A National Cohort Study of the Association Between the Polytrauma Clinical Triad and Suicide-Related Behavior Among US Veterans Who Served in Iraq and Afghanistan

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Objectives. We examined the association of posttraumatic stress disorder (PTSD), traumatic brain injury, and chronic pain—the polytrauma clinical triad (PCT)—independently and with other conditions, with suicide-related behavior (SRB) risk among Operation Enduring Freedom (OEF; Afghanistan) and Operation Iraqi Freedom (OIF) veterans.

Methods. We used Department of Veterans Affairs (VA) administrative data to identify OEF and OIF veterans receiving VA care in fiscal years 2009–2011; we used *International Classification of Diseases, Ninth Revision, Clinical Modification* codes to characterize 211 652 cohort members. Descriptive statistics were followed by multinomial logistic regression analyses predicting SRB.

Results. Co-occurrence of PCT conditions was associated with significant increase in suicide ideation risk (odds ratio [OR] = 1.9; 95% confidence interval [CI] = 1.5, 2.4) or attempt and ideation (OR = 2.6; 95% CI = 1.5, 4.6), but did not exceed increased risk with PTSD alone (ideation: OR = 2.3; 95% CI = 2.0, 2.6; attempt: OR = 2.0; 95% CI = 1.4, 2.9; ideation and attempt: OR = 1.8; 95% CI = 1.2, 2.8). Ideation risk was significantly elevated when PTSD was comorbid with depression (OR = 4.2; 95% CI = 3.6, 4.8) or substance abuse (OR = 4.7; 95% CI = 3.9, 5.6).

Conclusions. Although PCT was a moderate SRB predictor, interactions among PCT conditions, particularly PTSD, and depression or substance abuse had larger risk increases. (*Am J Public Health.* 2015;105:380–387. doi:10.2105/AJPH.2014.301957)

The mental health of service members and veterans has been an issue of growing concern since the beginning of the US conflicts in Iraq and Afghanistan,[1–5] with marked increases in the incidence of psychological disorders among veterans accompanied by a corresponding increase in suicides and suicide-related behavior (SRB).[6,7] Although suicide has historically been lower among service members than members of the general population (the so-called healthy warrior effect),[8] suicide rates among both service members and younger veterans have been on the increase during Operation Enduring Freedom (OEF; Afghanistan) and Operation Iraqi Freedom (OIF).[9,10] Although Kang and Bullman[8] found in 2008 that suicide risk was not significantly higher among OEF and OIF veterans compared with the US population as a whole, they did identify an elevated suicide rate among former active duty service members and those diagnosed with mental disorders, suggesting the presence of vulnerable subgroups within this population. It was recently estimated that some 22 veterans died by suicide every day in 2010[11] and both the Department of Defense and the Department of Veterans Affairs (VA) have identified suicide prevention as a key priority in ongoing initiatives.[12]

Among the risk factors for suicide among veterans, the most predictive appear to be previous history of suicide attempt[13] or previous diagnosis of psychiatric disorders including posttraumatic stress disorder (PTSD), depression, substance abuse, bipolar disorder, and schizophrenia.[14–17] Approximately one fifth of OEF or OIF veterans seeking care within VA have been diagnosed with PTSD.[18] Although the increase in suicide risk associated with PTSD may be smaller than for other psychiatric diagnoses,[16,19] PTSD appears to predict increased suicide ideation in both veterans[6,20] and nonveterans.[21] Jakupcak et al.[19] have found that veterans with even subthreshold PTSD are at increased risk for suicide ideation.

Like PTSD, traumatic brain injury (TBI) has also been associated with increased suicide ideation and attempts as well as completed suicides,[6,22,23] and may be associated with damage to the frontal lobe that can increase impulsivity and suicidality.[24] Incidence of TBI has gone up sharply over the past decade,[25] and high comorbidity between TBI and PTSD has often made it difficult to distinguish their unique effects on suicide risk. At least 1 study found that TBI of any severity is associated with an increased rate of completed suicides among veterans that is not accounted for by psychiatric comorbidity[22]; others have reported increased suicide risk among military personnel with TBI when assessed within a few days of their injuries.[26] More recent evidence indicates that military personnel who have experienced multiple TBIs are at incrementally increased risk for suicidality even when the study controlled for PTSD and depression severity.[23] By contrast, studies by Barnes et al.[6] and Skopp et al.[27] have reported that mild TBI does not significantly increase risk of suicide ideation or intent among active duty service members or veterans with PTSD, suggesting that there is room for additional clarification of TBI and its role in affecting SRBs.

Alongside these signature injuries of the wars in Iraq and Afghanistan, studies also identify high rates of chronic pain among OEF and OIF veterans.[28–31] The co-occurrence of PTSD, TBI, and chronic pain, affecting as many as 42% of those receiving polytrauma care, has

come to be known as the polytrauma clinical triad (PCT).[30] Like PTSD and TBI, chronic pain has been associated with increased suicidality,[16,32,33] but no studies to date have examined the unique or combined contributions of the PCT to suicide risk among OEF or OIF veterans.

In this article we respond to previous calls in the literature for research to determine if PTSD, TBI, and pain are more strongly associated with suicide risk when occurring in certain combinations,[33,34] as well as whether PCT conditions are associated with elevated risk of suicide compared with other disorders already known to be associated with suicide and identified among a significant number of OEF and OIF veterans, including chronic disease, depression, anxiety, bipolar disorder, and substance use and sleep disorders.[34,35–39] In targeting these conditions and examining the potential impact of interactions among them, our intention was to query whether particular subgroups may be at elevated risk for SRB and thus to support improved clinical and preventive efforts to identify those who may be missed under current guidelines.

METHODS

In this retrospective cohort study, we used the Department of Veterans Affairs OEF/OIF roster file to identify VA patients returned from OEF or OIF. Those who also received VA inpatient or outpatient care at least once per year during a 3-year period (fiscal year [FY] 2009–2011: October 1, 2008, to September 30, 2011) with valid race/ethnicity data were eligible for inclusion. Baseline characteristics and comorbidities were identified in FY 2009.

Measures

Suicide-related behavior. We used *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes[40] from national VA inpatient and outpatient data to identify the outcomes of interest: suicide ideation (V62.84) and attempt (E950–E958: suicide and self-inflicted injury) during each of the 3 years of the study. We identified baseline suicide ideation and suicide attempt in FY 2009, and created a categorical variable of SRB during FY 2010–2011. Cohort members were grouped into 4 mutually exclusive categories: (1) neither ideation nor attempt, (2) ideation only, (3) attempt only, and (4) both ideation and attempt.

Demographic characteristics. We noted that there were relatively few older veterans in this cohort and also that previous analyses of VA data had identified increased risk for suicide among male veterans aged 25 years and younger.[17] Therefore, we clustered age in FY 2011 as follows: 18 to 25 years, 26 to 40 years, 41 to 55 years, and 56 years and older. We obtained age, gender, and race/ethnicity from the OEF/OIF roster and supplemented with VA data when missing. We classified race/ethnicity as African American, Hispanic, other (Native American, Pacific Islander, Asian, other), and non-Hispanic White (3% missing data). We conducted sensitivity analyses and determined that the effects of interest were independent of the missing race indicator and of inclusion or exclusion of cases without valid race/ethnicity. We thus excluded observations with missing race/ethnicity data. We obtained marital status (married vs other) from VA data, as well as military measures including the component of service (active duty vs Guard or Reserve) and rank (enlisted vs officer or warrant officer).

Clinical characteristics. We identified baseline clinical characteristics in FY 2009 with *ICD-9-CM* codes from validated algorithms that, with the exception of TBI, required 2 episodes of care with a diagnosis for each specific condition at least 7 days apart (Table A, available as a supplement to the online version of this article at http://www.ajph.org).[41–43] We first identified conditions included in the PCT: TBI, PTSD, and pain (which included headache and back, neck, and other noncancer pain). As VA administrative data do not include information on the number of TBIs experienced, TBI was constructed as a dichotomous yes-or-no category, as were all other conditions. We then identified previous SRB, insomnia, and other mental health diagnoses (depression, anxiety, bipolar disorder, schizophrenia, substance use disorder) as well as psychiatric hospitalization in FY 2009. Finally, we identified conditions in the Charlson Comorbidity Index with the Deyo algorithm.[43]

Analysis

We first examined descriptive statistics by suicidality category. Bivariate statistics tested the associations between clinical–demographic characteristics and outcomes with the χ^2 and student t test as appropriate.

We assessed multicollinearity with the variance inflation factor. The tolerance consistent with Allison yielded no evidence of multicollinearity when variance inflation factor values are not greater than 5 and tolerance is not less than 0.4.[44] Thus, we estimated a multinomial logistic regression model of suicidality, with neither ideation nor attempt as the reference category, with the logistic procedure in SAS version 9.2 (SAS Institute Inc, Cary, NC). With our large sample size, the study was overpowered, meaning that statistical significance was easily achieved. Because of this, we focused on moderate (odds ratio [OR] >1.5 or <0.67) to large effect sizes (OR >2.0 or <0.5).[45]

To test the hypothesis that unique combinations of postdeployment conditions are associated with suicide risk, we included interactions between PCT conditions and other SRB risk factors. To identify the latter, we examined interactions including conditions that were associated with large effect sizes (as defined previously) across all 3 SRB categories (ideation only, attempt only, and both ideation and attempt) when entered singly into the multivariate model. Two conditions, depression and substance abuse, met these criteria. We therefore examined interactions among the 3 PCT conditions, depression, and substance abuse.

RESULTS

Of 211 652 OEF or OIF veterans in this cohort, 205 899 (97.3%) had neither suicide ideation nor a suicide attempt documented in FY 2010–2011. Among those veterans with SRB (n = 5653; 2.6% of cohort), 4310 (2.0%) had ideation only, 753 (0.4%) had attempt only, and 690 (0.3%) had both ideation and attempt. Table 1 shows demographic and clinical correlates of SRB in this cohort.

In the multivariable model (Table 2), veterans in the 18- to 25-year-old group were significantly more likely and those in the groups aged 41 to 55 years and 56 years and older were less likely to engage in SRB across all categories compared with the referent category (group aged 26–40 years). African American veterans were less likely than non-Hispanic White veterans to have any SRB

TABLE 1—Demographic and Clinical Correlates of Suicide-Related Behavior Among Operation Enduring Freedom and Operation Iraqi Freedom Veterans in Department of Veterans Affairs Care: United States, Fiscal Year 2010–2011

Variable Name	No Attempt or Ideation (n = 205 899), No. (%) or Mean ±SD	Ideation Only (n = 4310), No. (%) or Mean ±SD	Attempt Only (n = 753), No. (%) or Mean ±SD	Ideation and Attempt (n = 690), No. (%) or Mean ±SD	Total (n = 211 652), No. (%) or Mean ±SD
Age, y					
18–25	11 372 (5.5)	354 (8.2)	70 (9.3)	74 (10.7)	11 870 (5.6)
26–40	123 587 (58.4)	3053 (70.8)	558 (74.1)	493 (71.5)	127 691 (60.3)
41–55	59 955 (29.1)	835 (19.4)	113 (15.0)	115 (16.7)	61 018 (28.8)
≥ 56	10 985 (5.3)	68 (1.6)	12 (1.6)	8 (1.2)	11 073 (5.2)
Race/ethnicity					
African American	37 088 (18.6)	636 (15.0)	96 (12.9)	91 (13.3)	37 911 (18.5)
Hispanic	24 923 (12.5)	622 (12.3)	84 (11.3)	63 (9.2)	25 592 (12.5)
Other	8245 (4.1)	138 (3.3)	43 (5.8)	31 (4.5)	8457 (4.1)
White	129 019 (64.7)	2945 (69.5)	519 (70.0)	502 (73.1)	132 988 (64.9)
Marital status					
Married	95 962 (46.6)	1795 (41.7)	290 (38.5)	283 (41.0)	98 330 (46.5)
Single	109 937 (53.4)	2515 (58.4)	463 (61.5)	407 (59.0)	113 322 (53.5)
Gender					
Male	177 823 (86.4)	3880 (90.0)	643 (85.4)	592 (85.8)	182 938 (86.4)
Female	28 076 (13.6)	430 (10.0)	110 (14.6)	98 (14.2)	28 714 (13.6)
Service component					
Active duty	117 618 (57.1)	2544 (59.0)	511 (67.9)	450 (65.2)	121 123 (57.2)
Guard or Reserves	88 281 (42.9)	1766 (41.0)	242 (32.1)	240 (34.8)	90 527 (42.8)
Rank					
Enlisted	192 709 (93.6)	4241 (98.4)	742 (98.5)	679 (98.4)	198 371 (93.7)
Officer or warrant officer	13 190 (6.4)	69 (1.6)	11 (1.5)	11 (1.6)	13 281 (6.3)
Charlson Comorbidity Index score	0.12 ±0.47	0.12 ±0.46	0.12 ±0.46	0.18 ±0.65	0.12 ±0.48
Headache	25 841 (12.6)	817 (19.0)	147 (19.5)	148 (21.5)	26 953 (12.7)
Insomnia	25 808 (12.8)	738 (18.2)	118 (16.7)	110 (17.6)	26 774 (12.9)
Pain	78 017 (37.9)	1914 (44.4)	328 (43.6)	324 (47.0)	80 583 (38.1)
Bipolar disorder	6465 (3.1)	577 (13.4)	113 (15.0)	135 (19.6)	7290 (3.44)
Anxiety disorder	22 442 (10.9)	1013 (23.5)	182 (24.2)	216 (31.3)	23 853 (11.3)
Substance abuse disorder	19 916 (9.7)	1599 (37.1)	296 (39.3)	327 (47.4)	22 138 (10.5)
Schizophrenia	1002 (0.5)	132 (3.1)	16 (2.1)	22 (3.2)	1172 (0.6)
Psychiatric hospitalization, FY 2009	4002 (1.9)	851 (19.7)	158 (21.0)	195 (28.3)	5206 (2.5)
Suicide-related behavior, FY 2009	1925 (0.9)	631 (14.6)	172 (22.8)	174 (25.2)	2902 (1.4)

Note. FY = fiscal year. All variables presented were significant in χ^2 analysis at the $P < .001$ level, with the exception of the Charlson score, for which *t* test was more appropriate because of low numbers in some cells. Differences by suicide-related behavior category in mean Charlson score were also significant at the $P < .001$ level.

during the study period. Hispanic veterans were less likely than non-Hispanic Whites to both attempt and ideate, although there were no differences in odds of ideation or attempt alone. Veterans of other race/ethnicity were at increased risk of attempting suicide but not of ideating or both attempting and ideating. Female veterans were more likely than male veterans to attempt suicide or to both attempt and ideate, but were less likely to report ideation alone. Guard or Reserve status was associated with increased odds of reporting ideation and decreased odds of suicide attempt compared with active-duty status, but there was no significant relationship with service component among those who had both attempt and ideation. Higher rank was associated with significantly reduced risk of all SRBs.

The multivariable model revealed no significant increase in odds of SRB among those with insomnia. Veterans with a diagnosis of bipolar disorder, anxiety, substance abuse, schizophrenia, depression, or PTSD were significantly more likely to be diagnosed with all 3 categories of SRB. Psychiatric hospitalization in FY 2009 was also significantly associated with ideation and combined attempt and ideation in FY 2010–2011. Previous SRB was a significant predictor of subsequent suicidality across all categories. Having a TBI was not independently associated with any SRB. Pain was associated with significantly reduced

TABLE 2—Multivariable Model of Demographic and Clinical Characteristics Associated with Suicide-Related Behavior Among Operation Enduring Freedom and Operation Iraqi Freedom Veterans in Department of Veterans Affairs Care: United States, Fiscal Year 2010–2011

Variable	Ideation Only, OR (95% CI)	Attempt Only, OR (95% CI)	Ideation and Attempt, OR (95% CI)
Age, y			
18–25	1.4** (1.2, 1.6)	1.5** (1.1, 1.9)	1.8** (1.4, 2.4)
26–40 (Ref)	1.0	1.0	1.0
41–55	0.7** (0.6, 0.8)	0.6** (0.5, 0.8)	0.7** (0.5, 0.9)
≥ 56	0.4** (0.3, 0.5)	0.5* (0.3, 0.8)	0.3** (0.2, 0.7)
Race/ethnicity			
African American	0.9* (0.8, 1.0)	0.8* (0.6, 1.0)	0.8* (0.6, 1.0)
Hispanic	1.0 (0.9, 1.1)	0.9 (0.7, 1.2)	0.7* (0.6, 1.0)
Other	0.9 (0.7, 1.0)	1.5* (1.1, 2.0)	1.1 (0.8, 1.6)
White (Ref)	1.0	1.0	1.0
Married vs single	1.0 (0.9, 1.0)	1.0 (0.8, 1.2)	0.9 (0.7, 1.1)
Female vs male	0.8** (0.7, 0.9)	1.3* (1.0, 1.6)	1.3 (1.0, 1.6)
Guard or Reserve vs active duty	1.2** (1.1, 1.2)	0.8** (0.7, 0.9)	0.9 (0.7, 1.0)
Officer or warrant officer vs enlisted	0.5** (0.4, 0.6)	0.5** (0.3, 0.8)	0.5* (0.3, 0.9)
Charlson Comorbidity Index score	1.0 (0.9, 1.1)	1.1 (0.9, 1.2)	1.2** (1.1, 1.4)
Insomnia	1.0 (1.0, 1.1)	1.0 (0.8, 1.2)	0.9 (0.7, 1.1)
Bipolar disorder	1.7** (1.6, 1.9)	1.8** (1.5, 2.3)	2.2** (1.7, 2.7)
Anxiety disorder	1.3** (1.2, 1.4)	1.3** (1.1, 1.5)	1.7** (1.4, 2.1)
Schizophrenia	2.4** (2.0, 3.0)	1.6 (0.9, 2.7)	2.1** (1.3, 3.3)
Psychiatric hospitalization, FY 2009	1.9** (1.6, 2.1)	0.9 (0.7, 2.1)	1.5* (1.2, 2.1)
Suicide-related behavior, FY 2009	3.5** (3.1, 4.1)	10.0** (7.7, 13.2)	6.6** (5.0, 8.6)
No TBI, PTSD, pain, depression, or SA (Ref)	1.0	1.0	1.0
Single conditions			
TBI only (n = 1260)	0.9 (0.5, 1.7)	1.5 (0.5, 4.7)	0.6 (0.1, 4.6)
PTSD only (n = 13 468)	2.3** (2.0, 2.6)	2.0** (1.4, 2.9)	1.8** (1.2, 2.8)
Pain only (n = 38 426)	0.7** (0.6, 0.8)	0.7 (0.5, 1.0)	0.8 (0.5, 1.25)
Depression only (n = 6568)	2.8** (2.4, 3.4)	2.5** (1.7, 3.9)	3.2** (2.1, 5.0)
SA only (n = 2607)	3.6** (2.9, 4.5)	2.7** (1.5, 4.8)	3.7** (2.1, 6.5)
2 co-occurring conditions			
Comorbid TBI + PTSD (n = 1469)	2.3** (1.6, 3.4)	3.7** (1.9, 7.4)	1.1 (0.3, 4.4)
Comorbid TBI + pain (n = 2018)	1.0 (0.6, 1.6)	1.6 (0.7, 4.0)	0.9 (0.2, 3.5)
Comorbid TBI + depression (n = 232)	1.8 (0.7, 5.0)	2.6 (0.4, 18.6)	3.0 (0.4, 21.9)
Comorbid TBI + SA (n = 92)	4.5** (1.8, 11.5)	5.3 (0.7, 38.8)	. . .[a]
Comorbid PTSD + pain (n = 14 018)	2.3** (2.0, 2.7)	1.7** (1.2, 2.5)	2.0** (1.3, 3.1)
Comorbid PTSD + depression (n = 7729)	4.2** (3.6, 4.8)	3.7** (2.6, 5.3)	3.8** (2.6, 5.7)
Comorbid PTSD + SA (n = 2871)	4.7** (3.9, 5.6)	4.3** (2.7, 6.7)	5.2** (3.3, 8.3)
Comorbid pain + depression (n = 6744)	3.2** (2.7, 3.8)	3.0** (2.0, 4.5)	3.4** (2.2, 5.2)
Comorbid pain + SA (n = 1252)	3.2** (2.3, 4.4)	2.7* (1.2, 6.2)	4.2** (2.0, 8.8)
Comorbid depression + SA (n = 1341)	6.8** (5.4, 8.4)	6.8** (4.2, 11.1)	6.2** (3.6, 10.7)
3 co-occurring conditions			
TBI + PTSD + pain (n = 4383)	1.9** (1.5, 2.4)	1.7 (1.0, 3.2)	2.6** (1.5, 4.6)
TBI + PTSD + depression (n = 848)	3.2** (2.2, 4.7)	3.0* (1.2, 7.5)	4.6** (2.0, 10.6)
TBI + PTSD + SA (n = 426)	5.4** (3.6, 8.0)	4.2** (1.5, 11.6)	2.5 (0.6, 10.2)
TBI + pain + depression (n = 569)	2.6** (1.5, 4.5)	1.0 (0.1, 7.0)	1.2 (0.2, 8.6)

Continued

risk of suicide ideation during the study period, but there was no association with either attempt or attempt and ideation.

On the basis of our study hypotheses, we examined interactions for PCT, depression, and substance abuse. When we examined conditions occurring dually, we identified significant interactions for TBI and PTSD in the ideation- and attempt-only categories and for TBI and substance abuse in the ideation-only category. We identified significant interactions across all categories for co-occurring PTSD and pain, PTSD and depression, PTSD and substance abuse, pain and depression, pain and substance abuse, and depression and substance abuse. When we examined comparative risk by assessing where confidence intervals overlapped between interaction conditions, we found that, although veterans with comorbid TBI and PTSD or TBI and substance abuse were at elevated risk of SRB, TBI comorbidity was not associated with increased risk of SRB compared with PTSD or substance abuse alone. In addition, pain comorbidity was not associated with increased risk of SRB over PTSD, depression, or substance abuse alone. By contrast, adding comorbid depression to a diagnosis of PTSD significantly increased odds of ideation over that associated with PTSD alone, and adding comorbid substance abuse to a diagnosis of PTSD resulted in significantly increased odds of both ideation and ideation and attempt, although not attempt only. Veterans with comorbid PTSD and depression were at greater risk for ideation than those with depression alone, but not for attempt or attempt and ideation; comorbid PTSD made no additional contribution to risk for SRB among those with substance abuse.

We also examined interactions occurring when these conditions occurred in groups of 3, 4, or 5. As expected, nearly all of these combinations were associated with increased risk of SRB, including the triad of TBI, PTSD, and pain, which was associated with increased ideation and ideation and attempt, although not with attempt alone. Even so, the co-occurrence of all 3 PCT conditions did not increase risk above that associated with PTSD, depression, or substance abuse alone. As a general trend, as the number of comorbidities increased, those interactions including PTSD,

TABLE 2—*Continued*

TBI + pain + SA (n = 143)	2.7* (1.1, 6.8)	5.7* (1.4, 24.3)	. . .[a]
TBI + depression + SA (n = 45)	6.9** (2.4, 20.1)	9.0* (1.2, 69.0)	. . .[a]
PTSD + pain + depression (n = 11 038)	4.4** (3.9, 5.0)	4.2** (3.1, 5.7)	3.5** (2.4, 5.0)
PTSD + pain + SA (n = 2505)	5.1** (4.2, 6.1)	6.2** (4.1, 9.4)	8.1** (5.3, 12.3)
PTSD + depression + SA (n = 3178)	6.9** (5.9, 8.1)	6.2** (4.3, 8.8)	9.4** (6.6, 13.4)
4 co-occurring conditions			
TBI + PTSD + pain + depression (n = 3486)	4.3** (3.5, 5.2)	4.7** (3.0, 7.1)	4.1** (2.5, 6.7)
TBI + PTSD + pain + SA (n = 912)	7.5** (5.8, 9.7)	6.8** (3.8, 12.4)	7.3** (3.9, 13.7)
TBI + PTSD + depression + SA (n = 457)	6.0** (4.2, 8.6)	10.5** (5.8, 19.1)	8.0** (3.9, 16.6)
TBI + pain + depression + SA (n = 103)	4.0** (1.6, 10.1)	9.3** (2.2, 39.2)	19.1** (6.6, 55.7)
PTSD + pain + depression + SA (n = 3705)	7.7** (6.6, 8.9)	7.4** (5.3, 10.3)	7.7** (5.4, 11.1)
5 co-occurring conditions: TBI + PTSD + pain + depression + SA (n = 1497)	6.0** (4.9, 7.4)	7.4** (4.8, 11.4)	10.9** (7.2, 16.5)

Note. CI = confidence interval; FY = fiscal year; OR = odds ratio; PTSD = posttraumatic stress disorder; SA = substance abuse; TBI = traumatic brain injury.
[a]Too few cases for meaningful estimated effect.
*$P \leq .05$; **$P \leq .01$.

depression, and substance abuse continued to be associated with the highest levels of risk.

DISCUSSION

We report on a multiyear study of SRB among a national cohort of OEF and OIF veterans receiving care at the VA. In contrast with research reporting that TBI may increase risk of suicide[22] and despite a significant relationship between TBI and SRB in bivariate analyses, we found no association in the multivariable model once we included demographic and other clinical characteristics. Likewise, there was no increased risk of SRB associated with pain in the multivariable model; moreover, pain was associated with decreased risk of suicide ideation. Although this is somewhat surprising, as previous studies have linked pain with increased suicide ideation,[46] at least 1 other study has reported that pain is no longer associated with SRB among veterans once mental health diagnoses are taken into account.[34] As both TBI and pain ceased to be significantly associated with increased SRB risk in the multivariable model, it was not surprising that the interaction for PCT (co-occurring PTSD, TBI, and pain) conditions, though significantly associated with ideation and with ideation and attempt, did not appear to increase risk for SRB above that associated with PTSD, depression, or substance abuse alone.

We also examined the interaction between PTSD and TBI and found that, although veterans with both PTSD and TBI were at elevated risk of SRB, their risk was not significantly greater than that posed by PTSD alone. This may be attributable in part to the relative infrequency of TBI occurring without a comorbid PTSD diagnosis, making the chance of counting SRBs less likely because of small numbers. Adding depression or substance abuse to PTSD significantly increased risk for suicide ideation, thus reaffirming the role of these conditions—both independently and when co-occurring alongside PTSD—in suicidality.

Depression and substance abuse may be of particular importance in understanding suicide risk among OEF and OIF veterans. In contrast to the Ilgen et al.[16] study of suicidality among veterans of other eras, our study indicates that depression is associated with risk greater than or comparable to bipolar depression or anxiety disorder. Previous studies have been mixed in their findings with regard to the impact of co-occurring PTSD and depression on risk of SRB,[20] with some studies suggesting that depression asserts its influence independently of PTSD[47,48] and others suggesting that the 2 conditions may interact to amplify suicidality.[49] These mixed results may reflect differential risk associated with suicide ideation versus attempts, as we found that those with comorbid PTSD and depression were significantly more likely to exhibit suicide ideation than those with depression alone, but that the increase in risk was not significantly greater for those with attempts or attempts and ideation.

The multivariable model also reinforced previous research demonstrating the importance of substance abuse as a predictor for SRBs among veterans, particularly when co-occurring alongside depression or TBI or both.[50,51] This is consistent with previous findings that indicators of substance abuse, such as blood alcohol content at the time of death, are common among veterans who die by suicide, particularly those who are young or middle-aged.[17] The importance of substance abuse in our analyses is worrying, as some studies suggest that VA providers may underdiagnose substance use disorders.[52,53] However, it may also be that more severe substance abuse disorders are overrepresented in this sample because of this tendency, thus contributing to the power of substance abuse in predicting SRB in this analysis. Additional research will be required to better understand these linkages and how best to address them in clinical practice.

In accordance with previous literature, age, gender, bipolar disorder, anxiety, schizophrenia, previous psychiatric hospitalization, and previous SRB remained important predictors for SRB in this analysis. Veterans of OEF or OIF aged 56 years and older were least likely to exhibit SRB, with risk highest in the group aged 18 to 25 years. This finding is in contrast to age-related suicide risk among the broader population of veterans of all eras, for whom 69% of completed suicides are among those aged 50 years and older.[11] It may reflect the fact that older individuals in the OEF and OIF population are likely in better health than other veterans or nonveterans of the same age, having been healthy enough to deploy to a combat zone in the recent past. Veterans of officer or warrant officer rank were at markedly reduced risk for SRB, consistent with previous research.[54,55] Previous psychiatric hospitalization correlated with later ideation or ideation and attempt, but not attempt only. Previous SRB, which included any previous ideation as well as attempts, emerged as the strongest predictor of later SRB, and chronic

SRB may be among the most telling clinical predictors for completed suicide.[13,56]

It was interesting that we also found that female veterans were less likely than male veterans to exhibit suicide ideation, which directly contradicts previous research findings in this area[49] and may suggest that women are less comfortable reporting ideation within VA.[57,58] It is worth noting as a broader point that documented cases of suicide attempt outnumber cases of both suicide ideation and attempt, which suggests that suicide ideation may frequently go undetected—further highlighting the importance of developing improved strategies for identifying those at risk.

Strengths and Limitations

There are a number of strengths to this study, which reports on multiple years of data from a VA-wide patient sample and goes beyond self-reported assessments to draw on suicide ideation and attempts as documented by providers. Limitations include the following: only veterans enrolled in the VA health care system are included in the sample; providers are not always accurate in their coding of SRB or other conditions, thus introducing potential error into the data; and VA administrative data do not report on completed suicides and we therefore cannot determine which of the examined risk factors may be most closely linked to risk of death by suicide. Given their consistent utilization of VA services (at least 1 visit each year in FY 2009–2011), veterans in this cohort may have poorer health than the population of all OEF and OIF veterans. Use of VA administrative codes to identify suicide attempts is known to have high specificity, if low sensitivity.[59] Although an attribution of pain required 2 diagnoses occurring at least 7 days apart and therefore captured primarily chronic pain conditions, the pain variable may include some instances of acute as well as chronic pain.

Also, our analyses are based on categorical rather than continuous variables and so they do not address how SRB may be affected by the severity of conditions (e.g., PTSD) or frequency of utilization events (e.g., SRB). This may be especially relevant for our examination of TBI, for which several studies have suggested differential risk by severity of injury.[22,26] Our findings also do not capture the severity of ideation or the lethality of attempts. Use of categorical variables does suggest that our results are relatively conservative, as they account for all cases of a particular condition rather than solely the most severely affected.

Clinical Implications

In recent years, VA has placed increasing emphasis on improving clinical care for PTSD and TBI in an effort to respond to the growing numbers of men and women returning from combat deployment with cognitive and psychological sequelae. In confirming the role of PTSD as an independent predictor of both suicide ideation and attempts, our findings attest to the importance of such efforts. At the same time, this study reasserts the importance of depression and substance abuse as additional risk factors for suicide among OEF and OIF veterans,[3,14] particularly those with comorbid PTSD. Because these conditions remain strong predictors of suicide risk for this population, and may exacerbate suicidality among those struggling with symptoms of other "invisible wounds of war,"[60] it is more than ever essential to ensure that all veterans receive appropriate screening and treatment of symptoms of depression and substance abuse.

It may be that VA's suicide prevention efforts can benefit from developing screening criteria explicitly tailored to address the risk factors most salient for OEF and OIF veterans. The VA's system of electronic records and clinical reminders can be used to aid providers in targeting the needs of veterans of a particular cohort, age, or comorbidity profile. For example, a targeted OEF and OIF cohort risk assessment template could highlight the age group of 18 to 25 years as a time for heightened risk of suicidality.

Such a template might also signal a history of previous suicidality or presence of other psychiatric illness, including co-occurrence of depression or substance abuse alongside PTSD, as important "red flags" suggesting that additional screening, care integration, or follow-up care may be indicated. It may be appropriate to reexamine how depression and substance abuse treatment are integrated into existing care management for OEF and OIF veterans in primary and specialty mental health care settings. It may also be that those with comorbid PTSD and depression or substance abuse can benefit from an enhanced treatment model that is attentive to their full spectrum of mental health and rehabilitation needs. It is our hope that these findings can inform the development of more effective strategies to decrease suicide among our nation's most recent veterans. ■

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Contributors

M. J. V. Pugh is the principal investigator on the study from which these data were drawn. All authors made contributions to the design of research questions and data analyses. E. P. Finley was responsible for drafting the article and integrating co-author feedback. M. E. Amuan completed statistical analyses. All authors provided input on interpretation of findings and the final article. E. P. Finley and M. J. V. Pugh had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the analyses.

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Human Participant Protection

The study was approved by the authors' institutional review boards before initiation.

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