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PTSD and Death from Suicide

Understanding the causes of death from suicide has been the subject of scientific research for decades. In recent years, the increasing suicide rates among Veterans and active duty military members has brought predictors of suicide with specific relevance to these populations to the forefront of the research in this area (e.g., PTSD). Most of this work has focused on PTSD and suicidal ideation or suicide attempt, and provided evidence for these associations (see Additional Citations for a brief summary of some well-done studies in this area). Research on predictors of suicidal behavior like ideation and attempts is critical; however, it does not necessarily provide information about the association between PTSD and death from suicide. This distinction is important because only about 15% of people who survive a suicide attempt go on to eventually die by suicide and, further, there are well-known differences in the risk factors for these events (e.g., gender). The more limited body of work on death from suicide is in part a result of challenges inherent to studying suicide in general (e.g., rarity of the event on a population level, difficulty in predicting who will die by suicide even in a high-risk sample, need for data collected prior to death) and, accordingly, a large portion of our knowledge in this area has come from epidemiologic studies using registry-based data. Interestingly, while some studies provide clear evidence that PTSD increases risk for death from suicide several studies have found evidence of a protective effect (i.e., PTSD *decreases* risk of death from suicide), thus resulting in a debate regarding the true magnitude and direction of this association. Further complicating this issue is the effect of comorbid psychopathology (e.g., depression) on this association, which has been inconsistently considered across studies. Depression in particular is known to be highly comorbid with PTSD and is also a strong risk factor for death from suicide and thus may act as a confounder, mediator, or modifier of this association, or any combination of the three. In this overview, we will summarize the state of the literature on the association between PTSD and death from suicide across civilian, active duty, and Veteran populations.

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This guide to the literature focuses exclusively on risk factors for death from suicide and will not discuss the voluminous literature on risk factors for suicidal ideation, plans, or unsuccessful attempts. In the final sections, we discuss possible etiologic and methodologic causes of the disparate findings to date, and present possibilities for future research which may help elucidate this complex association.

Point: PTSD increases risk for death from suicide

Although few studies have examined the association between PTSD and suicide among civilian samples, the work that has been done has documented consistent evidence of a strong association, even while accounting for pre-existing psychiatric comorbidity (Gradus et al., 2010; Gradus et al., 2015). One study examined all suicide deaths from 1994–2006 using the Danish national healthcare and social registries, and found that persons with PTSD had 5.3 times the rate of death from suicide than persons without PTSD, after adjustment for gender, age, marital status, income, and pre-existing depression diagnoses ($n = 208,918$). A subsequent study examined death from suicide among all persons diagnosed with PTSD in Denmark from 1995–2011 and found that after adjustment for demographics and pre-existing comorbid psychiatric diagnoses, persons with PTSD had 13 times the rate of suicide than persons without PTSD ($n = 22,716$).

The association between PTSD and suicide is particularly relevant to military members and Veterans, and given the availability of registry-based data on these populations most of the research in this area has been conducted within these populations. A handful of studies have documented an association between PTSD and suicide in active duty military members, but these studies did not examine comorbid psychopathology. In the entire active duty military population in 2005 ($n = 2,064,183$) and 2007 ($n = 1,981,810$) evidence of an association between PTSD and suicide was found in Army and

Continued on page 2



U.S. Department
of Veterans Affairs

Air Force members in both years, with effects ranging in magnitude from 1.9 to over 10. Sample sizes were too small to calculate an association for service members in the Marines or Navy (Hyman, Ireland, Frost, & Cottrell, 2012). Among US Army service members from 2001–2009 those who died by suicide ($n = 874$) were almost 13 times more likely to have received a diagnosis of PTSD compared to all Army service members in the same time period (Black, Galloway, Bell, & Ritchie, 2011). These findings were corroborated in a smaller study of risk factors for suicide in the US Army from 2007–2008 ($n = 255$) in which persons with PTSD had 6 times the rate of suicide than those without PTSD (Bachynski et al., 2012). Using data from the Millennium Cohort Study ($n = 151,560$) that included current and former military personnel, LeardMann and colleagues (2013) found a sex- and age-adjusted association for PTSD and suicide of 1.8. Despite this evidence of an 80% increase in suicide risk among people with PTSD, this association was not statistically significant, likely due to sample size, and thus PTSD was not further examined in multivariate models.

Some of the earliest and most expansive epidemiologic studies on PTSD and death from suicide have been conducted among Veterans, and these have used varying methods to examine comorbid psychopathology. Among Vietnam-era Veterans included in the Department of Veterans Affairs (VA) Agent Orange Registry (Bullman & Kang, 1994), Veterans with PTSD ($n = 4,247$) had an approximately 4 times higher suicide rate than Veterans without PTSD ($n = 12,010$), adjusting only for age and race. This study did not adjust for other psychiatric disorders analytically, but, in a separate analysis, did examine the association between PTSD and suicide among 3,246 Veterans who had no comorbid diagnoses, thus, controlling for comorbidity through restriction. Among these Veterans the suicide rate was almost 6 times as high as the expected rate in general population US males.

Since this early study, several other epidemiologic studies have documented an association between PTSD and suicide in Veteran samples, primarily Veterans who use VA services, but with varying methods to assess comorbid psychopathology. Ilgen et al. (2010) examined the rate of suicide from fiscal year (FY) 1999 to FY 2006 among all Veterans who used VA care in FY 1999 ($n = 3,291,891$). Adjusting for age, male Veterans with PTSD had 1.8 times the rate of suicide than male Veterans without PTSD, while female Veterans with PTSD had 3.5 times the rate of suicide than female Veterans without PTSD. A subsequent study by Ilgen and colleagues (2012), examined all Veterans who received Veterans Health Administration (VHA) services during FY 2007 or FY 2008 ($n = 5,772,282$) and found a main effect for the association between PTSD and suicide among these Veterans, adjusting for sex, age, and VISN. Despite the contribution of this work to our understanding of this association, neither study examined the effect of comorbid psychiatric diagnoses on these associations. Further, it is unclear how this work might generalize to Veterans who do not use VA services.

These studies were followed by work from Conner et al. (2013) that explicitly examined psychiatric disorder comorbidity and suicide in all male patients who used VA services in FY 1999 ($n = 2,962,810$). Patients with PTSD and any psychiatric comorbidity had 2.6 times the rate of suicide than those with no psychiatric diagnoses. Similar to the previous work by Bullman and Kang (1994), the authors then conducted analyses which were restricted to patients with PTSD diagnosis and no comorbidity and, thus, controlled for potential confounding by psychiatric comorbidity through restriction.

Those with PTSD and no other psychiatric disorders had 1.6 times the rate of suicide than male Veterans without any psychiatric diagnoses. Subsequently, in the largest study to date focused specifically on PTSD and suicide, Conner and colleagues (2014) examined VHA patients from FY 2007–2008 ($n = 5,913,648$). In unadjusted analyses and demographically-adjusted analyses PTSD was associated with suicide with odds ratios that were all approximately 1.3. However, after adjustment for comorbid psychiatric diagnoses this association was reduced to 0.77, indicating a protective effect of PTSD on suicide.

Counterpoint: PTSD is protective against death from suicide

Given what we know about the potential negative, long-term consequences of PTSD and evidence of an association between PTSD and suicide, a study demonstrating a protective effect for the association between PTSD and suicide may seem counterintuitive or perhaps like a spurious finding. However, the 2014 study by Conner and colleagues is not the only one that has documented this association in this direction. A study of all US military personnel from 2001–2011 ($n = 3,795,823$) examined suicide during military service or post-separation and found a protective effect of PTSD across a range of time periods between diagnosis and death (effect estimates ranged from 0.63 to 0.82) compared to persons with no PTSD diagnoses (Shen, Cunha, & Williams, 2016). These estimates were adjusted for demographics, military variables, and comorbid psychopathology. In the Army STARRS study, the largest and most sophisticated study of risk factors for suicide among military members to date, a protective effect was found for the association between PTSD diagnosis during hospitalization and suicide after psychiatric hospitalization in 53,769 soldiers between 2004–2009 using novel machine learning methods that incorporated predictors from multiple domains including various forms of psychopathology (Kessler et al., 2015). The authors of the study do caution, however, that when building their models they prioritized the accuracy of the overall model, rather than the accurate estimation of each individual association, so the associations should be interpreted with caution.

Among Veterans, Desai, Dausey, and Rosenheck (2008) found that among VA patients who were discharged from an inpatient unit between 1994–1998 ($n = 1,057$) PTSD was protective against death from suicide when adjusting for demographics and psychiatric comorbidity (adjusted risk ratio = 0.62). Similarly, in a study of all male Veterans discharged from VA inpatient units from FY 2005 to FY 2010 ($n = 346,662$) the association between PTSD and suicide was 0.66 for the year following discharge, after adjustment for demographics and psychiatric comorbidity (Britton et al., 2017). Zivin and colleagues (2007) examined PTSD and suicide among VA patients receiving treatment for depression from 1999–2004 ($n = 807,694$) and also found the association between PTSD and suicide to be protective (adjusted hazard ratio = 0.77).

Understanding disparate findings

Although most studies have documented that PTSD is associated with an increased risk for suicide, more than a few well-done studies have found a protective association. Why this is remains an open and important question. Potential explanations span etiologic and methodologic reasoning. A large and obvious discrepancy between the studies in each category has to do with the assessment of psychiatric comorbidity. Most of the studies that provide evidence of

an association did not adjust for comorbidity, with the exception of the civilian research and the Veteran studies that adjusted through restriction. Studies that document an association without accounting for psychiatric comorbidity may report estimates that are inflated away from the null (due to lack of adjustment for these potential confounders); however, studies that did adjust for other psychopathology, particularly depression, provide compelling evidence of an association.

Conversely, studies that documented a protective effect either adjusted for psychiatric comorbidity statistically or examined study populations with high levels of psychopathology. While it is hard to imagine that PTSD actually protects individuals from death from suicide, it is possible that such findings were the result of methodological choices or biases. For example, depression and its symptoms frequently co-occur with PTSD. In samples with high levels of comorbid PTSD and depression statistical adjustment for depression would obscure the part of the effect of PTSD on suicide that is due to this comorbidity. This adjustment would drive observed associations towards the null (e.g., that PTSD has no effect on death by suicide) and perhaps beyond it to demonstrate a protective effect. In fact, when strictly adhering to traditional epidemiologic methods, adjustment for a variable that is on the “causal pathway” between a predictor of interest and an outcome (i.e., PTSD -> Depression -> Suicide) is not recommended because these variables are thought to play an etiologically important role that is worthy of description rather than adjustment. In addition, in studies conducted entirely among samples with psychopathology (e.g., patients with depression or patients discharged from inpatient units), numerically smaller effects may be observed due to the use of a very high-risk study population. In these studies, the risk of suicide conferred by PTSD may not be enough to demonstrate an increased association, when compared to the very elevated suicide risk among a reference group with depression and/or other forms of psychopathology. The use of a high-risk reference group could make ratio measures of effect appear null or even protective if the predictor of interest has a weaker association with the outcome than the other risk factors that characterizes the study sample.

Perhaps all results are evidence of different pieces of truth – that there are cross-population differences in the magnitude and direction of the association between PTSD and suicide. For that matter, there are likely within population differences in this association due to individual factors (e.g., gender or race/ethnicity – interestingly, the civilian studies which provide evidence for an association included a larger proportion of women than the active duty and Veteran studies). Epidemiologic research is critical for understanding the health of populations and documenting the need for resources. Yet, it is important to remember that one observed effect is an aggregation of likely varying effects that differ by people, places, and time included in one study. An important focus of future research will be to examine for whom PTSD is a risk factor for suicide and under what circumstances risk is potentiated. Further, future work will need to include rigorous and advanced methods to examine the many simultaneous and complicated roles of comorbid psychopathology can play in this association (e.g., marginal structural modeling, which allows for variables to be examined as confounders and modifiers simultaneously). Current novel applications of machine learning methods to understanding suicide risk are also a step in this direction (McCarthy et al., 2015).

Other data-driven methods that allow for the visualization of subpopulations for whom specific associations are particularly important (e.g., regression trees) may also result in a deeper understanding of the nuances of this association.

In sum, there is conflicting evidence regarding the direction of the association between PTSD and death from suicide. While the majority of studies point to an increased risk of suicide associated with PTSD, the studies that do not corroborate these findings are too many to be discounted. Further research is needed to understand this potentially critical association.

FEATURED ARTICLES

Bachynski, K. E., Canham-Chervak, M., Black, S. A., Dada, E. O., Millikan, A. M., & Jones, B. H. (2012). **Mental health risk factors for suicides in the US Army, 2007–8.** *Injury Prevention, 18*, 405–412. doi:10.1136/injuryprev-2011-040112 *Objective:* Suicides among active duty US Army personnel have been increasing since 2004, surpassing comparable civilian rates in 2008. This analysis uses US military data to assess suicide rates for the 2-year period 2007–8, and examines relative risks (RR) of suicide associated with mental health disorders. *Methods:* Historical trends of US Army suicides were assessed using 1977–2008 data from Army G-1 (Personnel). Suicide rates, RR and the 2000–8 trends of mental health disorders were calculated using data from the Defense Casualty Information Processing System and Defense Medical Surveillance System. *Results:* A total of 255 soldiers committed suicide in 2007–8 (2008 rate 20.2 per 100 000). Factors associated with higher suicide risk included male gender, lower enlisted rank and mental health disorders treated on an outpatient basis (RR 3.9), as well as a number of mental health disorders (mood disorders, anxiety disorders, post-traumatic stress disorder, personality/psychotic disorders, substance-related disorders and adjustment disorder; RR range 4.7–24.5). Analysis of historical trends suggested that 25–50% of the suicides that occurred in 2008 might have been related to the major commitment of troops to combat beginning in 2003. *Conclusions:* The recent increase in suicides parallels an increase in the prevalence of mental disorders across the army. This finding suggests that increasing rates of clinically treated psychopathology are associated with increasing rates of suicides; these rates probably serve as sentinels for suicide risk in this population. Soldiers seeking treatment for mental disorders and substance abuse should be a focus for suicide prevention.

Black, S. A., Gallaway, M. S., Bell, M. R., & Ritchie, E. C. (2011). **Prevalence and risk factors associated with suicides of Army soldiers 2001–2009.** *Military Psychology, 23*, 433–451. doi:10.1037/h0094766 Prevalence and risk factors associated with soldiers' suicides 2001–2009 (N = 874) were examined. Army suicide rates increased from 9 per 100,000 in 2001 to 22 per 100,000 in 2009. Soldier suicides were lower than civilians from 2001 to 2007, but higher than civilians after 2007. Army suicides were disproportionately higher for men, deployment experience, and a history of a mental health diagnosis/treatment; and lower for African Americans. Many involved planning (38%), communication (21%), alcohol (19%), or drugs (8%). Many had legal problems (31%), high stress loads (90%), a history of self-injury (10%), and other contributing factors prior to entry into the Army (31%). Implications for understanding suicide among military personnel are discussed.

Britton, P. C., Bohnert, K. M., Ilgen, M. A., Kane, C., Stephens, B., & Pigeon, W. R. (2017). **Suicide mortality among male veterans discharged from Veterans Health Administration acute psychiatric units from 2005 to 2010.** *Social Psychiatry and Psychiatric Epidemiology*, 52, 1081-1087. doi:10.1007/s00127-017-1377-x

Purpose: The purpose of this study was to calculate suicide rates and identify correlates of risk in the year following discharge from acute Veterans Health Administration psychiatric inpatient units among male veterans discharged from 2005 to 2010 (fiscal years). **Methods:** Suicide rates and standardized mortality ratios were calculated. Descriptive analyses were used to describe suicides and non-suicides and provide base rates for interpretation, and unadjusted and adjusted proportional hazard models were used to identify correlates of suicide. **Results:** From 2005 to 2010, 929 male veterans died by suicide in the year after discharge and the suicide rate was 297/100,000 person-years (py). The suicide rate significantly increased from 234/100,000 py (95% CI=193–282) in 2005 to 340/100,000 py (95% CI=292–393) in 2008, after which it plateaued. Living in a rural setting, HR (95% CI)=1.20 (1.05, 1.36), and being diagnosed with a mood disorder such as major depression, HR (95% CI)=1.60 (1.36, 1.87), or other anxiety disorder, HR (95% CI)=1.52 (1.24, 1.87), were associated with increased risk for suicide. **Conclusions:** Among male veterans, the suicide rate in the year after discharge from acute psychiatric hospitalization increased from 2005 to 2008, after which it plateaued. Prevention efforts should target psychiatrically hospitalized veterans who live in rural settings and/or are diagnosed with mood or other anxiety disorders.

Bullman, T. A., & Kang, H. K. (1994). **Posttraumatic stress disorder and the risk of traumatic deaths among Vietnam veterans.** *The Journal of Nervous and Mental Disease*, 182, 604-610.

Vietnam veterans have been reported to be at increased risk for posttraumatic stress disorder (PTSD) and deaths due to traumatic causes after service in the Vietnam War. This study evaluated whether an association exists between PTSD and traumatic deaths among Vietnam veterans. Mortality risk of 4,247 Vietnam veterans from the Agent Orange Registry (AOR) with a diagnosis of PTSD relative to that of 12,010 Vietnam veterans from the AOR with no diagnosis of PTSD was calculated using the Cox proportional hazards model. Mortality experience of both groups was also compared with U.S. males. The PTSD veterans were more likely than the non-PTSD veterans to die from suicide (relative risk = 3.97, 95% confidence interval [CI] = 2.20-7.03) and from accidental poisoning (relative risk = 2.89, CI = 1.03-8.12). The standardized mortality ratio for suicides was 6.74 (CI = 4.4-9.87) among PTSD veterans and 1.67 (CI = 1.05-2.53) among non-PTSD veterans. Among Vietnam veterans on the AOR, PTSD is associated with a significant increased risk for suicide and accidental poisoning.

Conner, K. R., Bohnert, A. S., McCarthy, J. F., Valenstein, M., Bossarte, R., Ignacio, R., . . . & Ilgen, M. A. (2013). **Mental disorder comorbidity and suicide among 2.96 million men receiving care in the Veterans Health Administration health system.** *Journal of Abnormal Psychology*, 122, 256-262. doi:10.1037/a0030163

Comorbid mental disorders are common among suicide decedents. It is unclear if mental disorders in combination confer additive risk for suicide, in other words, if risk associated with two disorders is approximately the sum of the risk conferred by each disorder considered separately, or if there are departures from additivity such

that the combined risk is less (i.e., subadditive) or more than additive (i.e., synergistic). Using a retrospective cohort design, all male Department of Veterans Affairs, Veterans Health Administration (VHA) service users who utilized VHA services in fiscal year (FY) 1999 and were alive at the start or FY 2000 ($N = 2,962,810$) were analyzed. Individuals were followed until death or the end of FY 2006. Using the VHA National Patient Care Database, diagnoses of mental disorders in FY 1999 were grouped into six categories (e.g., posttraumatic stress disorder). In proportional hazards models, 2-way interactions between disorders were used to examine departures from additive risk. There were 7,426 suicide deaths in the study period. Two-way interaction tests were nearly all statistically significant, indicating departures from additivity, and the results of these tests were consistent with subadditive risk. Sensitivity analyses examining the first year of follow-up showed similar results. Subadditive risk may be explained by factors that serve to lower the increased risk associated with a comorbid diagnosis, which may include common underlying causes of mental disorders, difficulties of differential diagnosis, the nature of etiological relationships between mental disorders, and intensive clinical care and monitoring of patients with comorbidity.

Conner, K. R., Bossarte, R. M., He, H., Arora, J., Lu, N., Tu, X. M., & Katz, I. R. (2014). **Posttraumatic stress disorder and suicide in 5.9 million individuals receiving care in the Veterans Health Administration health system.** *Journal of Affective Disorders*, 166, 1-5. doi:10.1016/j.jad.2014.04.067

Background: Post-traumatic stress disorder (PTSD) confers risk for suicidal ideation and suicide attempts but a link with suicide is not yet established. Prior analyses of users of the Veterans health administration (VHA) Health System suggest that other mental disorders strongly influence the association between PTSD and suicide in this population. We examined the association between PTSD and suicide in VHA users, with a focus on the influence of other mental disorders. **Methods:** Data were based on linkage of VA National Patient Care Database records and the Centers for Disease Control and Prevention's National Death Index, with data from fiscal year 2007–2008. Analyses were based on multivariate logistic regression and structural equation models. **Results:** Among users of VHA services studied ($N=5,913,648$), 0.6% ($N=3620$) died by suicide, including 423 who had had been diagnosed with PTSD. In unadjusted analysis, PTSD was associated with increased risk for suicide, with odds ratio, OR (95% confidence interval, 95% CI)=1.34 (1.21, 1.48). Similar results were obtained after adjustment for demographic variables and veteran characteristics. After adjustment for multiple other mental disorder diagnoses, PTSD was associated with decreased risk for suicide, OR (95% CI)=0.77 (0.69, 0.86). Major depressive disorder (MDD) had the largest influence on the association between PTSD and suicide. **Limitations:** The analyses were cross-sectional. VHA users were studied, with unclear relevance to other populations. **Conclusion:** The findings suggest the importance of identifying and treating comorbid MDD and other mental disorders in VHA users diagnosed with PTSD in suicide prevention efforts.

Desai, R. A., Dausey, D., & Rosenheck, R. A. (2008). **Suicide among discharged psychiatric inpatients in the Department of Veterans Affairs.** *Military Medicine*, 173, 721-728. doi:10.7205/MILMED.173.8.721

Objective: The objective of this study was to explore correlates of the use of firearms to commit suicide. **Methods:** A national sample of

psychiatric patients discharged from Department of Veterans Affairs medical centers was followed from the time of discharge until December 1999. The study explores state-level measures as correlates of overall suicide and suicide by firearm, controlling for individual sociodemographic characteristics and psychiatric diagnosis. The outcomes of interest were completed suicide and suicide by firearm. **Results:** Patients who were male, Caucasian, and who had a diagnosis of substance abuse or post-traumatic stress disorder were significantly more likely to use a firearm than another means to commit suicide. Multivariable models indicated that veterans living in states with lower rates of gun ownership, more restrictive gun laws, and higher social capital were less likely to commit suicide with a firearm. **Conclusions:** Gun ownership rates, legislation, and levels of community cohesiveness are significantly associated with the likelihood of psychiatric patients committing suicide with a gun.

Gradus, J. L., Antonsen, S., Svensson, E., Lash, T. L., Resick, P. A., & Hansen, J. G. (2015). **Trauma, comorbidity, and mortality following diagnoses of severe stress and adjustment disorders: A nationwide cohort study.** *American Journal of Epidemiology*, *182*, 451-458. doi:10.1093/aje/kwv066 Longitudinal outcomes following stress or trauma diagnoses are receiving attention, yet population-based studies are few. The aims of the present cohort study were to examine the cumulative incidence of traumatic events and psychiatric diagnoses following diagnoses of severe stress and adjustment disorders categorized using *International Classification of Diseases, Tenth Revision*, codes and to examine associations of these diagnoses with all-cause mortality and suicide. Data came from a longitudinal cohort of all Danes who received a diagnosis of reaction to severe stress or adjustment disorders (*International Classification of Diseases, Tenth Revision*, code F43.x) between 1995 and 2011, and they were compared with data from a general-population cohort. Cumulative incidence curves were plotted to examine traumatic experiences and psychiatric diagnoses during the study period. A Cox proportional hazards regression model was used to examine the associations of the disorders with mortality and suicide. Participants with stress diagnoses had a higher incidence of traumatic events and psychiatric diagnoses than did the comparison group. Each disorder was associated with a higher rate of all-cause mortality than that seen in the comparison cohort, and strong associations with suicide were found after adjustment. This study provides a comprehensive assessment of the associations of stress disorders with a variety of outcomes, and we found that stress diagnoses may have long-lasting and potentially severe consequences.

Gradus, J. L., Qin, P., Lincoln, A. K., Miller, M., Lawler, E., Sørensen, H. T., & Lash, T. L. (2010). **Posttraumatic stress disorder and completed suicide.** *American Journal of Epidemiology*, *171*, 721-727. doi:10.1093/aje/kwp456 Most research regarding posttraumatic stress disorder (PTSD) and suicide has focused on suicidal ideation or attempts; no known study of the association between PTSD and completed suicide in a population-based sample has been reported. This study examined the association between PTSD and completed suicide in a population-based sample. Data were obtained from the nationwide Danish health and administrative registries, which include data on all 5.4 million residents of Denmark. All suicides between January 1, 1994, and December 31, 2006, were included, and controls were selected from a sample of all Danish residents.

Using this nested case-control design, the authors examined 9,612 suicide cases and 199,306 controls matched to cases on gender, date of birth, and time. Thirty-eight suicide cases (0.40%) and 95 controls (0.05%) were diagnosed with PTSD. The odds ratio associating PTSD with suicide was 9.8 (95% confidence interval: 6.7, 15). The association between PTSD and completed suicide remained after controlling for psychiatric and demographic confounders (odds ratio = 5.3, 95% confidence interval: 3.4, 8.1). Additionally, persons with PTSD and depression had a greater rate of suicide than expected based on their independent effects. In conclusion, a registry-based diagnosis of PTSD based on *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision*, is a risk factor for completed suicide.

Hyman, J., Ireland, R., Frost, L., & Cottrell, L. (2012). **Suicide incidence and risk factors in an active duty US military population.** *American Journal of Public Health*, *102*(S1), S138-S146. doi:10.2105/AJPH.2011.300484 **Objectives:** The goal of this study was to investigate and identify risk factors for suicide among all active duty members of the US military during 2005 or 2007. **Methods:** The study used a cross-sectional design and included the entire active duty military population. Study sample sizes were 2 064 183 for 2005 and 1 981 810 for 2007. Logistic regression models were used. **Results:** Suicide rates for all services increased during this period. Mental health diagnoses, mental health visits, selective serotonin reuptake inhibitors (SSRIs), sleep prescriptions, reduction in rank, enlisted rank, and separation or divorce were associated with suicides. Deployments to Operation Enduring Freedom or Operation Iraqi Freedom were also associated with elevated odds ratios for all services in the 2007 population and for the Army in 2005. **Conclusions:** Additional research needs to address the increasing rates of suicide in active duty personnel. This should include careful evaluation of suicide prevention programs and the possible increase in risk associated with SSRIs and other mental health drugs, as well as the possible impact of shorter deployments, age, mental health diagnoses, and relationship problems.

Ilgén, M. A., Bohnert, A. S., Ignacio, R. V., McCarthy, J. F., Valenstein, M. M., Kim, H. M., & Blow, F. C. (2010). **Psychiatric diagnoses and risk of suicide in veterans.** *Archives of General Psychiatry*, *67*, 1152-1158. doi:10.1001/archgenpsychiatry.2010.129 **Context:** Although numerous studies have documented the clear link between psychiatric conditions and suicide, few have allowed for the comparison between the strength of association between different psychiatric diagnoses and suicide. **Objective:** To examine the strength of association between different types of psychiatric diagnoses and the risk of suicide in patients receiving health care services from the Department of Veterans Affairs in fiscal year (FY) 1999. **Design:** This project examined National Death Index data and Veterans Health Administration patient treatment records. **Setting:** Department of Veterans Affairs, Veterans Health Administration. **Participants:** All veterans who used Veterans Health Administration services during FY 1999 (N = 3 291 891) who were alive at the start of FY 2000. **Main Outcome Measures:** Psychiatric diagnoses were obtained from patient treatment records in FY 1998 and 1999 and used to predict subsequent death by suicide during the following 7 years in sex-stratified survival analyses controlling for age. **Results:** In the 7 years after FY 1999, 7684 veterans died by suicide. In diagnosis-specific analyses, patients with bipolar disorder had the greatest

estimated risk of suicide among men (hazard ratio, 2.98; 95% confidence interval, 2.73-3.25), and patients with substance use disorders had the greatest risk among women (6.62; 4.72-9.29). **Conclusions:** Although all the examined psychiatric diagnoses were associated with elevated risk of suicide in veterans, results indicate that men with bipolar disorder and women with substance use disorders are at particularly elevated risk for suicide.

Ilgén, M. A., McCarthy, J. F., Ignacio, R. V., Bohnert, A. S., Valenstein, M., Blow, F. C., & Katz, I. R. (2012). **Psychopathology, Iraq and Afghanistan service, and suicide among Veterans Health Administration patients.** *Journal of Consulting and Clinical Psychology, 80*, 323-330. doi:10.1037/a0028266 **Objective:** Despite concerns regarding elevated psychiatric morbidity and suicide among veterans returning from Operations Enduring Freedom and Iraqi Freedom (OEF/OIF), little is known about the impact of psychiatric conditions on the risk of suicide in these veterans. To inform tailored suicide prevention efforts, it is important to assess interrelationships between OEF/OIF status, psychiatric morbidity, and suicide mortality. This study sought to examine potential associations between OEF/OIF status and suicide mortality among individuals receiving care in the Department of Veterans Affairs health system, the Veterans Health Administration (VHA). Analyses assessed potential interactions between OEF/OIF status and psychiatric conditions as predictors of suicide. **Method:** Analyses included data for all individuals who received VHA services during fiscal year (FY) 2007 or FY08 and were alive at the start of FY08 (N = 5,772,282). **Results:** For this cohort, there were 1,920 suicide deaths in FY08, including 96 among OEF/OIF veterans. Controlling for demographic factors, psychiatric conditions, OEF/OIF status, and the interaction between psychiatric conditions and OEF/OIF status, no main effects of OEF/OIF status were observed. However, a significant interaction was found between psychiatric conditions and OEF/OIF status. Specifically, having a diagnosed mental health condition was associated with a greater risk of suicide among OEF/OIF veterans (hazard ratio [HR] = 4.41; 95% confidence interval [CI]: 2.57, 7.55; $p < .01$) than among non-OEF/OIF veterans (HR = 2.48; 95% CI [2.27, 2.71]; $p < .01$). **Conclusion:** These findings highlight the importance of mental health screening and intervention for OEF/OIF veterans.

Kessler, R. C., Warner, C. H., Ivany, C., Petukhova, M. V., Rose, S., Bromet, E. J., . . . & Ursano, R. J. (2015). **Predicting suicides after psychiatric hospitalization in US Army soldiers: The Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS).** *JAMA Psychiatry, 72*, 49-57. doi:10.1001/jamapsychiatry.2014.1754 **Importance:** The US Army experienced a sharp increase in soldier suicides beginning in 2004. Administrative data reveal that among those at highest risk are soldiers in the 12 months after inpatient treatment of a psychiatric disorder. **Objective:** To develop an actuarial risk algorithm predicting suicide in the 12 months after US Army soldier inpatient treatment of a psychiatric disorder to target expanded posthospitalization care. **Design, Setting, and Participants:** There were 53 769 hospitalizations of active duty soldiers from January 1, 2004, through December 31, 2009, with *International Classification of Diseases, Ninth Revision*, Clinical Modification psychiatric admission diagnoses. Administrative data available before hospital discharge abstracted from a wide range of data systems (sociodemographic, US Army career, criminal justice, and medical or pharmacy) were

used to predict suicides in the subsequent 12 months using machine learning methods (regression trees and penalized regressions) designed to evaluate cross-validated linear, nonlinear, and interactive predictive associations. **Main Outcomes and Measures:** Suicides of soldiers hospitalized with psychiatric disorders in the 12 months after hospital discharge. **Results:** Sixty-eight soldiers died by suicide within 12 months of hospital discharge (12.0% of all US Army suicides), equivalent to 263.9 suicides per 100 000 person-years compared with 18.5 suicides per 100 000 person-years in the total US Army. The strongest predictors included sociodemographics (male sex [odds ratio (OR), 7.9; 95% CI, 1.9-32.6] and late age of enlistment [OR, 1.9; 95% CI, 1.0-3.5]), criminal offenses (verbal violence [OR, 2.2; 95% CI, 1.2-4.0] and weapons possession [OR, 5.6; 95% CI, 1.7-18.3]), prior suicidality [OR, 2.9; 95% CI, 1.7-4.9], aspects of prior psychiatric inpatient and outpatient treatment (eg, number of antidepressant prescriptions filled in the past 12 months [OR, 1.3; 95% CI, 1.1-1.7]), and disorders diagnosed during the focal hospitalizations (eg, nonaffective psychosis [OR, 2.9; 95% CI, 1.2-7.0]). A total of 52.9% of posthospitalization suicides occurred after the 5% of hospitalizations with highest predicted suicide risk (3824.1 suicides per 100 000 person-years). These highest-risk hospitalizations also accounted for significantly elevated proportions of several other adverse posthospitalization outcomes (unintentional injury deaths, suicide attempts, and subsequent hospitalizations). **Conclusions and Relevance:** The high concentration of risk of suicide and other adverse outcomes might justify targeting expanded posthospitalization interventions to soldiers classified as having highest posthospitalization suicide risk, although final determination requires careful consideration of intervention costs, comparative effectiveness, and possible adverse effects.

LeardMann, C. A., Powell, T. M., Smith, T. C., Bell, M. R., Smith, B., Boyko, E. J., . . . & Hoge, C. W. (2013). **Risk factors associated with suicide in current and former US military personnel.** *JAMA, 310*, 496-506. doi:10.1001/jama.2013.65164 **Importance:** Beginning in 2005, the incidence of suicide deaths in the US military began to sharply increase. Unique stressors, such as combat deployments, have been assumed to underlie the increasing incidence. Previous military suicide studies, however, have relied on case series and cross-sectional investigations and have not linked data during service with postservice periods. **Objective:** To prospectively identify and quantify risk factors associated with suicide in current and former US military personnel including demographic, military, mental health, behavioral, and deployment characteristics. **Design, Setting, and Participants:** Prospective longitudinal study with accrual and assessment of participants in 2001, 2004, and 2007. Questionnaire data were linked with the National Death Index and the Department of Defense Medical Mortality Registry through December 31, 2008. Participants were current and former US military personnel from all service branches, including active and Reserve/National Guard, who were included in the Millennium Cohort Study (N = 151 560). **Main Outcomes and Measures:** Death by suicide captured by the National Death Index and the Department of Defense Medical Mortality Registry. **Results:** Through the end of 2008, findings were 83 suicides in 707 493 person-years of follow-up (11.73/100 000 person-years [95% CI, 9.21-14.26]). In Cox models adjusted for age and sex, factors significantly associated with increased risk of suicide included male sex, depression, manic-depressive disorder, heavy or binge drinking, and alcohol-related problems. None of the

deployment-related factors (combat experience, cumulative days deployed, or number of deployments) were associated with increased suicide risk in any of the models. In multivariable Cox models, individuals with increased risk for suicide were men (hazard ratio [HR], 2.14; 95% CI, 1.17–3.92; $P = .01$; attributable risk [AR], 3.5 cases/10 000 persons), and those with depression (HR, 1.96; 95% CI, 1.05–3.64; $P = .03$; AR, 6.9/10 000 persons), manic-depressive disorder (HR, 4.35; 95% CI, 1.56–12.09; $P = .005$; AR, 35.6/10 000 persons), or alcohol-related problems (HR, 2.56; 95% CI, 1.56–4.18; $P < .001$; AR, 7.7/10 000 persons). A nested, matched case-control analysis using 20:1 control participants per case confirmed these findings. **Conclusions and Relevance:** In this sample of current and former military personnel observed July 1, 2001–December 31, 2008, suicide risk was independently associated with male sex and mental disorders but not with military-specific variables. These findings may inform approaches to mitigating suicide risk in this population.

McCarthy, J. F., Bossarte, R. M., Katz, I. R., Thompson, C., Kemp, J., Hannemann, C. M., . . . & Schoenbaum, M. (2015). **Predictive modeling and concentration of the risk of suicide: Implications for preventive interventions in the US Department of Veterans Affairs.** *American Journal of Public Health, 105*, 1935–1942. doi:10.2105/AJPH.2015.302737

Objectives: The Veterans Health Administration (VHA) evaluated the use of predictive modeling to identify patients at risk for suicide and to supplement ongoing care with risk-stratified interventions. **Methods:** Suicide data came from the National Death Index. Predictors were measures from VHA clinical records incorporating patient-months from October 1, 2008, to September 30, 2011, for all suicide decedents and 1% of living patients, divided randomly into development and validation samples. We used data on all patients alive on September 30, 2010, to evaluate predictions of suicide risk over 1 year. **Results:** Modeling demonstrated that suicide rates were 82 and 60 times greater than the rate in the overall sample in the highest 0.01% stratum for calculated risk for the development and validation samples, respectively; 39 and 30 times greater in the highest 0.10%; 14 and 12 times greater in the highest 1.00%; and 6.3 and 5.7 times greater in the highest 5.00%. **Conclusions:** Predictive modeling can identify high-risk patients who were not identified on clinical grounds. VHA is developing modeling to enhance clinical care and to guide the delivery of preventive interventions.

Shen, Y.-C., Cunha, J. M., & Williams, T. V. (2016). **Time-varying associations of suicide with deployments, mental health conditions, and stressful life events among current and former US military personnel: A retrospective multivariate analysis.** *The Lancet Psychiatry, 3*, 1039–1048. doi:10.1016/S2215-0366(16)30304-2

Background: US military suicides have increased substantially 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 military service members. **Methods:** We did a retrospective multivariate analysis of all US military personnel between 2001 and 2011 ($n = 110\,035\,573$ person-quarter-years, representing 3 795 823 service members). Outcome was death by suicide, either during service or post-separation. We used Cox proportional hazard models at the person-quarter level to examine associations of deployment, mental disorders, history of unlawful activity, stressful life events, and other demographic and service factors with death by suicide.

Findings: The strongest predictors of death by suicide were current and past diagnoses of self-inflicted injuries, major depression, bipolar disorder, substance use disorder, and other mental health conditions (compared with service members with no history of diagnoses, the hazard ratio [HR] ranged from 1.4 [95% CI 1.14–1.72] to 8.34 [6.71–10.37]). Compared with service members who were never deployed, hazard rates of suicide (which represent the probability of death by suicide in a specific quarter given that the individual was alive in the previous quarter) were lower among the currently deployed (HR 0.50, 95% CI 0.40–0.61) but significantly higher in the quarters following first deployment (HR 1.51 [1.17–1.96] if deployed in the previous three quarters; 1.14 [1.06–1.23] if deployed four or more quarters ago). The hazard rate of suicide increased within the first year of separation from the military (HR 2.49, 95% CI 2.12–2.91), and remained high for those who had separated from the military 6 or more years ago (HR 1.63, 1.45–1.82). **Interpretation:** The increased hazard rate of death by suicide for military personnel varies by time since exposure to deployment, mental health diagnoses, and other stressful life events. Continued monitoring is especially needed for these high-risk individuals. Additional information should be gathered to address the persistently raised risk of suicide among service members after separation.

Zivin, K., Kim, M., McCarthy, J. F., Austin, K. L., Hoggatt, K. J., Walters, H., & Valenstein, M. (2007). **Suicide mortality among individuals receiving treatment for depression in the Veterans Affairs health system: Associations with patient and treatment setting characteristics.** *American Journal of Public Health, 97*, 2193–2198. doi:10.2105/AJPH.2007.115477

Objectives: We sought to report clinical and demographic factors associated with suicide among depressed veterans in an attempt to determine what characteristics identified depressed veterans at high risk for suicide. **Methods:** We used longitudinal, nationally representative data (1999–2004) to determine suicide rates among depressed veterans, estimating time until suicide using Cox proportional hazards regression models. **Results:** Of 807 694 veterans meeting study criteria, 1683 (0.21%) committed suicide during follow-up. Increased suicide risks were observed among male, younger, and non-Hispanic White patients. Veterans without service-connected disabilities, with inpatient psychiatric hospitalizations in the year prior to their qualifying depression diagnosis, with comorbid substance use, and living in the southern or western United States were also at higher risk. Posttraumatic stress disorder (PTSD) with comorbid depression was associated with lower suicide rates, and younger depressed veterans with PTSD had a higher suicide rate than did older depressed veterans with PTSD. **Conclusions:** Unlike the general population, older and younger veterans are more prone to suicide than are middle-aged veterans. Future research should examine the relationship between depression, PTSD, health service use, and suicide risks among veterans.

ADDITIONAL CITATIONS

Borges, G., Angst, J., Nock, M. K., Ruscio, A. M., & Kessler, R. C. (2008). **Risk factors for the incidence and persistence of suicide-related outcomes: A 10-year follow-up study using the National Comorbidity Surveys.** *Journal of Affective Disorders, 105*, 25–33. doi:10.1016/j.jad.2007.01.036 This study examined the

association between PTSD and various forms of suicidal behavior (suicidal ideation, suicide plan, suicide gesture and suicide attempts) using data from 5001 participants in the general population National Comorbidity Survey (NCS) and the NCS follow-up study (NCS-2). PTSD documented during the baseline NCS survey was associated with suicidal ideation endorsed on the NCS-2 (odds ratio [OR] = 1.8, 95% confidence interval [CI] = 1.1, 2.8), but not suicide plans, gestures or attempts among participants with suicidal ideation.

Gradus, J. L., King, M. W., Galatzer-Levy, I., & Street, A. E. (2017). **Gender differences in machine learning models of trauma and suicidal ideation in veterans of the Iraq and Afghanistan Wars.** *Journal of Traumatic Stress, 30*, 362-371. doi:10.1002/jts.22210

This study used machine learning methods to examine gender differences in predictors of suicidal ideation among male and female Veterans who served as part of the conflicts in Iraq and Afghanistan ($n = 2,244$). For both male and female Veterans, PTSD was identified as an important risk factor for suicidal ideation. The risk conferred by PTSD was potentiated when combined with other risk factors (e.g., depression), particularly for female Veterans.

Gradus, J. L., Leatherman, S., Raju, S., Ferguson, R., & Miller, M. (2014). **Posttraumatic stress disorder, depression, and non-fatal intentional self-harm in Massachusetts veterans.** *Injury Epidemiology, 1*, 20. doi:10.1186/s40621-014-0020-5

The association between PTSD and suicide attempts in a cohort of Massachusetts Veterans who used VA services from 2000-2008 was examined in this study ($n = 68,506$). PTSD was associated with suicide attempts even after adjustment for demographic and psychiatric confounders, and these associations were stronger for female Veterans (hazard ratio [HR] = 16, 95% CI = 4.8, 56) than male Veterans (HR = 3.2, 95% CI = 3.7, 6.8).

Kessler, R. C., Borges, G., & Walters, E. E. (1999). **Prevalence of and risk factors for lifetime suicide attempts in the National Comorbidity Survey.** *Archives of General Psychiatry, 56*, 617-626. doi:10.1001/archpsyc.56.7.617

This early and important study of the association between PTSD and suicide attempts used data from 5877 general population participants in the National Comorbidity Survey. PTSD was associated with suicidal ideation (OR = 5.1, 95% CI = 3.9, 6.8) and suicide attempts (OR = 6.0, 3.4, 10.7), adjusting for demographic variables. PTSD was also associated with suicide plans among those with suicidal ideation (OR = 2.4, 95% CI = 1.7, 3.3), and impulsive attempts among those with suicidal ideation (OR = 1.7, 95% CI = 1.1, 2.7). However, PTSD was not associated with planned attempts among those with suicidal ideation.

Lemaire, C. M., & Graham, D. P. (2011). **Factors associated with suicidal ideation in OEF/OIF veterans.** *Journal of Affective Disorders, 130*, 231-238. doi:10.1016/j.jad.2010.10.021

This cross-sectional study examined data from 1740 Veterans of the Iraq and Afghanistan wars who were registering for services at the Houston VA. Veterans with PTSD were found to have 10 times the odds of suicidal ideation than Veterans without PTSD (95% CI = 4.0, 25), even with depression included in the regression model.

Nock, M. K., Hwang, I., Sampson, N. A., & Kessler, R. C. (2010). **Mental disorders, comorbidity and suicidal behavior: Results from the National Comorbidity Survey Replication.** *Molecular Psychiatry, 15*, 868-876. doi:10.1038/mp.2009.29

Using data from 9,282 general population participants in the NCS-Replication

(NCS-R) this study examined the association between PTSD and suicidal ideation and attempts. In multivariate models, those with PTSD had greater odds of both suicidal ideation (OR = 1.7, 95% CI = 1.4, 2.0) and suicide attempts (OR = 2.1, 95% CI = 1.5, 2.9) than those without PTSD. Further, among those with suicidal ideation, PTSD was associated with suicide plans (OR = 1.6, 95% CI = 1.2, 2.3) and unplanned attempts (OR = 2.4, 95% CI = 1.3, 4.5), but not planned attempts.

Nock, M. K., Hwang, I., Sampson, N., Kessler, R. C., Angermeyer, M., Beautrais, A., . . . & Williams, D. R. (2009). **Cross-national analysis of the associations among mental disorders and suicidal behavior: Findings from the WHO World Mental Health Surveys.** *PLoS Medicine, 6*, e1000123. doi:10.1371/journal.pmed.1000123

This study used data from people in 21 countries included in the WHO World Mental Health Surveys ($n = 108,664$) to examine the association between PTSD and suicidal ideation and attempts. In multivariate models (adjusting for demographics and other psychiatric disorders), PTSD was associated with suicidal ideation in developed countries (OR = 2.7, 95% CI = 2.2, 3.2) and developing countries (OR = 3.9, 95% CI = 2.7, 5.6). Similarly, in developed countries PTSD was associated with suicide attempts (OR = 3.0, 95% CI = 2.3, 3.8) as well as in developing countries (OR = 5.6, 95% CI = 3.5, 8.8).

Nock, M. K., Stein, M. B., Heeringa, S. G., Ursano, R. J., Colpe, L. J., Fullerton, C. S., . . . & Kessler, R. C. (2014). **Prevalence and correlates of suicidal behavior among soldiers: Results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS).** *JAMA Psychiatry, 71*, 514-522. doi:10.1001/jamapsychiatry.2014.30

This study used cross-sectional data from Army STARRS to examine the association between pre- and post-enlistment PTSD and post-enlistment incidence suicide attempts ($n = 5,428$). Post-enlistment PTSD was associated with suicide attempts in bivariate models (OR = 3.3, 95% CI = 1.6, 6.8), however there was no evidence of an association in multivariate models. Further, pre-enlistment PTSD demonstrated a protective association with suicide attempts in the multivariate models (OR = 0.1, 95% CI = 0.0, 0.7).

Sareen, J., Cox, B. J., Stein, M. B., Afifi, T. O., Fleet, C., & Asmundson, G. J. G. (2007). **Physical and mental comorbidity, disability, and suicidal behavior associated with posttraumatic stress disorder in a large community sample.** *Psychosomatic Medicine, 69*, 242-248. doi:10.1097/PSY.0b013e31803146d8

Using data from the Canadian Community Health Survey Cycle 1.2, this study examined the association between PTSD and suicidal ideation and suicide attempts in the general population ($n = 36,984$). After adjustment for psychiatric, somatic and demographic variables PTSD was not associated with suicidal ideation (OR = 1.2, 95% CI = 0.73, 2.1) but was associated with suicide attempts (OR = 2.4, 95% CI = 1.3, 4.3).

Sareen, J., Houlahan, T., Cox, B. J., & Asmundson, G. J. G. (2005). **Anxiety disorders associated with suicidal ideation and suicide attempts in the National Comorbidity Survey.** *The Journal of Nervous and Mental Disease, 193*, 450-454. doi: 10.1097/01.nmd.0000168263.89652.6b

This study used cross-sectional data from the NCS to examine the association between PTSD and lifetime suicidal ideation and suicide attempts in a general population sample ($n = 5,877$). In models adjusted for both demographics and other psychiatric disorders, PTSD was associated with both suicide ideation (OR = 2.8, 95% CI = 2.0, 3.8) and suicide attempts (OR = 2.7, 95% CI = 1.8, 3.9).