mental health of OEF/OIF veterans. In S. MacDermin Wadsworth & D. S. Riggs (Eds.), *War and family life: Risk and resilience in military and veteran families* (pp. 17–34). Basel, Switzerland: Springer International Publishing.
- Vogt, D. S., Pless, A. P., King, L. A., & King, D. W. (2005). Deployment stressors, gender, and mental health outcomes among Gulf War I veterans. *Journal of Traumatic Stress*, *18*, 272–284. <https://doi.org/10.1002/jts.20044>
- Vogt, D. S., Smith B., Elwy, R., Martin, J., Schultz, M., Drainoni, M. -L., & Eisen, S. (2011). Predeployment, deployment, and postdeployment risk factors for posttraumatic stress symptomatology in female and male OEF/OIF veterans. *Journal of Abnormal Psychology*, *120*, 819–831. <https://doi.org/10.1037/a0024457>
- Vogt, D. S., Smith, B. N., King, L. A., King, D. W., Knight, J., & Vasterling, J. J. (2013). Deployment risk and resilience inventory-2 (DRRI-2): an updated tool for assessing psychosocial risk and resilience factors among service members and veterans. *Journal of Traumatic Stress*, *26*, 710–717. <https://doi.org/10.1002/jts.21868>
- Weathers, F., Litz, B., Herman, D., Huska, J., & Keane, T. (1993). *The PTSD Checklist (PCL): Reliability, validity, and diagnostic utility*. Paper presented at the 9th Annual Conference of the International Society for Traumatic Stress Studies, San Antonio, TX.
- Wetherell, J. L., Gatz, M., & Pedersen, N. L. (2001). A longitudinal analysis of anxiety and depressive symptoms. *Psychology and Aging*, *16*, 187–195. <https://doi.org/10.1037/0882-7974.16.2.187>
- Youssef, N. A., Green, K. T., Dedert, E. A., Hertzberg, J. S., Calhoun, P. S., Dennis, M. F., & Beckham, J. C. (2013). Exploration of the influence of childhood trauma, combat exposure, and the resilience construct on depression and suicidal ideation among U.S. Iraq/Afghanistan era military personnel and veterans. *Archives of Suicide Research*, *17*, 106–122. <https://doi.org/10.1080/13811118.2013.776445>