


# Recent Stressful Experiences and Suicide Risk: Implications for Suicide Prevention and Intervention in U.S. Army Soldiers

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**Objectives:** To identify the extent to which the presence of recent stressful events are risk factors for suicide among active-duty soldiers as reported by informants.

**Methods:** Next-of-kin (NOK) and supervisors (SUP) of active duty soldiers ( $n = 135$ ) who died by suicide and two groups of living controls: propensity-matched ( $n = 128$ ) and soldiers who reported suicidal ideation in the past year, but did not die (SI) ( $n = 108$ ) provided data via structured interviews from the Study to Assess Risk and Resilience in Servicemembers (Army STARRS). Multivariate logistic regression analyses were used to create a risk score for suicide.

**Results:** The odds of suicide increased significantly for soldiers experiencing relationship problems, military punishment, and perceived failure or humiliation in the month

prior to death. Suicide risk models with these risk factors predicted suicide death among those who reported SI in the past year (OR = 5.9, [95% CI = 1.5, 24.0]  $\chi^2 = 6.24$ ,  $p = 0.0125$ , AUC, 0.73 (0.7, 0.8) NOK) and (OR = 8.6, [95% CI = 1.4, 51.5]  $\chi^2 = 5.49$ ,  $p = 0.0191$ , AUC, 0.78 (0.7, 0.8); SUP) suggesting the combination of these recent stressors may contribute to the transition from ideation to action.

**Conclusions:** Our findings suggest for the first time recent stressors distinguished suicide ideating controls from suicide decedents in the month prior to death as reported by informants. Implications for preventive intervention efforts for clinicians, supervisors and family members in identifying the transition from ideation to action are discussed.

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Suicide is a leading cause of death in the U.S. and represents a serious public health concern particularly among service members and veterans (1). The Department of Defense (DoD) reported the suicide mortality rate for active duty soldiers statistically increased from 20.3 to 28.7 per 100,000 service members in 2015 to 2020, which translates to 580 service members who died by suicide in 2020 (2). Besides death-in-combat, suicide death has become the leading cause of mortality in the military, making suicidal behaviors a growing cause of concern to the Department of the Army (3,4).

Among military service members, specific stressful life events (e.g., legal problems, victimization, major financial crises, betrayal by a loved one, and separation/divorce/other breakup) have been associated with suicide attempts, after separation/deactivation from the military (5). The experience of both interpersonal violence and sexual assault or harassment, especially among female soldiers, may have a dose-response relationship with suicidal ideation

and attempts (6,7). In addition to interpersonal violence, relationship problems, major depression, posttraumatic stress disorder, and substance use disorder predicted

## HIGHLIGHTS

- The study identified recent stressors that increased the odds of suicide death as reported by informants, and described how these recent stressors contributed to suicide risk, especially the transition from ideation to completed suicide, after controlling for lifetime stressors and history of mental disorders in service members.
- The identification of relationship problems, military punishment, and perceived failure or humiliation in the month prior to death in service members is an actionable target for suicide prevention and intervention for clinicians, family members, and supervisors.

suicide attempt in an active duty military population (8). For veterans, adverse socially-determined lifetime stressful experiences such as homelessness, healthcare access, unemployment, and violence are some of the main risk factors associated with suicide death (9).

The specialized forms of training and the exceptional environments service members operate in expose them to military/deployment-related stressors that their civilian counterparts are spared and may make them more vulnerable to family/social-related stressful events. Military/deployment-related stressful events include combat experience, combat injuries, conformity to rigorous unit requirements, and loss of colleagues during combat. Family/social-related stressors prevalent among service members include failed romantic relationships, suicide of a close relative or friend, long periods of separation from family, infidelity, and romantic distress (10–12). Service members may be at greater risk of exposure and/or individuals may be more vulnerable to stressful events during deployment, and it may be useful to better understand the dynamics underlying the effects of adverse events in the 30 days leading up to suicide death, and to treat this period as a window of opportunity for intervention. This study may have important and timely policy implications for suicide prevention in military populations allowing for an opportunity to assess stressors immediately preceding suicide death.

The purpose of the current study is to identify the extent to which the presence of recent stressful events, lifetime traumatic stressors, and history of lifetime mental health disorders by administrative record are risk factors for suicide among active duty U.S. Army Soldiers, as reported by informants. A better understanding of how and to what extent these risk factors are associated with increased risk of suicide death, may assist both supervisors and family members in identifying those most at risk to inform preventive interventions. Further, we will explore other factors that may differentiate those who report suicidal ideation, from those who died by suicide, to identify how one moves from suicidal thoughts to action. We hypothesized that recent stressors such as interpersonal violence, legal problems, and family/social/relationship problems, after controlling for lifetime history of mental health disorders, and lifetime stressors would increase the risk of suicide death, and the combination of these factors may exacerbate symptoms of distress.

## METHOD

Data are from a psychological autopsy component of the Army Study to Assess Risk and Resilience among Servicemembers (Army STARRS) (13). Recruitment and data collection procedures were approved by the Humans Subjects Committees of The University of Michigan, Ann Arbor, MI; the Uniformed Services University, Bethesda, MD; and all other collaborating organizations. Due to

space constraints, please refer to study procedures published elsewhere (Supplemental S1) (13).

## Sample

**Cases.** The suicide cases were U.S. Army Soldiers ( $n = 135$ ) who died by suicide while on active duty between August 01, 2011–November 01, 2013. This sample excluded soldiers in the Army Reserve and National Guard and soldiers who died while deployed, as these soldiers were excluded from the pool of control soldiers by the design of the Army STARRS (14). The research team interviewed a next-of-kin (NOK) and/or first-line Army supervisor (SUP) for  $n = 135$  suicides. The response rates for the NOK and SUP cases were 61.6% and 69.5% respectively.

**Controls.** The controls were drawn from a large ( $N = 5428$ ) representative sample of living soldiers who participated in the Army STARRS All Army Study (AAS). Two groups of living controls were selected in two different manners. First, propensity-score matched (15) (PS) controls ( $n = 128$ ) were matched to Army suicide decedents on 22 sociodemographic and military characteristics. The second group of controls reported suicidal ideation (SI) in the past year in the AAS survey ( $n = 118$ ). (16) Neither group of controls differed from eligible AAS respondents who did not participate on: sex, race/ethnicity, marital status, or age of entry into the Army. However, controls were slightly older, had more dependents, were higher rank, and had higher educational attainment; although these effects were small in magnitude ( $r_s = 0.09$ – $0.18$ ). The response rates for the NOK and SUP propensity-matched (PS) and ideator (SI) controls were 66.7% and 56.7% respectively.

## Measures

The psychological autopsy interview included 26 sections assessing a wide range of risk and protective factors for suicide. The development of the psychological autopsy interview is described elsewhere (13). Measures are provided in the supplemental materials (Supplemental S2).

**Psychiatric disorders.** Classic mental health disorder is defined as a lifetime history of any of the following 22 diagnoses as indicated by administrative ICD-9 codes: ADHD, adjustment disorder, alcohol, anxiety, bipolar, conduct/ODD, minor depression, MDD, eating disorders, non-affective psychosis, organic mental disorders, other disorders, other impulse-control disorders, personality disorders, sex disorders, sleep disorders, somatoform/dissociative disorders, traumatic stress, PTSD, drug-induced mental illness, drug abuse without dependence, or drug dependence.

**Lifetime stressors.** The SLE items were adapted from the Life Event Questionnaire (17) and the Department of Defense Health Survey of Health Related Behaviors among Active Duty Military Personnel. (18) Informants reported

number of times the suicide decedent experienced 14 lifetime traumatic SLEs, and 15 deployment related SLEs. Informants then asked how many times in the suicide decedent's life an event occurred, and if the event occurred in the past 12 months. Items were dichotomized for subsequent analyses (yes/no).

**Recent stressors.** To capture whether SLEs occurred in the past week, past month, past year or more than a year, informants were asked whether the suicide decedent experienced 17 stressful experiences in the past week, month, year or more than a year before the decedent's death. Items were dichotomized (yes/no) for absence of presence of a recent SLE.

### Statistical Analyses

**Sample weights.** Post-stratification weights were developed based on the analysis of the Historical Administrative Data Study (HADS)<sup>1</sup> Army sample, using predictors of suicide found in administrative records and known population information gathered from the Army snapshot data set (14,16,19). Item-level missing data were handled in a process described in the Army STARRS study design and methodology publication (14).

**Univariable models.** Logistic regression models tested the significance of each item comparing suicide deaths (cases) to the controls (PS and SI controls), while adjusting for significant demographics. Coefficients were exponentiated in logistic models to create ORs with 95% CIs and  $\chi^2$  tests were performed when fitting each of the logistic regression models. To correct for multiple comparisons, we used the false discovery rate, (20) within each sample (NOK and SUP) for PS controls and SI controls comparisons, separately. The false discovery rate was conducted using the p.adjust function in R, version 3.4.2 (21). Models whose calculation involved cells with  $n < 5$  were corrected with Firth's penalized likelihood method to help address small sample size bias. All tests were 2-sided and considered significant at  $p \leq 0.05$ . All other analyses were conducted using SAS, version 9.4 (22).

**Risk scores.** To construct risk score regression models for suicide death, we identified lifetime SLEs, recent SLEs, lifetime survey mood disorder or lifetime class mental health disorder statistically significant at  $p \leq 0.05$  after FDR adjustment in the univariate analyses. The risk score variable was constructed by giving a point for each item the NOK and SUP endorsed in the past month. Standardized Chronbach Coefficient Alphas and Pearson Correlations were obtained for the NOK and SUP risk scores to check for internal consistency. After creating the risk score construct, a logistic regression model was fit using this score construct variable as an independent variable while adjusting for significant demographics. For the logistic regression, we examined this variable both as a continuous

variable and as categorical variable (1+ score vs. 0) and constructed models for each. A receiver operating characteristic curve (AUC) and 95% CI was calculated to evaluate model fit.

**Multivariable models.** To explore predictors of suicide death we examined lifetime and recent SLEs in multivariable models adjusting for significant demographics and history of lifetime classic mental health disorders. A stepwise model selection approach identified the most parsimonious model. In the NOK and SUP multivariable models, the independent variables included those significant in the univariable analyses after FDR adjustment with a  $p$ -value  $\leq 0.05$ . Interactions were assessed using multivariable models containing each variable of interest and a multiplicative interaction term. Those interactions whose models had sufficient cell sizes for model convergence and a  $p$ -value  $\leq 0.05$  were considered significant. Population attributable risk (PAR) was calculated using Levin's Formula [% PAR =  $(P_e \times (RR - 1)) / (P_e \times (RR - 1) + 1) \times 100$ ] to estimate the proportion of cases in the population that can be attributed to a specific risk factor. (23) PARP calculations are reported for lifetime SLEs significant after FDR adjustment in the univariable models.<sup>2</sup>

## RESULTS

Comparisons of cases and controls on sociodemographic and Army history variables revealed few differences for the NOK and SUP informant samples. (Supplemental Table S3).

### Univariable Models

**Psychiatric disorders.** NOK reported suicide decedents were five times more likely than PS controls to have a history of lifetime classic mental health disorder from the administrative record NOK (OR = 5.0 [95% CI = 2.3, 10.8]  $\chi^2 = 16.83$ ,  $p < 0.0001$ ) and for similarly for SUP (OR = 5.8 [95% CI = 3.2, 10.5]  $\chi^2 = 33.40$ ,  $p < 0.0001$ ).

**Lifetime stressors.** NOK reported suicide decedents were four times more likely to have a lifetime history of interpersonal violence (e.g., sexual assault or rape) (OR = 4.2 [95% CI = 1.5, 11.5]  $\chi^2 = 7.54$ ,  $p = 0.0420$ ) compared to PS controls and three times as likely to have experienced the suicide of a close friend or relative (OR = 3.0 [95% CI = 1.5, 6.3]  $\chi^2 = 8.87$ ,  $p = 0.0406$ ), but not SUP. Interestingly, NOK reported the protective effects of experiencing a disaster (OR = 0.2 [95% CI = 0.1, 0.9]  $\chi^2 = 4.29$ ,  $p = 0.1792$ ).

**Recent stressors<sup>3</sup>.** NOK reported suicide decedents were more likely to experience the following recent SLEs compared to PS controls: 1) spouse or partner left him/her (OR = 10.4 [95% CI = 3.5, 30.9]  $\chi^2 = 18.01$ ,  $p = 0.0009$ ); 2) serious betrayal by someone else close to him/her (OR = 5.3 [95% CI = 1.5, 18.0]  $\chi^2 = 8.25$ ,  $p = 0.0365$ ); 3)

**TABLE 1. Next-of-kin univariable logistic regression model of reported lifetime and recent stressful events**

Characteristics	Next of kin						
	Cases	Controls (propensity)			Controls (12-month ideation)		
	(n = 61)	(n = 128)			(n = 108)		
	%	%	OR <sup>a,b</sup>	(95% CI)	%	OR <sup>a,b</sup>	(95% CI)
I. Lifetime trauma stressors (Ever)							
a. Serious physical assault (e.g., mugging)							
Yes versus No	20.97	11.35	2.1	(1.0, 4.6)	19.02	1.0	(0.2, 5.3)
$\chi^2$ , $p_{fdr}^c$				3.53, 0.2111			<0.01, 0.9732
b. Sexual assault or rape							
Yes versus No	17.07	4.65	<b>4.2</b>	<b>(1.5, 11.5)</b>	7.48	2.5	(0.2, 26.4)
$\chi^2$ , $p_{fdr}^c$				<b>7.54, 0.0420</b>			0.58, 0.9732
c. Serious assault happened to a close friend or relative							
Yes versus No	28.69	21.47	1.3	(0.7, 2.7)	21.64	1.3	(0.3, 6.3)
$\chi^2$ , $p_{fdr}^c$				0.76, 0.5377			0.09, 0.9732
d. Murder of a close friend or relative							
Yes versus No	10.08	11.38	1.0	(0.4, 2.6)	11.73	0.8	(0.1, 6.2)
$\chi^2$ , $p_{fdr}^c$				<0.01, 0.9480			0.05, 0.9732
e. Suicide of a close friend or relative							
Yes versus No	28.22	10.36	<b>3.0</b>	<b>(1.5, 6.3)</b>	13.21	2.6	(0.4, 15.9)
$\chi^2$ , $p_{fdr}^c$				<b>8.87, 0.0406</b>			1.12, 0.9732
f. Attempted suicide of a close friend or relative							
Yes versus No	14.71	16.05	1.0	(0.4, 2.2)	14.29	1.0	(0.2, 6.2)
$\chi^2$ , $p_{fdr}^c$				0.01, 0.9480			<0.01, 0.9732
g. Combat death of a close friend or relative							
Yes versus No	34.06	37.77	0.9	(0.5, 1.7)	34.91	0.8	(0.2, 3.4)
$\chi^2$ , $p_{fdr}^c$				0.16, 0.8113			0.05, 0.9732
h. Accidental death of a close friend or relative							
Yes versus No	36.56	26.10	1.6	(0.8, 2.9)	25.62	1.5	(0.4, 6.5)
$\chi^2$ , $p_{fdr}^c$				1.86, 0.3462			0.35, 0.9732
i. He/She witnessed someone being seriously injured or killed							
Yes versus No	36.34	28.25	1.6	(0.8, 3.1)	39.24	0.8	(0.2, 3.5)
$\chi^2$ , $p_{fdr}^c$				2.08, 0.3462			0.05, 0.9732
j. He/She discovered or handled a dead body							
Yes versus No	16.99	25.54	0.6	(0.3, 1.3)	33.87	0.4	(0.1, 1.6)
$\chi^2$ , $p_{fdr}^c$				1.58, 0.3654			1.74, 0.9732
k. He/She had a life-threatening illness or injury							
Yes versus No	10.08	8.37	1.2	(0.4, 3.4)	8.12	1.2	(0.1, 12.0)
$\chi^2$ , $p_{fdr}^c$				0.15, 0.8113			0.01, 0.9732
l. He/She was in a disaster (for example, Hurricane, fire, flood, earthquake) where he/she could have died							
Yes versus No	4.44	13.22	<b>0.2</b>	<b>(0.1, 0.9)</b>	19.04	0.2	(0.0, 1.3)
$\chi^2$ , $p_{fdr}^c$				<b>4.29, 0.1792</b>			2.80, 0.9732
II. Psychiatric disorders							
Classic mental health disorder (Admin)	78.02	39.78	<b>5.0</b>	<b>(2.3, 10.8)</b>	61.45	2.0	(0.5, 8.3)
Yes versus No				<b>16.83, &lt;0.0001</b>			0.83, 0.3862
$\chi^2$ , $p_{fdr}^c$							
III. Recent stressful life events							
a. A serious financial problem							
Past month versus Never	25.94	17.78	2.0	(0.9, 4.4)	8.39	4.5	(0.5, 41.7)
Lifetime versus Never	35.21	30.30	1.4	(0.7, 2.9)	32.61	1.5	(0.4, 6.1)
$\chi^2$ , $p_{fdr}^c$				3.18, 0.2829			1.84, 0.7696
b. Spouse or partner left him/her							
Past month versus Never	21.51	2.52	<b>10.4</b>	<b>(3.5, 30.9)</b>	2.70	9.4	(0.3, 345.3)
Lifetime versus Never	22.59	27.25	1.1	(0.5, 2.3)	30.85	0.9	(0.2, 4.0)
$\chi^2$ , $p_{fdr}^c$				<b>18.01, 0.0009</b>			1.54, 0.7696
c. He/She went through a divorce							
Past month versus Never	3.09	3.17	1.2	(0.2, 7.0)	5.10	0.4	(0.0, 8.7)
Lifetime versus Never	13.71	15.98	0.8	(0.3, 1.9)	26.84	0.4	(0.1, 2.0)
$\chi^2$ , $p_{fdr}^c$				0.36, 0.8833			1.50, 0.7696
d. Spouse or partner cheated on him/her							
Past month versus Never	5.98	0.00	-	-	1.06	5.9	(0.0, -)
Lifetime versus Never	19.69	24.73	0.9	(0.4, 1.8)	30.67	0.6	(0.1, 2.6)

(Continues)

TABLE 1, continued

Characteristics	Next of kin						
	Cases	Controls (propensity)			Controls (12-month ideation)		
	(n = 61)	(n = 128)			(n = 108)		
	%	%	OR <sup>a,b</sup>	(95% CI)	%	OR <sup>a,b</sup>	(95% CI)
$\chi^2$ , $p_{fdr}^c$				0.12, 0.9396			0.92, 0.7696
e. Serious betrayal by someone else close to him/her							
Past month versus Never	11.62	2.41	<b>5.3</b>	<b>(1.5, 18.0)</b>	1.18	11.2	(0.1, -)
Lifetime versus Never	23.25	16.68	1.7	(0.8, 3.6)	21.55	1.2	(0.2, 6.0)
$\chi^2$ , $p_{fdr}^c$				<b>8.25, 0.0365</b>			0.81, 0.7696
f. Serious ongoing arguments or break-up with some other close friend or family member							
Past month versus Never	25.60	4.87	<b>5.9</b>	<b>(2.4, 14.5)</b>	5.14	5.8	(0.4, 89.6)
Lifetime versus Never	22.24	25.08	1.4	(0.6, 2.9)	28.08	1.0	(0.2, 4.8)
$\chi^2$ , $p_{fdr}^c$				<b>15.01, 0.0027</b>			1.66, 0.7696
h. He/She caused an accident where someone else was hurt or property was damaged							
Past month versus Never	10.89	0.00	-	-	0.59	20.9	(0.0, -)
Lifetime versus Never	14.71	6.24	<b>3.0</b>	<b>(1.2, 7.8)</b>	9.61	1.7	(0.2, 14.3)
$\chi^2$ , $p_{fdr}^c$				<b>5.33, 0.1255</b>			0.85, 0.7696
i. He/She didn't get promoted when he/she thought he/she should have been							
Past month versus Never	12.24	2.64	<b>4.3</b>	<b>(1.3, 14.1)</b>	2.32	4.7	(0.1, 234.7)
Lifetime versus Never	16.99	25.34	0.6	(0.3, 1.4)	28.68	0.5	(0.1, 2.6)
$\chi^2$ , $p_{fdr}^c$				<b>7.81, 0.0402</b>			1.39, 0.7696
j. He/She got a lower score than he/she expected on his/her efficiency report or performance rating							
Past month versus Never	6.99	4.14	1.2	(0.3, 4.4)	1.06	6.3	(0.0, -)
Lifetime versus Never	12.36	20.72	0.5	(0.2, 1.3)	21.57	0.5	(0.1, 2.9)
$\chi^2$ , $p_{fdr}^c$				2.29, 0.3765			1.10, 0.7696
k. He/She received military punishment (for example, Court Martial, Article 15, Captain's Mast, Office Hours, Letter of reprimand, other)							
Past month versus Never	21.31	0.46	<b>56.4</b>	<b>(7.2, 439.8)</b>	2.70	9.5	(0.3, 342.8)
Lifetime versus Never	13.90	16.50	1.1	(0.4, 2.5)	15.76	1.0	(0.2, 6.1)
$\chi^2$ , $p_{fdr}^c$				<b>14.84, 0.0027</b>			1.53, 0.7696
l. He/She had trouble with the police (civilian or military)							
Past month versus Never	20.23	0.00	-	-	0.59	72.3	(0.0, -)
Lifetime versus Never	23.98	6.17	<b>3.7</b>	<b>(1.5, 8.9)</b>	9.70	4.1	(0.5, 31.3)
$\chi^2$ , $p_{fdr}^c$				<b>8.25, 0.0162</b>			2.90, 0.7696
n. He/She was arrested for an incident not related to driving							
Past month versus Never	7.80	0.00	-	-	0.00	-	-
Lifetime versus Never	17.80	11.90	<b>1.8</b>	<b>(0.8, 4.0)</b>	5.41	4.2	(0.3, 56.9)
$\chi^2$ , $p_{fdr}^c$				<b>8.25, 0.0365</b>			1.14, 0.7696
q. He/She experienced some type of perceived failure or humiliation, such as letting down those around him/her in some way							
Past month versus Never	39.92	3.21	<b>24.4</b>	<b>(9.2, 64.5)</b>	5.02	<b>16.1</b>	<b>(1.1, 242.7)</b>
Lifetime versus Never	20.89	15.71	<b>3.0</b>	<b>(1.3, 6.9)</b>	15.33	2.8	(0.5, 15.9)
$\chi^2$ , $p_{fdr}^c$				<b>42.34, &lt;0.0001</b>			4.79, 0.7696
r. Any other very stressful event							
Past month versus Never	22.32	6.35	<b>4.7</b>	<b>(2.0, 11.1)</b>	7.61	4.3	(0.4, 44.0)
Lifetime versus Never	24.72	17.98	2.0	(1.0, 4.2)	13.50	3.0	(0.4, 20.7)
$\chi^2$ , $p_{fdr}^c$				<b>13.20, 0.0050</b>			2.33, 0.7696

Note: Bold values are statistically significant at  $p$ -value  $\leq 0.05$ . Table abbreviated due to space constraints. Results for excluded variables available upon request.

Abbreviations: FDR, false discovery rate; OR, odds ratio.

<sup>a</sup> ORs statistics obtained from separate multivariate logistic regression models testing differences between cases and each control group.

<sup>b</sup> Each predictor was adjusted for deployment status (never, previously) and number of years of active service, but not each other.

<sup>c</sup>  $p$  values have been corrected using false discovery rate (fdr).

serious argument/break up with a close friend or family member (OR = 5.9 [95% CI = 2.4, 14.5]  $\chi^2 = 15.01$ ,  $p = 0.0027$ ); 4) he/she caused an accident where someone else was hurt or property was damaged (OR = 3.0 [95% CI = 1.2, 7.8]  $\chi^2 = 5.33$ ,  $p = 0.1255$ ); 5) didn't get promoted (OR = 4.3 [95% CI = 1.3, 14.1]  $\chi^2 = 7.81$ ,  $p = 0.0402$ ); 6) received military punishment (e.g. Court Martial,

Article 15, Captain's Mast, Office Hours, Letter of Reprimand) (OR = 56.4 [95% CI = 7.2, 439.8]  $\chi^2 = 14.84$ ,  $p = 0.0027$ ); 7) trouble with the police (OR = 3.7 [95% CI = 1.5, 8.9]  $\chi^2 = 8.25$ ,  $p = 0.0162$ ); 8) arrested for an incident not related to driving (OR = 1.8 [95% CI = 0.8, 4.0]  $\chi^2 = 8.25$ ,  $p = 0.0365$ ); 9) some type of perceived failure or humiliation (OR = 24.4 [95% CI = 9.2, 64.5]

**TABLE 2. Supervisor univariable logistic regression model of reported lifetime and recent stressful events**

Characteristics	Supervisor						
	Cases	Controls (Propensity)			Controls (12-month ideation)		
	(n = 107)	(n = 80)			(n = 73)		
	%	%	OR <sup>a,b</sup>	(95% CI)	%	OR <sup>a,b</sup>	(95% CI)
<b>I. Lifetime trauma stressors (Ever)</b>							
a. Serious physical assault (for example, mugging)							
Yes versus No	4.83	1.95	3.0	(0.7, 13.4)	5.44	0.9	(0.0, 23.3)
$\chi^2$ , $p_{fdr}^c$				2.00, 0.5455			<0.01, 0.9774
b. Sexual assault or rape							
Yes versus No	7.86	0.80	8.6	(1.1, 65.3)	0.00	-	-
$\chi^2$ , $p_{fdr}^c$				4.29, 0.2681			
c. Serious assault happened to a close friend or relative							
Yes versus No	9.90	5.26	1.9	(0.7, 5.0)	7.97	1.2	(0.1, 17.3)
$\chi^2$ , $p_{fdr}^c$				1.49, 0.5455			0.02, 0.9774
d. Murder of a close friend or relative							
Yes versus No	3.29	4.57	0.8	(0.2, 3.1)	6.46	0.5	(0.0, 11.0)
$\chi^2$ , $p_{fdr}^c$				0.09, 0.8252			0.17, 0.9774
e. Suicide of a close friend or relative							
Yes versus No	12.44	5.91	2.2	(0.9, 5.4)	7.12	1.8	(0.1, 28.6)
$\chi^2$ , $p_{fdr}^c$				2.65, 0.4821			0.17, 0.9774
f. Attempted suicide of a close friend or relative							
Yes versus No	6.18	3.00	2.0	(0.6, 7.1)	5.86	1.0	(0.0, 22.3)
$\chi^2$ , $p_{fdr}^c$				1.13, 0.5754			<0.01, 0.9774
g. Combat death of a close friend or relative							
Yes versus No	19.33	23.55	0.9	(0.5, 1.7)	31.26	0.5	(0.1, 2.7)
$\chi^2$ , $p_{fdr}^c$				0.13, 0.8252			0.55, 0.9774
h. Accidental death of a close friend or relative							
Yes versus No	9.51	11.72	0.7	(0.3, 1.6)	9.54	0.9	(0.1, 11.2)
$\chi^2$ , $p_{fdr}^c$				0.66, 0.6997			0.01, 0.9774
i. He/She witnessed someone being seriously injured or killed							
Yes versus No	22.90	19.74	1.5	(0.8, 2.8)	22.64	1.1	(0.2, 6.7)
$\chi^2$ , $p_{fdr}^c$				1.42, 0.5455			0.02, 0.9774
j. He/She discovered or handled a dead body							
Yes versus No	15.22	19.94	0.8	(0.4, 1.6)	22.71	0.6	(0.1, 3.6)
$\chi^2$ , $p_{fdr}^c$				0.36, 0.6997			0.27, 0.9774
k. He/She had a life-threatening illness or injury							
Yes versus No	3.29	3.71	0.9	(0.2, 3.5)	0.54	6.8	(0.0, -)
$\chi^2$ , $p_{fdr}^c$				0.05, 0.8306			0.16, 0.9774
l. He/She was in a disaster (for example, Hurricane, fire, flood, earthquake) where he/she could have died							
Yes versus No	2.46	15.16	0.2	(0.0, 0.6)	7.25	0.3	(0.0, 6.7)
$\chi^2$ , $p_{fdr}^c$				7.50, 0.0868			0.50, 0.9774
<b>II. Psychiatric disorders</b>							
Classic mental health disorder (Admin)							
Yes versus No	77.13	38.6	<b>5.8</b>	<b>(3.2, 10.5)</b>	62.59	1.9	(0.4, 8.8)
$\chi^2$ , $p_{fdr}^c$				<b>33.40, &lt;0.0001</b>			0.75, 0.3862
<b>II. Recent stressful events</b>							
a. A serious financial problem							
Past month versus Never	17.29	7.72	2.6	(1.1, 5.8)	11.02	1.5	(0.1, 15.4)
Lifetime versus Never	21.23	21.79	1.0	(0.5, 1.9)	30.00	0.6	(0.1, 3.3)
$\chi^2$ , $p_{fdr}^c$				5.11, 0.1418			0.57, 0.9767
b. Spouse or partner left him/her							
Past month versus Never	22.24	1.94	<b>16.4</b>	<b>(4.4, 61.4)</b>	5.59	4.7	(0.2, 104.0)
Lifetime versus Never	23.94	17.62	<b>2.0</b>	<b>(1.1, 3.9)</b>	30.25	1.0	(0.2, 4.7)
$\chi^2$ , $p_{fdr}^c$				<b>19.93, &lt;0.0001</b>			1.01, 0.9767
c. He/She went through a divorce							
Past month versus Never	2.36	2.74	0.6	(0.1, 3.4)	0.88	2.8	(0.0, -)
Lifetime versus Never	18.40	15.12	1.4	(0.7, 2.8)	15.42	1.3	(0.2, 9.7)
$\chi^2$ , $p_{fdr}^c$				1.16, 0.6716			0.14, 0.9767
d. Spouse or partner cheated on him/her							
Past month versus Never	6.65	0.00	-	-	1.57	4.6	(0.0, -)
Lifetime versus Never	18.87	8.93	2.5	(1.2, 5.5)	17.15	1.2	(0.2, 7.9)

(Continues)



TABLE 2, continued

Characteristics	Supervisor					
	Cases		Controls (Propensity)		Controls (12-month ideation)	
	(n = 107)		(n = 80)		(n = 73)	
	%	%	OR <sup>a,b</sup>	(95% CI)	%	OR <sup>a,b</sup> (95% CI)
$\chi^2$ , $p_{fdr}^c$				5.46, 0.1418		0.30, 0.9767
e. Serious betrayal by someone else close to him/her						
Past month versus Never	5.54	0.00	-	-	0.00	-
Lifetime versus Never	12.26	13.85	0.9	(0.4, 2.0)	10.29	1.3 (0.1, 13.8)
$\chi^2$ , $p_{fdr}^c$				0.03, 0.9969		0.05, 0.9767
f. Serious ongoing arguments or break-up with some other close friend or family member						
Past month versus Never	13.76	1.66	<b>10.4</b>	<b>(2.5, 43.8)</b>	0.00	-
Lifetime versus Never	13.62	11.20	1.4	(0.6, 3.0)	12.14	1.3 (0.1, 11.8)
$\chi^2$ , $p_{fdr}^c$				<b>10.42, 0.0165</b>		0.05, 0.9767
h. He/She caused an accident where someone else was hurt or property was damaged						
Past month versus Never	4.83	1.70	2.6	(0.5, 12.9)	3.14	1.7 (0.0, 99.5)
Lifetime versus Never	5.93	7.95	0.9	(0.3, 2.4)	3.32	2.0 (0.0, 109.2)
$\chi^2$ , $p_{fdr}^c$				1.45, 0.6016		0.18, 0.9767
i. He/She didn't get promoted when he/she thought he/she should have been						
Past month versus Never	0.82	0.68	1.2	(0.1, 23.2)	4.02	0.2 (0.0, 12.1)
Lifetime versus Never	14.72	24.47	0.5	(0.2, 0.9)	22.25	0.6 (0.1, 3.3)
$\chi^2$ , $p_{fdr}^c$				5.08, 0.1418		0.92, 0.9767
j. He/She got a lower score than he/she expected on his/her efficiency report or performance rating						
Past month versus Never	4.00	2.19	1.4	(0.3, 6.7)	4.41	0.6 (0.0, 22.6)
Lifetime versus Never	4.11	20.11	<b>0.1</b>	<b>(0.0, 0.4)</b>	29.85	0.1 (0.0, 0.6)
$\chi^2$ , $p_{fdr}^c$				<b>12.67, 0.0081</b>		6.01, 0.8910
k. He/She received military punishment (for example, Court Martial, Article 15, Captain's Mast, Office Hours, Letter of reprimand, other)						
Past month versus Never	16.65	0.00	-	-	0.88	21.6 (0.0, -)
Lifetime versus Never	13.18	15.88	1.0	(0.5, 2.2)	23.19	0.6 (0.1, 3.7)
$\chi^2$ , $p_{fdr}^c$				0.01, 0.9969		0.93, 0.9767
l. He/She had trouble with the police (civilian or military)						
Past month versus Never	16.54	2.19	<b>7.9</b>	<b>(2.2, 28.4)</b>	2.56	8.1 (0.1, 674.8)
Lifetime versus Never	11.54	17.45	0.7	(0.3, 1.4)	7.00	2.1 (0.1, 34.9)
$\chi^2$ , $p_{fdr}^c$				<b>11.00, 0.0090</b>		1.10, 0.9767
n. He/She was arrested for an incident not related to driving						
Past month versus Never	9.79	1.21	<b>8.8</b>	<b>(1.6, 47.2)</b>	0.00	-
Lifetime versus Never	9.08	4.11	2.4	(0.8, 7.0)	2.98	3.7 (0.1, 229.7)
$\chi^2$ , $p_{fdr}^c$				<b>8.48, 0.0370</b>		0.38, 0.9767
q. He/She experienced some type of perceived failure or humiliation, such as letting down those around him/her in some way						
Past month versus Never	29.24	2.41	<b>18.3</b>	<b>(5.6, 60.1)</b>	3.44	11.3 (0.2, 530.6)
Lifetime versus Never	13.47	9.93	2.2	(1.0, 5.1)	20.21	0.9 (0.1, 5.7)
$\chi^2$ , $p_{fdr}^c$				<b>25.00, &lt;0.0001</b>		1.58, 0.9767
r. Any other very stressful event						
Past month versus Never	24.38	6.02	<b>5.3</b>	<b>(2.2, 12.3)</b>	2.56	11.4 (0.1, 952.4)
Lifetime versus Never	9.47	10.94	0.9	(0.4, 2.1)	19.75	0.6 (0.1, 3.7)
$\chi^2$ , $p_{fdr}^c$				<b>16.09, 0.0030</b>		1.62, 0.9767

Notes: Bold values are statistically significant at  $p$ -value  $\leq 0.05$ . Table abbreviated due to space constraints. Results for excluded variables available upon request.

Abbreviations: FDR, false discovery rate; OR, odds ratio.

<sup>a</sup> ORs statistics obtained from separate multivariate logistic regression models testing differences between cases and each control group.

<sup>b</sup> Each predictor was adjusted for deployment status (never, previously) but not for each other.

<sup>c</sup>  $p$  values have been corrected using false discovery rate (fdr).

$\chi^2 = 42.34$ ,  $p < 0.0001$ ) and 10) any other very stressful event (OR = 4.7 [95% CI = 2.0, 11.1]  $\chi^2 = 13.20$ ,  $p = 0.0050$ ).

SUP reported suicide decedents were more likely to experience a number of SLEs compared to PS controls: (1) spouse or partner left him/her (OR = 16.4 [95% CI = 4.4, 61.4]  $\chi^2 = 19.93$ ,  $p = 0.0001$ ); (2) serious ongoing arguments with a close friend or family member (OR = 10.4 [95% CI = 2.5, 43.8]  $\chi^2 = 10.42$ ,  $p = 0.0165$ ); (3) trouble with the

police (civilian or military) (OR = 7.9 [95% CI = 2.2, 28.4]  $\chi^2 = 11.00$ ,  $p = 0.0090$ ); 4) arrested for an incident not related to driving (OR = 8.8 [95% CI = 1.6, 47.2]  $\chi^2 = 8.48$ ,  $p = 0.0370$ ); (5) experienced some type of perceived failure or humiliation (OR = 18.3 [95% CI = 5.6, 60.1]  $\chi^2 = 25.00$ ,  $p < 0.0001$ ) and (6) any other very stressful event (OR = 5.3 [95% CI = 2.2, 12.3]  $\chi^2 = 16.09$ ,  $p = 0.0030$ ) (Tables 1 and 2).

**Population attributable risk.** The population attributable risk percent for suicide death associated with lifetime exposure to sexual assault or rape and lifetime exposure to the death of a close friend or relative by suicide was estimated to be 12.95% and 17.37% respectively (NOK) and 5.87% for lifetime exposure to sexual assault or rape (SUP).

### Multivariable models

The final NOK model predicting suicide death included the following: spouse or partner leaving them (OR = 8.5 [95% CI = 2.0, 35.8]  $\chi^2 = 9.79$ ,  $p < 0.0075$ ), military punishment<sup>4</sup> (OR = 25.3 [95% CI = 3.1, 206.2]  $\chi^2 = 14.67$ ,  $p < .0007$ ), trouble with the police (OR = 6.3 [95% CI = 1.8, 22.0]  $\chi^2 = 8.93$ ,  $p < 0.0115$ ), and some type of perceived failure or humiliation (OR = 9.3 [95% CI = 2.4, 35.1]  $\chi^2 = 10.97$ ,  $p < .0041$ ).

The final SUP model predicting suicide death included the following: spouse or partner leaving them (OR = 14.5 [95% CI = 2.9, 72.26]  $\chi^2 = 14.39$ ,  $p < 0.0008$ ); received lower score than expected on performance report

(OR = 0.03 [95% CI = 0.01, 0.14])  $\chi^2 = 19.10$ ,  $p < .0001$ ), experienced perceived failure or humiliation (OR = 15.10 [95% CI = 4.07, 56.08]  $\chi^2 = 20.38$ ,  $p < 0.0001$ ), any other stressful event (OR = 3.89 [95% CI = 1.44, 10.54]  $\chi^2 = 7.15$ ,  $p < 0.028$ ), and history of lifetime classic mental health disorder from the administrative record (OR = 4.5 [95% CI = 2.2, 9.1]  $\chi^2 = 16.76$ ,  $p < 0.0001$ ). (Tables 3 and 4).

**Risk score.** The recent SLEs statistically significant at  $p < 0.05$  after FDR adjustment in the univariable analyses used to create the risk score construct for NOK included: (1) spouse or partner left them; (2) serious betrayal by someone else close to him/her; (3) serious argument/breakup with close friend or family; (4) caused accident where someone else was hurt/property damaged; (5) didn't get promoted when they thought they should have been; (6) received military punishment; (7) had trouble with police; (8) arrested for non-driving violation; (9) experienced perceived failure/humiliation; and (10) any other stressful event. Items used to create the risk score

**TABLE 3. Next-of-kin multivariable logistic regression model of suicide with lifetime mental health and recent stressors**

Characteristics	Next of kin			
	Controls (propensity)		Controls (12-month ideation)	
	N = 128		N = 108	
	OR	(95% CI)	OR	(95% CI)
I. Demographics				
Deployment				
Never versus Previous	0.68	(0.21, 2.25)	0.85	(0.13, 5.67)
Wald $\chi^2$ , p-value	0.3899, 0.5323		0.0294, 0.864	
Years active				
5-8' versus 1-4'	0.69	(0.21, 2.24)	0.99	(0.16, 5.94)
9+ versus 1-4'	0.55	(0.17, 1.81)	1.0	(0.16, 6.25)
Wald $\chi^2$ , p-value	0.9825, 0.6119		0.0003, 0.9999	
II. Recent stressful events				
Spouse or partner left them				
Past month versus Never happened	<b>8.45</b>	<b>(2.0, 35.78)</b>	2.62	(0.27, 25.62)
Happened, but not in past month versus Never happened	0.63	(0.25, 1.6)	0.8	(0.18, 3.64)
Wald $\chi^2$ , p-value	<b>9.788, 0.0075</b>		0.8803, 0.6439	
He/She received military punishment (e.g., Court Marshall, Article 15, Captain's Mass, Office Hours, Letter of reprimand, other)				
Past month versus Never happened	<b>25.32</b>	<b>(3.11, 206.16)</b>	2.7	(0.28, 26.57)
Happened, but not in past month versus Never happened	<b>0.22</b>	<b>(0.06, 0.78)</b>	0.46	(0.06, 3.5)
Wald $\chi^2$ , p-value	<b>14.6682, 0.0007</b>		1.4245, 0.4906	
He/She had trouble with police				
Past month versus Never happened	5.11	(0.15, 169.56)	1.01	(0.03, 36.79)
Happened, but not in past month versus Never happened	<b>6.3</b>	<b>(1.8, 22.03)</b>	2.58	(0.39, 16.91)
Wald $\chi^2$ , p-value	<b>8.9306, 0.0115</b>		0.9844, 0.6113	
He/She experienced some type of perceived failure or humiliation, such as letting down those around him/her in some way				
Past month versus Never happened	<b>9.25</b>	<b>(2.44, 35.10)</b>	3.61	(0.38, 34.57)
Happened, but not in past month versus Never happened	2.07	(0.78, 5.51)	1.75	(0.32, 9.61)
Wald $\chi^2$ , p-value	<b>10.9739, 0.0041</b>		1.3702, 0.504	
III. Psychiatric disorder				
Lifetime classic mental health disorder (Admin)				
Yes versus no	<b>3.84</b>	<b>(1.46, 10.12)</b>	1.6	(0.32, 8.07)
Wald $\chi^2$ , p-value	<b>7.3933, 0.0065</b>		0.3231, 0.5697	

Notes: Bold values are statistically significant at  $p$ -value  $\leq 0.05$ . Multivariable Logistic regression model was constructed using predictors still significant at  $p \leq 0.05$  after FDR adjustment. The model was corrected with Firth's penalized likelihood method to help address small sample size bias. Abbreviations: CI, Confidence Interval; OR, Odds Ratio.



**TABLE 4. Supervisor multivariable logistic regression model of suicide with lifetime mental health and recent stressors**

Characteristics	Supervisor			
	Controls (propensity)		Controls (12-month ideation)	
	N = 80		N = 73	
	OR	(95% CI)	OR	(95% CI)
I. Demographics				
Deployment				
Never versus Previous	2.13	(0.87, 5.22)	0.77	(0.15, 3.92)
Wald $\chi^2$ , <i>p</i> -value	2.723, 0.0989		0.0956, 0.7571	
II. Recent stressful events				
Spouse or partner left them				
Past month versus Never happened	<b>14.48</b>	<b>(2.9, 72.26)</b>	4.26	(0.38, 47.32)
Happened, but not in past month versus Never happened	<b>3.39</b>	<b>(1.39, 8.24)</b>	1.31	(0.27, 6.29)
Wald $\chi^2$ , <i>p</i> -value	<b>14.3883, 0.0008</b>		1.39, 0.4991	
Received lower score than expected on performance report				
Past month versus Never happened	1.27	(0.15, 10.57)	0.23	(0.01, 3.67)
Happened, but not in past month versus Never happened	<b>0.03</b>	<b>(0.01, 0.14)</b>	<b>0.08</b>	<b>(0.01, 0.68)</b>
Wald $\chi^2$ , <i>p</i> -value	<b>19.1003, &lt;0.0001</b>		<b>6.0036, 0.0497</b>	
Experienced perceived failure/humiliation				
Past month versus Never happened	<b>15.10</b>	<b>(4.07, 56.08)</b>	3.42	(0.43, 26.89)
Happened, but not in past month versus Never happened	<b>5.84</b>	<b>(1.65, 20.61)</b>	1.33	(0.21, 8.51)
Wald $\chi^2$ , <i>p</i> -value	<b>20.376, &lt;0.0001</b>		1.3809, 0.5013	
Any other stressful event				
Past month versus Never happened	<b>3.89</b>	<b>(1.44, 10.54)</b>	4.42	(0.41, 47.57)
Happened, but not in past month versus Never happened	1.26	(0.38, 4.21)	0.57	(0.09, 3.65)
Wald $\chi^2$ , <i>p</i> -value	<b>7.1521, 0.028</b>		1.9503, 0.3771	
III. Psychiatric disorder				
Lifetime classic mental health disorder (Admin)				
Yes versus no	<b>4.47 (2.18, 9.15)</b>		2.51	(0.58, 10.81)
Wald $\chi^2$ , <i>p</i> -value	<b>16.7647, &lt;0.0001</b>		1.5251, 0.2169	

Note: Bold values are statistically significant at *p*-value  $\leq 0.05$ . Multivariable Logistic regression model was constructed using predictors still significant at *p*  $\leq 0.05$  after FDR adjustment. The model was corrected with Firth's penalized likelihood method to help address small sample size bias. Abbreviations: CI, Confidence Interval; OR, Odds Ratio.

construct for SUP included: (1) spouse or partner left them; (2) received lower score than expected on performance report; (3) had trouble with police; (4) arrested for non-driving violation; (5) experienced perceived failure/humiliation; and (6) other stressful event.

For NOK and SUP, standardized Chronbach Alpha = 0.809392 and 0.59307 respectively, suggesting the items are measuring one dimension. NOK and SUP models predicting suicide death among PS controls were high (OR = 8.3, [95% CI = 4.4, 15.8]  $\chi^2 = 42.04$ , *p* < 0.0001, AUC, 0.74 (0.7, 0.8); NOK) and (OR = 13.0 [95% CI = 6.7, 25.3]  $\chi^2 = 57.13$ , *p* < 0.0001, AUC, 0.76 (0.7, 0.8); SUP) and slightly higher among those who reported SI in the past year, suggesting a strong model fit (OR = 5.9, [95% CI = 1.5, 24.0]  $\chi^2 = 6.24$ , *p* = 0.0125, AUC, 0.73 (0.7, 0.8); NOK) and (OR = 8.6, [95% CI = 1.4, 51.5]  $\chi^2 = 5.49$ , *p* = 0.0191, AUC, 0.78 (0.7, 0.8); SUP) (Tables 5 and 6) and (Figure 1).

## DISCUSSION

There are two significant findings to emerge from this study. First, the combination of significant recent stressors predicted suicide death in those who reported suicide ideation in the past year. To our knowledge, this is the first

time this finding has been reported and the evidence from this study suggests the combination of these recent stressors (e.g., relationship problems, military punishment, and the experience of perceived failure or humiliation) may contribute to the transition from ideation to action. Second, soldiers who experienced military punishment, spouse/relationship problems or perceived failure or humiliation in the month prior to death had significantly increased odds of suicide death. These findings persisted even after controlling for lifetime stressful events and lifetime classic mental health disorders from the administrative record. Each will be described below.

Our risk score models predict suicide death with accuracy and suggest the importance of a combination of stressful life events in the month prior to death. These findings were observed for both types of controls and, importantly, for controls who reported SI in the past year, suggesting that the combination of these recent events may contribute to the transition from ideation to action. Ideation-to-action theories of suicide emphasize the dynamic nature of suicidal behaviors and focus on the temporal dynamics of suicide risk. The fluid-vulnerability theory—a diathesis-stress model provides a framework for examining suicidal behaviors as a dynamic construct

**TABLE 5. Next-of-kin risk score logistic regression model for suicide**

	Next-of-kin			
	Controls (propensity)		Controls (12-month ideation)	
	<i>n</i>	Weighted %	<i>n</i>	Weighted %
Risk score: # Of at risk events				
0	106	84.25	88	81.41
1	16	11.41	13	12.65
2	5	2.38	4	3.79
3	1	1.96	3	2.14
4	-	-	0	0.00
5	-	-	-	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-
9	-	-	-	-
10	-	-	-	-
Mean	0.23		0.28	
Median	0		0	
Mode	0		0	
Q1	0		0	
Q3	0		0	
Minimum				
Maximum				
Std	0.55		0.67	
<b>Logistic Model with risk score + deployment + years active</b>				
	OR	(95% CI)	OR	(95% CI)
Score construct (continuous var)	<b>2.739</b>	<b>(1.9, 3.9)</b>	2.216	(1.0, 4.5)
$\chi^2$ , <i>p</i> -value	<b>31.4322</b>	<b>&lt;0.0001</b>	3.78	0.0517
AUC	0.7545	(0.7, 0.8)	0.7484	(0.7, 0.8)
Score construct (categorical var)	<b>8.339</b>	<b>(4.4, 15.8)</b>	<b>5.923</b>	<b>(1.5, 24.0)</b>
1+ versus 0				
$\chi^2$ , <i>p</i> -value	<b>42.0359</b>	<b>&lt;0.0001</b>	<b>6.237</b>	<b>0.0125</b>
AUC	0.7382	(0.7, 0.8)	0.7267	(0.7, 0.8)

Note: Bold values are statistically significant at *p*-value  $\leq 0.05$ . Variables for constructing risk score construct included whether the soldier experienced (1) Spouse or partner left them, (2) Serious betrayal of someone close, (3) Serious argument/breakup with close friend or family member, (4) Caused accident where someone else was hurt/property damaged, (5) Didn't get promoted when they thought they should have been, (6) Received military punishment, (7) Had trouble with police, (8) Arrested for driving violations, (9) Experienced perceived failure/humiliation, (10) Any other stressful event within the past month. Deployment status (never, previously) and Years Active (1-4', 5-8', 9+) were controlled for in the model. The model was corrected with Firth's penalized likelihood method to help address small sample size bias.

Abbreviations: AUC, Area under the receiver operator characteristic curve; CI, Confidence Interval; OR, Odds Ratio.

and may serve as a framework for the development of interventions for suicide prevention and aid clinicians in predicting one at high risk for a suicide. (24,25) In the model, predisposition or baseline risk (e.g., prior suicide attempts, adverse childhood experiences, and genetic vulnerabilities) are exacerbated by environmental triggers (e.g., relationship problems, trauma, death of a loved one, financial stress, job loss) which leads to "the suicidal mode", which consists of cognitive, behavioral, emotional

**TABLE 6. Supervisor risk score logistic regression model for suicide**

	Supervisor			
	Controls (propensity)		Controls (12-month ideation)	
	<i>n</i>	Weighted %	<i>n</i>	Weighted %
Risk score: # Of at risk events				
0	71	89.39	66	88.41
1	4	6.11	6	9.03
2	5	4.49	1	2.56
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
6	-	-	-	-
Mean	0.18		0.11	
Median	0		0	
Mode	0		0	
Q1	0		0	
Q3	0		0	
Minimum				
Maximum				
Std	0.52		0.36	
<b>Logistic model with risk score + deployment</b>				
	OR	(95% CI)	OR	(95% CI)
Score construct (continuous var)	<b>4.7</b>	<b>(2.9, 7.4)</b>	<b>3.9</b>	<b>(1.7, 14.0)</b>
$\chi^2$ , <i>p</i> -value	<b>42.12</b>	<b>&lt;0.0001</b>	<b>4.23</b>	<b>0.0395</b>
AUC	0.7610	(0.7, 0.8)	0.7754	(0.7, 0.8)
Score construct (categorical var)	<b>13.0</b>	<b>(6.7, 25.3)</b>	<b>8.6</b>	<b>(1.4, 51.5)</b>
1+ versus 0				
$\chi^2$ , <i>p</i> -value	<b>57.13</b>	<b>&lt;0.0001</b>	<b>5.49</b>	<b>0.0191</b>
AUC	0.7571	(0.7, 0.8)	0.7825	(0.7, 0.8)

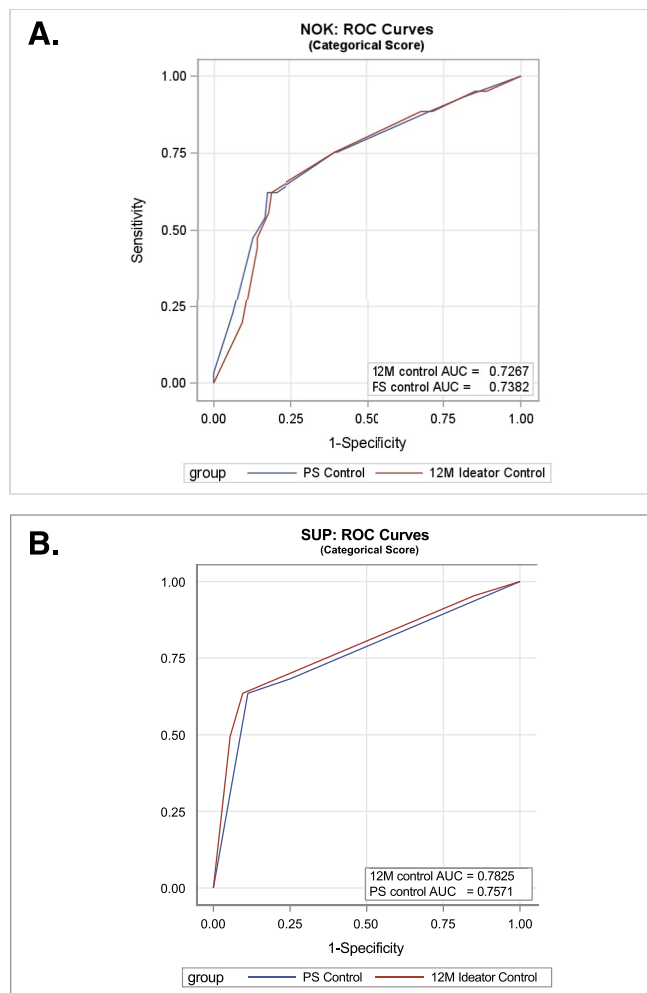
Note: Bold values are statistically significant at *p*-value  $\leq 0.05$ . Variables for constructing risk score construct included whether the soldier experienced (1) Spouse or partner left them, (2) Serious argument/breakup with other close friend or family member, (3) Had trouble with the police, (4) Arrested for non-driving violation, (5) Experienced perceived failure/humiliation, (6) Any other stressful event within the past month. Deployment status (never, previously) was controlled for in the model. The model was corrected with Firth's penalized likelihood method to help address small sample size bias.

Abbreviations: AUC, Area under the receiver operator characteristic curve; CI, Confidence Interval; OR, Odds Ratio.

and physiological domains that are actionable targets for intervention.

Our findings confirm the importance of relationship problems in the month prior to death even after controlling for a lifetime history of classic mental health disorders. The fact that NOK and SUP both reported spousal/significant other relationship problems suggests the importance of family/couple interventions as a target for suicide intervention and is consistent with our hypothesis and recent research highlighting the association between marital distress and suicidal ideation in active-duty soldiers (26).

NOK reported receiving military punishment in the month prior to the soldier's death as a significant stressor, even after controlling for lifetime history of classic mental

**FIGURE 1. A. Stressful life events and suicide risk next-of-kin. B. Stressful life events and suicide risk supervisor**

health disorder from the administrative record. SUP were not asked specifically about military punishment and thus could not corroborate this finding, but did point to the potential importance of poor work performance and suicidal behaviors. Prior research has reported the association between demotion and failure to be promoted and suicide death, but to our knowledge, this is the first time military punishment has been observed as a significant predictor of suicide death, as reported by informants. Recent research reported strong association between discharge characterization (e.g., honorable, “bad paper” or other than honorable, bad conduct, dishonorable, and uncharacterized) and homelessness among those separated from service (27). The importance of context is emphasized in recent research by Bryan, who described how one’s quality of life, and environmental stressors may lead to suicide in the Cusp Catastrophe Model of Suicide (28).

Perceived humiliation and failure predicted suicide death as reported by informants, after controlling for lifetime classic mental health disorders from the

administrative record. Humiliation, perceived burdensomeness, social defeat, and thwarted belongingness mediated the relationship between suicide crisis syndrome and past month suicide attempt and ideations in high risk psychiatric outpatients (29). Humiliation hypothesized as a state characteristic may interact with trait characteristics of increased vulnerability and lead to suicidal ideation, plan and attempts (30).

Our findings may be interpreted considering several limitations. Psychological autopsy studies are limited by bias related to the informant’s knowledge of the status of cases and controls. Despite widely held preconceptions about the informant method of research, including recall bias, studies have shown informant data to be valid and reliable (31). The relatively small sample size limited the power to examine interactions. Stressful life events measures are associated with recall bias and intracategory variability (32). The response rates were low compared to surveys conducted in the general population, but they were high for multi-informant interviews conducted in a military population (33,34). We were not able to examine gender differences and this, with the high rates of interpersonal violence in females, may account for our lack of significant findings of lifetime interpersonal violence as a predictor of suicide death. Despite these limitations, our results may help inform suicide prevention and intervention efforts which target unique stressors that may significantly increase risk of suicide in the month prior to death, such as relationship problems, military punishment and perceived failure or humiliation.

Future studies need to be replicated in larger samples where gender differences can be examined, as recent research suggests gender differences in exposure to longstanding and severe life problems are associated with suicide risk (35). Furthermore, replication in a prospective cohort to predict suicide death will minimize recall bias and inform prevention efforts in this population. It will also be important for future research to examine the association of different types of military punishment (e.g., Article 15s, Court Marshall, Captain’s Mass, Office Hours, Letter of reprimand) in service members to identify targets for intervention and suicide prevention for supervisors so they can provide resources and access to support the accused.

### Implications

The study identified several recent stressors that increased the odds of suicide death and how these recent stressors contributed to suicide risk, especially the transition from ideation to completed suicide, after adjusting for lifetime mental disorders. The dynamic and heterogeneous nature of suicide necessitate the need to tailor treatment to the individual. For example, new smartphone applications with just-in-time interventions that are adaptive to internal states and external contexts are recommended (36).

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## ENDNOTES

<sup>1</sup>HADS is an integrated administrative data file containing key elements from 38 different Army and DOD data systems for over 1.6 million soldiers (Regular Army, Army Reserve, and National Guard) on active duty during calendar years 2004–2009.

<sup>2</sup>Levin's Formula is only applicable for binary variables; therefore, PARP could only be calculated for the lifetime stressors.

<sup>3</sup>Due to space constraints only the recent stressors significant in past month, compared to never were included in the text and not those stressors significant in the soldier's lifetime, but not in the past month.

<sup>4</sup>Due to space constraints only the significant past month recent stressors were included in the text and not those stressors that happened, but not in the past month.

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