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Original Contribution

Longitudinal Examination of Posttraumatic Stress Disorder as a Long-Term Outcome of Iraq War Deployment

Jennifer J. Vasterling*, Mihaela Aslan, Susan P. Proctor, John Ko, Brian P. Marx, Matthew Jakupcak, Paula P. Schnurr, Theresa Gleason, Grant D. Huang, and John Concato

* Correspondence to Dr. Jennifer J. Vasterling, Psychology (116B), VA Boston Healthcare System, 150 S. Huntington Avenue, Boston, MA 02130 (e-mail: jennifer.vasterling@va.gov).

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The mental health toll of the Iraq and Afghanistan Wars on military veterans has been considerable, yet little is known about the persistence of these adverse outcomes, especially relative to predeployment status. We prospectively examined posttraumatic stress disorder (PTSD) as a long-term consequence of warzone deployment, integrating data collected from 2003–2014. In the Neurocognition Deployment Health Study, we measured PTSD symptoms in US Army soldiers before and shortly after Iraq War deployment. We used the PTSD Checklist–Civilian Version and a structured clinical interview (i.e., Clinician-Administered PTSD Scale) to reassess PTSD in 598 service members and military veterans a median of 7.9 years (interquartile range, 7.2–8.5 years) after an index Iraq deployment. At long-term follow-up, 24.7% (95% confidence interval (CI): 21.5, 28.4) of participants met the case definition for PTSD, which was an absolute increase of 14.2% from the percentage assessed postdeployment (10.5%; 95% CI: 7.8, 13.7) and of 17.3% from the percentage assessed predeployment (7.4%; 95% CI: 5.5, 9.8). These findings highlight that PTSD is an enduring consequence of warzone participation among contemporary military personnel and veterans. The largest increase in PTSD cases occurred between the postdeployment and long-term follow-up assessments, which suggests that adverse stress reactions cannot necessarily be expected to dissipate over time and actually may increase.

Iraq War; longitudinal study; military deployment; prospective study; PTSD prevalence

Abbreviations: CAPS, Clinician Administered PTSD Scale; CI, confidence interval; CSP#566, Cooperative Studies Program #566; NDHS, Neurocognition Deployment Health Study; PCL-C, PTSD Checklist–Civilian Version; PTSD, posttraumatic stress disorder.

Posttraumatic stress disorder (PTSD) is a significant health concern among the more than 2.7 million US service members who have served in the Iraq and Afghanistan Wars (1) and among international forces with comparable combat exposure (2). PTSD is associated with enormous personal and societal costs, including elevated risks of suicidality (3) and overall mortality (4), functional impairment and reduced quality of life (5), and more psychiatric and medical comorbid conditions (6). A burgeoning literature has produced a wide range of PTSD prevalence estimates (0%–68%) among veterans of the Iraq and Afghanistan Wars (7). Although long-term mental health outcomes have been measured in Vietnam War veterans (8, 9), as concluded by a 2013 Institute of Medicine report (1) and others (7), a significant need exists for longitudinal research examining longer-term mental health outcomes after deployments in Operation Enduring Freedom and Operation Iraqi Freedom, especially among warzone veterans sampled from and assessed in nonclinical contexts.

Baseline data are critical in contextualizing postdeployment PTSD in military personnel, given the high rates of PTSD reported before warzone deployment and the association of predeployment PTSD with postdeployment mental health concerns (10). In previous prospective research assessing PTSD before deployment to Iraq or Afghanistan, researchers often examined shorter-term outcomes measured

relatively soon (e.g., 2–7 months) after return from warzone service (11–13), with results from several studies suggesting that PTSD symptoms increase after deployment, particularly among service members who were exposed to combat (11–14). Of note, studies in which outcomes were captured more than 1 year after deployment have often not timed PTSD assessments in close relation to the deployment (14, 15) or have been conducted on samples for whom large subsets (>50% of the sample) had prior warzone exposure (16) or deployed for briefer (4-month) intervals (17, 18).

In the present study, we examined PTSD as a long-term (>5 year) outcome in a nationally dispersed sample of US active duty soldiers, reservists, and military veterans who participated in the Neurocognition Deployment Health Study (NDHS) (19). Participants were assessed multiple times in nonclinical contexts, including before an index deployment in Operation Iraqi Freedom (the first warzone deployment for most of the cohort). The primary objectives of Department of Veterans Affairs Cooperative Studies Program #566 (CSP#566) (20), the most recent phase of the NDHS, were to determine the current prevalence of PTSD and to prospectively examine changes in PTSD symptoms from a predeployment assessment through postdeployment and long-term follow-up assessments.

METHODS

Sampling and recruitment

Human subject approval was obtained from the Veterans' Affairs Central Institutional Review Board. Documentation of written consent was waived. All participants provided phone consent.

CSP#566 participants were recruited from among 1,120 surviving NDHS cohort members who 1) provided consent to be contacted for future research during previous NDHS assessments, 2) deployed for 30 days or more in support of Operation Iraqi Freedom at least once after their baseline NDHS assessment, 3) provided valid self-report, which was indicated by the absence of invalid response patterns (i.e., uniform endorsement of unidirectional extreme responses on psychometric measures in which the pathologic response varied in direction), and 4) had accessible Defense Manpower Data Center military records. Participants with invalid response patterns within the CSP#566 assessment were additionally excluded from the analytic sample.

Previous NDHS sampling procedures entailed cluster-based sampling and onsite (at military installations) recruitment of regular active duty and activated reservist battalion-level US Army units (10). Because of the occupational and geographic dispersion of NDHS cohort members, which spanned both nonmilitary careers and other unit assignments within the military, sampling for the present study was conducted at the individual level. To avoid confounding of the timing of CSP#566 assessments relative to prior NDHS assessments, we used stratified random sampling based on the initial battalion-level strata to create 7 recruitment waves chronologically spaced over 5 years (20).

Recruitment involved introductory mailings to potential participants, followed by screening calls conducted by a professional survey corporation. Study psychologists contacted eligible, interested individuals to obtain consent. Because many potential participants remained in the military and therefore faced the possibility of deploying during the study, contact re-attempts were made 1 year after initial failed attempts and again at the end of the study.

Procedures

Details of the CSP#566 assessment methods have been described elsewhere (20). In brief, primary data for the current phase of this prospective cohort study were derived from both phone interviews conducted by clinical psychologists and from written mail surveys. Deployment information and duty status (active duty, reservist, or military veteran) were verified using Defense Manpower Data Center records. Pre- and postdeployment data on PTSD symptom severity, which were previously collected in person via a written questionnaire at military installations, were available from archived NDHS databases.

The PTSD Checklist-Civilian Version (PCL-C) (21), which is used to measure PTSD symptom severity and yields a summary score of 17–85, was administered at long-term follow-up by mail survey. Consistent with other studies of Iraq deployment (2, 14), in our study, a positive PTSD screen required *Diagnostic and Statistical Manual, Fourth Edition, Text Revision* (22) symptom congruency and a PCL-C score of 50 or higher.

The Clinician Administered PTSD Scale (CAPS) (23), a structured clinical interview questionnaire used to assess PTSD diagnosis based on *Diagnostic and Statistical Manual, Fourth Edition, Text Revision* (22) criteria, was administered by phone at long-term follow-up, providing a convergent measure of cross-sectional PTSD study prevalence. Symptoms rated with frequency scores greater than or equal to 1 and intensity scores greater than or equal to 2 were coded as present (23). Interviewers first queried participants about symptoms in relation to warzone events; if warzone PTSD was not present, interviewers then queried about symptoms related to nonwarzone trauma events. In addition to diagnostic symptom congruency, a CAPS diagnosis of PTSD required an overall severity score 45 or higher (24) of a possible score of 0–136, duration of symptoms for 1 month or longer, and clinical significance, as determined by a score of 2 or higher on either the distress item or functional impairment item. Interviews judged by examiners to be of questionable validity were coded as missing.

Interviewers were doctoral-level psychologists who underwent extensive training, including didactic instruction, practice, and feedback on their taped practices by the CAPS study consultant (who was one of the developers of the CAPS). Interviewers did not administer the CAPS to study participants until the CAPS study consultant judged their practices to be of acceptable quality. Interviewers met weekly with the Chair's office psychologist to discuss questions that arose from the interviews and conducted ongoing reliability checks via peer review. The CAPS study consultant addressed any unresolved questions. CAPS diagnostic data demonstrated excellent interrater reliability ($\kappa = 0.84$) within a randomly selected subset of 10% of CSP#566 interviews that were distinct from those included in ongoing reliability assessments.

Statistical analyses

Data were analyzed using SAS, version 9.2 (SAS Institute, Inc., Cary, North Carolina) and Spotfire S+ v8.2 (TIBCO Software Inc, Palo Alto, California). All *P* values are 2-tailed. Missing values, which involved less than 4% of participants, were imputed casewise for specific items on the PCL-C, using the mean value of the individual's completed PCL-C items within the diagnostic symptom cluster (i.e., criteria B, C, D) relevant to the missing item and to the assessment episode. Among these participants, the maximum number of missing items was 5 (29% of 17 total items); no cases were missing more than 50% of the items relevant to each PTSD symptom cluster.

Baseline characteristics of participants in the analytic sample were compared with those of nonparticipants (excluded participants and nonresponders). Because the subset of the targeted participant pool included in the analytic sample did not differ significantly at baseline from the entire targeted participant pool (data not shown), analyses were not weighted. McNemar tests and paired *t* tests were used to compare PTSD diagnostic prevalence (i.e., the proportion of PTSD cases within the study sample) and PTSD symptom severity, respectively, across time. A priori calculations indicated that enrolling a minimum of 500 participants would provide sufficient precision, based on 95% confidence intervals for a range of prevalence values.

To examine change in PTSD symptoms over assessments with unequally spaced data points (i.e., predeployment, postdeployment, and long-term follow-up assessments), we evaluated an autoregressive linear mixed effects model for repeated PCL-C symptom scores that was adjusted for age, sex, ethnicity, educational level, marital status, duty status, occupational type, deployment history (before and after the index deployment), and time in months from the predeployment assessment to the subsequent assessments. We assumed random intercepts to account for random effects that arose from baseline variability in PCL-C across participants and random slopes to account for variability in slope across participants over time. The model thus provides a multivariable analysis of various demographic and military factors that can affect change in PTSD symptoms across assessments.

RESULTS

Participant characteristics

Figure 1 depicts the procedure for the derivation of the analytic sample ($n = 598$). The 2 most common reasons for noninclusion were being unreachable for CSP#566 screening or consent (21.4%) and declining to give consent or not completing procedures subsequent to consent (23.5%). Participants in the analytic sample (53.4% of the pool of 1,120 potential participants) did not differ from nonparticipants with regard predeployment characteristics except that participants were less likely to self-identify as ethnic minorities and more likely to have completed post–high school education (Appendix Table 1).

At the time of NDHS enrollment (Appendix Table 1), the analytic sample resembled the deployed Army population, except that women (6.9%), ethnic minorities (32.6%), and officers (3.5%) were underrepresented. Sample characteristics at long-term follow-up—with changes over time in some factors (e.g., marital status, officer status)—are presented in Table 1.

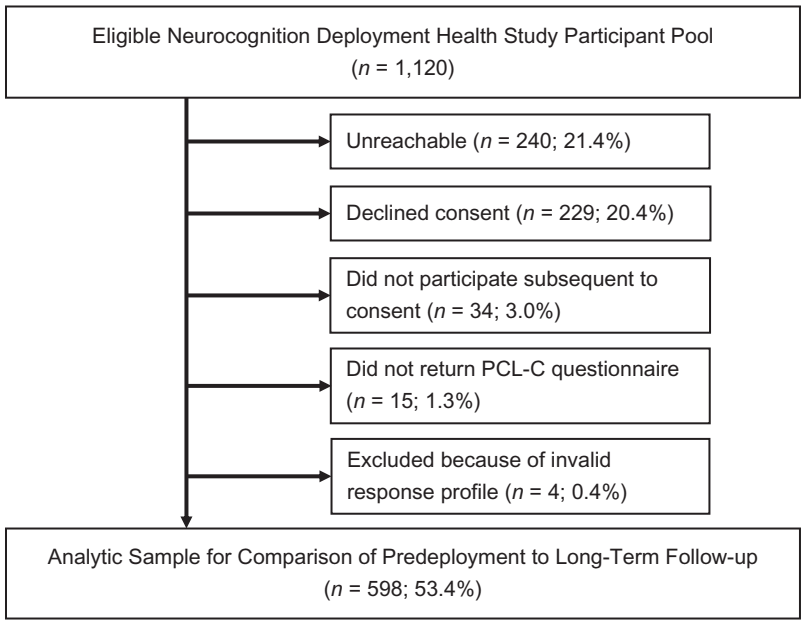

Figure 1. Derivation of the analytic sample for Cooperative Studies Program #566, 2003–2014. Data were collected longitudinally (predeployment assessment through long-term follow-up). PCL-C, PTSD Checklist–Civilian Version.

Table 1. Characteristics of Study Participants at Long-Term Follow-up ($n = 598$), Cooperative Studies Program #566, 2010–2014

Characteristic	Mean (SD)	No.	%
Age, years	35.3 (6.1)		
Sex			
Men		557	93.1
Women		41	6.9
Race/ethnicity[a]			
Caucasian		414	69.3
African American		75	12.6
Hispanic American		69	11.6
Other			
Asian American		22	3.7
Multiracial		11	1.8
Native American		1	0.2
Unknown		5	0.8
Educational level			
High school diploma or equivalence degree		132	22.1
Some college		335	56.0
College degree or more		131	21.9
Married		413	69.1
Army service, years	11.2 (5.9)		
Duty status			
Regular active duty		174	29.1
Reservist		105	17.6
Military veteran		319	53.3
Most recent rank (pay grade)			
Junior enlisted (E1–E4)		136	22.7
Noncommissioned officers (E5–E9)		422	70.6
Officers (commissioned or warrant)		40	6.7
Most recent military occupation type[a]			
Combat arms		305	51.1
Combat support		91	15.2
Service support		201	33.7
Operational deployment before index deployment		80	13.4
No. of deployments subsequent to index deployment			
0		263	44.0
1		191	31.9
2		117	19.6
3		26	4.3
4		1	0.2
Assessment interval, months[b]	112.9 (11.1)		

Abbreviation: SD, standard deviation.
[a] $n = 597$.
[b] Time from predeployment assessment to long-term follow-up assessment.

PTSD prevalence

As shown in Table 2 and based on previously obtained assessments derived from the PCL-C for the present study population ($n = 598$), PTSD prevalence increased from the predeployment assessment (7.4%; 95% confidence interval (CI): 5.5, 9.8) to the short-term postdeployment assessment (10.5%, 95% CI: 7.8, 13.7). On the basis of long-term follow-up assessments conducted a median of 7.9 years (interquartile range, 7.2–8.5 years) after the index Iraq deployment, the long-term PTSD prevalence for these participants was 24.7% (95% CI: 21.5, 28.4) as determined by PCL-C and 25.7% (95% CI: 22.4, 29.4) as determined by CAPS. When trauma context was considered, CAPS estimates were 25.2% (95% CI: 21.9, 28.9) for deployment-related PTSD and 0.5% for non–deployment-related PTSD (95% CI: 0.2, 1.5). PCL-C and CAPS symptom severity summary scores were highly correlated (Pearson $r = 0.82$, $P < 0.0001$), and PCL-C and CAPS diagnostic concordance was substantial ($\kappa = 0.63$).

Table 3 summarizes the diagnostic course at the individual level for participants who completed all 3 assessments ($n = 399$). Overall, 70.2% of participants never met case criteria for PTSD at any point, whereas 29.8% screened positive for PTSD on more than 1 assessment, including 22.8% who screened positive at long-term follow-up. Individual-level data also revealed that the increase in PTSD prevalence from postdeployment to long-term follow-up was attributable to both new-onset PTSD at long-term follow-up among a large subset of participants (14.5%) and to sustained or recurrent PTSD in a subset of participants who had PTSD at a previous assessment (8.3%).

Change in symptom severity over time

In adjusted analyses ($n = 598$), the linear mixed effects model (Table 4) showed that higher PTSD symptom severity was associated with single marital status, military veteran status at long-term follow-up (versus remaining in the military as regular active duty), non-African American/non-Hispanic ethnic minority status (versus white), and greater time elapsed between the predeployment assessment and subsequent assessments. Although older age and having fewer operational deployments were associated with more severe PTSD symptoms in unadjusted analyses, neither association was significant when we accounted for potentially confounding variables (e.g., veteran status).

DISCUSSION

In the present prospective study of 598 current and former Army soldiers, we found that approximately one-quarter (24.7%) of the sample met the case definition for PTSD more than 5 years after an index Iraq War deployment (Table 2). Longer-term follow-up, which was conducted a median of 7.9 years after an index deployment, revealed a 14.2% increase in PTSD from a postdeployment assessment (10.5%) and a notable 17.3% increase in PTSD from the predeployment assessment (from 7.4%). Estimates from

Table 2. Posttraumatic Stress Disorder Summary Scores and Prevalence at Predeployment, Postdeployment, and Long-Term Follow-up, Cooperative Studies Program #566, 2003–2014

Time Point of Assessment	No.	PCL-C[a]				CAPS						
		Summary Score, mean (SD)	No. of PTSD Cases	%	95% CI	Summary Score, mean (SD)	No. of Warzone Trauma PTSD Cases	%	95% CI	No. of Civilian Trauma PTSD Cases	%	95% CI
Predeployment	595	28.9 (12.2)	44	7.4	5.5, 9.8							
Postdeployment	401	32.2 (12.6)	42	10.5	7.8, 13.7							
Long-term follow-up	598	37.9 (17.2)	148	24.7	21.5, 28.4	29.8 (28.5)	149	24.9	21.9, 28.9	3	0.5	0.2, 1.5

Abbreviations: CAPS, Clinician Administered PTSD Scale; CI, confidence interval; PCL-C, PTSD Checklist–Civilian Version; PTSD, posttraumatic stress disorder.

[a] $P < 0.001$ for increase in prevalence of PTSD across the 3 assessments.

psychometric self-report measures were comparable to those obtained from clinical interviews. Overall, the findings indicate that reported PTSD symptoms increased in many soldiers soon after deployment and continue to increase years after deployment. In fact, the cumulative proportion of soldiers meeting the case definition for PTSD at any study assessment (29.8%) only modestly surpassed the current prevalence (22.8%), highlighting the onset of new cases between prior assessments and long-term follow-up, which was offset only partially by remission of PTSD observed at prior assessments.

Previous research in US military populations has found that lifetime PTSD prevalence may be almost double that of cross-sectional prevalence estimates (25–27), which suggests that warzone-related PTSD may dissipate over time in a large number of warzone veterans. Given that our cumulative PTSD prevalence estimate was only modestly larger than the current estimate at long-term follow-up, our findings may reflect that we did not identify PTSD cases that occurred outside of our specific assessment episodes. Another possible explanation is that the NDHS cohort is young in age relative to samples in prior studies of military-related PTSD in which there were more participants with distal warzone deployments (8, 9, 25–27). Because of this, our cohort as a whole has had less time for PTSD to remit.

Our findings, however, are consistent with those of a recently published longitudinal study of Dutch military personnel in which investigators found an initial increase in PTSD symptoms 6 months after deployment to Afghanistan as part of a multinational force, as well as a larger increase in symptoms 5 years after deployment (18). Our findings, combined with those from the Dutch sample, highlight the importance of long-term follow-up and monitoring of PTSD symptoms after deployment, even among warzone veterans for whom symptoms apparently subsided after an initial increase. In our sample, symptom increases over time were more likely among military veterans relative to regular active duty service members or reservists (Table 4), even after adjustment for military and demographic factors. The increase in new-onset cases at our long-term follow-up may therefore be attributable in part to the transition of more than half (53%) of the sample to military veteran status by the follow-up assessment.

Several possible mechanisms can explain the association between military veteran status and more severe PTSD symptoms. First, soldiers who re-enlist or remain in military service may demonstrate relatively enhanced psychological health (28). We did not find significant associations between PTSD symptoms and military attrition a year after return from deployment in an analysis (29) involving a subgroup of this cohort, although 1 year may have been insufficient to detect separations related to PTSD. It is also possible that service members underreported and/or veterans overreported symptoms. Contextual factors potentially related to underreporting (30) or overreporting (31) (e.g., stigma and secondary gain, respectively) should, however, have been reduced by the confidentiality conferred by the research context (32). Mission demands that occur during some phases of the deployment cycle (e.g., while deployed or preparing for deployment) may also shift the focus away from emotional concerns and toward task objectives for service members. Conversely, military veterans may lose emotional support from fellow service members while simultaneously encountering new

Table 3. Longitudinal Patterns of Posttraumatic Stress Disorder Among Participants in Cooperative Studies Program #566 Who Completed Predeployment (2003–2005), Postdeployment (2004–2006), and Long-Term Follow-up (2010–2014) Assessments ($n = 399$)[a]

Diagnostic Course	No.	%
PTSD absent at long-term follow-up	308	77.2
Never developed (absent at all time points)	280	70.2
PTSD resolved (present at pre- and/or postdeployment)	28	7.0
PTSD present at long-term-follow-up	91	22.8
New-onset (absent at pre- and postdeployment)	58	14.5
Persistent/recurrent (also present at pre- and/or postdeployment)	33	8.3

Abbreviation: PTSD, posttraumatic stress disorder.

[a] Diagnoses derived from the PTSD Checklist–Civilian Version.

Table 4. Associations of Participant Demographic Factors, Military Status, and Deployment History With Longitudinal Course of PTSD Checklist–Civilian Version Summary Scores (n = 598), Cooperative Studies Program #566, 2003–2014

Variable[a]	Unadjusted			Adjusted[b]		
	Estimate	95% CI	*P* Value	Estimate	95% CI	*P* Value
Age, years	0.35	0.24, 0.45	<0.0001	−0.05	−0.21, 0.12	0.58
Sex						
Male		Referent			Referent	
Female	3.04	−0.38, 6.47	0.08	3.38	−0.23, 6.98	0.07
Race/ethnicity						
White		Referent			Referent	
African American	1.48	−1.14, 4.09	0.27	1.20	−1.54, 3.96	0.39
Hispanic American	−0.97	−3.66, 1.71	0.48	−0.95	−3.64, 1.75	0.49
Other	4.45	0.96, 7.95	0.01	3.83	0.40, 7.26	0.03
Educational level at long-term follow-up						
High school diploma or equivalence degree		Referent			Referent	
Some college	0.47	−1.66, 2.60	0.19	0.65	−1.45, 2.75	0.55
College degree or more	−1.72	−4.28, 0.85	0.66	−2.48	−5.06, 0.10	0.06
Marital status						
Not married		Referent			Referent	
Married	−0.45	−1.87, −0.98	0.54	−1.71	−3.14, −0.28	0.02
Duty status, predeployment						
Regular active duty		Referent			Referent	
Activated reservist	−1.19	−3.61, 1.24	0.34	−0.88	−3.72, 1.96	0.54
Duty status at long-term follow-up						
Regular active duty		Referent			Referent	
Reservist	1.74	−0.78, 4.26	0.18	2.31	−0.50, 5.11	0.11
Military veteran	4.44	2.52, 6.36	<0.0001	4.39	2.22, 6.57	<0.0001
Military occupation type						
Service support		Referent			Referent	
Combat arms	0.94	−0.94, 2.83	0.32	1.27	−0.67, 3.22	0.20
Combat support	−1.90	−4.54, 0.75	0.16	−1.57	−4.21, 1.07	0.24
Operational deployment before index deployment						
No		Referent			Referent	
Yes	0.29	−2.11, 2.69	0.81	1.22	−1.32, 3.77	0.34
Operational deployments subsequent to index deployment						
0					Referent	
≥1	−2.01	−3.71, −0.30	0.02	−0.50	−2.41, 1.41	0.61
Time from predeployment assessment, months	0.10	0.06, 0.09	<0.0001	0.08	0.06, 0.10	<0.0001

Abbreviations: CI, confidence interval; PTSD, posttraumatic stress disorder.
[a] Based on the time-varying factor in the model unless otherwise indicated.
[b] Adjusted for age, sex, ethnicity, educational level, marital status, duty status, occupational type, deployment history (before and after the index deployment), and time in months from predeployment assessment.

stressors (e.g., employment and interpersonal challenges) as they reintegrate into civilian life (13).

Other military factors (e.g., occupational role, rank) showed little association with outcomes. Results from some (11) but not all (33) studies have suggested that activation for deployment from reservist status may lead to poorer mental health outcomes, but our data did not reveal significant differences in the outcomes of regular active duty soldiers versus activated reservists. Although prior research has suggested that multiple deployments confer additional risk of poor mental health outcomes (34, 35), this finding has not been uniform (15, 33). We found that deploying more than once—whether before or after an index deployment—was not significantly associated with PTSD symptom severity after adjustment for other

variables, including duty status. In our unadjusted analyses, veteran status was associated with both fewer deployments and more severe PTSD symptoms at long-term follow-up relative to active duty status. In analyses adjusted for veteran status, the confounding of veteran status with fewer deployments likely contributed to the lack of association observed between number of deployments and PTSD.

Being married was associated with less severe PTSD symptoms. Although this finding highlights the possible role of social resources in attenuating psychological symptoms after trauma exposure, it is also possible that PTSD symptoms negatively affected marital relationships, leading to changes in marital status. Previous research (36) has suggested a downward spiral in which insufficient resources create risk of poorer outcomes after trauma, which in turn erode social and other resources. Our findings also suggest that ethnic minority status other than African American or Hispanic (relative to non-Hispanic whites) may confer additional risk of more severe symptoms. Relationships between demographic characteristics such as ethnicity and PTSD, however, are complex and thought to be determined by multiple factors, such as cumulative trauma exposure, environmental resources, and premilitary risk factors. The association between ethnic minority status and PTSD in our sample is particularly difficult to interpret because some participants selected an "other" category of ethnicity.

This study provides unique prospective data addressing longer-term PTSD outcomes after warzone participation, including lifetime and current prevalence estimates and patterns of change. In the context of many methodological strengths, the results should also be interpreted while considering study limitations. NDHS sampling was designed to represent varied US Army occupational specialties and functions, including both combat and noncombat functions, but was not population based. Officers and women are underrepresented relative to the US Army population deployed in Operation Enduring Freedom/Operation Iraqi Freedom, and we examined only Army soldiers to the exclusion of other service branches. Because of the rapid pace of deployment subsequent to the first 2 assessments of NDHS cohort members, a nondeployed comparison sample without confounding variables (e.g., attrition from military service before deployment due to health concerns) was no longer available at long-term follow-up. Thus, we cannot definitively exclude the possibility that the increase in PTSD over time in our cohort was attributable to the passage of time or other reasons unrelated to Iraq deployment. We have previously demonstrated in the NDHS cohort, however, that PTSD significantly increased immediately after warzone participation in persons who had deployed compared with those who had not (13). Our findings in this regard are also consistent with those from other studies of veterans of the Iraq and Afghanistan Wars, in which investigators have reported that PTSD is more prevalent in deployed service members than in nondeployed service members (7). Findings from a 25-year follow-up study of Vietnam War–era veterans likewise suggested that long-term PTSD prevalence is greater in combat theater veterans than in non–combat theater veterans (8).

Our longitudinal retention reflected some loss to follow-up, although such loss is not unexpected, given the transition from onsite enrollment at military installations (94% participation rate) to participation via mail survey and phone at long-term follow-up. In addition, our participation rate at long-term follow-up compares favorably with current trends in survey research on nationally dispersed military populations (14). More importantly, respondents did not differ significantly from the overall pool of potential eligible participants, which suggests minimal response bias. Longitudinal assessment of PTSD was measured via a self-report instrument (i.e., PCL-C), but the PCL-C, which was designed to measure symptom severity (one of our primary outcomes), has strong psychometric properties, showed diagnostic concordance with a gold-standard interview (i.e., CAPS), and showed strong correlations with CAPS symptom severity scores when analyzed as a severity measure. Finally, although our findings identify an important public health problem (i.e., increased PTSD over time), our data do not address mechanisms of this increase.

In summary, findings of the present longitudinal study highlight PTSD as a persistent, long-term consequence of 21st century warzone participation. Our results, which indicated an increase in the prevalence of PTSD cases between a postdeployment assessment and long-term follow-up, suggests that stress reactions among many warzone participants cannot be ignored because they may increase, rather than dissipate, over time. Access to appropriate treatment and increased provider awareness of the potential for PTSD symptom increase long after return from the warzone is imperative to help address this adverse long-term outcome of war.

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Author affiliations: National Center for PTSD, VA Boston Healthcare System, Boston, Massachusetts (Jennifer J. Vasterling, Brian P. Marx); Psychology Service, VA Boston Healthcare System, Boston, Massachusetts (Jennifer J. Vasterling); Department of Psychiatry, Boston University School of Medicine, Boston, Massachusetts (Jennifer J. Vasterling, Brian P. Marx); Clinical Epidemiology Research Center, VA Cooperative Studies Program, West Haven, Connecticut (Mihaela Aslan, John Ko, John Concato); Department of Medicine, School of Medicine, Yale University, New Haven, Connecticut (Mihaela Aslan, John Concato); US Army Research Institute of Environmental Medicine, Natick, Massachusetts (Susan P. Proctor); Research Service, VA Boston Healthcare System, Boston, Massachusetts (Susan P. Proctor); Department of Environmental Health, School of Public Health, Boston University, Boston, Massachusetts (Susan P. Proctor); VA Puget Sound Healthcare System, Seattle, Washington (Matthew Jakupcak); Department of Psychiatry and Behavioral Sciences, School of Medicine, University of Washington, Seattle, Washington (Matthew Jakupcak); National Center for PTSD, White River Junction, Vermont (Paula P. Schnurr); Department of Psychiatry, Geisel School of Medicine, Dartmouth College, Hanover, New Hampshire (Paula P. Schnurr); VA Office of Research and Development, Washington, DC (Theresa Gleason); and VA

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(Appendix follows)

Appendix Table 1. Comparison of Cooperative Studies Program #566 Participants (2010–2014) With Nonparticipants in the Eligible Neurocognition Deployment Health Study Participant Pool on Predeployment (2003–2005)[a]

Variable	Participants (n = 598)			Nonparticipants (n = 522)			P Value[b]
	Mean (SD)	No.	%	Mean (SD)	No.	%	
Age, years	26.0 (6.0)			25.5 (5.7)			0.19
Sex							0.69
Male		557	93.1		483	92.5	
Female		41	6.9		39	7.5	
Ethnicity							0.0014
Caucasian		414	69.2		315	60.5	
African American		75	12.5		90	17.3	
Hispanic American		69	11.6		55	10.5	
Other		40	6.7		61	11.7	
Educational level							0.05
High school or high school equivalence		386	64.6		371	71.0	
Part college		201	33.6		146	28.0	
College or greater		11	1.8		1.8	1.0	
Army service, years	4.9 (4.9)			4.5 (4.6)			0.29
Duty status							0.85
Regular active duty		512	85.6		449	86.0	
Activated reservist		86	14.4		73	14.0	
Rank (using pay grade)							0.12
Junior enlisted (E1–E4)		411	68.8		382	73.2	
Noncommissioned officers (E5–E9)		165	27.7		125	24.0	
Officers (commissioned or warrant)		21	3.5		15	2.8	
Previous operational deployment							0.71
Any		85	14.3		70	13.4	
OEF/OIF		15	97.5		13	2.5	
Married		289	48.5		242	46.5	0.50
Military occupation type							0.26
Combat arms		302	52.2		238	47.7	
Combat support		82	14.2		85	17.0	
Service support		194	33.6		176	35.3	
PTSD screening cases		44	7.4		53	10.2	0.10
PCL-C summary score	28.8 (12.2)			29.5 (12.7)			0.62

Abbreviations: OEF, Operations Enduring Freedom; OIF, Operation Iraqi Freedom; PCL-C, PTSD Checklist–Civilian Version; PTSD, post-traumatic stress disorder; SD, standard deviation.

[a] Sample sizes varied slightly across variables because of missing data.

[b] P values correspond to the Wilcoxon rank-sum test or the χ^2 test, as appropriate.