

RESEARCH ARTICLE

Prospective associations of perceived unit cohesion with postdeployment mental health outcomes

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Background: Prior investigations have found negative associations between military unit cohesion and posttraumatic stress disorder (PTSD); however, most relied on cross-sectional data and few examined relationships of unit cohesion to other mental disorders. This study evaluates prospective associations of perceived unit cohesion with a range of mental health outcomes following combat deployment.

Methods: U.S. Army soldiers were surveyed approximately 1–2 months before deployment to Afghanistan (T0); and 1 month (T1), 3 months (T2), and 9 months (T3) after return from deployment. Logistic regression was performed to estimate associations of perceived unit cohesion at T0 with risk of PTSD, major depressive episode (MDE), generalized anxiety disorder (GAD), alcohol or substance use disorder (AUD/SUD), and suicidal ideation at T2 or T3 among soldiers who completed all study assessments ($N = 4,645$). Models were adjusted for sociodemographic and Army service characteristics, predeployment history of the index outcome, and deployment stress exposure.

Results: Higher perceived unit cohesion at T0 was associated with lower risk of PTSD, MDE, GAD, AUD/SUD, and suicidal ideation at T2 or T3 (AORs = 0.72 to 0.85 per standard score increase in unit cohesion; P -values < 0.05). Models of incidence of mental disorders and suicidal ideation among soldiers without these problems predeployment yielded similar results, except that perceived unit cohesion was not associated with incident AUD/SUD.

Conclusions: Soldiers who reported strong unit cohesion before deployment had lower risk of postdeployment mental disorders and suicidal ideation. Awareness of associations of perceived unit cohesion with postdeployment mental health may facilitate targeting of prevention programs.

KEYWORDS

anxiety disorders, major depressive disorder, military personnel, posttraumatic stress disorder, risk factors, suicidal ideation

1 | INTRODUCTION

Unit cohesion refers to the bonds that maintain service member commitment to each other, the unit, and the mission (Van Epps, 2008). The construct of unit cohesion encompasses trust and camaraderie among peers (horizontal cohesion), as well as support from and respect for unit leadership (vertical cohesion; King, King, Vogt, Knight, & Samper,

2006; Van Epps, 2008). Unit cohesion correlates positively with individual and unit performance, retention, and combat readiness (Griffith, 2002; Oliver, Harman, Hoover, Hayes, & Pandhi, 1999; Vasterling et al., 2015).

Unit cohesion also may contribute to mental health outcomes of military personnel (McAndrew et al., 2017; Mulligan et al., 2010; Rona et al., 2009). Numerous studies have found negative associations

between perceived unit cohesion and posttraumatic stress disorder (PTSD; Brailey, Vasterling, Proctor, Constans, & Friedman, 2007; Dickstein et al., 2010; DuPreez, Sundin, Wessely, & Fear, 2012; Iversen et al., 2008; Jones et al., 2012; Kanesarajah, Waller, Zheng, & Dobson, 2016; Pietrzak et al., 2010; Rona et al., 2009). Available evidence also suggests that service members who report strong unit cohesion have lower risk of depression (Bryan & Heron, 2015; Pietrzak et al., 2010) and suicidal ideation (Griffith, 2015; Mitchell, Gallaway, Millikan, & Bell, 2012). The relationship of unit cohesion to alcohol use disorders is less clear, as studies examining this association have yielded discrepant results (Kanesarajah et al., 2016; Orr et al., 2014) including some that indicate positive associations of unit cohesion with alcohol misuse (Breslau, Setodji, & Vaughan, 2016; Browne et al., 2008; Jones & Fear, 2011).

Stress exposure is a robust predictor of mental health outcomes following deployment (Hoge et al., 2004; Smith et al., 2008). Some studies suggest that strong unit cohesion serves as a buffer against adverse effects of deployment stress on mental health (Armistead-Jehle, Johnson, Wade, & Ecklund, 2011; Mitchell et al., 2012), possibly by providing stress-exposed unit members with social support and empathy (Griffith, 2002). However, other research has failed to find evidence that unit cohesion moderates effects of deployment stress on mental health (Armstrong, Bryan, Stephenson, Bryan, & Morrow, 2014; Kanesarajah et al., 2016). Some researchers have proposed a more complex relationship, whereby strong unit cohesion protects against mental disorders at low-to-moderate levels of stress but loses its protective effect—and potentially becomes detrimental—at high levels of stress (e.g., Fontana, Rosenheck, & Horvath, 1997). Loss or reversal of the protective effect of unit cohesion could result from diminishment of group efficacy or greater sense of loss/survivorship guilt among personnel from cohesive units subjected to high stress. Consistent with this model, Fontana et al. (1997) found that strong perceived unit cohesion was associated with lower rates of psychopathology among Vietnam veterans with low-to-moderate combat stress exposure, but higher rates of psychopathology among those with high combat stress exposure. Dickstein et al. (2010) failed to replicate this finding in a sample of U.S. Air Force medical personnel deployed to Iraq, but acknowledged that levels of stress exposure in their sample may have been insufficient to detect loss of protective effects of unit cohesion at high levels of stress (see also Brailey et al., 2007). Differences in sample characteristics likely contribute to the inconsistent findings of prior studies of unit cohesion, stress exposure, and service member mental health.

Most studies of unit cohesion and mental health have utilized cross-sectional designs, which offer limited evidence of “protective effects” of strong cohesion or, conversely, detrimental effects of weak cohesion. In particular, cross-sectional self-report data are vulnerable to recall bias in which the respondent's current emotional status (e.g., state anxiety and depressed mood) may influence his or her retrospective report of past events or circumstances (e.g., Southwick, Morgan, Nicolaou, & Charney, 1997). Such bias could lead to inflated estimates of associations between pre- or perideployment unit cohesion and postdeployment mental disorders; in that service members with high postdeployment distress might underestimate

the cohesiveness of their unit before and/or during deployment, whereas those experiencing positive mood might overestimate unit cohesion during earlier periods. Prospective studies that evaluate perceived unit cohesion prior to deployment stress exposure and outcome evaluation can provide stronger evidence of protective effects.

The few prospective studies that have examined unit cohesion in relation to postdeployment mental health have yielded mixed results. Predeployment perceived unit support was not associated with postdeployment PTSD among Army National Guard soldiers (Han et al., 2014; Polusny et al., 2011) or Regular Army soldiers (Han et al., 2014). A modest negative association was observed between perceived unit support during deployment and postdeployment PTSD symptoms in the Regular Army sample (Han et al., 2014). However, unit support during deployment was evaluated postdeployment (i.e., concurrent with outcome assessment; and thus vulnerable to the recall bias described above), and its association with postdeployment PTSD symptoms became nonsignificant in the presence of controls for postdeployment social support. On the other hand, a prospective study that employed multilevel analysis found significant associations between individual perceptions of unit cohesion and postdeployment mental health. In that study, Marines who reported stronger cohesion than their unit-mates before deployment were less likely to screen positive for PTSD and depression after return from deployment (Breslau et al., 2016).

Improved understanding of the interrelationships among unit cohesion, deployment stress, and mental health could aid efforts to prevent mental disorders and suicidal behaviors among service members. Evidence of increased risk of these problems among soldiers who report low unit cohesion—either in general or in conjunction with certain levels of deployment stress exposure—could inform targeting of the military's risk mitigation programs. However, the existing literature precludes strong conclusions about effects of unit cohesion on service member mental health, due to methodological limitations (e.g., reliance on cross-sectional data), scarcity of investigation of certain outcomes (e.g., anxiety disorders and suicidal behaviors), and mixed results of prospective studies and of investigations of the interrelationships of unit cohesion, deployment stress, and mental health.

The aim of this investigation was to estimate associations of predeployment perceived unit cohesion with a range of postdeployment mental health outcomes including PTSD, major depressive episode (MDE), generalized anxiety disorder (GAD), panic disorder (PD), alcohol or substance use disorder (AUD/SUD), and suicidal ideation. Data were drawn from the Pre-/Postdeployment Study (PPDS), a prospective, longitudinal component of the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS; Ursano et al., 2014). The analysis adjusted for sociodemographic and Army service characteristics, predeployment history of the index outcome, and deployment stress exposure—factors that could influence both perceptions of unit cohesion and risk of postdeployment mental disorders. The analysis also examined whether the associations of perceived unit cohesion with postdeployment mental health outcomes were moderated by deployment stress exposure.

2 | MATERIAL AND METHODS

2.1 | Participants and procedures

The design and implementation of Army STARRS studies have been described previously (Kessler, Colpe et al., 2013; Ursano et al., 2014). PPDS self-administered questionnaire (SAQ) data were collected from soldiers in three Brigade Combat Teams (BCTs), approximately 1–2 months before their deployment to Afghanistan in 2012 (T0). Soldiers who consented to follow-up contact were asked to complete three follow-up SAQs, which occurred within 1 month of their return to the United States (T1), 3 months later (T2), and 9 months later (T3). The T0 SAQ collected information regarding sociodemographic characteristics, lifetime and past-30-day mental disorders, and potential risk and resilience factors. The T1 SAQ was a brief survey of experiences during the index deployment, such as stress exposure and unit cohesion. The T2 and T3 SAQs included comprehensive assessment of past-30-day mental disorders and experiences that had occurred since the previous survey. The PPDS was approved by the Human Subjects Committees of all collaborating institutions and all participants gave written informed consent to participate.

A total of 9,949 soldiers were present for duty in the participating BCTs at T0; and 86.0% provided complete SAQ data and consent to linkage of survey responses to their Army/Department of Defense administrative records. These soldiers comprised the sample for cross-sectional (T0) analyses presented in this report ($N = 8,558$). Most of the T0 analysis sample ($n = 7,742$; 90.5%) subsequently deployed to Afghanistan. Because the longitudinal analysis relied on data from all assessment waves, the eligible sample of 7,742 deployed soldiers was restricted to the 4,645 soldiers (60.0%) who completed all follow-up SAQs (at T1, T2, and T3).

Combined analysis weights were applied in all analyses and included: (1) a propensity-based adjustment for baseline attrition due to incomplete surveys or inability to link to administrative data (e.g., due to absence of soldier consent); (2) poststratification to map the sample of eligible PPDS soldiers to key demographic and Army service characteristics of soldiers in the three BCTs that deployed to Afghanistan after the T0 interview dates; and (3) a propensity-based attrition adjustment to account for loss of respondents due to incomplete data in one or more of the three follow-up waves. More information about weighting of Army STARRS data can be obtained elsewhere (Kessler, Heeringa et al., 2013).

2.2 | Measures

2.2.1 | Diagnostic assessment

PPDS T0 respondents completed a computerized version of the Composite International Diagnostic Interview screening scales (CIDI-SC; Kessler & Ustun, 2004) and a six-item screening version of the PTSD Checklist (PCL; Wilkins, Lang, & Norman, 2011) to assess lifetime DSM-IV mental disorders, including PTSD, MDE, GAD, PD, and AUD/SUD. For most disorders, the T0 survey also assessed the frequency of symptoms during the preceding 30 days, which permitted derivation of “past-30-day” mental disorder

diagnoses. Analogous assessment of past-30-day mental disorders was conducted at T2 and T3. The CIDI-SC was not administered at T1. The Army STARRS Clinical Reappraisal Study found satisfactory concordance between the CIDI-SC/modified PCL diagnoses and independent diagnoses based on blinded Structured Clinical Interviews for DSM-IV (Kessler, Santiago et al., 2013). Lifetime and past-30-day suicidal ideation was assessed at T0 using an expanded self-report version of the Columbia-Suicide Severity Rating Scale (Posner et al., 2011). Past-30-day suicidal ideation was determined at T2 and T3 using the same scale. Suicidal ideation was not assessed at T1.

2.2.2 | Unit cohesion

Unit cohesion was measured at the individual level; thus, scores reflect soldiers' individual perceptions of cohesion within their unit, not the consensus judgment of all members of a given unit. The unit cohesion items included in both the T0 and T1 surveys are shown in Figure 1. Respondents rated most items using the options “strongly disagree,” “disagree,” “neither agree nor disagree,” “agree,” or “strongly agree” (coded 0–4 for analysis). Morale was rated as “very low,” “low,” “medium,” “high,” or “very high” (coded 0–4 for analysis). Perceived respect for one's work was rated “not at all,” “a little,” “some,” or “a lot,” and coded 0–3 for analysis. A time frame was not specified; thus, the ratings reflect soldiers' current perceptions at the time of each survey.

Ratings of the T0 unit cohesion items were subjected to exploratory factor analysis (EFA) with minimum residual estimation and promax rotation. One- to three-factor solutions were evaluated. The multi-factor models were rejected due to the presence of poorly defined factors (e.g., factors consisting of one item) and high factor correlations (e.g., $R = 0.80$ in the two-factor model). The one-factor model was deemed satisfactory; all unit cohesion items had salient loadings on the single factor (item-factor loadings = 0.49–0.86), which explained 55% of the variance in ratings. Based on the EFA results, an overall unit cohesion score (available at T0 and T1) was calculated as the sum of the seven items (theoretical range = 0–27; higher scores reflecting stronger unit cohesion). Internal consistency of the unit cohesion scale was excellent (Cronbach's $\alpha = 0.89$ at T0 and $\alpha = 0.90$ at T1). For logistic regression analyses where perceived unit cohesion was the predictor of interest, the total unit cohesion scores were standardized to facilitate interpretation of results.

2.2.3 | Deployment stress exposure

The T1 survey assessed the frequency of 14 highly stressful deployment experiences (e.g., During your deployment, how many times did you... fire rounds at the enemy or take enemy fire?... have members of your unit who were seriously wounded or killed?). Responses to each item were discretized and summed to create a deployment stress score (theoretical range = 0–16; for details, see Campbell-Sills et al., 2018). Based on analysis of the distribution and functional form of the association of deployment stress scores with a clinically salient criterion (onset of PTSD or MDE at T2), scores <6 were considered “low-to-moderate deployment stress” and scores ≥ 6 were considered “high deployment stress.” These categories were used in the analysis

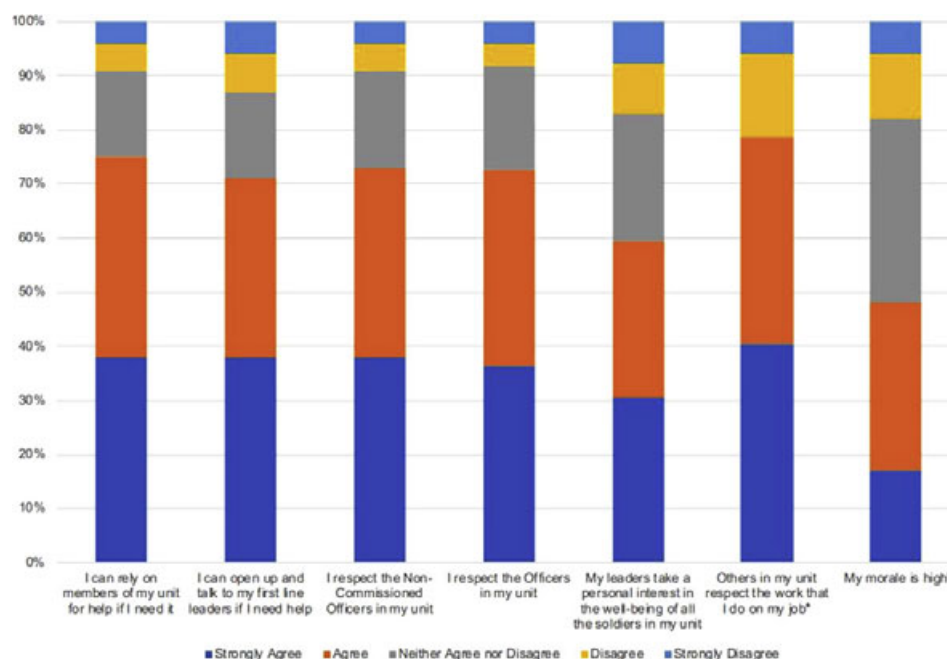


FIGURE 1 Distribution of responses to each item of the perceived unit cohesion scale among PPDS T0 respondents ($N = 8,558$). *Response options for the item “How much do you feel that others respect the work you do on your job?” (“a lot,” “some,” “a little,” and “not at all”) are labeled “strongly agree,” “agree,” “disagree,” and “strongly disagree,” respectively. Response options for the item “How would you rate your morale?” (“very high,” “high,” “medium,” “low,” and “very low”) are labeled “strongly agree,” “agree,” “neither agree nor disagree,” “disagree,” and “strongly disagree,” respectively

presented in this report; however, results did not differ when the continuous deployment stress score was used in the models (results available upon request).

2.2.4 | Sociodemographic and Army service variables

Age, sex, ethnicity (Hispanic or non-Hispanic), race (White, Black, Asian, or other), BCT, number of prior deployments (0, 1, or 2+), and time in unit at T0 (<1 month, 1–6 months, or >6 months) were adjusted for in all models.

2.3 | Data analysis

Multivariable linear regression was used to examine associations of sociodemographic and Army service variables with perceived unit cohesion at baseline (T0). Multivariable logistic regression was subsequently performed to evaluate the cross-sectional associations of unit cohesion at T0 with 30-day PTSD, MDE, GAD, PD, and suicidal ideation at T0 (30-day AUD/SUD was not available), controlling for sociodemographic and Army service variables.

In the main analysis, multivariable logistic regression was used to estimate the effects of perceived unit cohesion at T0 on odds of PTSD, MDE, GAD, PD, AUD/SUD, and suicidal ideation at T2 or T3, adjusting for sociodemographic characteristics, Army service variables, and deployment stress exposure (low-to-moderate vs. high). For each postdeployment outcome (except PD; see below), two models were tested. The first evaluated the relationship of predeployment unit cohesion to the mental health outcome at T2 or T3 in the entire longitudinal sample ($n = 4,645$), controlling for predeployment history of the outcome in question. For example, the model of postdeployment

PTSD in the full sample controlled for predeployment PTSD status (no lifetime PTSD vs. lifetime but not 30-day PTSD vs. 30-day PTSD at T0). The second model examined new onset of the outcome among soldiers with no predeployment history of the index disorder (e.g., analysis of incidence of PTSD at T2 or T3 was conducted among soldiers without lifetime PTSD at T0). Because 30-day AUD/SUD diagnosis was not captured at T0, longitudinal models of AUD/SUD adjusted for both lifetime AUD/SUD and 30-day binge drinking at T0 (binge drinking was defined as one or more episodes of consuming five or more alcoholic drinks in the same day; for details, see Campbell-Sills et al., 2018). Also, due to differences in the survey assessment of PD, only new onset of PD during or since the index deployment was considered in the analysis. To examine whether deployment stress exposure moderated the relationships between perceived unit cohesion and postdeployment mental health (e.g., Fontana et al., 1997), all models were subsequently refit after incorporating terms representing interactions of the unit cohesion score and deployment stress (low-to-moderate vs. high).

Sensitivity models were run in which the T0 unit cohesion score was replaced with the T1 unit cohesion score. The T1 score reflects perceived unit cohesion upon return from deployment, which may be particularly relevant to postdeployment mental health outcomes. However, models featuring the T1 unit cohesion score are limited by the fact that full diagnostic data were not collected at T1. Only predeployment mental disorder status—not mental disorder status concurrent with reporting of T1 unit cohesion—could be adjusted for in the T1 unit cohesion models. For this reason, we present the T1 unit cohesion models as a sensitivity analysis and the T0 unit cohesion models as the primary analysis.

TABLE 1 Association of sociodemographic and Army service characteristics with perceived unit cohesion in the baseline PPDS sample (N = 8,558)

	Association with perceived unit cohesion		
	b (95% CI)	χ^2	P-value
Age (years)	0.06 (0.02, 0.09)	10.15	0.001
Male sex (reference: female)	1.06 (0.50, 1.63)	13.50	<0.0005
Race (reference: White)		6.02	0.11
Black	-0.54 (-0.99, -0.08)		
Asian	-0.23 (-0.79, 0.33)		
Other	0.13 (-0.23, 0.49)		
Hispanic ethnicity (reference: non-Hispanic)	0.18 (-0.19, 0.56)	0.90	0.34
Brigade Combat Team (reference: Fort #1)		29.35	<0.0005
Fort #2	0.70 (0.03, 1.36)		
Fort #3	-0.76 (-1.38, -0.14)		
Number of prior deployments (reference: none)		32.68	<0.0005
One	-1.22 (-1.65, -0.79)		
Two or more	-0.98 (-1.49, -0.47)		
Time in unit (reference: >6 months)		30.52	<0.0005
<1 month	1.70 (1.01, 2.40)		
1–6 months	0.71 (0.37, 1.05)		

Note. Regression coefficients show the estimated change in raw unit cohesion score (theoretical range = 0–27) associated with each socio-demographic and Army service variable category. In the case of age, the coefficient reflects the estimated change in unit cohesion score per unit increase in age.

PPDS data are clustered (by BCT and administration session) and weighted; therefore, the design-based Taylor series linearization method was used to estimate standard errors. Multivariable significance was examined using design-based Wald χ^2 tests. Two-tailed $P < 0.05$ was considered statistically significant. Analyses were conducted using R Version 3.3.2 (R Core Team, 2013).

3 | RESULTS

3.1 | Sample characteristics at predeployment assessment

PPDS T0 respondents (N = 8,558) were predominantly male (94.72%, SE = 0.50%) and White (71.90%, SE = 0.76%). Smaller proportions identified their race as Black (12.04%, SE = 0.58%), Asian (3.62%, SE = 0.26%), and other (12.44%, SE = 0.47%); and 15.94% (SE = 0.50%) reported their ethnicity as Hispanic. Mean age was 26.94 years (SE = 0.18). Nearly half (45.00%, SE = 1.10%) of T0 respondents indicated that the index deployment was their first, 24.26% (SE = 0.70%) reported one previous deployment, and 30.74% (SE = 0.98%) reported multiple prior deployments. Lifetime prevalence of mental disorders among T0 respondents was 11.94% (SE = 0.48%) for PTSD, 9.34% (SE = 0.49%) for MDE, 8.32% (SE = 0.36%) for GAD, 3.34% (SE = 0.26%) for PD, 20.14% (SE = 0.53%) for AUD/SUD, and 10.69% (SE = 0.33%) for suicidal ideation. Prevalence of 30-day disorders was 5.36% (SE = 0.26%) for PTSD, 5.02% (SE = 0.29%) for MDE, 3.87% (SE = 0.26%) for GAD, 2.21% (SE = 0.19%) for PD, and 0.97% (SE = 0.09%) for suicidal ideation; 30-day AUD/SUD diagnosis was not available at T0.

3.2 | Cross-sectional correlates of predeployment unit cohesion

Mean predeployment unit cohesion score was 19.37 (SE = 0.13). Figure 1 shows the distribution of responses to each item that contributed to the total unit cohesion score (note that two items had different response options than the others; see Figure Caption). Linear regression including sociodemographic and Army service predictors indicated that male soldiers and those with shorter tenure in their units perceived higher unit cohesion, whereas soldiers with prior deployments reported lower unit cohesion (Table 1). Statistically significant differences in unit cohesion scores also were observed based on age and BCT.

Logistic regression models adjusting for sociodemographic and Army service variables showed that perceived unit cohesion at T0 was strongly associated with 30-day mental disorders and suicidal ideation at T0. Adjusted odds ratios (AORs) per standard score increase in unit cohesion were 0.50 (95% CI = 0.44–0.55) for PTSD, 0.35 (95% CI = 0.32–0.39) for MDE, 0.37 (95% CI = 0.33–0.41) for GAD, 0.57 (95% CI = 0.49–0.67) for PD, and 0.34 (95% CI = 0.27–0.43) for suicidal ideation (P-values < 0.0005).

3.3 | Prospective associations of unit cohesion with postdeployment mental health outcomes

3.3.1 | Models adjusting for predeployment history of the index disorder

Models adjusting for sociodemographic and Army service variables, deployment stress exposure, and predeployment history of the index

TABLE 2 Associations of sociodemographic and Army service characteristics, predeployment perceived unit cohesion, and deployment stress exposure with 30-day PTSD at 3 or 9 months postdeployment

	Full longitudinal sample (n = 4,645)				Subsample without lifetime PTSD at T0 (n = 4,120)			
	AOR	95% CI	χ^2	P-value	AOR	95% CI	χ^2	P-value
Age	1.00	(0.99, 1.02)	0.11	0.75	1.00	(0.99, 1.02)	0.13	0.72
Sex			1.97	0.16			0.22	0.64
Female	1.00				1.00			
Male	0.73	(0.46, 1.14)			0.88	(0.51, 1.51)		
Race			4.85	0.18			2.14	0.54
White	1.00				1.00			
Black	0.99	(0.67, 1.48)			1.04	(0.72, 1.49)		
Asian	1.28	(0.77, 2.12)			1.38	(0.80, 2.39)		
Other	1.49	(1.04, 2.15)			1.25	(0.86, 1.82)		
Ethnicity			0.72	0.40			1.30	0.25
Non-Hispanic	1.00				1.00			
Hispanic	1.15	(0.83, 1.59)			1.22	(0.87, 1.73)		
Brigade Combat Team			1.79	0.41			3.62	0.16
Fort #1	1.00				1.00			
Fort #2	1.15	(0.90, 1.47)			1.31	(0.97, 1.77)		
Fort #3	1.00	(0.80, 1.24)			1.09	(0.82, 1.45)		
Prior deployments			0.82	0.67			0.44	0.80
Zero	1.00				1.00			
One	1.09	(0.84, 1.42)			0.96	(0.73, 1.27)		
Two or more	1.12	(0.87, 1.43)			0.92	(0.71, 1.19)		
Time in unit			14.37	0.001			22.04	<0.0005
>6 months	1.00				1.00			
<1 month	1.51	(1.12, 2.05)			1.81	(1.24, 2.63)		
1–6 months	0.75	(0.58, 0.96)			0.77	(0.64, 0.94)		
Lifetime PTSD at T0	3.06	(2.24, 4.17)	49.75	<0.0005				
30-day PTSD at T0 ^a	2.28	(1.36, 3.82)	9.67	0.002				
Deployment stress			217.05	<0.0005			190.26	<0.0005
Low/moderate	1.00				1.00			
High	3.21	(2.75, 3.74)			3.52	(2.94, 4.21)		
Unit cohesion at T0 (standardized)	0.82	(0.73, 0.91)	13.37	<0.0005	0.74	(0.65, 0.84)	20.09	<0.0005

Note. Weight-adjusted logistic regression was performed to estimate the association of unit cohesion with 30-day PTSD at 3 or 9 months postdeployment (T2 or T3) among soldiers who completed surveys at all four waves (T0, T1, T2, and T3) of the Pre-/Postdeployment Study ("full longitudinal sample"). A separate logistic regression model estimated the association of unit cohesion with incident PTSD at T2 or T3; this was tested within the subsample of soldiers without predeployment lifetime PTSD. Deployment stress was measured at T1 (within 1 month of return from deployment). Other predictors were assessed at T0 (1–2 months before deployment). Odds ratios that appear in bold are statistically significant ($p < .05$); exact p values are provided for χ^2 tests.

^aBy definition, all respondents with 30-day PTSD at T0 also had lifetime PTSD at T0. The adjusted odds of PTSD at T2 or T3 for those with 30-day PTSD at T0 are thus equal to $3.06 \times 2.28 = 6.98$. The adjusted odds of PTSD at T2 or T3 for those with lifetime but not 30-day PTSD at T0 are 3.06.

disorder indicated that higher perceived unit cohesion at T0 was associated with lower odds of mental disorders and suicidal ideation at T2 or T3. Adjusted odds ratios per standard score increase in unit cohesion were 0.82 (95% CI = 0.73–0.91; $P < 0.0005$) for PTSD, 0.72 (95% CI = 0.65–0.80; $P < 0.0005$) for MDE, 0.85 (95% CI = 0.73–0.99; $P < 0.05$) for GAD, 0.82 (95% CI = 0.73–0.91; $P < 0.0005$) for AUD/SUD, and 0.80 (95% CI = 0.71–0.90; $P < 0.0005$) for suicidal ideation. Full results of the postdeployment PTSD and suicidal ideation models are presented in Tables 2 and 3 (see columns labeled "Full longitudinal sample"). Detailed results of MDE,

GAD, and AUD/SUD models are shown in Supporting Information Tables S1–S3.

3.3.2 | Subgroup models of incidence of mental disorders

Models of incident mental disorders and suicidal ideation were evaluated among soldiers without predeployment lifetime history of the outcome in question. Higher perceived unit cohesion was associated with lower odds of incident PTSD, MDE, GAD, PD, and suicidal ideation; but not of incident AUD/SUD. Adjusted odds ratios per standard score increase in unit cohesion were 0.74 (95% CI = 0.65–

TABLE 3 Associations of sociodemographic and Army service characteristics, predeployment perceived unit cohesion, and deployment stress exposure with 30-day suicidal ideation at 3 or 9 months postdeployment

	Full sample (n = 4,645)				Subsample without lifetime SI at T0 (n = 4,119)			
	AOR	95% CI	χ^2	P-value	AOR	95% CI	χ^2	P-value
Age	0.99	(0.97, 1.01)	1.09	0.30	0.98	(0.96, 1.02)	1.00	0.32
Sex			4.62	0.03			0.82	0.36
Female	1.00				1.00			
Male	0.56	(0.33, 0.95)			0.72	(0.36, 1.46)		
Race			1.61	0.66			2.36	0.50
White	1.00				1.00			
Black	0.99	(0.65, 1.52)			1.01	(0.64, 1.57)		
Asian	1.15	(0.60, 2.21)			1.07	(0.52, 2.21)		
Other	1.23	(0.87, 1.75)			1.45	(0.88, 2.38)		
Ethnicity			0.04	0.85			0.01	0.93
Non-Hispanic	1.00				1.00			
Hispanic	1.04	(0.70, 1.54)			1.02	(0.64, 1.63)		
Brigade Combat Team			0.66	0.72			0.20	0.90
Fort #1	1.00				1.00			
Fort #2	0.94	(0.71, 1.24)			0.92	(0.65, 1.31)		
Fort #3	1.05	(0.79, 1.41)			0.97	(0.68, 1.38)		
Prior deployments			0.16	0.93			0.24	0.89
Zero	1.00				1.00			
One	1.04	(0.81, 1.32)			1.09	(0.76, 1.55)		
Two or more	1.05	(0.79, 1.40)			1.07	(0.74, 1.56)		
Time in unit			2.28	0.32			6.46	0.04
>6 months	1.00				1.00			
<1 month	1.31	(0.81, 2.12)			2.07	(1.17, 3.66)		
1–6 months	0.89	(0.68, 1.16)			1.05	(0.73, 1.49)		
Lifetime suicidal ideation at T0	5.04	(3.99, 6.36)	184.90	<0.0005				
30-day suicidal ideation at T0 ^a	2.57	(1.37, 4.82)	8.66	0.003				
Deployment stress			9.13	0.003			6.74	0.009
Low/moderate	1.00				1.00			
High	1.50	(1.15, 1.94)			1.56	(1.12, 2.19)		
Unit cohesion (standardized)	0.80	(0.71, 0.90)	13.48	<0.0005	0.72	(0.63, 0.81)	26.82	<0.0005

Note. Weight-adjusted logistic regression was performed to estimate the association of unit cohesion with 30-day suicidal ideation at 3 or 9 months post-deployment (T2 or T3) among soldiers who completed surveys at all four waves (T0, T1, T2, and T3) of the Pre-/Postdeployment Study ("full longitudinal sample"). A separate logistic regression model estimated the association of unit cohesion with incident suicidal ideation at T2 or T3; this model was tested within the subsample of soldiers without pre-deployment lifetime suicidal ideation. Deployment stress was measured at T1 (within 1 month of return from deployment). Other predictors were assessed at T0 (1–2 months before deployment).

^aBy definition, all respondents with 30-day suicidal ideation at T0 also had lifetime suicidal ideation at T0. The adjusted odds of suicidal ideation at T2 or T3 for those with 30-day suicidal ideation at T0 are thus equal to $5.04 \times 2.57 = 12.95$. The adjusted odds of suicidal ideation at T2 or T3 for those with lifetime but not 30-day suicidal ideation at T0 are 5.04.

0.84; $P < 0.0005$) for PTSD, 0.65 (95% CI = 0.57–0.74; $P < 0.0005$) for MDE, 0.79 (95% CI = 0.68–0.93; $P = 0.005$) for GAD, 0.85 (95% CI = 0.76–0.96; $P = 0.009$) for PD, 0.92 (95% CI = 0.81–1.04; $P = 0.16$) for AUD/SUD, and 0.72 (95% CI = 0.63–0.81; $P < 0.0005$) for suicidal ideation. Full results of the incident PTSD and suicidal ideation models are presented in Tables 2 and 3 (see columns labeled "Subsample without lifetime PTSD/suicidal ideation at T0"). Incident MDE, GAD, AUD/SUD, and PD models appear in Supporting Information Tables S1–S4.

3.3.3 | Models including interactions of unit cohesion with deployment stress exposure

High deployment stress was associated with increased risk of post-deployment mental disorders and suicidal ideation (see Tables 2 and 3, and Supporting Information Tables S1–S4). To test if the effect of unit cohesion varied based on level of deployment stress exposure, unit cohesion $\times$ deployment stress interactions were added to the models of all mental health outcomes. No significant unit cohesion $\times$ deployment stress interaction effects were

observed in the full-sample or subgroup/incidence models (P -values > 0.19).

3.3.4 | Post hoc models

The prospective analysis revealed that short (<1 month) unit tenure at T0 was associated with increased risk of PTSD and GAD in both the full sample and among soldiers with no predeployment history of these disorders (Table 2 and Supporting Information Table S2). Short unit tenure also was associated with increased risk of incident suicidal ideation and PD (Table 3 and Supporting Information Table S4). To explore whether unit cohesion moderated the effects of short unit tenure on risk of PTSD, GAD, incident PD, or incident suicidal ideation, we added unit cohesion $\times$ time in unit interaction terms to the models in question. None of these unit cohesion $\times$ time in unit interactions was significant (P -values > 0.15).

3.3.5 | Sensitivity analysis

The models of postdeployment mental disorders and suicidal ideation were refit after replacing perceived unit cohesion at T0 (predeployment) with perceived unit cohesion at T1 (upon return from deployment). Analogous results were obtained, in that higher perceived unit cohesion at T1 was associated with lower odds of all postdeployment mental disorders and suicidal ideation in the full sample (AORs = 0.60–0.81; P -values < 0.0005), and of all incident mental disorders and suicidal ideation (AORs = 0.55–0.74; P -values < 0.0005), except AUD/SUD (AORs = 0.88, 95%CI = 0.75–1.03; P = 0.12). The lack of significant deployment stress $\times$ unit cohesion interactions in the full-sample and subgroup models (P -values > 0.13) also aligned with results of the main analysis.

4 | DISCUSSION

This prospective study found that U.S. Army soldiers who reported strong unit cohesion prior to deployment exhibited lower risk of PTSD, MDE, GAD, PD, AUD/SUD, and suicidal ideation at 3 or 9 months postdeployment. These associations were independent of level of deployment stress exposure; and, in most cases, were observed both in the full sample and in subgroups of soldiers without predeployment lifetime history of the disorder in question. Perceived unit cohesion assessed upon return from deployment (as opposed to predeployment) exhibited analogous associations with mental health outcomes at 3 or 9 months postdeployment.

The current results converge with those of other investigations that found negative associations of unit cohesion with stress-related and depressive disorders; including one prior prospective study that observed lower risk of postdeployment PTSD and depression among Marines who reported stronger unit support before deployment (relative to other members of their unit; Breslau et al., 2016). On the other hand, our findings diverge from those of two other prospective studies that found no evidence of associations between predeployment perceived unit support and postdeployment PTSD (Han et al., 2014; Polusny et al., 2011). Discrepancies between the current results and findings of those studies could be due to

differences in sample characteristics (e.g., sample comprised entirely of Regular Army soldiers (current study) vs. Army National Guard soldiers; Polusny et al., 2011) or other study methodology (e.g., differences in measures of unit cohesion or PTSD; timing of outcome evaluation; or covariates included in models of postdeployment PTSD).

The accumulating evidence of prospective associations between perceived unit cohesion and postdeployment mental health has implications for the Armed Forces and for future research. Awareness of associations of perceived unit cohesion with postdeployment mental health may inform the military's efforts to reduce incidence of mental disorders and suicidal behaviors among service members. Soldiers who report low unit cohesion prior to or upon return from deployment may be candidates for prevention programs, particularly if other risk factors for mental disorders or suicidal behaviors are present.

Evidence suggests that improving unit cohesion leads to enhanced soldier performance and retention (Griffith, 2002; Oliver et al., 1999; Vasterling et al., 2015). A critical question is whether strengthening unit cohesion also improves the mental health of unit members. The current results do not directly address this question, as unit cohesion was measured at the individual level and scores are influenced by soldiers' idiosyncratic experiences and individual differences (e.g., personality traits; mental disorders). Additional research is needed that employs group-level measures of unit cohesion (see Breslau et al., 2016; Griffith, 2015), ideally with quantification of cohesion at multiple organizational levels (e.g., platoon; company). The limited available data suggest that the relationship of group-level cohesion measures to service member mental health depends on the specific outcome under investigation. Group-level cohesion scores have been observed to have a positive association with alcohol misuse (Breslau et al., 2016), a negative association with suicidal ideation (Griffith, 2015), and no apparent association with PTSD or depression (Breslau et al., 2016). Future studies should continue to investigate whether group-level cohesion scores predict mental disorders and suicidal behaviors; and, if so, whether strengthening cohesion at specific Army organizational levels reduces risk of these problems. Evidence of salutary effects would imply that unit cohesion should be targeted in programs to prevent mental disorders and suicidal behaviors among service members.

The finding that unit cohesion was associated with suicidal ideation—including incidence among soldiers with no history of suicidal ideation predeployment—may relate to evidence that thwarted belongingness contributes to suicidal thoughts and behavior (e.g., Van Orden et al., 2010). The concept of thwarted belongingness encompasses an individual's perception that he or she lacks meaningful connection to a valued group. A strong cross-sectional association was observed between perceived unit cohesion and suicidal ideation at the predeployment assessment. Soldiers scoring one standard deviation below the mean unit cohesion score had nearly three times the odds of past-month suicidal ideation as soldiers with average unit cohesion scores. Clinicians working with soldiers should consider inquiring about their perceptions of unit climate; and should be aware that perceived lack of support from fellow unit members may signal mental health problems, including suicidal thoughts.

An exception to the overall pattern of study findings was that unit cohesion lacked association with new onset of AUD/SUD postdeployment. This null result was not entirely unexpected, given the divergent findings of previous studies of unit cohesion and alcohol use (Breslau et al., 2016; Browne et al., 2008; Orr et al., 2014). Contrary to a few prior studies that found positive relationships between unit cohesion and alcohol misuse (Breslau et al., 2016; Browne et al., 2008), we found no evidence that strong unit cohesion was associated with increased risk of AUD/SUD. However, it is possible that other alcohol misuse outcomes (e.g., binge drinking) relate differently to unit cohesion than does AUD/SUD diagnosis. Overall, the literature suggests that the relationship between unit cohesion and alcohol/stance use is complex and requires more nuanced study.

As expected based on a previous investigation of this cohort (Stein et al., 2015), high deployment stress exposure was associated with increased risk of postdeployment mental disorders and suicidal ideation. Some prior work suggested that unit cohesion might interact with deployment stress to predict mental health outcomes (Fontana et al., 1997). Among members of the participating BCTs, the protective effects of perceived unit cohesion did not vary based on whether deployment stress exposure was low-to-moderate versus high. The results instead suggested that high perceived unit cohesion exerted protective effects irrespective of level of deployment stress exposure.

We also observed that short (<1 month) tenure in one's unit at the time of predeployment assessment was associated with increased risk of PTSD, GAD, incident PD, and incident suicidal ideation. These increased risks did not appear to be mitigated by high perceived unit cohesion (or exacerbated by low perceived unit cohesion). With respect to the cross-sectional relationship between unit tenure and unit cohesion at predeployment baseline, we found that soldiers who were new to their units endorsed higher unit cohesion than soldiers with longer unit tenure. The reasons for this are unclear; however, the association might be indicative of a "honeymoon period" (i.e., soldiers may express more optimistic views of cohesion at the outset of joining a particular unit). More in-depth study of the relationship between unit tenure, unit cohesion, and postdeployment mental health is warranted.

Results of this study must be interpreted in light of several limitations. The predictors and outcomes of interest were assessed via self-report, a modality that is susceptible to recall and response bias. The ratings of unit cohesion might be considered "snapshots" of soldiers' perceptions at the time of the baseline survey; these could have been unduly influenced by recent experiences or could have changed as a result of subsequent deployment preparations. Additionally, unit cohesion was not assessed using a previously validated measure. However, survey items loaded strongly on a single factor and had excellent internal consistency, which offers preliminary evidence of construct validity. As noted above, our study focuses exclusively on individual perceptions of unit cohesion, which could be affected by emotional state, personality traits, and cognitive bias. Members of the same unit may differ substantially in their judgments of that unit's cohesion, and we did not explore this issue in the current study. Our team is working to develop group-level cohesion scores that could be examined in relation to outcomes of this cohort.

Another direction for future research is to evaluate how changes in soldiers' experiences of cohesion (e.g., perceived loss of cohesion) relate to fluctuations in psychological distress and functioning of service members. Research focused on identifying unit experiences (e.g., trauma exposure) that affect cohesiveness of the unit also would be valuable to the Armed Forces. Finally, future studies should attempt to clarify the relative contributions of unit cohesion and support provided by soldiers' broader social networks (i.e., friends and family) to soldier mental health. One study found that postdeployment PTSD symptoms were more strongly associated with postdeployment social support than with unit cohesion during deployment (Han et al., 2014). Although social support is a potentially important protective factor, it may be a less feasible target for military-based programs than is unit cohesion.

In summary, perceived unit cohesion was prospectively associated with a broad range of mental health outcomes following combat deployment. Soldiers reporting low unit cohesion either before or upon return from deployment may be candidates for risk mitigation programs, especially when concomitant risk factors for mental disorders or suicidal behaviors are present. Additional research with group-level measures of cohesion is needed to evaluate whether interventions that strengthen unit cohesion can help prevent adverse mental health outcomes such as PTSD, depression, and suicidal behaviors.

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DISCLOSURES

In the past 3 years, Dr. Stein has been a consultant for Actelion, Aptinyx, Bionomics, Dart Neuroscience, Healthcare Management Technologies, Janssen, Oxeia Biopharmaceuticals, Pfizer, and Resilience Therapeutics. In the past 3 years, Dr. Kessler received support for his epidemiological studies from Sanofi Aventis; was a consultant for Johnson & Johnson Wellness and Prevention, Sage Pharmaceuticals, Shire, Takeda; and served on an advisory board for the Johnson & Johnson Services Inc. Lake Nona Life Project. Kessler is a co-owner of DataStat, Inc., a market research firm that carries out health-care research. The remaining authors have no disclosures.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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