

## RESEARCH ARTICLE

# A longitudinal study of risk factors for suicide attempts among Operation Enduring Freedom and Operation Iraqi Freedom veterans

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**Background:** Suicide rates among veterans have increased markedly since the onset of Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF; LeardMann et al., 2013). Identification of factors with the greatest contribution to suicide risk among veterans is needed to inform risk assessment and to identify intervention targets.

**Methods:** This study examined predictors of suicide attempts among participants in the Veterans After-Discharge Longitudinal Registry; a nationwide cohort of OEF/OIF veterans enrolled in Department of Veterans Affairs (VA) services. Veterans with and without probable posttraumatic stress disorder (PTSD) were sampled at a 3:1 ratio, and male and female veterans were sampled at a 1:1 ratio. Participants ( $N = 1,649$ ) were assessed at two time points, roughly 2 years apart ( $M = 28.74$  months,  $SD = 8.72$ ).

**Results:** Seventy-four participants (4.49%) attempted suicide during the follow-up period. The strongest predictors of suicide attempts among the full sample were suicidal intent, attempt history, suicide ideation, PTSD symptoms, alcohol use disorder (AUD) symptoms, and depression. Veterans with multiple risk factors were particularly vulnerable; of veterans with 0,  $\geq 1$ ,  $\geq 2$ ,  $\geq 3$ , or  $\geq 4$  of these risk factors, 0%, 7.81%, 10.31%, 18.45%, and 20.51% made a suicide attempt, respectively.

**Conclusions:** This prospective study identified several strong predictors of suicide attempts among OEF/OIF veterans which may be important targets for suicide prevention efforts. Further, co-occurrence of multiple risk factors was associated with markedly greater risk for suicide attempts; veterans with multiple risk factors appear to be at the highest risk among OEF/OIF veterans enrolled in VA care.

## KEYWORDS

alcoholism/alcohol use disorders, PTSD/posttraumatic stress disorder, suicide/self harm, trauma, traumatic brain injury

## 1 | INTRODUCTION

The rate of suicide among military and veteran populations has increased markedly since the onset of Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) and has remained elevated (Black, Gallaway, Bell, & Ritchie, 2011; Department of the Army, 2010;

Gibbons, Brown, & Hur, 2012; Kang, 2008; LeardMann et al., 2013; Ursano et al., 2015). Recent population level data indicate that the risk for suicide is considerably higher among veterans compared with the general United States population during this same period of time (Kang et al., 2015) and this rate appears to be particularly high among former active duty veterans (Kang, 2008). Accordingly, proper identification of

predictors of suicidal behavior among OEF/OIF veterans is imperative to inform risk assessment and reduction efforts.

Numerous risk factors for suicidal behavior among veterans have been identified. For example, white race has been identified as a risk factor for completed suicide (Kaplan, Huguet, McFarland, & Newsom, 2007). Likewise, Hispanic veterans appear to be at lower suicide risk compared with non-Hispanic veterans (Maguen et al., 2015). Consistent with findings for the general population (e.g., Nock et al., 2008), male veterans are more likely to die by suicide than female veterans (e.g., Black et al., 2011; Lambert & Fowler, 1997). Among previously deployed veterans, combat exposure is associated with increased suicide risk (e.g., Maguen et al., 2011). Additionally, traumatic brain injury (TBI; Brenner, Ignacio, & Blow, 2011; Gutierrez, Brenner, & Huggins, 2008) and sexual assault (Benda, 2005; Tiet, Finney, & Moos, 2006) have both been linked to increased suicide risk among veterans.

Posttraumatic stress disorder (PTSD) has been identified as a prospective predictor of suicide risk. Bullman and Kang (1994) found, among a large sample of Vietnam veterans ( $N = 16,257$ ), that those with PTSD were nearly four times more likely to die by suicide than Vietnam veterans without PTSD. Likewise, Ilgen et al. (2012) found that PTSD was associated with completed suicide among all Department of Veterans Affairs Health Administration (VHA) users. In addition to PTSD, several other psychiatric disorders, including depression (e.g., McLean et al., 2017), anxiety disorders (e.g., Pfeiffer, Ganoczy, Ilgen, Zivin, & Valenstein, 2009), and alcohol use disorder (AUD; e.g., Maguen et al., 2015) have been linked to elevated suicide risk among veterans. Somatoform symptoms have also been linked to suicide risk among community samples (e.g., de Klerk et al., 2011; Park et al., 2012; Wiborg et al., 2013), but have received less attention among veterans. Further, functional impairment has been closely linked with suicidal behavior among community samples (e.g., Kaplan, McFarland, Huguet, & Newsom, 2007), but has received less attention among veteran samples.

Self-injurious thoughts and behaviors have also been established as risk factors for suicide among veterans. Non-suicidal self-injury (NSSI) has been linked to increased suicide risk among veterans (Kimbrel et al., 2015; Kimbrel, Meyer, DeBeer, Gulliver, & Morissette, 2016). Of previously identified risk factors, a prior suicide attempt is one of the strongest predictors of a future suicide attempt (e.g., Bryan, Bryan, Ray-Sannerud, Etienne, & Morrow, 2014; Gradus, Shipherd, Suvak, Giasson, & Miller, 2013; Ribeiro et al., 2016).

Notably, existing studies on suicide risk factors among veterans possess several important limitations. First, many studies examining suicide risk factors focused on those associated with suicidal ideation (SI), rather than suicide attempts. This limitation is particularly noteworthy, given evidence that some risk factors differentially predict SI and suicide attempts (Nock, Kessler, & Franklin, 2016). Second, as noted by Nock (2016), risk factors for suicide are often studied separately, prohibiting evaluation of risk conferred by co-occurrence of multiple risk factors. Understanding the cumulative effects of risk factors on subsequent suicide attempts has the potential to substantively inform and increase specificity of clinical suicide risk assessment and interventions (Borges et al., 2010). Third, many of these prior studies employed retrospective or cross-sectional methods. Finally, although SI is preva-

lent among veterans (Bryan, Bryan, May, & Klonsky, 2015; Nock et al., 2014; Pietrzak et al., 2010), only a small portion of veterans who experience SI make a suicide attempt (Gradus, Street, Suvak, & Resick, 2013; Kimbrel et al., 2016). Prospective research examining which suicide ideators (i.e., individuals who think about suicide) attempt suicide is limited among veterans (May & Klonsky, 2016; Stein et al., 2010).

This study aimed to: (1) identify risk factors with the greatest prospective contribution to suicide attempts, (2) identify risk factors that differentiate veterans experiencing SI who do and do not subsequently make a suicide attempt, and (3) explore the cumulative effect of co-occurring risk factors. We hypothesized, consistent with findings from prior studies, that male sex, White race, non-Hispanic ethnicity, greater combat exposure, greater psychopathology symptom severity, greater functional impairment, history of TBI, history of sexual assault, history of NSSI, SI, suicidal intent, and history of a suicide attempt would each be associated with greater prospective likelihood of a suicide attempt. We also hypothesized these associations would be consistent among veterans experiencing SI. Additionally, we conducted exploratory analyses to examine the degree to which co-occurrence of multiple risk factors conferred increased risk for a suicide attempt.

## 2 | METHODS

### 2.1 | Participants and procedures

Participants were veterans enrolled in the Veterans After-discharge Longitudinal Registry (Project VALOR), a longitudinal study of veterans deployed in support of OEF and OIF and enrolled in the VA healthcare system (see Rosen et al., 2012). Detailed information regarding participant recruitment is reported elsewhere (Rosen et al., 2012; Wisco et al., 2014). To be included, participants must have been United States Army or Marine Corps veterans who were deployed in support of OEF or OIF and received a mental health evaluation at a VA facility. Potential participants were contacted by phone. Veterans with probable PTSD (as indicated through medical records) and veterans without PTSD were sampled at a 3:1 ratio, and male and female veterans were sampled at a 1:1 ratio. Of participants who were contacted ( $n = 4,391$ ), 2,712 consented to participate and 1,649 completed the first assessment (T1). All interviews were conducted by phone by doctoral-level clinicians and self-report questionnaires were administered online or by mail when requested. The average timeframe for completing both portions of the first assessment (T1) was 14 days. These data were collected between July 2009 and September 2014. All study procedures were approved by the VA Boston Healthcare System Institutional Review Board and the Human Research Protection Office of the US Army Medical Research and Materiel Command.

The only potential exclusion criterion was high risk for suicide at initial contact as determined by a cutoff score of  $\geq 17$  on the Mini-International Neuropsychiatric Interview (MINI; Lecrubier et al., 1997) suicide module. For participants who met this criterion ( $n = 151$ ; 9.16%), study staff contacted the participants' treatment providers to determine if they were appropriate to include in the longitudinal study. Of the 151 participants at high risk, 42 (2.55% of the full sample) were

**TABLE 1** ICD-9 Diagnoses from Medical Records

Condition	n (%)
Psychiatric Diagnoses	
Posttraumatic Stress Disorder	895 (54.28%)
Depressive Disorder, Not Elsewhere Classified	257 (15.59%)
Anxiety, Unspecified	113 (6.58%)
Major Depressive Disorder, Recurrent, Unspecified	64 (4.06%)
Major Depressive Disorder, Recurrent, Moderate	56 (3.40%)
Adjustment Disorder with Mixed Anxiety and Depressed Mood	55 (3.34%)
Alcohol Dependence	36 (2.18%)
Physical Health Diagnoses	
Lumbago	237 (14.37%)
Hypertension	168 (10.19%)
Hyperlipidemia	141 (8.55%)
Backache, unspecified	79 (4.79%)
Obesity	63 (3.82%)
Tobacco Use Disorder	63 (3.82%)
Sleep Apnea	48 (2.19%)
Asthma	38 (2.30%)

Notes. ICD-9 = International Statistical Classification of Diseases and Related Health Problems, 9<sup>th</sup> edition; only diagnoses in  $\geq 2\%$  of participant sample reported.

determined to be inappropriate and were excluded from follow-up assessment; follow-up data for these participants was treated as missing.

All participants who completed the T1 assessment were included in analyses ( $N = 1,649$ ). The majority of participants identified as White ( $n = 1,238$ , 75.08%); the remaining participants identified as Black ( $n = 261$ , 15.83%), American Indian/Alaskan Native ( $n = 18$ , 0.91%), Asian ( $n = 15$ , 0.91%), Native Hawaiian/Pacific Islander ( $n = 5$ , 0.30%), or multiracial ( $n = 61$ , 0.91%). Fifty-one participants (3.09%) did not identify their race. Regarding ethnicity, 211 participants (12.80%) identified as Hispanic. Mean age of the sample was 37.49 ( $SD = 9.88$ ). The most prevalent medical record psychiatric and physical health diagnoses are listed in Table 1. The majority of participants identified as married ( $n = 821$ ; 49.79%) or living with a partner ( $n = 140$ ; 8.49%). Most participants reported being deployed once ( $n = 1096$ ; 66.46%). However, a significant minority reported multiple deployments, with 428 (25.96%), 91 (5.52%), and 30 (1.82%) participants reporting 2, 3, or  $\geq 4$  tours, respectively. Of the 1,649 veterans who completed both self-report questionnaires and diagnostic interviews at T1 (see Wisco et al., 2014 for a detailed overview), 1,348 (81.75%) completed the second assessment (T2) approximately 2 years later (mean = 28.74 months,  $SD = 8.72$ ).

## 2.2 | Procedure for suicide attempt assessment

Three sources of information were used in an effort to identify all suicide attempts. First, participants who completed T2 were assessed

regarding suicide attempt history between T1 and T2 using the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos, & Michel, 2007), a clinician-administered interview. Second, participants' VA medical records and Suicide Behavior Reports entered into the Suicide Prevention and Application Network (SPAN), a national database which receives reports on suicide-related behavior from Veterans Health Administration Suicide Prevention Coordinators, were reviewed. Finally, for participants who died between T1 and T2, medical records were reviewed to determine cause of death. In the case of participants who did not complete T2 and for whom no Suicide Behavior Reports or information indicating death was available, suicide attempt data were treated as missing.

## 3 | MEASURES

### 3.1 | Clinician-administered measures

Doctoral-level interviewers who were fully trained in administration and scoring procedures administered several clinician-administered measures. Interviewers administered the Structured Clinical Interview for *Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV; SCID; First, Spitzer, Gibbon, & Williams, 1995)* PTSD module to establish current PTSD diagnostic status. Inter-rater reliability in the current sample was high ( $\kappa > .85$ ; Wisco et al., 2014).

Interviewers assessed TBI history using a structured interview guided by current classification standards (Kay et al., 1993; see Wisco et al., 2014 for a detailed overview). Participants were classified as having a TBI history if they endorsed having a head injury or blast exposure that resulted in amnesia, loss of consciousness, or altered mental state. Inter-rater agreement for TBI classification was high ( $\kappa = .97$ ; see Wisco et al., 2014).

Interviewers administered the MINI (Leclercq et al., 1997) suicide module at T1 (see Wisco et al., 2014) to assess SI and suicide intent during the past month as well as lifetime history of suicide attempt. Lifetime history of NSSI, and, as mentioned previously, suicide attempts between T1 and T2 were assessed using the SITBI (Nock et al., 2007).

### 3.2 | Self-report measures

Participants also completed a battery of self-report measures. This battery included a demographics questionnaire, the depression, panic disorder, generalized anxiety disorder, and somatoform symptom modules of the Prime-MD Patient Health Questionnaire (PHQ; Spitzer et al., 1994), AUDs Identification Test (AUDIT; Saunders, Aasland, Babor, De la Fuente, & Grant, 1993), Inventory of Psychosocial Functioning (IPF; Bovin et al., in press), Life Events Checklist (LEC; Gray, Litz, Hsu, & Lombardo, 2004), and PTSD Checklist (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993), and the combat experiences, aftermath of battle, and postdeployment support scales of the Deployment Risk and Resilience Inventory (DRRI; King, King, Vogt, Knight, & Samper, 2006). We used a demographics questionnaire to gather age, sex, race, ethnicity, education level, and marital status information.

The PHQ depression scale is a nine-item measure of unipolar depressive symptoms. Respondents rate the degree to which they have been bothered by a list of symptoms during the past 2 weeks on a four-point scale ranging from *not at all* to *nearly every day*. The item assessing SI (item 9) was removed for analyses. Items are summed to a total score with higher scores indicating greater depression symptom severity. The total score demonstrated strong internal consistency in the current study ( $\alpha = .90$ ). In addition to the total score, the algorithm for calculation of provisional diagnosis was used.

The PHQ panic disorder scale is a 15-item measure of panic symptoms. Respondents rate whether or not they have experienced each symptom on a dichotomous *yes/no* response metric during the past 4 weeks. Items are summed to a total score with higher scores indicating greater panic symptom severity. The total score demonstrated adequate internal consistency in the current study ( $\alpha = .69$ ). In addition to the total score, the algorithm for calculation of provisional diagnosis was used.

The PHQ generalized anxiety disorder scale is a seven-item measure of anxiety symptoms. Respondents rate how often they were bothered by each symptom during the past 4 weeks on a 3-point scale ranging from *not at all* to *more than half the days*. Items are summed to a total score with higher scores indicating greater generalized anxiety disorder symptom severity. The total score demonstrated good internal consistency in the current study ( $\alpha = .82$ ). In addition to the total score, the algorithm for calculation of provisional diagnosis was used.

The PHQ somatoform symptoms scale is a 13-item measure of physical symptoms (e.g., stomach pain, back pain). Respondents rate the degree to which they were bothered by each symptom during the past 4 weeks on a three-point scale ranging from *not bothered* to *bothered a lot*. Items are summed to a total score with higher scores indicating greater somatoform symptom severity. The total score demonstrated good internal consistency in the current study ( $\alpha = .81$ ). In addition to the total score, the algorithm for calculation of provisional diagnosis was used.

The AUDIT is a 10-item self-report measure of hazardous alcohol consumption. Items are summed into a total score; higher scores indicate greater alcohol abuse. The total score demonstrated strong internal consistency in the current study ( $\alpha = .86$ ). In addition to the total score, we utilized the established 16-point cut-off score for provisional diagnosis of AUD (Saunders et al., 1993).

The IPF is a self-report measure of impairment within the last 30 days across seven psychosocial domains (e.g., friendships and socializing, parenting, work). Respondents rate the degree to which they agree with a list of psychosocial statements on a seven-point scale ranging from *never* to *always*. Items are summed with higher IPF total scores and subscale scores indicate greater functional impairment. The total score demonstrated strong internal consistency in the current study ( $\alpha = .95$ ).

The LEC is a 17-item self-report measure of exposure to a number of potentially traumatic events. For each category of events (e.g., natural disaster, fire, or explosion), respondents rate their degree of exposure (e.g., happened to me, witnessed it, learned about it). For the purposes of the current study, only the sexual assault item was used; responses were dichotomized (i.e., did or did not experience sexual assault).

The PCL is a 17-item self-report measure of PTSD symptom severity during the past month. Respondents rate the degree to which they have been bothered by each symptom on a 5-point scale ranging from *not at all* to *extremely*. Items are summed to a total score reflecting overall PTSD symptom severity; higher scores indicate greater severity. The total score demonstrated strong internal consistency in the current study ( $\alpha = .95$ ).

The 16-item combat experiences, 16-item aftermath of battle, and 15-item postdeployment support DRR1 scales are measures of combat exposure (e.g., going on patrols, firing on the enemy) battle aftermath experiences (e.g., administering care to wounded, handling human remains), and perceived social support following deployment (e.g., feeling understood and appreciated after returning home), respectively. Respondents rate how often they were exposed to various combat and aftermath experiences on a 5-point scale ranging from *never* to *daily or almost daily* and, for the postdeployment support scale, the degree to which they agree with a list of statements reflecting perceived support following deployment on a 5-point scale ranging from *strongly disagree* to *strongly agree*. Items are summed to a total score; higher scores indicate greater level of each respective domain. The combat, aftermath, and support scales each demonstrated strong internal consistency ( $\alpha = .91, .92, \text{ and } .84$ , respectively).

### 3.3 | Data analytic strategy

We conducted analyses in four stages. First, suicide attempt was regressed on each predictor in separate logistic regressions; odds ratios (OR) were calculated for each predictor. Second, we identified optimal cutoff scores for each continuous measure. Using procedures outlined by Kraemer (1992), both measures of test performance (i.e., traditional signal detection analyses used to calculate receiver operating characteristics curves: sensitivity, specificity, and efficiency) and measures of test quality (i.e., quality receiver operating characteristics: calibrated quality of sensitivity, specificity, and efficiency) were calculated. Cutoff scores were determined by identifying the score with optimal sensitivity (i.e., quality of efficiency:  $k[.5]$ ), or those which minimize classification errors (Kraemer, 1992). Third, to examine risk conferred by co-occurrence of multiple risk factors, we created two count variables reflecting the number of co-occurring risk factors for each participant. This analytic approach is identical to the approach taken to examine risk conferred by co-occurring psychopathology in other large-scale suicide research studies (e.g., Kessler, Borges, & Walters, 1999; Nock & Kessler, 2006; Stein et al., 2010). The first count variable (labeled Risk Profile A) included all significant predictors with  $OR > 2$ , the second (labeled Risk Profile B) included only significant predictors with  $OR > 4$ . For instances where two or more measures of a single construct met these criteria (e.g., PCL cutoff score and SCID PTSD diagnosis), the measure with the highest OR was retained. Fourth, predictors and optimally sensitive cutoff scores were examined among the subsample who endorsed SI at T1 ( $n = 417$ ). We conducted regression analyses using Mplus version 8 (Muthén & Muthén, 1998). Missing data were handled using multiple imputation, the recommended technique for handling missing categorical data (Enders, 2010). ROC analyses and cross-tabulations were conducted using SPSS version 24.

## 4 | RESULTS

Of the 1,649 participants who completed T1 assessment, 1,348 completed the T2 assessment. Of those who completed the T2 assessment, 1,281 (95.03%) denied making a suicide attempt between T1 and T2 and SPAN records were consistent with this report, 11 (0.82%) reported making an attempt that was also documented in SPAN records, 40 (2.97%) reported making an attempt that was not documented in SPAN records, and 16 (1.19%) denied making a suicide attempt, but had SPAN records documenting an attempt between T1 and T2. Records for the 16 participants who denied making an attempt between T1 and T2, but had a SPAN record of an attempt were systematically reviewed by two authors (J.C.K. and J.D.G.) who determined details provided in records were sufficient to identify these events as attempts; accordingly, these participants were classified as attempters. In addition to those who completed T2, SPAN records documented suicide attempts for five additional participants between T1 and T2. Finally, a medical record review indicated that two participants who completed T1 died by suicide before T2, and were included as attempters in analyses (three other participants died of other causes between T1 and T2). Taken together, information was available and sufficient to determine suicide attempt status for 1,355 participants, 74 of whom (5.46%) were identified as having made a suicide attempt between T1 and T2. The remaining 294 (17.83%) participants' suicide attempt information was treated as missing for subsequent analyses.

Logistic regression results are presented in Table 2. Ethnicity, education, history of sexual assault, functional impairment, post-battle experiences, postwar social support, alcohol abuse (continuous score and provisional diagnosis), depression (continuous score and provisional diagnosis), somatoform symptoms (continuous score and provisional diagnosis), panic symptoms (total score only), GAD symptoms (continuous score and provisional diagnosis), PTSD symptoms, PTSD diagnosis, SI, suicidal intent, attempt history, and NSSI each predicted a subsequent suicide attempt. Suicidal intent and attempt history had the highest ORs (7.83 and 6.96, respectively). Significant differences were not observed for age, gender, race, marital status, TBI, combat exposure, or panic disorder provisional diagnosis.

In the second stage of analyses, optimally sensitive cutoff scores were identified for each continuous measure which significantly predicted suicide attempt (see Table 3). Identified cutoff scores were predictive of a subsequent suicide attempt for functional impairment, post-battle experiences, postwar social support, alcohol abuse, depression symptoms, somatoform symptoms, panic symptoms, GAD symptoms, and PTSD symptoms. Although the continuous score for post-battle experiences predicted subsequent suicide attempts, the identified cutoff score was not significantly associated with suicide attempts.

In the third stage of analyses, the two count variables reflecting the number of co-occurring risk factors was calculated for each participant. The first count variable, consisting of all significant predictors with OR > 2, included the following 13 variables: Hispanic ethnicity, sexual assault history, IPF  $\geq$  59, AUDIT  $\geq$  19, PHQ depression provisional diagnosis, PHQ somatoform  $\geq$  15, PHQ panic  $\geq$  13, PHQ GAD  $\geq$  13, PCL  $\geq$  70, SI, suicidal intent, attempt history, and NSSI. The second

**TABLE 2** Bivariate analyses predicting suicide attempts among the full sample ( $N = 1,649$ )

	<b>B</b>	<b>SE</b>	<b>p</b>	<b>OR</b>
Age	-0.02	0.01	.070	0.98
Female	0.15	0.25	.529	1.17
Race (non-White)	0.05	0.27	.868	1.05
Hispanic	0.72	0.30	.015	2.06
Married	-0.15	0.25	.537	0.86
College Degree	-0.78	0.30	.010	0.46
LEC-Sexual Assault	0.81	0.23	.001	2.25
TBI	0.30	0.25	.224	1.35
IPF Total	0.04	0.01	<.001	1.05
IPF $\geq$ 59	1.22	0.26	<.001	3.39
DRRI-Combat Severity Total	0.01	0.01	.102	1.01
DRRI-Post-Battle Total	0.02	0.01	.042	1.02
DRRI-Post-Battle $\geq$ 30	0.45	0.25	.066	1.57
DRRI-Postwar Social Total	-0.03	0.01	.003	0.97
DRRI-Postwar Social $\leq$ 58	0.84	0.35	.015	0.43
AUDIT Total	0.07	0.01	<.001	1.07
AUDIT PDx	1.25	0.30	<.001	3.49
AUDIT $\geq$ 19	1.62	0.32	<.001	5.03
PHQ-Depression Total	0.13	0.04	<.001	1.14
PHQ-Depression PDx	1.44	0.26	<.001	4.23
PHQ-Depression $\geq$ 10	0.84	0.08	.003	2.32
PHQ-Somatoform Total	0.11	0.03	<.001	1.12
PHQ-Somatoform PDx	0.91	0.28	.001	2.49
PHQ-Somatoform $\geq$ 15	0.96	0.29	.001	2.60
PHQ-Panic Total	0.12	0.03	<.001	1.13
PHQ-Panic PDx	0.47	0.30	.117	1.60
PHQ-Panic $\geq$ 13	1.22	0.27	<.001	3.40
PHQ-GAD Total	0.24	0.05	<.001	1.27
PHQ-GAD PDx	1.06	0.25	<.001	2.88
PHQ-GAD $\geq$ 13	1.17	0.26	<.001	3.23
PCL Total	0.08	0.02	<.001	1.08
PCL $\geq$ 70	1.67	0.35	<.001	5.31
SCID PTSD Diagnosis	1.34	0.33	<.001	3.81
Ideation at T1	1.70	0.28	<.001	5.49
Intent at T1	2.06	0.27	<.001	7.83
Attempt History	1.94	0.25	<.001	6.96
NSSI	0.88	0.33	.009	2.40

Notes. Parameter estimates are unstandardized; AUD, Alcohol Use Disorder; AUDIT, Alcohol Use Disorders Identification Test; DRRI, Deployment Risk and Resilience Inventory; IPF, Inventory of Psychosocial Functioning; NSSI, nonsuicidal self-injury; PCL, PTSD Checklist; PDx, provisional diagnosis; PHQ-9, 9-item Patient Health Questionnaire; SCID, Structured Clinical Interview for DSM-IV Diagnoses; TBI, traumatic brain injury.

count variable, consisting of only significant predictors with OR > 4, included only the following six variables: PHQ depression provisional diagnosis, AUDIT  $\geq$  19, PCL  $\geq$  70, SI, suicidal intent, and attempt history. Within both profiles, no participants with zero risk factors made a suicide attempt and a linear dose-response association was

**TABLE 3** Diagnostic utility of continuous predictors of suicide attempts

Measure	AUC	Cutoff	Sensitivity	Specificity	PPV	NPV	Eff	k(.5)
IPF Total	.694	≥59	.333	.870	.128	.958	.841	.116
DRRI-Post-Battle	.624	≥30	.603	.520	.067	.958	.524	.026
DRRI-Postwar Social	.443	≤58	.137	.730	.028	.936	.697	.048
AUDIT Total	.657	≥19	.216	.947	.193	.954	.907	.155
PHQ-Depression	.678	≥10	.270	.866	.104	.954	.833	.078
PHQ-Somatoform	.701	≥15	.297	.860	.106	.956	.830	.084
PHQ-Panic	.669	≥13	.297	.893	.138	.957	.861	.124
PHQ-GAD	.735	≥13	.414	.816	.118	.959	.793	.105
PCL-C Total	.805	≥70	.500	.844	.130	.973	.829	.146

Notes. AUC, area under the curve; Eff, efficiency; NPV, negative predictive value; PPV, positive predictive value; k(.5), quality of efficiency.

**TABLE 4** Association between multiple risk factors and suicide attempts

Risk Profile A		Risk Profile B	
Factors	% attempted	Factors	% attempted
0	0.00%	0	0.00%
1	1.57%	1	4.60%
2	1.94%	2	3.33%
3	3.39%	3	17.19%
4	2.27%	4	17.86%
5	8.82%	5	27.27%
6	18.18%	≥1	7.81%
7	12.50%	≥2	10.31%
≥1	5.20%	≥3	18.45%
≥2	6.76%	≥4	20.51%
≥3	9.33%		
≥4	11.94%		
≥5	16.67%		
≥6	21.43%		
≥7	26.09%		

Notes. Risk Profile A reflects number of significant predictors with odds ratios > 2; Risk Profile B reflects number of significant predictors with odds ratios > 4.

observed between number of co-occurring risk factors and percentage of veterans at each risk level who made a suicide attempt (see Table 4). Within both risk profiles, the greatest observed risk conferred by co-occurrence of any two co-occurring risk factors was suicidal intent and attempt history; 2.09, 12.33, and 40% of veterans with neither, only one, or both of these risk factors made a suicide attempt, respectively.

In the fourth stage of analyses, we limited our sample to the group of veterans who endorsed SI at T1 ("ideators"), and compared T1 data between ideators who did and did not attempt suicide (see Table 5). Among ideators, Hispanic ethnicity, sexual assault history, functional impairment (continuous score and optimally efficient cutoff), alcohol abuse (continuous score, provisional diagnosis, and optimally efficient cutoff), GAD symptoms (continuous score only), suicidal intent, and attempt history were predictive of a subsequent suicide attempt. Unlike results among the full sample, measures of deployment

experiences, depression, somatoform symptoms, panic symptoms, and PTSD did not predict a subsequent suicide attempt. As with the full sample, suicidal intent and attempt history had the highest ORs (3.04 and 3.25, respectively).

## 5 | DISCUSSION

Given the elevated rate of suicide among military veterans since the onset of OEF/OIF, identification of factors with the greatest contribution to risk of future suicide attempts is imperative to inform risk assessment and reduction efforts. We identified several strong predictors of subsequent suicide attempts among a large sample of OEF/OIF veterans. Hispanic ethnicity, education, history of sexual assault, functional impairment, post-battle experiences, postwar social support, SI, suicidal intent, attempt history, NSSI, and symptoms of PTSD, alcohol abuse, depression, somatoform, panic, and GAD each predicted a subsequent suicide attempt. The strongest observed predictors of suicide attempts among the full sample were suicidal intent, attempt history, suicide ideation, severe PTSD symptoms, severe AUD symptoms, and provisional depression diagnosis. Veterans with multiple risk factors were particularly vulnerable; of veterans with 0, ≥1, ≥2, ≥3, or ≥4 of these risk factors, 0, 7.81, 10.31, 18.45, and 20.51% made a suicide attempt within the subsequent 2 year period, respectively. The greatest risk conferred by co-occurrence of any two risk factors was suicidal intent and attempt history; 2.09, 12.33, and 40% of veterans with neither, only one, or both of these risk factors made a suicide attempt, respectively.

This study extends the literature as one of the first longitudinal studies of risk factors for suicide attempts among OEF/OIF veterans, and as one of the few studies to examine the risk conferred by the co-occurrence of multiple risk factors. Our findings regarding co-occurrence of risk factors are consistent with a small body of research on civilians (Borges et al., 2010). However, relatively little research has been conducted to examine cumulative risk for suicide (Nock, 2016). To our knowledge, this is the first study to examine the cumulative association between risk factors and suicide attempts prospectively in a veteran sample. Increased understanding of the cumulative impact of co-occurring risk factors on likelihood of future suicide attempts may

**TABLE 5** Univariate analyses predicting suicide attempts among the ideators ( $N = 417$ )

	<i>B</i>	<i>SE</i>	<i>p</i>	<i>OR</i>
Age	-0.03	0.02	.059	0.97
Female	0.23	0.32	.479	1.25
Race (non-White)	-0.30	0.37	.420	0.74
Hispanic	1.07	0.34	.002	2.90
Married	0.11	0.32	.736	1.12
College Degree	-0.48	0.34	.163	0.62
LEC-Sexual Assault	0.66	0.31	.034	1.93
TBI	-0.05	0.33	.870	0.95
IPF Total	0.03	0.01	.017	1.03
IPF $\geq 59$	0.98	0.32	.003	2.65
DRRI-Combat Severity Total	0.00	0.01	.733	1.00
DRRI-Post-Battle Total	0.01	0.01	.559	1.01
DRRI-Post-Battle $\geq 30$	0.06	0.33	.864	1.06
DRRI-Postwar Social Total	-0.02	0.02	.299	0.99
DRRI-Postwar Social $\leq 58$	-1.05	0.63	.094	0.35
AUDIT Total	0.04	0.02	.022	1.05
AUDIT PDx	0.77	0.39	.045	2.17
AUDIT $\geq 19$	1.09	0.42	.010	2.99
PHQ-Depression Total	0.03	0.05	.617	1.03
PHQ-Depression PDx	0.38	0.37	.300	1.46
PHQ-Depression $\geq 10$	0.37	0.35	.284	1.45
PHQ-Somatoform Total	0.01	0.04	.797	1.01
PHQ-Somatoform PDx	0.13	0.32	.669	1.14
PHQ-Somatoform $\geq 15$	0.16	0.40	.680	1.18
PHQ-Panic Total	0.06	0.04	.110	1.06
PHQ-Panic PDx	-0.58	0.41	.156	0.56
PHQ-Panic $\geq 13$	0.39	0.35	.259	1.48
PHQ-GAD Total	0.13	0.06	.046	1.13
PHQ-GAD PDx	0.33	0.34	.322	1.39
PHQ-GAD $\geq 13$	0.62	0.34	.064	1.86
PCL Total	0.02	0.03	.409	1.02
PCL $\geq 70$	0.70	0.51	.169	2.01
SCID PTSD Diagnosis	0.69	0.47	.140	1.99
Intent at T1	1.11	0.31	<.001	3.04
Attempt History	1.18	0.33	<.001	3.25
NSSI	0.30	0.45	.503	1.35

Notes. Parameter estimates are unstandardized; AUD, Alcohol Use Disorder; AUDIT, Alcohol Use Disorders Identification Test; DRRI, Deployment Risk and Resilience Inventory; IPF, Inventory of Psychosocial Functioning; NSSI, nonsuicidal self-injury; PCL, PTSD Checklist; PDx, provisional diagnosis; PHQ-9, 9-item Patient Health Questionnaire; SCID, Structured Clinical Interview for DSM-IV Diagnoses; TBI, traumatic brain injury.

greatly inform techniques for tailoring safety planning with veterans not simply based on the presence of individual risk factors considered separately, but risk conferred by their co-occurrence.

The observed associations between history of self-injurious thoughts and behaviors and subsequent suicide attempts are consistent with well-replicated findings in suicide research (e.g., Gradus et al.,

2013; LeardMann et al., 2013). Suicidal intent and history of suicide attempts emerged as particularly important risk factors. Two in five veterans with both of these risk factors made a suicide attempt during the 2-year follow-up period. These findings emphasize the critical importance of considering the combination of suicidal intent and attempt history in suicide risk assessment among OEF/OIF veterans.

The observed associations between PTSD, AUD, depression, and subsequent suicide attempts are also consistent with previous research among veterans. Given the prevalence of these symptoms among military veterans following deployment (Hoge, Auchterlonie, & Milliken, 2006; Thomas et al., 2010), the observed prospective associations between these phenomena and suicide attempts may account for part of the increased suicide rate among veterans since the onset of the conflicts in Iraq and Afghanistan. These constructs are regularly assessed as components of intakes in mental health clinics and even primary care within VA. Results from this study suggest that, beyond identifying areas of treatment needed, assessing for these symptoms individually and collectively provides valuable information about suicide risk.

Further, this study adds to the literature examining what differentiates those who consider suicide from those who subsequently act on this ideation (May & Klonsky, 2016). Many of the risk factors identified among the full sample remained significant among this subsample. As with the full sample, suicidal intent and attempt history were the strongest predictors of a subsequent suicide attempt. This line of inquiry has the potential to inform clinical decision making. Given the prevalence of SI among veterans, future research may benefit from working to identify risk factors for transition from ideation to suicidal behavior (Klonsky & May, 2014).

Most of the risk factors identified in this study are modifiable. Evidence based treatments for PTSD, AUD, and depression are widely disseminated within VA. Further, preliminary evidence suggests that evidence based interventions for PTSD also reduce SI (e.g., Bryan et al., 2016; Gradus, Suvak, Wisco, Marx, & Resick, 2013). Additionally, problem solving therapy (Haley, 1976), cognitive therapy (Brown et al., 2005), brief cognitive behavioral therapy for suicide prevention (Rudd et al., 2015), and the attempted suicide short intervention program (Gysin-Maillart, Schwab, Soravia, Megert, & Michel, 2016) have each shown promise in reducing suicidal intent and SI. From a larger scale perspective, Franklin et al. (2016) developed a mobile app which demonstrated preliminary evidence in reducing self-injurious thoughts and behaviors, including suicide plans, among individuals with recent history of such behavior. Accordingly, engaging veterans in evidence based treatment likely represents a critical step toward reducing suicidal behavior in this population.

Several features of the study design are ideal for studying suicide risk in veterans such as the large geographically dispersed sample, prospective design, and use of reliable and valid assessment measures. However, the nature of the sample and sampling scheme (i.e., self-selected, gender-balanced, over-sampled for PTSD, U.S. Army and Marine veterans enrolled in the VA healthcare system) may affect generalizability of the findings beyond these parameters. This study was not able to investigate all suicide risk factors, and the dataset does not include some of the empirically identified and theoretically

proposed risk factors for suicide (e.g., hopelessness, thwarted belongingness, perceived burdensomeness). Accordingly, this study should not be interpreted as a comprehensive examination of all potential risk factors for suicide. Finally, two of the 74 participants who attempted suicide died as a result of their attempt. Accordingly, results may not generalize to factors that predict suicide death.

In conclusion, we identified suicidal intent, attempt history, suicide ideation, severe PTSD symptoms, severe AUD symptoms, and provisional depression diagnosis as robust predictors of subsequent suicide attempts among a large sample of OEF/OIF veterans enrolled in VA healthcare services. Veterans with multiple co-occurring risk factors were at considerably greater likelihood of making a suicide attempt. These risk factors appear to warrant careful consideration in suicide risk assessment among OEF/OIF veterans enrolled in VA healthcare services. In addition to suicidal intent and ideation, PTSD, depression, and AUD appear to represent salient treatment targets in the effort to prevent suicide attempts among this population. Finally, OEF/OIF veterans enrolled in VA healthcare services with multiple risk factors appear to be a particularly high-risk group.

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## CONFLICT OF INTEREST

Authors have do not have any financial disclosures.

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