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RESEARCH ARTICLE

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Predictive validity and correlates of self-assessed resilience among U.S. Army soldiers

Laura Campbell-Sills PhD[1] | Ronald C. Kessler PhD[2] | Robert J. Ursano MD[3] | Xiaoying Sun MS[4] | Charles T. Taylor PhD[1] | Steven G. Heeringa PhD[5] | Matthew K. Nock PhD[6] | Nancy A. Sampson BA[2] | Sonia Jain PhD[4] | Murray B. Stein MD, MPH[1,4,7]

[1]Department of Psychiatry, University of California San Diego, San Diego, CA, USA

[2]Department of Health Care Policy, Harvard Medical School, Boston, MA, USA

[3]Center for the Study of Traumatic Stress, Department of Psychiatry, Uniformed Services University of the Health Sciences, Bethesda, MD, USA

[4]Department of Family Medicine and Public Health, University of California San Diego, San Diego, CA, USA

[5]Institute for Social Research, University of Michigan, Ann Arbor, MI, USA

[6]Department of Psychology, Harvard University, Cambridge, MA, USA

[7]VA San Diego Healthcare System, San Diego, CA, USA

Correspondence
Laura Campbell-Sills, Department of Psychiatry, University of California San Diego, 9500 Gilman Drive, Mail Code 0855La Jolla, CA 92093, USA.
Email: campbell-sills@ucsd.edu

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Background: Self-assessment of resilience could prove valuable to military and other organizations whose personnel confront foreseen stressors. We evaluated the validity of self-assessed resilience among U.S. Army soldiers, including whether predeployment perceived resilience predicted postdeployment emotional disorder.

Methods: Resilience was assessed via self-administered questionnaire among new soldiers reporting for basic training (N = 35,807) and experienced soldiers preparing to deploy to Afghanistan (N = 8,558). Concurrent validity of self-assessed resilience was evaluated among recruits by estimating its association with past-month emotional disorder. Predictive validity was examined among 3,526 experienced soldiers with no lifetime emotional disorder predeployment. Predictive models estimated associations of predeployment resilience with incidence of emotional disorder through 9 months postdeployment and with marked improvement in coping at 3 months postdeployment. Weights-adjusted regression models incorporated stringent controls for risk factors.

Results: Soldiers characterized themselves as very resilient on average [M = 14.34, SD = 4.20 (recruits); M = 14.75, SD = 4.31 (experienced soldiers); theoretical range = 0–20]. Demographic characteristics exhibited only modest associations with resilience, while severity of childhood maltreatment was negatively associated with resilience in both samples. Among recruits, resilience was inversely associated with past-month emotional disorder [adjusted odds ratio (AOR) = 0.65, 95% CI = 0.62–0.68, P < .0005 (per standard score increase)]. Among deployed soldiers, greater predeployment resilience was associated with decreased incidence of emotional disorder (AOR = 0.91; 95% CI = 0.84–0.98; P = .016) and increased odds of improved coping (AOR = 1.36; 95% CI = 1.24–1.49; P < .0005) postdeployment.

Conclusions: Findings supported validity of self-assessed resilience among soldiers, although its predictive effect on incidence of emotional disorder was modest. In conjunction with assessment of known risk factors, measurement of resilience could help predict adaptation to foreseen stressors like deployment.

KEYWORDS
coping skills, military personnel, psychological resilience, stress, stress disorders

1 | INTRODUCTION

Resilience refers to successful adaptation to adversity (American Psychological Association, 2014; Bonanno, 2004; Rutter, 2006). Outcomes indicative of resilience are heterogeneous and may include swift recovery of acute stress reactions, maintenance of healthy, stable levels of functioning, and even personal growth following stress exposure (Bonanno & Diminich, 2013; Tsai, El-Gabalawy, Sledge, Southwick, & Pietrzak, 2015). Proposed determinants of resilience are similarly diverse, encompassing genetic (Feder, Nestler, & Charney,

2009; Liberzon et al., 2014; Stein, Campbell-Sills, & Gelernter, 2009), other neurobiological (Haase et al., 2016; Russo, Murrough, Han, Charney, & Nestler, 2012; Vythilingam et al., 2009), psychological (Alim et al., 2008; Campbell-Sills, Cohan, & Stein, 2006; New et al., 2009), and environmental factors (Campbell-Sills, Forde, & Stein, 2009; Ozbay, Fitterling, Charney, & Southwick, 2008).

Scientific investigation of resilience has implications for the military, whose personnel are called on to confront stressful and life-threatening situations. Improved understanding of mechanisms underlying resilience could inform prevention and treatment of stress-related disorders that impact service members (Johnson et al., 2014; Southwick & Charney, 2012). However, the complexity of the resilience construct poses challenges to its operational definition and measurement (Southwick, Bonanno, Masten, Panter-Brick, & Yehuda, 2014). In some studies, resilience is inferred from trajectories of symptoms and functioning over time (Bonanno & Diminich, 2013; Bonanno et al., 2012; Pietrzak et al., 2014) or from observation of minimal symptoms in conjunction with high stress exposure (Pietrzak & Cook, 2013; Pietrzak & Southwick, 2011). Self-report instruments also have been developed to explicitly measure resilience (Connor & Davidson, 2003; Johnson et al., 2011; Maoz, Goldwin, Lewis, & Bloch, 2016). These vary in approach, but may evaluate respondents' abilities to handle stress, protective characteristics or resources, or use of adaptive coping strategies. In military settings, valid self-assessment of resilience could help prospectively identify personnel likely to adapt successfully to foreseen stressors (e.g., deployment, survival training); or, conversely, those at risk of adverse stress reactions due to low resilience.

The Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS; Kessler et al., 2013; Ursano et al., 2014) aims to expand knowledge of risk and resilience factors for suicidal behaviors and associated psychopathology in U.S. Army soldiers. Army STARRS surveys included assessment of soldiers' perceived resilience. We investigated factors associated with self-reported resilience within two groups: new soldiers reporting for basic training and experienced soldiers preparing to deploy to Afghanistan. Among new soldiers, concurrent validity of self-assessed resilience was evaluated by estimating its relationship to past-month emotional disorder (i.e., any past-month anxiety, depressive, or trauma-related disorder diagnosis assessed by the survey). Because resilience is conceptualized as bouncing back from difficult experiences, we further examined whether the relationship between resilience and emotional disorder varied depending on level of recent life stress. We hypothesized that protective effects of resilience would be more apparent in the context of higher stress burden (Campbell-Sills et al., 2006; Campbell-Sills & Stein, 2007).

The design of the Army STARRS Pre/Post Deployment Study (PPDS) also allowed a rare opportunity to evaluate predictive validity of self-assessed resilience. Predictive validity was evaluated by estimating associations of predeployment resilience with incidence of emotional disorder through 9 months postdeployment. Models also tested for moderating effects of predeployment resilience on associations between severity of perideployment stressors (e.g., combat/deployment stress; personal life stress) and incidence of emotional disorder. Finally, because resilience also may encompass growth from adversity (Southwick et al., 2014), we examined the association of predeployment resilience with improvement in coping ability at 3 months postdeployment.

2 | MATERIALS AND METHODS

2.1 | Participants and procedures

Detailed descriptions of Army STARRS design and procedures are available elsewhere (Heeringa et al., 2013; Kessler et al., 2013; Ursano et al., 2014). Recruitment, consent, and data protection procedures were approved by Human Subjects Committees of all collaborating institutions. For both studies described below, soldiers gave written informed consent for survey participation. Consent to link responses to their Army/Department of Defense (DoD) administrative records was also requested.

The New Soldier Study (NSS) was conducted at three Army installations from April 2011 to November 2012. Soldiers were surveyed shortly before Basic Combat Training. Virtually all (99.9%) selected soldiers consented and 93.5% completed the survey. Most survey completers (77.1%) consented to linkage of responses to their Army/DoD administrative records. These 38,507 soldiers comprised the sample for the current NSS analyses. Analyses incorporated a combined analysis weight that adjusted for differential administrative record linkage consent among survey completers, and included poststratification of consent weights to known traits of the population attending Basic Combat Training during the study period (Kessler et al., 2013).

The PPDS is a multiwave panel survey of soldiers from three Brigade Combat Teams (BCTs). Baseline evaluation was conducted 1–2 months before deployment of the BCTs to Afghanistan in 2012 (T0). Follow-up assessment occurred within 1 month of their return to the U.S. (T1), 3 months later (T2), and 9 months later (T3). At T0, 9,949 soldiers were present for duty in the BCTs, the majority of whom (95.3%) consented to the survey. Most consenting soldiers (86.0%) completed the survey and consented to administrative record linkage; they comprised the sample for cross-sectional analyses of PPDS T0 data (n = 8,558). The majority of these soldiers subsequently deployed to Afghanistan (n = 7,742; 90.5%). Given that hypothesis testing relied on T1, T2, and T3 data, the eligible baseline sample for longitudinal analysis was restricted to soldiers with complete follow-up data (n = 4,645; 60.0%). The sample was further constrained to soldiers without lifetime posttraumatic stress disorder (PTSD), major depressive episode (MDE), generalized anxiety disorder (GAD), panic disorder (PD), or suicidal ideation (SI) at T0 (n = 3,526), because incidence of emotional disorder was the primary outcome of interest for predictive validity analysis. Response propensity and poststratification weighting factors were developed and applied in all PPDS analyses (Heeringa, West, & Berglund, 2010).

2.2 | Measures

2.2.1 | Resilience

A pool of 17 items was tested during early pilot administrations of the Army STARRS All Army Study (AAS) and NSS surveys. Items

were adapted from prior large-scale surveys (Merikangas, Avenevoli, Costello, Koretz, & Kessler, 2009) or rationally developed following review of content areas covered by validated resilience measures (Campbell-Sills & Stein, 2007; Wagnild & Young, 1993). Exploratory factor analysis showed that 16 of the 17 candidate items loaded on one factor (item-factor loadings = 0.53–0.74) and item response theory analysis led to selection of 10 of these 16 items for inclusion in subsequent pilot administrations of AAS and NSS surveys. Stepwise regression analysis of data from the 10-item scale indicated that five items accounted for the vast majority of variance in total resilience scores ($R^2 = 0.94$); these five items were included in the final NSS and PPDS T0 surveys.

The resilience scale was prefaced by, "People differ a lot in how well they handle stress. How would you rate your ability to handle stress in each of the following ways?" Soldiers rated their abilities to "keep calm and think of the right thing to do in a crisis," "manage stress," "try new approaches if old ones don't work," "get along with people when you have to," and "keep your sense of humor in tense situations" as *poor*, *fair*, *good*, *very good*, or *excellent*. Ratings were coded 0–4 and summed to create a total resilience score (theoretical range = 0–20). Internal consistency was good in both the NSS ($\alpha = 0.86$) and PPDS T0 ($\alpha = 0.89$) samples; note that these should be considered lower bound estimates as scale items were selected to be minimally redundant. Distribution of raw resilience scores was examined in both samples. For regression analyses, resilience scores were standardized to facilitate interpretation of results.

2.2.2 | Mental disorders and suicidal ideation

NSS and PPDS mental disorder diagnoses were based on the Composite International Diagnostic Interview Screening Scales (Kessler & Ustun, 2004) and PTSD Checklist (Weathers, Litz, Herman, Huska, & Keane, 1993), and validated in the Army STARRS Clinical Reappraisal Study (Kessler et al., 2013). SI was assessed with an expanded self-report version of the Columbia Suicide Severity Rating Scale (Posner et al., 2011). Two composite diagnostic outcomes were derived as indicators of general emotional health/disorder. The composite outcome used for the NSS concurrent validity analysis reflected presence versus absence of any past-month PTSD, MDE, GAD, or SI (past-month PD was not available). For the PPDS predictive validity analysis, the composite outcome was any lifetime PTSD, MDE, GAD, PD, or SI at T3. Because longitudinal models were tested among soldiers without lifetime PTSD, MDE, GAD, PD, or SI at T0, the lifetime composite diagnosis at T3 represents new onset of these disorders from the start of the index deployment through 9 months postdeployment.[1]

2.2.3 | Personal growth

A PPDS T2 survey item inquired about effects of deployment on coping ability. Soldiers characterized their ability to handle stress as *a lot worse*, *somewhat worse*, *a little worse*, *no difference*, *a little better*, *somewhat better*, or *a lot better* than it was prior to the index deployment (coded 1–7). Most soldiers included in the longitudinal analysis indicated that deployment improved their ability to handle stress (median = 6; IQR = 4–7). We therefore chose marked improvement in coping ability as an indicator of personal growth (*a lot better* = 1; all others = 0).

2.2.4 | Childhood maltreatment

NSS and PPDS T0 surveys assessed experiences of maltreatment through age 17. A prior study provided evidence for the reliability and validity of five maltreatment subtype scales (sexual abuse, physical abuse, emotional abuse, physical neglect, and emotional neglect) and a Global Maltreatment scale (Stein et al., 2017). Global Maltreatment score was examined in relation to self-reported resilience, and adjusted for in all models of mental health outcomes. It reflects the average of the five maltreatment subtype scales (theoretical range = 1 [average response of "Never"] to 5 [average response of "Very Often"]) and displays satisfactory internal consistency in the NSS ($\alpha = 0.76$) and PPDS ($\alpha = 0.78$) samples.

2.2.5 | Recent stress

The NSS survey assessed past-year stress related to finances, career, health, love life, relationships with family, health of loved ones, and other problems experienced by loved ones. Respondents rated the severity of stress in each area (*none*, *mild*, *moderate*, *severe*, or *very severe*; coded 0–4). Item ratings were summed (theoretical range = 0–28; $\alpha = 0.87$) and the resulting total scores standardized to quantify past-year life stress severity.

Models of postdeployment outcomes adjusted for severity of perideployment stressors (assessed in the PPDS T1 survey). Combat/deployment stress was quantified using a Deployment Stress Scale (theoretical range = 0–16), which assessed exposures to potentially traumatic events such as firing at the enemy/taking enemy fire or seeing severely wounded or dying people. A Personal Life Stress score captured severity of stress during deployment due to personal matters (e.g., relationship, family, or financial problems; theoretical range = 0–20); and a Military Life Stress Scale score quantified stress from problems with chain of command and unit members (theoretical range = 0–8). Scores on each stress scale were standardized to facilitate interpretation of logistic regression results. More information about these scales can be obtained from a separate report (Campbell-Sills et al., 2017).

2.2.6 | Sociodemographic and Army service variables

Sociodemographic characteristics considered were sex, age, race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, or other), marital status (married, never married, or separated/divorced/widowed), and education (general equivalency, high school, or college/postgraduate degree). NSS analyses adjusted for service component (Regular Army, Reserve, or National Guard) and site of basic training. PPDS analyses adjusted for number of previous deployments (0, 1, or 2+) and BCT. Due to very low representation of Reserve and National Guard members in the PPDS sample, service component was not included in analyses of PPDS data.

2.3 | Data analysis

Weights-adjusted multivariable linear regression was used to estimate associations of resilience with sociodemographic characteristics and childhood maltreatment in the NSS and PPDS T0 samples. To assess concurrent validity of self-assessed resilience in the NSS sample, weights-adjusted logistic regression was performed to estimate the association of resilience score with 30-day composite diagnosis (PTSD, MDE, GAD, or SI), adjusting for sociodemographic and Army service variables, childhood maltreatment, and past-year life stress. To evaluate predictive validity of self-assessed resilience among soldiers with no predeployment emotional disorders, weights-adjusted logistic regression analyses were performed to estimate the association of predeployment resilience score with lifetime composite diagnosis at T3 and with odds of endorsing personal growth at T2. Longitudinal models included adjustment for sociodemographic characteristics; BCT; number of prior deployments; and childhood maltreatment (from T0); and severity of combat/deployment stress, personal life stress, and military life stress during deployment (from T1).

NSS and PPDS data are clustered and weighted; thus, 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 $P < .05$ was considered significant. All analyses were conducted using R Version 3.1.3 (R Core Team, 2013).

3 | RESULTS

3.1 | Descriptive analysis

3.1.1 | NSS

Mean resilience score was 14.34 (SD = 4.20) among new soldiers. Regression of standardized resilience scores onto sociodemographic, Army service, and childhood maltreatment variables indicated that sex [$X^2(1) = 87.31$, $P < .0005$], age [$X^2(1) = 111.95$, $p < .0005$], race/ethnicity [$X^2(3) = 267.83$, $P < .0005$], service component [$X^2(2) = 24.18$, $P < .0005$], and childhood maltreatment [$X^2(1) = 93.50$, $P < .0005$] were significantly associated with resilience (Table 1). Women endorsed slightly lower resilience than men; the most substantive race difference was between Black and White soldiers (with Black soldiers reporting greater resilience). Although statistically significant, differences between resilience scores of Reserve, National Guard, and Regular Army soldiers were trivial. Resilience was positively associated with age and negatively associated with childhood maltreatment.

3.1.2 | PPDS

Among soldiers preparing to deploy, mean resilience score was 14.75 (SD = 4.31). An analogous linear regression analysis yielded partly

TABLE 1 Correlates of Self-Assessed Resilience in the New Soldier Study and Baseline Pre/Post Deployment Study Samples

	NSS Sample ($n = 38,507$)			Baseline PPDS Sample ($n = 8,558$)		
	b (95% CI)	X^2	*P*	*b* (95% CI)	X^2	*P*
Age, years	0.02 (0.02 to 0.02)	111.95	<.0005	0.00 (−0.01 to0.01)	0.04	.84
Female sex (reference: male)	−0.15 (−0.19 to −0.12)	87.31	<.0005	−0.31 (−0.37 to −0.25)	89.09	<.0005
Race/ethnicity (reference: white, non-Hispanic)		267.83	<.0005		2.33	.51
Black, non-Hispanic	0.25 (0.22 to 0.28)			0.03 (−0.03 to 0.09)		
Hispanic	0.11 (0.08 to 0.15)			0.03 (−0.04 to 0.10)		
Other	0.04 (−0.01 to 0.09)			−0.04 (−0.12 to 0.04)		
Education (reference: high school degree)		3.62	.16		29.35	<.0005
General equivalency diploma	−0.01 (−0.05 to 0.03)			0.10 (0.00–0.20)		
College degree	0.05 (0.00 to 0.09)			0.16 (0.10–0.22)		
Marital status (reference: married)		2.46	.29		2.99	.22
Divorced/separated/widowed	−0.18 (−0.45 to 0.10)			−0.06 (−0.14 to 0.02)		
Never married	−0.02 (−0.06 to 0.02)			0.01 (−0.04 to 0.06)		
Service component (reference: Regular Army)		24.18	<.0005		–	–
Reserve	−0.06 (−0.09 to −0.03)			–		
National Guard	−0.06 (−0.09 to −0.03)			–		
Number of prior deployments (reference: none)		–	–		2.50	.29
One	–			−0.04 (−0.10 to 0.02)		
Two or more	–			−0.03 (−0.08 to 0.03)		
Childhood maltreatment (1–5 scale)	−0.12 (−0.15 to −0.10)	93.50	<.0005	−0.25 (−0.31 to −0.20)	79.66	<.0005

Results are from weights-adjusted multivariable linear regression of standardized resilience scores onto the independent variables listed in table rows. The NSS model also adjusted for site of Basic Combat Training and the PPDS model also adjusted for Brigade Combat Team. Number of prior deployments does not apply to the NSS sample, which was comprised of new Army recruits. Service component was not adjusted for in the PPDS analysis due to very low representation of Reserve and National Guard soldiers.

NSS, New Soldier Study; PPDS, Pre/Post Deployment Study.

TABLE 2 Associations of Sociodemographic Characteristics, Stressors, and Resilience with 30-Day Emotional Disorder among New Soldiers ($N = 38,507$)

	30-Day PTSD, MDE, GAD, or SI at Time of Survey		
	AOR (95% CI)	X^2	*P*
Age, years	0.94 (0.92–0.96)	31.49	<.0005
Female sex (reference: male)	1.15 (1.04–1.28)	7.47	.006
Race/ethnicity (reference: white, non-Hispanic)		19.40	<.0005
Black, non-Hispanic	0.85 (0.75–0.97)		
Hispanic	0.81 (0.72–0.90)		
Other	0.89 (0.76–1.04)		
Education (reference: high school degree)		8.31	.016
General equivalency diploma	0.90 (0.78–1.04)		
College degree	0.70 (0.54–0.90)		
Marital status (reference: married)		34.53	<.0005
Divorced/separated/widowed	6.89 (3.45–13.77)		
Never married	0.96 (0.81–1.14)		
Service component (reference: Regular Army)		3.53	.17
Reserve	0.86 (0.73–1.01)		
National Guard	0.95 (0.85–1.07)		
Childhood maltreatment severity (1–5 scale)	1.77 (1.66–1.88)	325.31	<.0005
Resilience (standardized)	0.65 (0.62–0.68)	324.00	<.0005
Past-year life stress (standardized)	2.31 (2.22–2.41)	1,622.05	<.0005
Resilience × past-year life stress	0.96 (0.92–0.99)	5.57	.018

The weights-adjusted logistic regression model also adjusted for site of Basic Combat Training.
PTSD, posttraumatic stress disorder; MDE, major depressive episode; GAD, generalized anxiety disorder; SI, suicidal ideation; AOR, adjusted odds ratio; CI , confidence interval.

convergent results (Table 1). Resilience again exhibited significant associations with sex [$X^2(1) = 89.09$, $P < .0005$] and childhood maltreatment [$X^2(1) = 79.66$, $P < .0005$], but was not associated with age [$X^2(1) = 0.04$, $P = .84$] or race/ethnicity [$X^2(3) = 2.33$, $P = .51$]. Resilience differed by education [$X^2(2) = 29.35$, $P < .0005$], with college degree holders endorsing slightly greater resilience than high school graduates.

3.2 | Concurrent validity

Adjusting for sociodemographic and Army service characteristics, childhood maltreatment, and past-year life stress, self-reported resilience was inversely associated with odds of 30-day emotional disorder among new soldiers (adjusted odds ratio [AOR] = 0.63; 95% CI = 0.61–0.65; $X^2(1) = 574.27$, $P < .0005$). Holding other factors constant, Army recruits endorsing high resilience ($z = 1.00$) displayed less than two-thirds the risk of emotional disorder of those reporting average resilience ($z = 0.00$) and less than half the risk (AOR = 0.40) of those reporting low resilience ($z = -1.00$).

Past-year life stress also displayed a strong (positive) association with 30-day emotional disorder (AOR = 2.34; 95% CI = 2.25–2.43; $X^2(1) = 1,802.44$, $P < .0005$). An interaction was added to the initial regression model to test whether the association of resilience with 30-day emotional disorder differed depending on degree of past-year life stress. A small but statistically significant resilience × life stress interaction was observed (AOR = 0.96; 95% CI = 0.92–0.99; $X^2(1) = 5.57$, $P = .018$), whereby the "protective" effect of resilience on odds of emotional disorder grew stronger as past-year life stress increased. Table 2 displays full results of this model and Figure 1 illustrates the interaction effect.

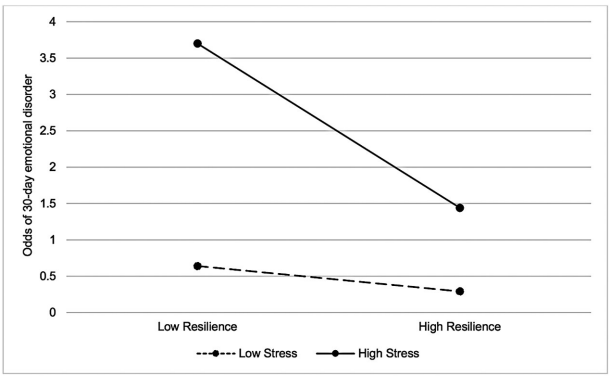

FIGURE 1 Depiction of the interaction effect of self-reported resilience and past-year life stress severity on odds of 30-day emotional disorder (PTSD, MDE, GAD, or SI) among New Soldier Study respondents ($N = 38,507$). To illustrate the nature of the interaction, estimated odds of 30-day emotional disorder are plotted for soldiers with standard scores of −1.0 (low) and 1.0 (high) on measures of resilience and past-year life stress severity. Estimated odds of emotional disorder are relative to soldiers with average scores ($z = 0$) on both resilience and life stress, holding other variables constant (age, sex, race/ethnicity, education, marital status, service component, site of Basic Combat Training, and childhood maltreatment)

3.3 | Predictive validity

Mean predeployment resilience score in the longitudinal sample (i.e., soldiers without lifetime PTSD, MDE, GAD, PD, or SI predeployment) was 15.54 (SD = 3.86). Nearly one-quarter (23.4%) of these soldiers met criteria for the composite diagnosis at T3, that is, had new onset of PTSD, MDE, GAD, PD, or SI during or postdeployment.

Adjusting for soldier characteristics, prior deployment history, childhood maltreatment, and perideployment stressors, predeployment resilience was negatively associated with incidence of emotional disorder through 9 months postdeployment (AOR = 0.91; 95% CI = 0.84–0.98; $X^2(1) = 5.82$, $P = .016$). Holding other factors constant, soldiers who endorsed high resilience predeployment ($z = 1.00$) exhibited 9% lower risk of incidence of emotional disorder than soldiers who reported average resilience ($z = 0.00$), and 18% lower risk than soldiers who reported low resilience ($z = -1.00$). Subsequent models added interactions of predeployment resilience with childhood maltreatment, combat/deployment stress, and personal and Army life stress; however, none were significant (*P*s > .17). The base model of postdeployment emotional disorder (with main effects only) was therefore retained; full results of this model are presented in Table 3.

The second predictive validity analysis estimated the association between predeployment resilience and an indicator of personal growth from deployment. Adjusting for soldier characteristics, prior deployment history, childhood maltreatment, and perideployment stressors, predeployment resilience was positively associated with marked improvement in coping at 3 months postdeployment (AOR = 1.36; 95% CI = 1.24–1.49; $X^2(1) = 42.53$; $P < .0005$). Holding other factors constant, soldiers who reported high resilience predeployment ($z = 1.00$) had 36% greater odds of endorsing improved coping relative to soldiers who reported average resilience ($z = 0.00$), and almost twice the odds (AOR = 1.84) of soldiers who reported low resilience predeployment ($z = -1.00$).

4 | DISCUSSION

The current study provides evidence of the validity of self-assessed resilience among U.S. Army soldiers. Support principally derives from longitudinal analyses showing that greater predeployment resilience was associated with decreased odds of incidence of emotional disorder (PTSD, MDE, GAD, PD, or SI) through 9 months postdeployment. Put another way, soldiers who characterized themselves as more resilient before deploying to Afghanistan were more likely to maintain good mental health—remaining free from common anxiety, depressive, and trauma-related disorders—for an extended period following their deployment. Moreover, an indication of personal growth was apparent among soldiers who endorsed high resilience prior to deployment. At 3 months postdeployment, these soldiers were more likely to report that deploying to a combat zone had markedly strengthened their coping abilities—raising the interesting possibility that adaptability to stress "breeds" further resilience as additional stressors are confronted successfully.

Few other large-scale studies have evaluated predictive validity of self-assessed resilience among servicemembers. Most notably, a recent investigation of U.S. Air Force personnel found that self-reported resilience at enlistment predicted both attrition and assignment of a mental health diagnosis during the first 6 months of service (Bezdjian, Schneider, Burchett, Baker, & Garb, 2017). A caveat to the current findings is that, although predeployment resilience was significantly associated with postdeployment outcomes, the size of its association with incidence of postdeployment emotional disorders was modest. However, it is noteworthy that predictive effects were detected in a sample selected for robust mental health (i.e., prospective analyses were limited to soldiers without predeployment lifetime PTSD, MDE, GAD, PD, or SI), with stringent adjustment for risk factors and brief assessment consisting of five survey items.

The majority of Army recruits and soldiers preparing to deploy characterized themselves as very good at handling stress. High self-reported resilience was also common among Air Force recruits (Bezdjian et al., 2017). Among new soldiers, concurrent validity of self-reported resilience was substantiated by its strong negative association with past-month emotional disorder (PTSD, MDE, GAD, or SI). A study of OEF/OIF veterans also found negative associations of self-reported resilience with concurrent PTSD and depressive symptoms (Pietrzak, Johnson, Goldstein, Malley, & Southwick, 2009). In the current analysis, the "protective" effect of resilience on odds of emotional disorder appeared stronger under conditions of intensified stress. This may offer further evidence of construct validity, in that reduced vulnerability to stress—as opposed to low vulnerability in general—seemed to be captured by the resilience measure. Analogous interaction effects between resilience and severity of perideployment stressors (e.g., combat/deployment stress; personal life stress) were not observed in the predictive validity analysis. Divergence of NSS versus PPDS findings with regard to interrelationships of resilience, stress severity, and emotional disorder may pertain to various factors including study design (e.g., cross-sectional versus longitudinal assessment of key constructs), sample composition (e.g., recruits versus experienced soldiers), and disparities in degree of "ambient" stress present when the assessment of specific stressors and symptoms occurred (i.e., NSS respondents were surveyed during intake procedures prior to Basic Combat Training; PPDS respondents were surveyed shortly before and at several points after combat deployment).

While high resilience was the norm within *all* demographic groups, some small between-groups differences were observed. Converging with results of civilian studies (Alim et al., 2008; Bonanno, Galea, Bucciarelli, & Vlahov, 2007; Campbell-Sills et al., 2009), male soldiers in each sample characterized themselves as more resilient than female soldiers. This finding may represent the inverse of sex differences in traits such as neuroticism that encompass stress vulnerability (Schmitt, Realo, Voracek, & Allik, 2008). Age and race/ethnicity differences—observed in some civilian samples (e.g., Bonanno et al., 2007)—were observed among recruits but not PPDS respondents. While the source of this discrepancy is unknown, one possibility is that PPDS respondents' common experience of military service attenuated differences that might have previously existed across age and race/ethnicity groups. On the other hand, college degree attainment was related to

TABLE 3 Associations of Sociodemographic Characteristics, Stressors, and Predeployment Resilience with Incidence of Emotional Disorders during or Postdeployment ($n = 3,526$)

	New Onset of PTSD, MDE, GAD, PD, or SI (Through 9 Months Postdeployment)		
	AOR (95% CI)	X^2	*P*
Age, years	1.01 (0.99–1.03)	0.82	.36
Female sex (reference: male)	1.08 (0.72–1.62)	0.15	.70
Race/ethnicity (reference: white, non-Hispanic)		7.53	.06
Black, non-Hispanic	1.18 (0.86–1.63)		
Hispanic	1.01 (0.79–1.30)		
Other	1.48 (1.09–1.99)		
Education (reference: high school degree)		9.52	.009
General equivalency diploma	1.49 (1.02–2.17)		
College degree	0.79 (0.64–0.97)		
Marital status (reference: married)		0.80	.67
Divorced/separated/widowed	1.10 (0.79–1.55)		
Never married	1.08 (0.87–1.33)		
Number of prior deployments (reference: none)		7.96	.019
One	0.81 (0.66–0.99)		
Two or more	0.71 (0.56–0.90)		
Childhood maltreatment (1–5 scale)	1.42 (1.23–1.65)	21.72	<.0005
Personal life stress during deployment (standardized)	1.44 (1.33–1.55)	84.19	<.0005
Army life stress during deployment (standardized)	1.21 (1.11–1.32)	18.18	<.0005
Combat/deployment stress (standardized)	1.46 (1.37–1.56)	129.37	<.0005
Predeployment resilience score (standardized)	0.91 (0.84–0.98)	5.82	.016

The weights-adjusted logistic regression model also adjusted for Brigade Combat Team.
PTSD, posttraumatic stress disorder; MDE, major depressive episode; GAD, generalized anxiety disorder; PD, panic disorder; SI, suicidal ideation; AOR, adjusted odds ratio; CI, confidence interval.

slightly higher resilience among PPDS respondents—concurring with results of a community study (Campbell-Sills et al., 2009)—but was unassociated with resilience among new soldiers. Interpretation is again speculative; but benefits of high educational attainment may be more apparent in the context of greater life experience, which PPDS respondents possessed relative to younger NSS respondents.

Also replicating observations from civilian studies (Campbell-Sills et al., 2009) were findings that childhood maltreatment was associated with lower resilience among both new and experienced soldiers. Childhood maltreatment is a risk factor for suicidal behaviors among U.S. Army soldiers (Stein et al., 2017); and additive effects of childhood maltreatment and combat stress on risk of suicidal behaviors were observed among Canadian Armed Forces personnel (Afifi et al., 2016). Taken together, these findings suggest that victims of childhood maltreatment are a subgroup for military organizations to consider in the development and targeting of risk mitigation and resilience programs.

The current results must be interpreted in light of several limitations. Most generally, self-report data are vulnerable to response biases such as social desirability. Emotional states arising from mental disorders (e.g., anxiety, sadness) could bias self-assessment of resilience in a negative direction. Because both resilience and mental disorders were assessed via self-report, method effects could contribute to their observed associations.

The resilience scale used in the current analysis was developed specifically for Army STARRS, which precludes potentially informative comparisons between the resilience scores of NSS and PPDS respondents and those of other (e.g., matched general population) samples. Survey items assessing resilience did not comprehensively cover the many hypothesized contributors to resilience; however, the scale was developed based on evidence that the final items explained the vast majority of variance in total scores from a larger pool of items. Although we cannot assume generalizability of the current findings to more widely used self-report measures of resilience such as the Connor-Davidson Resilience Scale (CD-RISC; Connor & Davidson, 2003), it is notable that the CD-RISC also was shown to prospectively predict mental health of servicemembers (i.e., assignment of mental disorder diagnosis during the first 6 months of Air Force service; Bezdjian et al., 2017). Future studies of resilience and postdeployment mental health could employ other scales such as the CD-RISC to rule out the possibility that the current findings were idiosyncratic to the Army STARRS resilience measure. The indicator of personal growth in our investigation was a single survey item focused on improvement in coping abilities; future studies should include broader definitions of this construct and examine personal growth over time (Tsai, Sippel, Mota, Southwick, & Pietrzak, 2016). Finally, neurobiological bases of resilience were not considered; however, we aim to

investigate genetic factors associated with resilience in future investigations of Army STARRS cohorts.

5 | CONCLUSION

The majority of U.S. Army recruits and soldiers preparing to deploy perceived themselves as resilient. Modest differences in self-assessed resilience were observed based on sociodemographic characteristics, and soldiers with histories of childhood maltreatment endorsed lower resilience. Higher resilience was associated with substantially lower odds of past-month emotional disorder among new soldiers; particularly among those with greater past-year life stress. Soldiers who reported high resilience before deployment exhibited reduced incidence of emotional disorders through 9 months postdeployment and greater odds of personal growth postdeployment. Self-assessment of resilience has various potential applications in military settings, and may prove valuable in identifying soldiers likely to thrive under stress as well as those at increased risk of adverse reactions to deployment, survival training, or other foreseen stressors.

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CONFLICT OF INTEREST

Dr. Stein has in the past three years been a consultant for Actelion, Dart Neuroscience, Healthcare Management Technologies, Janssen, Oxeia Biopharmaceuticals, Pfizer, Resilience Therapeutics, and Tonix Pharmaceuticals. 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, 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 financial disclosures. 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.

ENDNOTE

[1] This outcome captures all episodes of PTSD, MDE, GAD, PD, and SI that occurred during deployment, as well as postdeployment episodes that occurred (or were ongoing) during the 30 days preceding the T2 and T3 interviews. Episodes with both onset and offset during the time between surveys may not have been captured (e.g., an episode with onset after T2 assessment and resolution >1 month prior to T3 assessment).

ORCID

Laura Campbell-Sills PhD http://orcid.org/0000-0002-2716-5441

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