

Word count: 4954

Number of Tables: 3

Number of Figures: 1

Number of Supplementary Tables: 4

RUNNING TITLE: Unit cohesion and post-deployment mental health

Prospective associations of perceived unit cohesion with post-deployment mental health outcomes

Lauren Anderson, M.D.^a

Laura Campbell-Sills, Ph.D.^a

Robert J. Ursano, M.D.^b

Ronald C. Kessler, Ph.D.^c

Xiaoying Sun, M.S.^d

Steven G. Heeringa, Ph.D.^e

Matthew K. Nock, Ph.D.^f

Paul D. Bliese, Ph.D.^g

CPT Oscar I. Gonzalez, Ph.D.^b

LTC Gary H. Wynn, M.D.^b

Sonia Jain, Ph.D.^d

Murray B. Stein, M.D., M.P.H.^{a,d,h}

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1002/da.22884](#).

This article is protected by copyright. All rights reserved.

^aDepartment of Psychiatry, University of California San Diego, La Jolla, CA, USA

^bCenter for the Study of Traumatic Stress, Department of Psychiatry, Uniformed Services University of the Health Sciences, Bethesda, MD, USA

^cDepartment of Health Care Policy, Harvard Medical School, Boston, MA, USA

^dDepartment of Family Medicine and Public Health, University of California San Diego, La Jolla, CA, USA

^eUniversity of Michigan, Institute for Social Research, Ann Arbor, MI, USA

^fDepartment of Psychology, Harvard University, Cambridge, MA, USA

^gDepartment of Management, Darla Moore School of Business, University of South Carolina, Columbia, SC, USA

^hVA San Diego Healthcare System, San Diego, CA, USA

Please address correspondence to:

Laura Campbell-Sills, PhD

UCSD Department of Psychiatry

9500 Gilman Drive, Mail Code 0855

La Jolla, CA 92093-0855

Phone: (858) 534-6448; Fax: (858) 534-6460

Email: campbell-sills@ucsd.edu

Acknowledgments

The Army STARRS Team consists of Co-Principal Investigators: Robert J. Ursano, MD (Uniformed Services University of the Health Sciences) and Murray B. Stein, MD, MPH (University of California San Diego and VA San Diego Healthcare System); Site Principal Investigators: Steven Heeringa, PhD (University of Michigan), James Wagner, PhD (University of Michigan) and Ronald C. Kessler, PhD (Harvard Medical School); Army liaison/consultant: Kenneth Cox, MD, MPH (US Army Public Health Center); and other team members: Pablo A. Aliaga, MA (Uniformed Services University of the Health Sciences); COL David M. Benedek, MD (Uniformed Services University of the Health Sciences); Laura Campbell-Sills, PhD (University of California San Diego); Carol S. Fullerton, PhD (Uniformed Services University of the Health Sciences); Nancy Gebler, MA (University of Michigan); Robert K. Gifford, PhD (Uniformed Services University of the Health Sciences); Paul E. Hurwitz, MPH (Uniformed Services University of the Health Sciences); Sonia Jain, PhD (University of California San Diego); Tzu-Cheg Kao, PhD (Uniformed Services University of the Health Sciences); Lisa Lewandowski-Romps, PhD (University of Michigan); Holly Herberman Mash, PhD (Uniformed Services University of the Health Sciences); James E. McCarroll, PhD, MPH (Uniformed Services University of the Health Sciences); James A. Naifeh, PhD (Uniformed Services University of the Health Sciences); Tsz Hin Hinz Ng, MPH (Uniformed Services University of the Health Sciences); Matthew K. Nock, PhD (Harvard University); Nancy A. Sampson, BA (Harvard Medical School); CDR Patcho Santiago, MD, MPH (Uniformed Services University of the Health Sciences); LTC Gary H. Wynn, MD (Uniformed Services University of the Health Sciences); and Alan M. Zaslavsky, PhD (Harvard Medical School).

Army STARRS was sponsored by the Department of the Army and funded under cooperative agreement number U01MH087981 (2009-2015) with the U.S. Department of Health and Human Services, National Institutes of Health, National Institute of Mental Health (NIH/NIMH).

Subsequently, STARRS-LS was sponsored and funded by the Department of Defense (USUHS grant number HU0001-15-2-0004). The contents are solely the responsibility of the authors and do not

necessarily represent the views of the Department of Health and Human Services, NIMH, the Department of the Army, the Department of Veterans Affairs, or the Department of Defense.

Disclosures: Dr. Stein has in the past three years 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 healthcare research. The remaining authors have no disclosures.

Author Manuscript

Abstract

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:** US 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 adjusted for socio-demographic and Army service characteristics, pre-deployment 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; $p<.05$). Models of incidence of mental disorders and suicidal ideation among soldiers without these problems pre-deployment 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 post-deployment mental disorders and suicidal ideation. Awareness of associations of perceived unit cohesion with post-deployment mental health may facilitate targeting of prevention programs.

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

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; Du Preez, 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 et al., 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 US 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; 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 peri-deployment unit cohesion and post-deployment mental disorders; in that service members with high post-deployment distress might underestimate the cohesiveness of their unit before and/or during deployment, while 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 post-deployment mental health have yielded mixed results. Pre-deployment perceived unit support was not associated with post-deployment 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 post-deployment PTSD symptoms in the Regular Army sample (Han et al., 2014). However, unit support during deployment was evaluated post-deployment (i.e., concurrent with outcome assessment; and thus vulnerable to the recall bias described above), and its association with post-deployment PTSD symptoms became non-significant in the presence of controls for post-deployment social support. On the other hand, a prospective study that employed multilevel analysis found significant associations between individual perceptions of unit cohesion and post-deployment 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, Setodji, & Vaughan, 2016).

Improved understanding of the inter-relationships 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, suicidal behaviors), and mixed results of prospective studies and of investigations of the inter-relationships of unit cohesion, deployment stress, and mental health.

The aim of this investigation was to estimate associations of pre-deployment perceived unit cohesion with a range of post-deployment 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/Post Deployment Study (PPDS); a prospective, longitudinal component of the Army Study to Assess Risk and Resilience in Service members (Army STARRS; Ursano et al., 2014). The analysis adjusted for socio-demographic and Army service characteristics, pre-deployment history of the index outcome, and deployment stress exposure – factors that could influence both perceptions of unit cohesion and risk of post-deployment mental disorders. The analysis also examined whether the associations of perceived unit cohesion with post-deployment mental health outcomes were moderated by deployment stress exposure.

Material and Methods

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 3 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 3 follow-up SAQs, which occurred within 1 month of their return to the US (T1), 3 months later (T2), and 9 months later (T3). The T0 SAQ collected information regarding socio-demographic 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) post-stratification to map the sample of eligible PPDS soldiers to key demographic and Army service characteristics of soldiers in the 3 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 3 follow-up waves. More information about weighting of Army STARRS data can be obtained elsewhere (Kessler, Heeringa, et al., 2013).

Measures

Diagnostic assessment. PPDS T0 respondents completed a computerized version of the Composite International Diagnostic Interview screening scales (CIDI-SC; Kessler & Ustun, 2004) and a 6-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. 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.

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 6 of the 7 items using a 5-point scale (*strongly disagree, disagree, neither agree nor disagree, agree, or strongly agree*; coded 0-4 for analysis). Perceived respect for one's work was rated on a 4-point scale (*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 3-factor solutions were evaluated. The multi-factor models were rejected due to the presence of poorly-defined factors (e.g., factors consisting of 1 item) and high factor correlations (e.g., $R=0.80$ in the 2-factor model). The 1-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 7 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.

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

Socio-demographic 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.

Data Analysis

Multivariable linear regression was used to examine associations of socio-demographic 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 socio-demographic 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 socio-demographic characteristics, Army service variables, and deployment stress exposure (low-to-moderate vs. high). For each post-deployment outcome (except PD; see below), two models were tested. The first evaluated the relationship of pre-deployment unit cohesion to the mental health outcome at T2 or T3 in the entire longitudinal sample ($n=4645$), controlling for pre-deployment history of the outcome in question. For example, the model of post-deployment PTSD in the full sample controlled for pre-deployment 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 pre-deployment 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 1 or more episodes of consuming 5 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 post-deployment mental health (e.g., Fontana et al., 1997), all models were subsequently re-fit 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 post-deployment 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 pre-deployment 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.

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 X^2 tests. Two-tailed $p < 0.05$ was considered statistically significant. Analyses were conducted using R Version 3.3.2 (R Core Team, 2013).

Results

Sample characteristics at pre-deployment 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, and 0.97% ($SE=0.09\%$) for suicidal ideation; 30-day PD and AUD/SUD diagnoses were not available at T0.

Cross-sectional correlates of pre-deployment unit cohesion

Mean pre-deployment 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 one item had a different response scale than the others; see Figure Caption). Linear regression including socio-demographic and Army service predictors indicated that male soldiers and those with shorter tenure in their units perceived higher unit cohesion, while 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 socio-demographic 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 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 ($p < .0005$).

Prospective associations of unit cohesion with post-deployment mental health outcomes

Models adjusting for pre-deployment history of the index disorder. Models adjusting for socio-demographic and Army service variables, deployment stress exposure, and pre-deployment history of the index 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; $p < .0005$] for PTSD, 0.72 [95% CI=0.65-0.80; $p < .0005$] for MDE, 0.85 [95% CI=0.73-0.99; $p < .05$] for GAD, 0.82 [95% CI=0.73-0.91; $p < .0005$] for AUD/SUD, and 0.80 [95% CI=0.71-0.90; $p < .0005$] for suicidal ideation. Full results of the post-deployment PTSD and suicidal ideation models are presented in **Table 2** and **Table 3** (see columns labeled “Full longitudinal sample”). Detailed results of MDE, GAD, and AUD/SUD models are shown in **Supplementary Tables S1-S3**.

Subgroup models of incidence of mental disorders. Models of incident mental disorders and suicidal ideation were evaluated among soldiers without pre-deployment 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=0.65-0.84; $p < .0005$] for PTSD, 0.65 [95% CI=0.57-0.74; $p < .0005$] for MDE, 0.79 [95% CI=0.68-0.93; $p = .005$] for GAD, 0.85 for PD [95% CI=0.76-0.96; $p = .009$], 0.92 [95% CI=0.81-1.04; $p = .16$] for AUD/SUD, and 0.72 [95% CI=0.63-0.81; $p < .0005$] for suicidal ideation. Full results of the incident PTSD and suicidal ideation models are presented in **Table 2** and **Table 3** (see columns labeled “Subsample without lifetime PTSD/suicidal ideation at T0”). Incident MDE, GAD, AUD/SUD, and PD models appear in **Supplementary Tables S1-S4**.

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 **Table 2**, **Table 3**, and **Supplementary Tables S1-S4**]. To test if the effect of unit cohesion varied based on level of deployment stress exposure, Unit Cohesion x Deployment Stress interactions were added to the models of all mental health outcomes. No significant Unit Cohesion x Deployment Stress interaction effects were observed in the full-sample or subgroup/incidence models ($p > .19$).

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 pre-deployment history of these disorders (**Table 2** and **Table S2**). Short unit tenure also was associated with increased risk of incident suicidal ideation and PD (**Table 3** and **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 x Time in Unit interaction terms to the models in question. None of these Unit Cohesion x Time in Unit interactions were significant ($p > .15$).

Sensitivity analysis. The models of post-deployment mental disorders and suicidal ideation were re-fit after replacing perceived unit cohesion at T0 (pre-deployment) 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 post-deployment mental disorders and suicidal ideation in the full sample (AORs=0.60-0.81; $p < .0005$); and of all incident mental disorders and suicidal ideation (AORs=0.55-0.74; $p < .0005$), except AUD/SUD (AORs= 0.88, 95%CI=0.75-1.03; $p = .12$). The lack of significant Deployment Stress x Unit Cohesion interactions in the full-sample and subgroup models ($p > .10$) also aligned with results of the main analysis.

Discussion

This prospective study found that US 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 post-deployment. These associations were independent of level of deployment stress exposure; and, with one exception, were observed both in the full sample and in subgroups of soldiers without pre-deployment lifetime history of the disorder in question. Perceived unit cohesion assessed upon return from deployment (as opposed to pre-deployment) exhibited analogous associations with mental health outcomes at 3 or 9 months post-deployment.

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 post-deployment 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 pre-deployment perceived unit support and post-deployment 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) versus 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 post-deployment PTSD).

The accumulating evidence of prospective associations between perceived unit cohesion and post-deployment mental health has implications for the Armed Forces and for future research. Awareness of associations of perceived unit cohesion with post-deployment 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 and 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 pre-deployment – 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 pre-deployment assessment. Soldiers

scoring one standard deviation below the mean unit cohesion score had nearly 3 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 post-deployment. 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/ substance 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 post-deployment 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 pre-deployment 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 pre-deployment 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 post-deployment 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 impact 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 post-deployment PTSD symptoms were more strongly associated with post-deployment 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.

References

- Armistead-Jehle, P., Johnson, S.L., Wade, N.G., & Ecklund, C.J. (2011) Posttraumatic stress in U.S. Marines: the role of unit cohesion and combat exposure. *Journal of Counseling and Development, 89*, 81-88.
- Armstrong, E.L., Bryan, C.J., Stephenson, J.A., Bryan, A.O., & Morrow, C.E. (2014). Warzone stressor exposure, unit support, and emotional distress among U.S. Air Force pararescuemen. *Journal of Special Operations Medicine, 14*, 26-34.
- Brailey, K., Vasterling, J.J., Proctor, S.P., Constans, J.I., & Friedman, M.J. (2007). PTSD symptoms, life events, and unit cohesion in U.S. soldiers: baseline findings from the neurocognition deployment health study. *Journal of Traumatic Stress, 20*, 495-503.
- Breslau, J., Setodji, C.M., & Vaughan, C.A. (2016). Is cohesion within military units associated with post-deployment behavioral and mental health outcomes? *Journal of Affective Disorders, 198*, 102-107.
- Browne, T., Iversen, A., Hull, L., Workman, L., Barker, C., Horn, O., ...Fear, N.T. (2008). How do experiences in Iraq affect alcohol use among male UK armed forces personnel? *Occupational and Environmental Medicine, 65*, 628-633.
- Bryan, C.J., & Heron, E.A. (2015). Belonging protects against postdeployment depression in military personnel. *Depression and Anxiety, 12*, 349-355.
- Campbell-Sills, L., Ursano, R.J., Kessler, R.C., Sun, X., Heeringa, S.G., Nock, M.K., ...Stein, M.B. (2018). Prospective risk factors for post-deployment heavy drinking and alcohol or substance use disorder among U.S. Army soldiers. *Psychological Medicine, 48*, 1624-1633.

- Dickstein, B.D., McLean, C.P., Mintz, J., Conoscenti, L.M., Steenkamp, M.M., Benson, T.A., ... Litz, B.T. (2010). Unit cohesion and PTSD symptoms severity in Air Force Medical personnel. *Military Medicine*, 175, 482-486.
- DuPreez, J., Sundin, J., Wessely, S., & Fear, N.T. (2012). Unit cohesion and mental health in UK armed forces. *Occupational Medicine*, 62, 47-53.
- Fontana, A., Rosenheck, R., & Horvath, T. (1997). Social support and psychopathology in the war zone. *Journal of Nervous and Mental Disease*, 185, 675-681.
- Griffith, J. (2002). Multilevel analysis of cohesion's relation to stress, well-being, and perceived combat readiness. *Military Psychology*, 14, 217-239.
- Griffith, J. (2015). Cross (Unit)-Level Effects of Cohesion on Relationships of Suicide Thoughts to Combat Exposure, Postdeployment Stressors, and Postdeployment Social Support. *Behavioral Medicine*, 41, 98-106.
- 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.
- Hoge, C.W., Castro, C.A., Messer, S.C., McGurk, D., Cotting, D.I., & Koffman, R.L. (2004). Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. *New England Journal of Medicine*, 351, 13-22.
- Iversen, A.C., Fear, N.T., Ehlers, A., Hacker Hughes, J., Hull, L., Earnshaw, M., ...Hotopf, M. (2008). Risk factors for post-traumatic stress disorder among UK Armed Forces personnel. *Psychological Medicine*, 38, 511-522.
- Jones, E., & Fear, N.T. (2011). Alcohol use and misuse within the military: a review. *International Review of Psychiatry*, 23, 166-172.

- 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, 75*, 49-59.
- Kanesarajah, J., Waller, M., Zheng, W.Y., & Dobson, A.J. (2016). Unit cohesion, traumatic exposure and mental health of military personnel. *Occupational Medicine, 66*, 308-315.
- Kessler, R.C., Colpe, L.J., Fullerton, C.S., Gebler, N., Naifeh, J.A., Nock, M.K., ...Heeringa, S.G. (2013). Design of the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *International Journal of Methods in Psychiatric Research, 22*, 267-275.
- Kessler, R.C., Heeringa, S.G., Colpe, L.J., Fullerton, C.S., Gebler, N., Hwang, I., ...Ursano, R.J. (2013). Response bias, weighting adjustments, and design effects in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *International Journal of Methods in Psychiatric Research, 22*, 288-302.
- Kessler, R.C., Santiago, P.N., Colpe, L.J., Dempsey, C.L., First, M.B., Heeringa, S.G., ...Ursano, R.J. (2013). Clinical reappraisal of the Composite International Diagnostic Interview Screening Scales (CIDI-SC) in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *International Journal of Methods in Psychiatric Research, 22*, 303-321.
- Kessler, R.C., & Ustun, T.B. (2004). The World Mental Health (WMH) Survey Initiative Version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). *International Journal of Methods in Psychiatric Research, 13*, 93-121.
- 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.

- McAndrew, L.M., Markowitz, S., Lu, S.E., Borders, A., Rothman, D., & Quigley, K.S. (2017). Resilience during war: Better unit cohesion and reductions in avoidant coping are associated with better mental health function after combat deployment. *Psychological Trauma, 9*, 52-61.
- Mitchell, M.M., Gallaway, M.S., Millikan, A.M., & Bell, M. (2012). Interaction of combat exposure and unit cohesion in predicting suicide-related ideation among post-deployment soldiers. *Suicide and Life-Threatening Behavior, 42*, 486-494.
- Mulligan, K., Jones, N., Woodhead, C., Davies, M., Wessely, S., & Greenberg, N. (2010). Mental health of UK military personnel while on deployment in Iraq. *British Journal of Psychiatry, 197*, 405-10.
- Oliver, L.W., Harman, J., Hoover, E., Hayes, S.M., & Pandhi, N.A. (1999). A quantitative integration of the military cohesion literature. *Military Psychology, 11*, 57-83.
- Orr, M.G., Prescott, M.R., Cohen, G.H., Calabrese, J.R., Tamburrino, M.B., Liberzon, I., & Galea, S. (2014). Potentially modifiable deployment characteristics and new-onset alcohol abuse or dependence in the US National Guard. *Drug and Alcohol Dependence, 142*, 325-32.
- 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.
- Polusny, M.A., Erbes, C.R., Murdoch, M., Arbisi, P.A., Thuras, P., & Rath, M.B. (2011). Prospective risk factors for new-onset post-traumatic stress disorder in National Guard soldiers deployed to Iraq. *Psychological Medicine, 41*, 687-698.

Posner, K., Brown, G.K., Stanley, B., Brent, D.A., Yershova, K.V., Oquendo, M.A., ...Mann, J.J. (2011).

The Columbia-Suicide Severity Rating Scale: initial validity and internal consistency findings from three multisite studies with adolescents and adults. *American Journal of Psychiatry*, *168*, 1266-1277.

R Core Team (2013). R: A language and environment for statistical computing. R Foundation for Statistical Computing: Vienna, Austria.

Rona, R.J., Hooper, R., Jones, M., Iversen, A.C., Hull, L., Murphy, D., ... Wessely, S. (2009). The contribution of prior psychological symptoms and combat exposure to post Iraq deployment mental health in the UK military. *Journal of Traumatic Stress*, *22*, 11-19.

Smith, T.C., Ryan, M.A., Wingard, D.L., Slymen, D.J., Sallis, J.F., & Kritz-Silverstein, D. (2008). New onset and persistent symptoms of post-traumatic stress disorder self-reported after deployment and combat exposures: prospective population based US military cohort study. *British Medical Journal*, *336*, 366-371.

Southwick, S.M., Morgan, C.A. 3rd, Nicolaou, A.L., & Charney, D.S. (1997). Consistency of memory for combat-related traumatic events in veterans of Operation Desert Storm. *American Journal of Psychiatry*, *154*, 173-177.

Stein, M.B., Kessler, R.C., Heeringa, S.G., Jain, S., Campbell-Sills, L., Colpe, L.J., ... Ursano, R.J. (2015). Prospective longitudinal evaluation of the effect of deployment-acquired traumatic brain injury on posttraumatic stress and related disorders: results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *American Journal of Psychiatry*, *172*, 1101-1111.

Ursano, R.J., Colpe, L.J., Heeringa, S.G., Kessler, R.C., Schoenbaum, M., & Stein, M.B. (2014). The Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Psychiatry*, *77*, 107-119.

Van Epps, G. (2008). Relooking unit cohesion: A sensemaking approach. *Military Review*, 88, 102-110.

Van Orden, K.A., Witte, T.K., Cukrowicz, K.C., Braithwaite, S.R., Selby, E.A., & Joiner, T.E. Jr. (2010). The interpersonal theory of suicide. *Psychological Review*, 117, 575-600.

Vasterling, J.J., Proctor, S.P., Aslan, M., Ko, J., Jakupcak, M., Harte, C.B., ... Concato, J. (2015). Military, demographic, and psychosocial predictors of military retention in enlisted Army soldiers 12 months after deployment to Iraq. *Military Medicine*, 180, 524-32.

Wilkins, K.C., Lang, A.J., & Norman, S.B. (2011). Synthesis of the psychometric properties of the PTSD checklist (PCL) military, civilian, and specific versions. *Depression and Anxiety*, 25, 596-606.

Author Manuscript

Table 1

Association of socio-demographic and Army Service characteristics with perceived unit cohesion in the baseline PPDS sample ($N=8558$)

	Association with Perceived Unit Cohesion		
	b (95% CI)	χ^2	p
Age, y	0.06 (0.02, 0.09)	10.15	.001
Male sex (reference: female)	1.06 (0.50, 1.63)	13.50	<.0005
Race (reference: White)		6.02	.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	.34
Brigade Combat Team (reference: Fort #1)		29.35	<.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	<.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	<.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.

Table 2

Associations of socio-demographic and Army service characteristics, pre-deployment perceived unit cohesion, and deployment stress exposure with 30-day posttraumatic stress disorder (PTSD) at 3 or 9 months post-deployment

	Full longitudinal sample (n=4645)				Subsample without lifetime		
	AOR	95% CI	χ^2	<i>p</i>	AOR	95% CI	
Age	1.00	0.99-1.02	0.11	.75	1.00	0.99-1.02	0
Sex			1.97	.16			0
Female	1.00				1.00		
Male	0.73	0.46-1.14			0.88	0.51-1.51	
Race			4.85	.18			2
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	.40			1
Non-Hispanic	1.00				1.00		
Hispanic	1.15	0.83-1.59			1.22	0.87-1.73	

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1002/da.22884](https://doi.org/10.1002/da.22884).

This article is protected by copyright. All rights reserved.

Brigade Combat Team			1.79	.41			3
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	.67			0
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	.001			2
>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	<.0005			
30-day PTSD at T0 ⁺	2.28	1.36-3.82	9.67	.002			
Deployment Stress			217.05	<.0005			1
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	<.0005	0.74	0.65-0.84	2

Note. Weights-adjusted logistic regression was performed to estimate the association of unit cohesion with 30-day PTSD 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/Post Deployment 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 pre-deployment 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). ¹By 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.

Table 3

Associations of socio-demographic and Army service characteristics, pre-deployment perceived unit cohesion, and deployment stress exposure with 30-day suicidal ideation at 3 or 9 months post-deployment

	Full sample (n=4645)				Subsample without lifetime SI at T0 (n=4119)			
	AOR	95% CI	χ^2	<i>p</i>	AOR	95% CI	χ^2	<i>p</i>
Age	0.99	0.97- 1.01	1.09	.30	0.98	0.96- 1.02	1.00	.32
Sex			4.62	.03			0.82	.36
Female	1.00				1.00			
Male	0.56	0.33- 0.95			0.72	0.36- 1.46		
Race			1.61	.66			2.36	.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		

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1002/da.22884](https://doi.org/10.1002/da.22884).

This article is protected by copyright. All rights reserved.

Other	1.23	0.87- 1.75			1.45	0.88- 2.38		
Ethnicity			0.04	.85			0.01	.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	.72			0.20	.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	.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	.32			6.46	.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	<.0005				
30-day suicidal ideation at T0 ¹	2.57	1.37- 4.82	8.66	.003				
Deployment Stress			9.13	.003			6.74	.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	<.0005	0.72	0.63- 0.81	26.82	<.0005

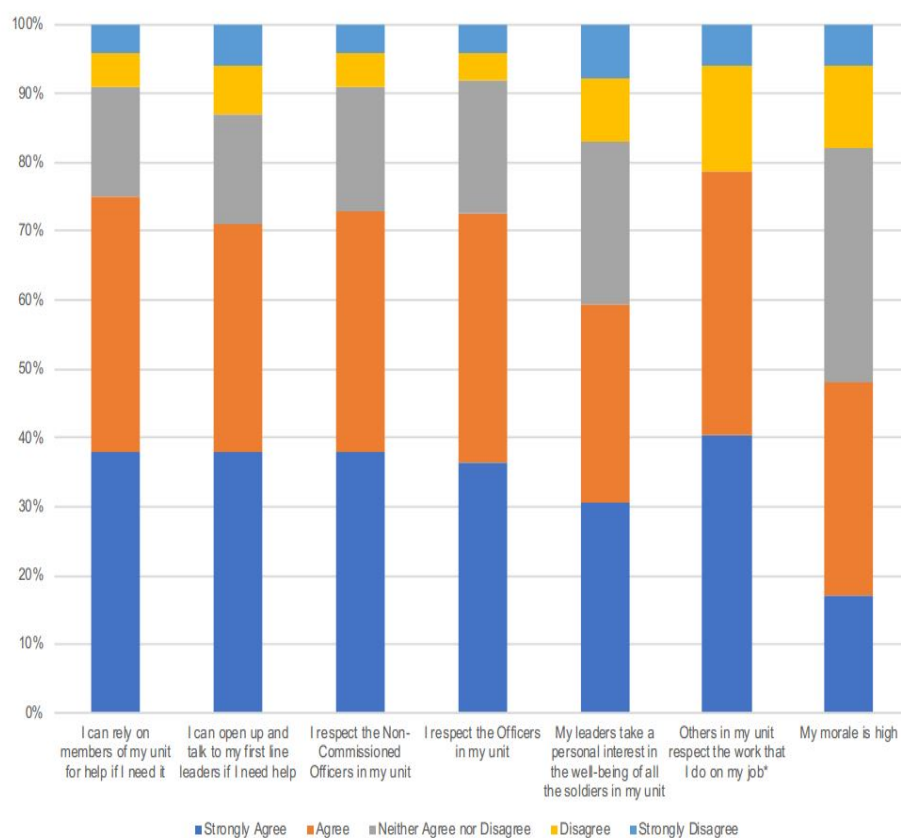
Note. Weights-adjusted logistic regression was performed to estimate the association of unit cohesion with 30-day suicidal ideation at 3 or 9 months post-deployment (T2 or T3) among soldiers who completed surveys at all four waves (T0, T1, T2, and T3) of the Pre/Post Deployment Study (“full longitudinal 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). ¹By 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.

Author Manuscript

Figure Caption

Figure 1. Distribution of responses to each item of the perceived unit cohesion scale among PPDS TO respondents ($N=8558$). *Response options for this item differed from those of the other items. For the purpose of the figure, the response options *A lot*, *Some*, *A little*, and *Not at all* were relabeled as *Strongly Agree*, *Agree*, *Disagree*, and *Strongly Disagree*, respectively.



This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](https://doi.org/10.1002/da.22884). Please cite this article as [doi: 10.1002/da.22884](https://doi.org/10.1002/da.22884).

This article is protected by copyright. All rights reserved.