Time-varying associations of suicide with deployments, mental health conditions, and stressful life events among current and former US military personnel

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Abstract

Background

U.S. military suicides have increased significantly over the past decade and currently account for almost 20% of all military deaths. We investigated the associations of a comprehensive set of time-varying risk factors with suicides among current and former service members.

Methods

Retrospective multivariate analysis of all U.S. military personnel between 2001-2011 (N=110,035,573 person-quarters, representing 3,795,823 service members). Outcome was death by suicide, either during service or post-separation. Cox proportional hazard models at the person-quarter level were used to examine associations of deployment, mental disorders, history of unlawful activity, stressful life events, and other demographic and service factors with suicide death.

Findings

The strongest predictors of suicide were current and past diagnoses of self-inflicted injuries, major depression, bipolar disorder, substance use disorder, and other mental health conditions (comparing to those with no history of diagnoses, hazard ratio, HR, ranged from 1.4 [CI, 1.14-1.72] to 8.34 [CI, 6.71-10.37]). Compared to those never deployed, hazards were lower among the currently-deployed (HR=0.50; CI,0.40-0.61) but significantly higher in the quarters following first deployment (HR=1.51; CI, 1.17-1.96). Hazard of suicide was elevated within the first year of separation from the military (HR=2.49; CI,2.12-2.91), and remained high for those who separated 6 or more years ago (HR=1.63; CI,1.45-1.82).

Interpretation

Elevated hazard of suicide death varies by time-since-exposure to deployment, mental health diagnoses, and other stressful life events. Continued monitoring is particularly needed for these high-risk individuals. Additional information should be gathered to address the persistent elevated risks of suicides among service members after separation.

Introduction

Suicide rates amongst U.S. military personnel have increased dramatically since the start of the recent wars in Iraq and Afghanistan in 2001.[1,2] In 2010, suicide became the second highest cause of death after death by combat[3] and the military suicide rate exceeded the rate in the demographically similar civilian population.[4-6]

Although considerable research has been carried out on the demographic and service profiles of military suicide decedents, much of this work failed to make the comparisons with non-decedents that are necessary for individual-level risk projections;[3,7-9] and many of the studies that made such comparisons focused only on a subset of service members[4,6,10] or used a non-representative sample of service members.[1,11] Research that examines risk factors for all military suicides is rare[2] and has not examined the role of prior diagnosed mental disorders in predicting subsequent suicide death, despite the fact that strong associations of these predictors with suicides have been found in other populations.[6-8,10,12-16] A history of unlawful activity has also been shown to be associated with increased suicide risk in other populations.[17,18] Furthermore, while some previous military studies have implicitly assumed that the association of combat deployment with suicide is the same during and after deployment, other research suggests that this assumption might be inaccurate.[6,12] Finally, many previous research in military samples failed to consider the possibility that other stressful life events (e.g., demotions, divorce) might predict suicides, even though such associations have been found in previous civilian research.[5,6,12,19]

We addressed the above limitations by carrying out an epidemiological analysis of the associations of a more comprehensive set of potential predictors of suicide death among current and former service members than previous studies, using quarterly data on all uniformed U.S.

military personnel who were on active duty between 2001- 2011. We observed deaths by suicide that occurred either during active duty, while in the reserves, or after separation from service; and we captured all mental health diagnoses from service members' medical records while on active duty. We also evaluated the joint predictive effects of all variables in our model by calculating *concentration of suicide risk*.[20] To our knowledge, this is the most comprehensive study of risk factors for suicide in the U.S. service member population to date.

Methods

Sample and Data

Our population was all uniformed service members in the U.S. Army, Navy, Air Force, and Marine Corps who served on active duty at anytime between 2001 and 2011. This population was followed through the time of death or December 2011, regardless of whether the individual separated from the military. The population included 3,795,823 unique service members with complete information who were followed over 110,035,573 person-quarters.

Quarterly personnel data were obtained during years of service from administrative databases maintained by the U.S. military. The Defense Enrollment Eligibility Reporting System contains data on demographics (gender, race/ethnicity, age, marital status, dependents) and service characteristics (e.g., rank, branch, reserve or active duty status), and data from the Defense Manpower Data Center contains other service characteristics (occupation, separation date, and for the enlisted population, Armed Forces Qualification Test [AFQT] score and enlistment waiver status). The Contingency Tracking System identifies dates and locations deployments under Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF). TRICARE, the DoD health care system in which all service members are automatically enrolled,

provided clinical diagnoses of mental health conditions from all medical visits during years of service. Death data between 2001 and 2011 were obtained from the National Death Index for deaths within the US and from the Defense Casualty Analysis System for deaths overseas.

Outcome Measure

Our outcome was an indicator of whether an individual died by suicide anytime between 2001 and 2011, as identified by ICD-10 codes.

Potential predictors

Predictors with potentially time-varying effects were grouped as follows: *OEF/OIF deployment history*; *history of mental health diagnosis* (diagnosis of self-inflicted injuries [ICD-9 codes E950-E958], post-traumatic stress disorder [PTSD; ICD-9 code 309.81], major depression [ICD-9 296.2-296.3], substance use disorder [ICD-9 291–292 and 303–305], bipolar [ICD-9 296, except for 296.2-296.3 and 296.9], other psychotic diagnoses [290 293 294, and 296.9—299], anxiety [ICD-9 300], and all other mental health diagnoses [ICD-9 codes 310—319 not covered in previous categories]); *other potentially stressful events* (demotion and divorce); and *military career status* (on active duty, in the reserves, separated from service). We explicitly modeled time-since-exposure with indicators for exposure in either in the current quarter or in various groups of quarters in the past (e.g., the previous 3 quarters, 4 or more quarters ago).

Other predictors were grouped into the following categories*: type of waiver required for enlistment* upon failure to meet a given recruitment standard[21] (waiver for drug use, minor non-drug related offense, major non-drug related offense, or for failure to meet physical standards [e.g., above the maximum age, overweight, physical aliments]); *demographics* (age, gender,

race/ethnicity, marital status, and dependent quantity); *service variables* (branch, rank, AFQT score, and five broad categories of occupations: combat arms, combat service, service support, medical, or aviation). We created 5 categories of AFQT scores by percentile (0-30, 31-49, 50-64, 65-92, 93-100), and one category for the 18% of enlisted individuals with missing AFQT. Finally, we included an indicator for those who separated within 6 months of joining the military, a population known to have high risk of suicide.[2,22]

Statistical Methods

Following prior literature,[1,2] we estimated the hazard of suicide using the Cox proportional hazard model. We use the person-quarter as the unit of analysis and included all risk factors described above.[23] Individuals entered the risk window in either the first quarter of 2001 or the quarter they joined the military. Individuals left the risk window when they died. Individuals were censored either at the end of 2011 or at the quarter they died by means other than suicide.

All time-invariant exposure variable (gender, race, waiver status, and AFQT) did not fail tests of the proportional hazard assumption[24] except for AFQT categories. Our results are robust to either allowing the hazard of AFQT to vary over time or excluding AFQT from the model; results are also robust to using multiple imputation[25] on the 18% of enlisted population with missing AFQT. All analyses were performed using STATA version 14.

Results

Table 1 reports crude suicide rates and fully risk-adjusted hazard ratios for overall and selected subpopulations (Appendix Table 1 contains the complete results). Between 2001 and 2011, we observed 4,492 suicides, a crude suicide rate of 16.33 per 100,000 person-years. The crude

suicide rate in the adult US population (18 and older, including military) was 14.71 per 100,000 person-years.[26]

Conditional on other risk factors, deployments in support of OEF/OIF were associated with a reduced hazard of suicide *during* the quarter of deployment (HR=0.50; CI,0.40-0.61) but an elevated hazard in the quarters *after* deployment (HR=1.51 if deployed in the previous 3 quarters, CI,1.17-1.96; HR=1.14 if deployed 4 or more quarters ago, CI,1.06-1.23). Consistent with two recent studies,[1,2] when we used only an indicator for whether a person was ever deployed we found no significant association between deployment and suicide (HR=1.06; CI,0.98-1.14; see Appendix Table 2). Additional analyses showed that the positive relationship between deployment and the risk of suicide dissipates by 16 quarters post-deployment (Table 2). Although less precisely estimated, this decreasing trend was observed across all branches except for the Navy, where the hazard ratio increased over time.

By far the strongest predictors were diagnoses of self-inflicted injury: during the quarter in which an individual was diagnosed, the hazard of suicide death was 8.34 times higher than those with no history of self-inflicted injuries (CI,6.71-10.37). The hazard remained substantially elevated in all subsequent quarters (e.g., HR=3.12 if diagnosed 4 or more quarters ago; CI,2.28-4.28).

Current and past diagnoses of all other mental health diagnoses except for PTSD were also strongly associated with elevated risk of suicide death. For example, the hazard of suicide death from major depression ranged from 2.1 during the quarter an individual was diagnosed (CI,1.61-2.73) to 1.65 if diagnosed 4 or more quarters ago (CI,1.36-2.0); the equivalent hazard ratios for bipolar were 2.44 (CI 1.42-4.2) and 1.40 (CI 1.14-1.72), respectively. The regression-adjusted hazard of suicide is lower for those diagnosed with PTSD in past quarters, even though

the crude suicide rate of those ever diagnosed was higher for those who were never diagnosed. This is partly reflecting the fact that PTSD is often comorbid with other mental health conditions. In an additional analysis where we combined all mental health diagnoses, we found that the hazard ratios associated with having any mental health diagnosis were 3.44, 4.83, and 2.68 if diagnosed during current quarter, in the previous 3 quarters, and 4 or more quarters ago, respectively ($p<0.0001$ for all).

Enlisted personnel with a history of law violations, as measured by receiving an enlistment entry waiver for drug and non-drug related offenses, also had elevated hazards of suicide death. For example, relative to having no enlistment waiver, a waiver for a major, non-drug-related offense was associated with a 53 percent elevated hazard of suicide death (HR=1.53; CI,1.31-1.79). After controlling for mental health diagnoses while in service, enlistment waivers in the "other wavier" category - which includes waivers for past mental health problems - were not significantly associated with suicides. Stressful life events such as divorce (HR=1.48 if divorced in previous 3 quarters, CI,1.18-1.86; HR=1.33 if divorced 4 or more quarters ago, CI,1.14-1.55) and demotion in rank (HRs ranged from 1.49 [CI,1.27-1.76] during the quarter of demotion to 1.35 [CI,1.12-1.63] if demoted in previous 3 quarters) were both significantly associated with elevated hazards of suicide death. Hazards were also elevated after leaving military service: it was the highest during the first year of separation and remained significantly elevated in all subsequent years (HR ranged from 2.49 [CI,2.12-2.91] if separated during the current quarter to 1.63 [CI,1.45-1.82] if separated 6 or more years ago).

To investigate whether our results might be driven by differences between the deployed and never-deployed population, we re-estimated our model separately for these two groups. Table 3 shows that while mental health history is associated with elevated risks of suicide deaths

for both groups, the risk of suicide death is especially high among the deployed population that were diagnosed with self-inflicted injuries (HR=26.25 [CI, 18.83-36. 61] among deployed population versus 4.69 [CI, 3.49-6.3] among those never deployed). For both populations, the hazard of death by suicide is higher after separation, but the relationship is stronger in the never deployed sample.

We also estimated a separate model for veterans (i.e., those were alive and separated from the military). Table 4 shows that amongst veterans, having been deployed was weakly associated with a higher hazard of suicide after discharge from service (HR=1.09 if deployed 4 or more quarters ago; CI, 0.99-1.2). Mental health diagnoses continued to be strongly associated with suicide deaths amongst veterans (except for diagnoses of anxiety); however, stressful events occurring during the military career (divorce and demotion) did not appear to be significant risk factors. The hazard ratio of suicide death for those who had only served for 1 or 2 quarters at the time of separation was a staggering 12.00 (CI, 7.78-18.52). This high risk factor could be reflecting either the impact of the military training environment or that this population was pre-disposed to commit suicide before joining the military.

The nature of occupations and deployments varies widely across the Army, Navy, Air Force, and Marine Corps. Appendix Table 5 shows that hazard ratios were generally similar in magnitude across branches, but less precisely estimated due to smaller sample sizes.

Sensitivity analyses confirmed that our conclusions are robust to several changes in model specification. For example, similar to prior studies, we found that the elevated risk of suicide post-deployment is similar regardless of whether it was the first or a subsequent deployment. Nor did we find the hazards to differ by locations of deployment (Afghanistan and Iraq versus other OEF/OIF locations).[2,14,27]

Concentration of risk

Based on our main model, we generated a predicted probability of suicide death for each person-quarter. We rank-ordered these predicted values, grouped them into twenty ventiles, and plotted the fraction of suicide deaths occurring in each ventile (Figure 1). The risk of suicide death is rather concentrated: 25% of all suicides are in the 20th ventile (i.e., those person-quarters with the highest predicted risk). Doing this exercise separately for the never- and ever-deployed populations, risk is even more concentrated for the deployed population, with close to 30% of suicides occurring in the 20th ventile.

Discussion

Our analysis contributes several important insights to the literature. First, two recent papers find combat deployments were not associated with suicide death.[1,2] However, our empirical specification is more nuanced by using quarterly rather than yearly data and separating those *during* combat deployment from those who *returned from* a combat deployment. We find a striking result: while on deployment hazards of suicide death were *lower* than the never-deployed population, but significantly *higher* upon returning from deployment (particularly in the first 3-7 quarters post-deployment and remained elevated 16 quarters post-deployment). This finding may reflect the positive psychological impact of belonging to a group with a definitive purpose, and is consistent with evidence of the delayed onset of psychological disorders.[28,29] Thus, our results support the recent mandate in the 2012 National Defense Authorization Act to continue screening up to 18-30 months post-deployment.

Second, using clinical records, our study highlighted the importance of a broad array of

underlying mental disorders as significant risk factors of suicide. While recent efforts to screen for suicide risk exclusively among patients with major depression might identify many of those at risk, our results showed that such a narrow focus might not be adequate, and there is a need for a broad array of stigma reduction efforts and for health care systems to ensure that there is adequate capacity for treatment.

Third, we found that those with a history of law violations had a significantly higher hazard of suicide. This result indirectly confirms the rationale behind restrictions on enlistments for these individuals, and suggests there is a cost associated with the policy of offering these enlistment waivers. However, it was notable that once we control for mental disorder diagnoses while in service, receiving a waiver for other reasons (which include waivers for having mental disorders) was not associated with increased risk. Mental disorder waivers may be granted for milder conditions that have resolved. Furthermore, individuals who were willing to report past mental health problem during waiver process are likely very different than individuals who had conditions that were unrecognized or for which information was deliberately withheld.

Finally, we showed that the risk of suicide almost tripled during the first year after separation from the military and remained elevated even after 6 years of separation. In addition, we found that the risk of suicide was 12 times higher amongst those who only served for a short time (6 months) before separating. The elevated risk of suicide could reflect the lingering effects of stressful military experiences, the difficulties of reintegrating into civilian life, or a pre-enlistment disposition to commit suicide. Unfortunately our model cannot identify the underlying causes of these associations, but identifying these causes is an important area for future research.

Our study has several limitations. First, we did not observe mental health diagnoses after

separation from service; this classical measurement error likely biases hazard ratios towards one. Second, our TRICARE data may not capture all incidents of mental health disorders, due to stigma associated with mental health problems in the military. If undiagnosed cases of mental health disorders are positively correlated with suicide (as were the observed diagnoses), our estimates are lower bounds of the true relationships. Third, we did not observe deployments other than under OEF/OIF (e.g, deployments in other regions) nor activation status for reservists called up for reasons unrelated to OEF/OIF. To the extent that these events were similar in nature to those under OEF/OIF, these missing data would bias hazard ratios towards one. Fourth, we did not address how dwell time in between deployments may affect the association of deployment with suicide death. Finally, there are many non-military life stressors that we do not observe (e.g. financial stability, housing, employment status) which may be the underlying causal mechanisms behind the relationships we estimate. This is especially important amongst veterans.

Despite these limitations, we found that nearly 25% of suicide deaths occurred in the highest ventile of predicted suicide risk, similar to the concentration found among veterans who had recently used VA health services.[30] Given the substantial increase in military suicides after separation, it seems clear that future efforts focused on suicide risk among veterans need to capture a more complete mental health history from additional sources, such as the Department of Veterans Affairs (VA) and/or private insurers, as well as capture major life events both during and after the service member left service, in order to increase concentration of risk in refined prediction models that could be used for targeted outreach with high-risk veterans.

Conclusions

Suicide among current and former service members continues to be a pressing issue. By examining a comprehensive set of risk factors, we have three major findings. First, the strongest risk factors of suicide were prior incidents of self-inflicted injuries and previously diagnosed mental health disorders. Second, we refined our understanding of the association between deployment and suicide through our findings that the risk of suicide was lower during deployment, increased substantially during the first 7 quarters post-deployment, and remained elevated up to 4 years post-deployment. Third, we found suicide risk was very high among those who were separated during the initial training period; and, conditional on time-in-service, the risk of suicide death remained high after separation from service for all veterans.

Finally, despite the wealth of data at our disposal, our understanding of the risk factors of suicide could still be improved with more comprehensive data, particularly for veterans. Such data are crucial if we were to use prediction models to target the most at-risk service members and veterans for preventive interventions.

Research in context

Evidence before this study

We performed an exhaustive search of the literature using the keywords "suicide," "risk factors," "military," and "deployment" in PubMED, EconLit, and Google Scholar. Furthermore, we reviewed all references in any relevant articles. Past experience has proven that US Department of Defense (DoD) published reports are sometimes not catalogued in these databases, and so we performed an independent search in the Defense Technical Information Center (DTIC) using the same keywords.

Most of the prior literature on this topic did not compare suicide decedents with non-decedents, a comparison that is necessary in order to make individual-level risk projections; and many of the studies that made such comparisons focused only on a subset of service members or used a non-representative sample of service members. Research that examines risk factors for all military suicides is rare and has not examined the role of prior diagnosed mental disorders in predicting subsequent suicide death despite the fact that strong associations of these predictors with suicides have been found other populations. Furthermore, while some previous military studies have implicitly assumed that the association of combat deployment with suicide is the same during and after deployment, other research suggests that this assumption might be inaccurate.

Added value of this study

We addressed the above limitations by using a more comprehensive set of potential predictors of suicide deaths among service members than did previous studies. We showed that wide ranges of mental health diagnoses, whether currently diagnosed or diagnosed in the past, are strong predictors of suicide death. Our study also found that the risk of suicide remained elevated long after the occurrence of stressful events, such as after returning from combat deployment, divorce, demotion, and separation from the military.

Implications of all the available evidence

Our findings have two main implications for public health efforts to reduce the incidence of suicide. First, clinicians should be aware that deployments may increase suicide risk independently of underlying mental disorders, and so asking patients about deployment history is advisable. Second, our results highlight the importance of using comprehensive data in the development of prediction models that can target the most at-risk service members and veterans for the implementation of preventive interventions. The clinical community is a key component for increased coordination between DoD and Veterans Affairs Administration to develop exhaustive, integrated data sharing efforts. Partnerships between DoD, VA, and clinicians can provide effective targeting of high-risk individuals while coupling with efforts to expand and optimize preventive and clinical interventions based on knowledge of these high-risk targets.

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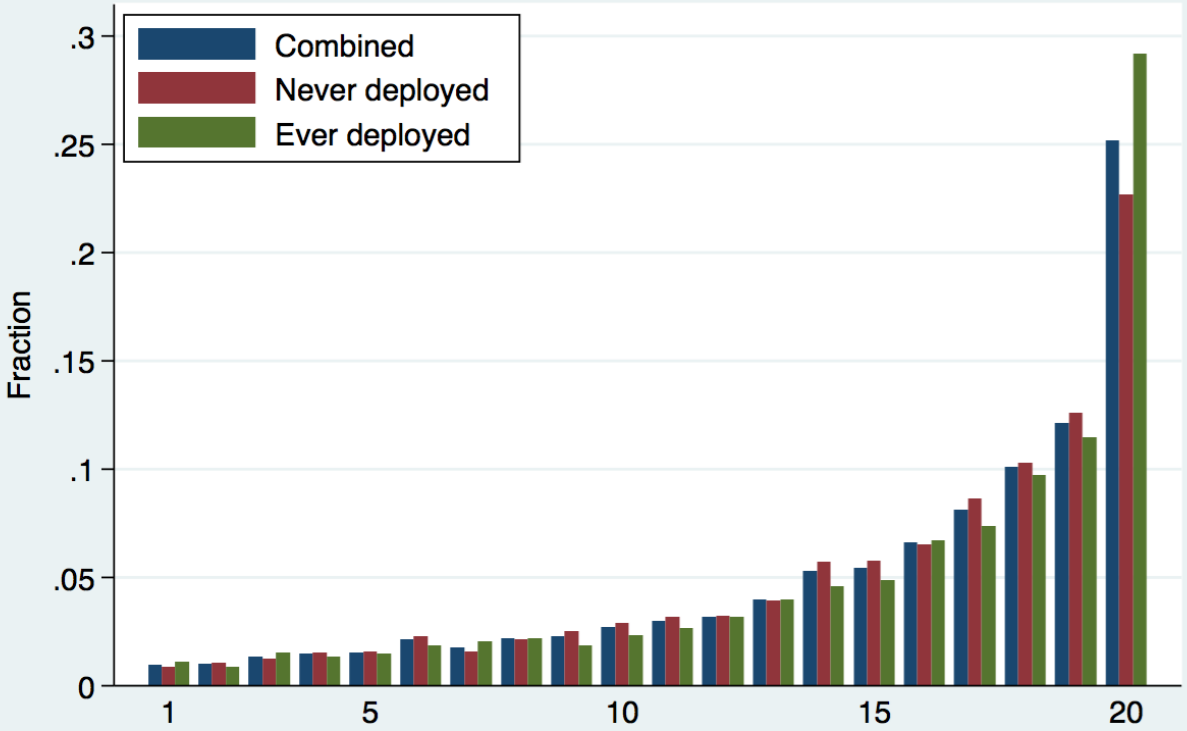
Figure 1. Legend. Fraction of total suicides, by ventile of the predicted hazard of suicide.



Note: Each bar shows the percent of suicides out of the entire population within each ventile of the predicted hazard of suicide. The predicted hazard of suicide is calculated from the fully regression adjusted Cox proportional hazard model in Appendix Table 2. Five percent of the sample is contained in each ventile, with the 1st ventile representing those with the lowest predicted hazard of suicide.

Table 1. Suicide counts, rates, and hazard ratios, overall and by select categories.

	Person-quarter observations	Suicide deaths	Suicide rate (per 100,000 person-quarters)[1]	Fully regression adjusted hazard ratio of suicide death[2]	
				HR	95% CI
All personnel (N=3,795,823)	110,035,573	4,492	(4.08)		
OEF/OIF deployment status					
Not deployed	69,590,523	2,760	(3.97)	1.00	
Deployed during the current quarter	8,970,422	110	(1.23)	0.50**	[0.41,0.61]
Deployed in the previous 3 quarters	1,781,499	62	(3.48)	1.51**	[1.17,1.96]
Deployed 4 or more quarters ago	29,693,129	1,560	(5.25)	1.14**	[1.06,1.23]
Mental health diagnoses					
Self-inflicted injuries					
Never diagnosed	109,718,289	4,275	(3.90)	1.00	
Diagnosed during the current qtr	81,014	104	(128.37)	8.34**	[6.71,10.37]
Diagnosed in the previous 3 qtrs	130,066	70	(53.82)	2.77**	[2.15,3.57]
Diagnosed 4 or more quarters ago	106,204	43	(40.49)	3.12**	[2.28,4.28]
Post Traumatic Stress Disorder (PTSD)					
Never diagnosed	108,126,634	4,258	(3.94)	1.00	
Diagnosed during the current qtr	204,686	21	(10.26)	0.82	[0.53,1.28]
Diagnosed in the previous 3 qtrs	660,480	105	(15.90)	0.81*	[0.65,1.00]
Diagnosed 4 or more quarters ago	1,043,773	108	(10.35)	0.63**	[0.51,0.78]
Major depression					
Never diagnosed	107,978,303	4,139	(3.83)	1.00	
Diagnosed during the current qtr	253,485	67	(26.43)	2.10**	[1.61,2.73]
Diagnosed in the previous 3 qtrs	730,041	151	(20.68)	1.76**	[1.46,2.11]
Diagnosed 4 or more quarters ago	1,073,744	135	(12.57)	1.65**	[1.36,2.00]
Substance use disorder					
Never diagnosed	109,063,734	4,236	(3.88)	1.00	
Diagnosed during the current qtr	152,727	36	(23.57)	1.27	[0.90,1.80]
Diagnosed in the previous 3 qtrs	391,620	119	(30.39)	1.74**	[1.42,2.13]
Diagnosed 4 or more quarters ago	427,492	101	(23.63)	2.19**	[1.77,2.71]
Bipolar disorder					
Never diagnosed	109,336,460	4,328	(3.96)	1.00	
Diagnosed during the current qtr	34,067	15	(44.03)	2.44**	[1.42,4.20]
Diagnosed in the previous 3 qtrs	99,366	39	(39.25)	2.08**	[1.47,2.94]
Diagnosed 4 or more quarters ago	565,680	110	(19.45)	1.40**	[1.14,1.72]
Other psychotic disorders					
Never diagnosed	108,680,682	4,219	(3.88)	1.00	
Diagnosed during the current qtr	77,796	19	(24.42)	1.68*	[1.03,2.73]
Diagnosed in the previous 3 qtrs	218,423	66	(30.22)	1.94**	[1.47,2.56]

Diagnosed 4 or more quarters ago	1,058,672	188	(17.76)	1.51**	[1.28,1.78]
Anxiety disorder					
Never diagnosed	108,581,727	4,211	(3.88)	1.00	
Diagnosed during the current qtr	83,633	23	(27.50)	1.46	[0.93,2.29]
Diagnosed in the previous 3 qtrs	233,685	66	(28.24)	1.34*	[1.01,1.77]
Diagnosed 4 or more quarters ago	1,136,528	192	(16.89)	1.01	[0.85,1.19]
Other mental health diagnoses					
Never diagnosed	98,855,501	3,192	(3.23)	1.00	
Diagnosed during the current qtr	560,032	72	(12.86)	2.34**	[1.81,3.04]
Diagnosed in the previous 3 qtrs	1,607,874	240	(14.93)	3.43**	[2.94,4.01]
Diagnosed 4 or more quarters ago	9,012,166	988	(10.96)	2.10**	[1.92,2.30]
Enlistment waivers					
No waiver	98,225,938	3,781	(3.85)	1.00	
Minor, non-drug-related offense	570,906	42	(7.36)	1.46*	[1.07,1.98]
Major, non-drug-related offense	3,412,507	279	(8.18)	1.53**	[1.35,1.73]
Drug related waiver	955,266	86	(9.00)	1.28*	[1.03,1.59]
Other type of waiver	6,870,956	304	(4.42)	0.98	[0.87,1.11]
Potentially stressful life events					
Divorce					
Not divorced	101,777,439	4,132	(4.06)	1.00	
Divorced during the current qtr	727,729	32	(4.40)	1.27	[0.90,1.81]
Divorced in the previous 3 qtrs	1,794,328	82	(4.57)	1.48**	[1.18,1.86]
Divorced 4 or more quarters ago	5,736,077	246	(4.29)	1.33**	[1.14,1.55]
Demotion					
Not demoted	104,331,475	4,006	(3.84)	1.00	
Demoted during the current qtr	1,673,687	173	(10.34)	1.49**	[1.27,1.76]
Demoted in the previous 3 qtrs	1,315,952	116	(8.81)	1.35**	[1.12,1.63]
Demoted 4 or more quarters ago	2,714,459	197	(7.26)	1.13	[0.97,1.31]
Career status					
On active duty	59,141,217	1,771	(2.99)	1.00	
In the reserve component	4,498,195	109	(2.42)	0.60**	[0.50,0.74]
Left service (by time since separation)					
Separated during the current qtr	2,200,215	176	(8.00)	2.49**	[2.12,2.91]
Separated in the previous 3 qtrs	6,281,817	424	(6.75)	2.64**	[2.37,2.95]
Separated b/w 1 and 3 years ago	14,473,331	923	(6.38)	2.48**	[2.27,2.71]
Separated b/w 4 and 5 years ago	11,156,160	572	(5.13)	1.88**	[1.70,2.09]
Separated 6 or more years ago	12,284,638	517	(4.21)	1.63**	[1.45,1.82]
Time in service at the time of separation					
More than 2 quarters of service	109,830,396	4,375	(3.98)	1.00	
1 or 2 quarters of service	205,177	117	(57.02)	1.70**	[1.39,2.08]
Enlisted	94,457,652	4,233	(4.48)	1.00	

Officer	15,577,921	259	(1.66)	0.82	[0.63,1.07]
Military branch					
Army	46,383,748	2,087	(4.50)	1.00	
Marine Corps	16,678,619	841	(5.04)	1.03	[0.94,1.12]
Navy	21,807,297	747	(3.43)	0.58**	[0.53,0.64]
Air Force	25,165,909	817	(3.25)	0.94	[0.86,1.02]

Notes: + p<0.1 *p<0.05 ** p<0.01

[1] The crude suicide rate per 100,000 person-quarters is calculated as the number of suicide deaths per quarter divided by the total person-quarters times 100,000.

[2] The regression adjustment is via a Cox proportional hazard model which includes all variables presented in this table as well as the following additional variables: gender, race, age, marital status, dependent quantity, rank, Armed Forces Qualifying Test (AFQT) percentile, military occupational specialty. Summary statistics of these additional variables are included in Appendix 1 and the complete survival analysis results are included in Appendix Table 2.

Table 2. The longer term association of past deployments with suicide, overall and by service branch

Sample =	Whole sample		Army		Marines		Navy		Air Force	
Outcome =	Suicide deaths		Suicide deaths		Suicide deaths		Suicide deaths		Suicide deaths	
	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI	Hazard ratio	95% CI
OEF/OIF deployment status										
Not deployed										
Deployed during the current quarter	0.51**	[0.41,0.62]	0.40**	[0.30,0.53]	0.36**	[0.21,0.64]	1.35	[0.86,2.11]	0.50**	[0.30,0.82]
Deployed in the previous 3 quarters	1.54**	[1.19,2.00]	1.68*	[1.05,2.70]	1.62	[0.87,3.00]	0.98	[0.52,1.86]	2.19**	[1.42,3.40]
Deployed in the previous 4-7 quarters	1.44**	[1.26,1.65]	1.56**	[1.30,1.87]	1.36+	[0.98,1.88]	1.11	[0.73,1.70]	1.10	[0.76,1.59]
Deployed in the previous 8-11 qtrs	1.18*	[1.03,1.36]	1.14	[0.93,1.40]	1.12	[0.81,1.57]	1.24	[0.85,1.79]	0.94	[0.65,1.38]
Deployed in the previous 12-15 qtrs	1.20**	[1.05,1.38]	1.04	[0.85,1.28]	1.29	[0.95,1.76]	1.46*	[1.05,2.02]	1.02	[0.70,1.47]
Deployed in the previous 16+ qtrs	1.03	[0.93,1.12]	0.89	[0.78,1.03]	1.03	[0.82,1.29]	1.14	[0.93,1.39]	0.99	[0.80,1.23]
Number of observations	110,035,573		46,383,748		16,678,619		21,807,297		25,165,909	
Number of service members	3,795,823		1,648,313		605,211		739,647		802,716	

Notes: + p<0.1 *p<0.05 ** p<0.01
The rest of the model specification is identical to those reported in Table 1.

Table 3. Selected hazard ratios of suicide, by deployment history.

	Sample =	Never deployed		Ever deployed	
	Outcome =	Suicide deaths		Suicide deaths	
		Hazard ratio	95% CI	Hazard ratio	95% CI
OEF/OIF Deployment status					
Deployed during the current quarter				1.00	
Deployed in the previous 3 quarters				8.25**	[5.96,11.42]
Deployed 4 or more quarters ago				8.39**	[6.65,10.58]
Mental health					
Self-inflicted injuries					
Diagnosed during the current quarter		4.69**	[3.49,6.30]	26.25**	[18.83,36.61]
Diagnosed in the previous 3 quarters		2.31**	[1.68,3.17]	3.78**	[2.48,5.76]
Diagnosed 4 or more quarters ago		2.86**	[1.81,4.53]	3.65**	[2.36,5.63]
Post Traumatic Stress Disorder (PTSD)					
Diagnosed during the current quarter		0.77	[0.36,1.63]	0.66	[0.37,1.18]
Diagnosed in the previous 3 quarters		0.76	[0.51,1.12]	0.91	[0.69,1.19]
Diagnosed 4 or more quarters ago		0.67*	[0.45,0.99]	0.68**	[0.52,0.88]
Major depression					
Diagnosed during the current quarter		2.23**	[1.62,3.06]	1.65*	[1.02,2.65]
Diagnosed in the previous 3 quarters		1.89**	[1.52,2.36]	1.38*	[1.00,1.90]
Diagnosed 4 or more quarters ago		1.69**	[1.31,2.18]	1.56**	[1.17,2.08]
Substance use disorder					
Diagnosed during the current quarter		1.42	[0.93,2.16]	0.83	[0.46,1.53]
Diagnosed in the previous 3 quarters		1.69**	[1.30,2.20]	1.66**	[1.21,2.27]
Diagnosed 4 or more quarters ago		2.09**	[1.53,2.85]	2.20**	[1.64,2.97]
Bipolar disorder					
Diagnosed during the current quarter		2.29*	[1.09,4.81]	2.44*	[1.10,5.41]
Diagnosed in the previous 3 quarters		1.54+	[0.95,2.52]	2.79**	[1.70,4.57]
Diagnosed 4 or more quarters ago		1.36*	[1.06,1.74]	1.39+	[0.96,2.01]
Other psychotic disorders					
Diagnosed during the current quarter		1.19	[0.54,2.62]	1.74+	[0.93,3.26]
Diagnosed in the previous 3 quarters		1.99**	[1.36,2.91]	1.66*	[1.10,2.49]
Diagnosed 4 or more quarters ago		1.64**	[1.34,2.02]	1.28+	[0.97,1.68]
Anxiety disorder					
Diagnosed during the current quarter		1.50	[0.78,2.86]	1.19	[0.64,2.24]
Diagnosed in the previous 3 quarters		1.12	[0.75,1.67]	1.46+	[0.99,2.17]
Diagnosed 4 or more quarters ago		1.17	[0.95,1.43]	0.79	[0.59,1.06]
Other mental health diagnoses					

Diagnosed during the current quarter	1.59*	[1.11,2.27]	3.55**	[2.42,5.20]
Diagnosed in the previous 3 quarters	3.84**	[3.16,4.65]	2.41**	[1.87,3.11]
Diagnosed 4 or more quarters ago	1.99**	[1.77,2.22]	2.05**	[1.78,2.37]
Enlistment waivers				
Minor, non-drug-related offense waiver	1.38	[0.92,2.06]	1.57+	[0.99,2.51]
Major, non-drug-related offense waiver	1.62**	[1.37,1.90]	1.39**	[1.15,1.69]
Drug related waiver	1.32*	[1.01,1.74]	1.16	[0.81,1.66]
Other type of waiver	0.95	[0.82,1.11]	1.00	[0.83,1.20]
Potentially stressful life events				
Divorce				
Divorced during the current quarter	1.24	[0.77,2.00]	1.33	[0.80,2.21]
Divorced in the previous 3 quarters	1.29	[0.92,1.81]	1.60**	[1.16,2.19]
Divorced 4 or more quarters ago	1.41**	[1.12,1.76]	1.19	[0.96,1.48]
Demotion				
Demoted during the current quarter	1.53**	[1.25,1.86]	1.29	[0.95,1.75]
Demoted in the previous 3 quarters	1.13	[0.87,1.47]	1.56**	[1.18,2.08]
Demoted 4 or more quarters ago	1.07	[0.86,1.34]	1.14	[0.93,1.39]
On active duty			1.00	
In the reserve component	0.54**	[0.42,0.69]	0.71*	[0.51,0.98]
Time since separation				
Separated during the current quarter	1.83**	[1.49,2.26]	2.06**	[1.63,2.62]
Separated in the previous 3 quarters	2.42**	[2.10,2.79]	1.62**	[1.36,1.94]
Separated between 1 and 3 years ago	2.28**	[2.04,2.55]	1.54**	[1.34,1.77]
Separated between 4 and 5 years ago	1.67**	[1.46,1.91]	1.29**	[1.09,1.53]
Separated 6 or more years ago	1.42**	[1.23,1.63]	1.26*	[1.03,1.53]
Number of observations		55,568,783		54,466,790
Number of service members		2,053,250		1,742,465

Notes: + p<0.1 *p<0.05 ** p<0.01. Model specifications are the same as those in Table 1, except for the omission of deployment variables for the never deployed sample. Complete survival analysis results are included in Appendix 3.

Table 4. Selected hazard ratios of suicide, sample of separated individuals.

	Sample =	Separated as of 2011 (only quarters since separation)	
	Outcome =	Suicide deaths	
		Hazard ratio	95% CI
OEF/OIF deployment status			
Never deployed		1.00	
Deployed in the previous 3 quarters		0.66	[0.27,1.59]
Deployed 4 or more quarters ago		1.09+	[0.99,1.20]
Mental health diagnoses while in service			
Ever diagnosed with self-inflicted injuries		2.31**	[1.84,2.89]
Ever diagnosed with Post Traumatic Stress Disorder (PTSD)		0.70**	[0.57,0.86]
Ever diagnosed with major depression		1.71**	[1.45,2.01]
Ever diagnosed with a substance use disorder		1.82**	[1.52,2.19]
Ever diagnosed with bipolar disorder		1.31*	[1.05,1.65]
Ever diagnosed with any other psychotic disorder		1.58**	[1.32,1.89]
Ever diagnosed with anxiety disorder		1.16	[0.97,1.40]
Ever diagnosed with any other mental health condition		1.73**	[1.56,1.92]
Enlistment waivers			
Minor, non-drug-related offense waiver		1.25	[0.82,1.91]
Major, non-drug-related offense waiver		1.53**	[1.31,1.79]
Drug related waiver		1.13	[0.86,1.48]
Other type of waiver		0.97	[0.83,1.13]
Potentially stressful life events while in service			
Ever divorced		1.09	[0.91,1.30]
Ever demoted		1.13+	[1.00,1.29]
Time in service at the time of separation			
1 or 2 quarters of service		12.00**	[7.78,18.52]
3 to 8 quarters of service		1.14*	[1.01,1.29]
9 to 16 quarters of service		1.16**	[1.04,1.30]
More than 16 quarters of service		1.00	
Time since separation			
Separated during the current quarter		0.14**	[0.12,0.18]
Separated in the previous 3 quarters		1.72**	[1.49,1.98]
Separated between 1 and 3 years ago		1.56**	[1.39,1.76]
Separated between 4 and 5 years ago		1.19**	[1.05,1.35]
Separated 6 or more years ago		1.00	
Number of observations		46,396,161	
Number of service members		2,202,937	

Notes: + p<0.1 *p<0.05 ** p<0.01 Complete survival analysis results are included in Appendix 4.