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J.M. Cunha, Y.-C. Shen, Z.R. Burke, "Contrasting the impacts of combat and humanitarian assistance/disaster relief missions on the mental health of military service members," *Defence and Peace Economics*, (2017), 17 p.

<http://hdl.handle.net/10945/56098>

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Contrasting the Impacts of Combat and Humanitarian Assistance/ Disaster Relief Missions on the Mental Health of Military Service Members

Jesse M. Cunha^{a,b}, Yu-Chu Shen^{a,c} and Zachary R. Burke^d

^aNaval Postgraduate School, Monterey, CA, USA; ^bUC Santa Cruz, Santa Cruz, CA, USA; ^cNational Bureau of Economic Research, Cambridge, MA, USA; ^dU.S. Marine Corps, Washington, DC, USA

ABSTRACT

We study the differential impacts of combat and humanitarian assistance/ disaster relief (HA/DR) missions on the mental health of U.S. Marine Corps members. The deployment experiences of any individual Marine are plausibly random conditional on the observable characteristics which are used to assign Marines into units. Leveraging this exogenous variation, we compare the incidence of post-traumatic stress disorder (PTSD) and suicide deaths among Marines who deployed to either Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) or HA/DR missions between 2001 and 2011. We find that the hazard of PTSD is close to eight times higher among Marines returning from OEF/OIF compared to those never deployed, and just 1.33 times higher among those returning from HA/DR (and never participated in OEF/OIF). Those returning from OEF/OIF missions are 1.81 times more likely than those never deployed to die by suicide when they were still active duty, and the hazard increases to almost 3 after they have left the military. In contrast, we find no difference in the hazards of suicide death between those that deployed to only HA/DR missions and non-deployed Marines.

ARTICLE HISTORY

Received 30 November 2016
Accepted 30 March 2017

KEYWORDS

Mental health; suicide; military; deployment; humanitarian aid; disaster relief

Introduction

Following the attacks on 11 September 2001, the United States military entered its longest period of continuous armed conflict since the Vietnam War, with more than 2 million service members deployed in support of armed conflicts in Afghanistan (Operation Enduring Freedom, OEF) or Iraq (Operation Iraqi Freedom, OIF). A large literature has documented the increased incidence of mental health problems among deployed service members (see, for example, Hoge et al., 2006; Tanielian and Jaycox 2008; Shen, Arkes, and Williams 2012; Cesur, Sabia, and Tekin 2013; Shen, Cunha, and Williams 2016). It is difficult to isolate the cause of these mental health problems, but likely candidates include both the acts of killing and trying not to be killed, as well as other associated horrors of war.

During the same period, the U.S. military was also engaged in numerous non-combat missions in countries around the world providing humanitarian assistance or disaster relief, or both (HA/DR). In fact, HA/DR operations have been a large part of the U.S. military's mission for the last several decades, with over 300 named operations since 1975 (DoD 2013). HA/DR missions generally do not involve armed

CONTACT Jesse M. Cunha  jcunha@nps.edu

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combat, but service members nonetheless experience many war-like situations, such as seeing death, disease, destruction of homes and cities, political and social insecurity, and suffering populations. To date, there is no empirical literature documenting either the direct impacts of HA/DR missions on mental health or comparing the impacts of HA/DR missions to combat missions. Understanding the differential impacts of mission types can help to unpack the mechanisms behind the documented mental health impacts of combat, and also inform training, prevention, and treatment policies related to both mission types.

We study the U.S. Marines Corps, the only service branch that both routinely responds to HA/DR missions and is involved in combat operations. The Marine Corps responds to HA/DR missions because Marine Expeditionary Units (MEUs) can respond rapidly from their positions on Navy ships which are continuously forward deployed around the world (this is in contrast to U.S. Army units which, being land-based, take longer to deploy). Our data includes all U.S. Marines who were on active duty at any time between 2001 and 2011, during which time close to 266,000 Marines were deployed to OEF/OIF missions and over 30,000 deployed to HA/DR operations. Our outcomes of interest are whether a Marine was diagnosed with PTSD and whether he died by suicide. We focus on these outcomes because they are costly to the military and society (Ramchand, Acosta, and Burns 2011; Tanielian and Jaycox 2008), and they tend to be caused by stressful and/or traumatic events.

An important issue is whether there are systematic differences between Marines who deployed to different mission types, as non-random selection into deployments could bias the estimated relationship between deployment type and mental health. Fortunately, from an analytical point of view, the Marine Corps mans its various units solely by choosing individuals with the requisite occupation and rank; and units – not individuals – are selected for deployment. While individual preferences help determine occupation, and rank is a function of one's time in service and ability, conditional on rank and occupation, deployment and deployment type can be considered to be exogenous for any individual Marine.

Using a Cox proportional hazard model that controls for a large number of observable characteristics (including occupation, rank, and prior mental health diagnoses), we find the hazard of PTSD is 7.8 times higher among Marines returning from OEF/OIF missions compared to those who never deployed to a combat or HA/DR mission, and just 1.33 times higher among those returning from an HA/DR mission. Those returning from OEF/OIF missions are 1.81 times more likely than those never deployed to die by suicide when they were still active duty, and the hazard increases to almost three times after they leave the military. In contrast, the hazards of suicide death are comparable between those that deployed to HA/DR only and non-deployed Marines.

The remainder of this paper proceeds as follows: The second section provides a background on Marine Corps combat and HA/DR deployments, and their potential impacts on PTSD and suicide. The third section describes our data and sample. The fourth section outlines the empirical model we use to study the relationship between deployments and mental health. The fifth section presents the results, and the sixth section provides concludes.

Background on Military Deployments and Mental Health

The stressors inherent in combat deployment – uncertainty, separation, isolation, danger, and fatigue – can also be experienced in the conduct of a humanitarian assistance operation. HA/DR responders often are confronted with difficult physical environments and significant language and cultural barriers. As in combat missions, HA/DR respondents may be vulnerable to security threats and lack proper equipment and tools (Holloway and Everly 2009).

A wealth of empirical studies have documented significant mental health problems and suicide deaths among service members who have returned from OEF/OIF missions (for PTSD, see Hoge, Auchterlonie, and Milliken (2006), Seal et al. (2007), and Tanielian and Jaycox (2008); for suicide, see Ramchand, Acosta, and Burns (2011); LeardMann et al. (2013), Reger et al. (2015), Shen, Cunha, and Williams (2016)). Many studies use convenience samples, without a control group, and compare mental health rates before and after an OEF/OIF mission. The studies that compared military personnel who deployed with those who did not deploy generally find that the risk of PTSD and other mental health

problems increased substantially after a service member returned from an OEF/OIF mission (Shen et al. 2010; Shen, Arkes, and Williams 2012; Cesur, Sabia, and Tekin 2013). Similarly, suicide deaths have been found to be higher upon return from an OEF/OIF mission (Shen, Cunha, and Williams 2016).

In contrast, there is almost no empirical evidence on the impacts of HA/DR missions on the mental health of service members, and no evidence on suicide deaths. One case study interviewed 35 Army personnel before and during medical humanitarian assistance mission and found no change in symptoms of depression during the deployment (Britt and Adler 1999).

Importantly, combat experiences are very different from those experienced in HA/DR missions. In combat, the trauma experienced is often focused on the individual and his survival or the survival of his closest friends. This level of threat to personal safety may not exist in a HA/DR operation. However, there is exposure to death and the destruction of an innocent population. As one Marine said, 'It's one thing to see a dead body in combat. It's another thing to see dead bodies being pulled from rubble,' (Talton 2010).

Some insights into the mental health impact of military HA/DR operations can be drawn from the experiences of civilian relief workers and first responders.¹ Past studies have suggested that the level of strain placed on relief workers and first responders is substantial, with mental health effects similar to those experienced by combat veterans. Earlier studies on relief workers generally found them to be at higher risk of developing trauma-related illness, and the level of risk depends on the intensity and duration of exposure to traumatic situations (Holloway and Everly 2009; Norris et al. 2002). However, a recent systematic review of health outcomes among relief workers found a wide range of prevalence of PTSD upon returning from missions, from 0 to 36% (Garbern, Ebbeling, and Bartels 2016).

Views vary on whether military relief workers are at a higher or lower risk of stress-triggered mental health problems than civilian relief workers. On one hand, Connorton et al. (2011) speculate that organized military units might be less affected by the stresses and danger prevalent in humanitarian assistance operations due to unit cohesion, the ability to be armed, and access to pre- and post-deployment medical screening which can detect symptoms early-on. On the other hand, Holloway and Everly (2009) argue the risk is just as high or higher for military relief workers as HA/DR missions pose a unique set of challenges to military units that do not necessarily exist in combat, and for which they are not explicitly trained. For example, a Marine's main focus in combat is on surviving, while when responding to an HA/DR operation, Marines are usually thrust into an environment in which they know little about culture, history, language, or needs of the local population. The frustration that surrounds an inability to understand what is truly needed in an emergency situation, and perhaps not being able to provide for that need may cause significant harm to a Marine's self-confidence and self-efficacy. Another source of the frustration comes with the realization that their efforts might be short-lived given the lack the infrastructure in developing countries to continue provision of services after the Marines depart (Ritchie and Mott 2003). Similar feelings have been felt by veterans of Operation Iraqi Freedom following the recent fall of key cities such as Ramadi and Mosul to the Islamic State (NPR Staff 2014).

In summary, the literature to date does not provide clear theoretical or empirical evidence as to what the differential impacts of combat and HA/DR missions may be on the mental health of service members. This mainly stems from the fact that the overall nature of these mission types differ substantially, yet the individual experiences of service members may be similar. Knowing how these missions impact Marines' mental health can provide valuable insights to inform training, prevention and treatment policy.

Population and Data

Our population is all uniformed Marines who served on active duty for at least 30 consecutive days anytime between 2001 and 2011. Our main administrative database is from the Defense Enrollment Eligibility Reporting System which contains data on demographics (gender, race/ethnicity, age, marital status, number of dependents) and service characteristics (rank, reserve or active duty status). The master personnel file and separation file from the Defense Manpower Data Center supplement the database with other service characteristics (occupation, separation date, and, for the enlisted population, Armed Forces Qualification Test [AFQT] score and enlistment waiver status).

We merge several other databases to that administrative panel. First, mental health diagnoses are identified through clinical encounter records from TRICARE, the military health care system in which all service members are automatically enrolled. TRICARE records include all clinical encounters (inpatient admissions and outpatient visits) and resulting ICD-9 diagnostic codes from all treatment locations (both military treatment facilities and civilian providers) while a Marine is on active duty; unfortunately, we do not observe clinical encounters – and thus mental health diagnoses – once a Marine left the service. Second, suicides are identified from the National Death Index for deaths within the U.S. (both during and after separation from the military) and from the Defense Casualty Analysis System for deaths while deployed overseas.

Third, we merge records from the Contingency Tracking System that identify the dates and locations (countries) of all deployments in support of OEF or OIF missions. OEF/OIF countries include Afghanistan, Iraq, Bahrain, Djibouti, Jordan, Kyrgyzstan, Kuwait, Kazakhstan, Qatar, and Turkey. Unfortunately, there is no person-level database that directly identifies who participated in an HA/DR mission. The main reason this data is not recorded is because HA/DR missions are generally performed by Marine Expeditionary Units which are embedded in a Navy amphibious ready group. These ready groups are continuously forward-deployed around the world to both project force and to permit rapid action if a conflict or disaster arises. As such, there is no additional deployment recorded in response to an HA/DR event.

To identify HA/DR deployments, we instead rely on awards of the Humanitarian Service Medal, as identified in the Marine Corps' Total Forces Data Warehouse. This medal is awarded to every Marine who participates in an HA/DR deployment (per Executive Order 11965, 1977). We observe the exact date of the action which warranted the Humanitarian Service Medal and, when we cross reference to the Department of Defense's list of authorized humanitarian operations, we can identify the exact HA/DR operation under which an individual was deployed.

Figure 1 shows the yearly trend of the number of Marines deployed to OEF/OIF and HA/DR missions between 2001 and 2011. On average, more Marines per year were deployed to OEF/OIF (57,126) than HA/

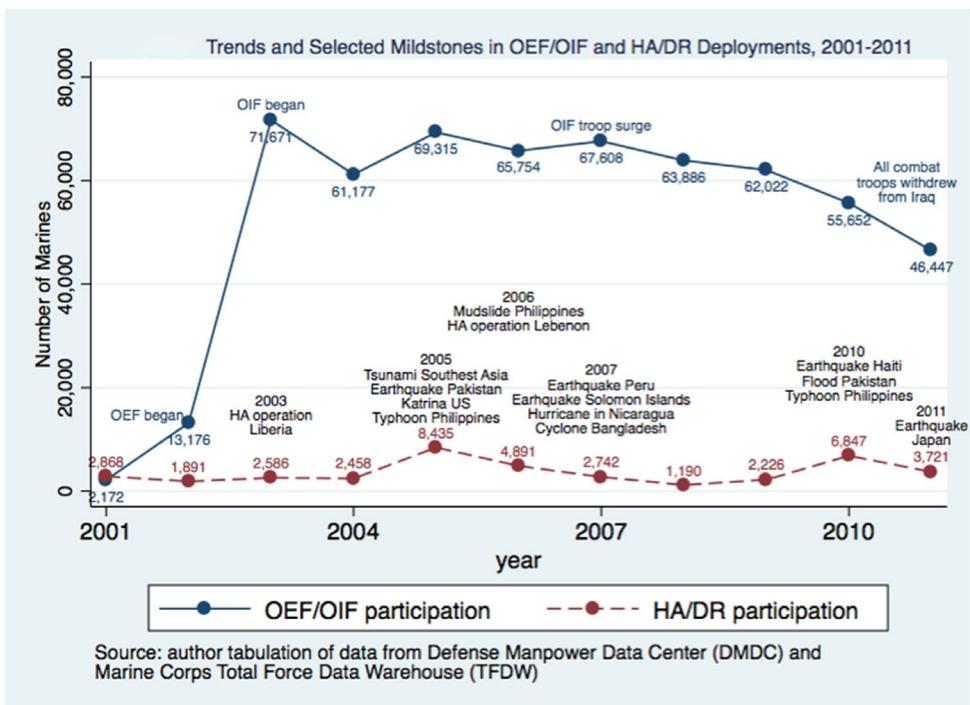


Figure 1. Trends and selected milestones in OEF/OIF and HA/DR deployments, 2001–2011.

DR missions (3,333), although some were deployed to each mission type in each year. HA/DR missions are more sporadic and of limited duration, owing to the unpredictable nature of natural disasters and the eventual restoration of civilian control.

Two years have noteworthy changes in the number of Marines conducting HA/DR operations. In 2005, nearly 8,500 Marines supported either disaster relief efforts for Hurricanes Katrina and Rita in the United States or a six-month relief operation in Pakistan following an earthquake. And in 2010, almost 7,000 Marines deployed to help victims of either an earthquake in Haiti, floods in the Philippines, or floods in Pakistan. Each of these events left thousands dead and caused billions of dollars in damage.

Marine deployments to OIF/OEF also have some noteworthy milestones. First, in 2001, at the start of the Global War on Terror, nearly as many Marines deployed to HA/DR operations as OEF/OIF operations. Next, the invasion of Iraq in March 2003 increased Marine OEF/OIF deployments from 13,176 in 2002 to 71,671 in 2003, which included an entire division of Marines for and lasted for an extended campaign. Finally, the steady decline in deployed Marines in support of OIF/OEF starting in 2008 was a result of the end of the Iraq War, with the final combat troops returning to the United States in 2011.

Table 1 summarizes our population. We observed 604,874 unique Marines between 2001 and 2011, of whom 54% were never deployed, 44% participated in OEF/OIF missions, and 5% participated in HA/DR missions. The majority were male (93%), white (69%), young (the average age was 24.5 years old), and enlisted Marines (93%). The remaining characteristics in Table 1 are used as control variables in our empirical analysis, as they help explain the selection of Marines into deployment categories.

Empirical Methods

As discussed above, Marines deploy as units and units are formed by selecting individuals with the requisite qualifications, mainly occupation and rank. As individual Marines do not have a choice of unit, their deployment history is plausibly exogenous conditional on their qualifications; importantly, the qualifications we condition on in our empirical analysis are exactly the same ones that the Marine Corps sees when forming units. In a similar vein, Marines who are assigned to Marine Expeditionary Units have no say over the deployment location of that unit, as it is Marine Corps policy to respond to HA/DR missions with the closest available MEU. Thus, following the recent literature, our identifying assumption is that conditional on being deployed, the type of deployment is random conditional on observables (Lyle 2006; Cesur, Sabia, and Tekin 2013; Negrusa, Negrusa, and Hosek 2014; Cesur and Sabia 2016).

The main difference between the two outcomes we study is that we do not observe PTSD diagnoses after an individual left active duty service whereas we can identify death by suicide even after the person left the military. We first present our model for PTSD and then describe the modifications to this model when considering death by suicide as an outcome.

We use a Cox proportional hazard model with the person-quarter as the unit of analysis, as it allows us to explicitly model time-since-exposure and thus can capture how risks might change over time (LeardMann et al. 2013; Reger et al. 2015; Shen, Cunha, and Williams 2016). The hazard rate that Marine i was diagnosed with PTSD in quarter t given that he was not diagnosed prior to a given quarter is described by the function $\lambda_i(t) = \exp(D'_{it}\beta_1 + D'_{it-1}\beta_2 + \beta'_3X_{it} + \beta'_4O_i)\lambda_0(t)$ where $\lambda_0(t)$ is the baseline hazard rate for PTSD, D'_{it} and D'_{it-1} are sets of binary deployment indicators, X_{it} are demographic and occupation-related characteristics, and O_i are occupation fixed effects for 11 main job types. Individuals enter the risk window either in the first quarter of 2001 or the quarter in which they joined the military, and they leave the risk window in the first quarter they were diagnosed with PTSD. Individuals are censored either at the end of 2011, in the quarter they left service, or in the quarter of death.

We allow the relationship between deployment and PTSD to vary over time by including binary indicators for whether a Marine was deployed in the current quarter or in previous quarters in support of OEF/OIF, for an HA/DR mission, or for both types of missions. The reference group is Marines who were never deployed to either type of mission.

The demographic and occupation characteristics can be grouped into the following categories: *type of waiver required for enlistment* upon failure to meet a given recruitment standard (waiver for drug use,

Table 1. Summary statistics of the population of Marines who served in active duty between 2001 and 2011.

	By deployment status				
	All Marines	Never Deployed	Deployed to HA/ DR only	Deployed to OEF/ OIF only	Deployed to both HA/DR and OEF/ OIF
	(1)	(2)	(3)	(4)	(5)
Number of Marines	604,874	328,380	10,547	245,588	20,359
Marines diagnosed with PTSD					
Count	17,336	3680	169	12,449	1038
# per 10,000	286.61	112.07	160.24	506.91	509.85
Marines who died by suicide					
Count	841	519	7	297	18
# per 10,000	13.90	15.80	6.64	12.09	8.84
<i>Demographics</i>					
Male	0.93	0.91	0.95	0.96	0.98
Officer	0.07	0.05	0.10	0.09	0.15
Married	0.45	0.35	0.52	0.56	0.68
Age	24.49	23.85	24.45	24.94	26.46
<i>Race/ethnicity</i>					
White	0.69	0.70	0.67	0.68	0.66
Black	0.11	0.12	0.11	0.10	0.11
Hispanic	0.10	0.09	0.11	0.11	0.11
Asian	0.03	0.03	0.04	0.03	0.03
Other race	0.07	0.07	0.06	0.08	0.09
<i>Occupation categories</i>					
Infantry	0.20	0.12	0.17	0.29	0.32
Engineering	0.05	0.03	0.04	0.07	0.05
Artillery	0.03	0.02	0.02	0.04	0.04
Aviation	0.14	0.13	0.23	0.14	0.21
Armor	0.02	0.02	0.02	0.03	0.01
Communications	0.09	0.07	0.12	0.11	0.11
Legal	0.03	0.03	0.02	0.02	0.01
Intelligence	0.02	0.02	0.03	0.03	0.03
Logistics	0.03	0.03	0.05	0.04	0.05
Ammunition han- dling	0.01	0.01	0.01	0.01	0.01
Other occupation	0.39	0.53	0.30	0.23	0.15
<i>Enlistment waivers</i>					
Waiver for minor, non-drug-related offense	0.01	0.01	0.01	0.01	0.02
Waiver for major, non-drug-related offense	0.02	0.02	0.02	0.03	0.02
Waiver for drug use	0.04	0.04	0.03	0.05	0.02
Other type of waiver	0.10	0.09	0.10	0.11	0.11

Notes: HA/DR = Humanitarian Assistance/Disaster Relief. OEF/OIF = Operation Enduring Freedom/Operation Iraqi Freedom. AFQT = Armed Forces Qualifying Test. PTSD = Post Traumatic Stress Disorder.

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 ailments]); *potentially stressful events* (demotion and divorce, modeled as whether the event occurred in the past quarters); *military career status* (whether the person was in the reserves); *demographics* (age, gender, race/ethnicity, marital status, and dependent quantity); *service variables* (rank, AFQT score as a proxy for ability of enlisted personnel), and variables detailing the *history of mental health diagnosis* based on ICD-9 codes (diagnosis of self-inflicted injuries [ICD-9 E950-E958], post-traumatic stress disorder [ICD-9 309.81], major depression [ICD-9 296.2-296.3], substance use disorder [ICD-9 291-292 and 303-305], bipolar disorder [ICD-9 296, except for 296.2-296.3

and 296.9], other psychotic diagnoses [ICD-9 290, 293, 294, and 296.9-299], anxiety [ICD-9 300], and all other mental health diagnoses not covered in previous categories [ICD-9 310-316]).

Our second outcome of interest is whether an individual died by suicide anytime between 2001 and 2011, as identified by ICD-10 codes X71–X83 and based on the cause of death entry in the death certificate. As we observe the universe of suicide deaths, we are able to include quarters after a person separated from the Marine Corp in this analysis. Reflecting this richer data-set, we allow the relationship between deployment and suicide deaths to vary based on whether the Marine was on active duty or was a veteran. We also include the following variables to capture variation in death by suicide as a function of separation from service: *time-in-service at separation* (under 6 months, 7 months to 2 years, 2 to 4 years) and *time since separation* (separated 2–3 years ago, separated 4–5 years ago, separated 6 or more years ago).

There are a few things to keep in mind when interpreting our empirical results. First, there may be a stigma associated with mental health issues and so the clinical diagnoses we observe may be a lower bound on actual diagnoses; this measurement error would tend to downward bias the overall effect of deployments on mental health. However, there is no reason to expect any under-reporting to be systematically different between those deployed under OEF/OIF compared to HA/DR missions. Second, for the PTSD analysis, censoring may not be entirely random because those who develop mental health problems are less likely to stay in the military, in which case we would not observe their diagnosis. This would tend to downward bias the impacts of deployments on mental health. (Note this censoring issue does not affect the suicide analysis as we do observe death by suicide after Marines leave the military.)

Results

We first explore whether there is differential selection into deployment and, conditional on any deployment, selection into deployment type. Table 2 contains estimates from Cox models exploring the determinants of deployment to either HA/DR (Column 1) or OEF/OIF (Column 2) missions and it is clear that the propensity to deploy varies across demographic groups. For example, those with past diagnoses of mental health disorders are significantly less likely to deploy to both HA/DR and OEF/OIF missions; the lowest ranked enlisted Marines (E1 and E2, the omitted group) are less likely to deploy as they are still in training; and those in infantry occupations (the omitted occupation) are the most likely to deploy. Next, we look at the subset of Marines who ever deployed and estimate a logit model explaining the deployment type (HA/DR vs. OEF/OIF). Table 3 contains these results, and the magnitudes of the odds ratios are much smaller than in Table 2. Nonetheless, some significant differences remain between the populations who deployed to HA/DR and OEF/OIF missions. For example, those deployed to HA/DR were slightly less likely to have a past diagnosis of major depression and more likely to be male, non-white, young (less than 22 years old is the omitted age category), and of a higher rank. To control for selection based on observables into deployment and deployment type, we control for a full set of observable characteristics in our main analysis.

Table 4 contains our main estimates on the impacts of deployment on PTSD and death by suicide.² Column 1 shows that the hazard of being diagnosed with PTSD during deployments to OEF/OIF is 2.26 times higher than those never deployed, and the equivalent hazard ratio is only 0.27 during deployments to HA/DR missions. The two hazard ratios significantly differ by more than a factor of 8 (p -value = 0.00). This difference may be reflecting the fact that Marines had differential access to health care: on most HA/DR missions, Marines are stationed on either Navy ships or in minimal shore-based encampments which may lack the resources to properly diagnose PTSD, while on OEF/OIF mission there were significantly built-up medical facilities with a greater ability to diagnose mental health problems.

Aside from differential availability of care, both deployment types are exhaustive and fast paced, and Marines may simply be too busy to afford the mental space for introspective on the disaster or combat experiences while on deployment. However, once they return home, they not only have more time for self-reflection on their experiences, but they also generally have less camaraderie and peer protection upon dispersion of their units. Column 1 shows that Marines' experiences after returning home from


Table 2. Characteristics of the deployed and never deployed populations.

Sample =	Excludes person-quarters during or after an OEF/OIF deployment		Excludes person-quarters during or after an HA/DR deployment	
	Deployed to HA/DR (1)		Deployed to OEF/OIF (2)	
Outcome =	Odds Ratio	[95% CI]	Odds Ratio	[95% CI]
<i>Past diagnoses</i>				
Past diagnosis of self-inflicted injury	0.83	[0.52,1.33]	0.92	[0.80,1.06]
Past diagnosis of PTSD	0.87	[0.65,1.18]	0.97	[0.89,1.06]
Past diagnosis of major depression	0.48***	[0.37,0.62]	0.59***	[0.55,0.64]
Past diagnosis of substance abuse	0.72**	[0.53,0.99]	0.83***	[0.76,0.91]
Past diagnosis of bipolar disorder	0.55**	[0.35,0.87]	0.44***	[0.37,0.51]
Past diagnosis of other psychotic disorder	0.50***	[0.38,0.67]	0.50***	[0.46,0.55]
Past diagnosis of anxiety	0.65***	[0.48,0.90]	0.69***	[0.63,0.76]
Past diagnosis of other mental disorder	0.56***	[0.50,0.62]	0.55***	[0.53,0.57]
<i>Enlistment waivers</i>				
Waiver, minor non-drug-related offense	0.93	[0.82,1.05]	0.92***	[0.89,0.95]
Waiver, major non-drug-related offense	0.95	[0.86,1.04]	0.97**	[0.95,0.99]
Waiver, drug use	0.79***	[0.72,0.86]	0.85***	[0.83,0.87]
Other type of waiver	0.87***	[0.83,0.91]	0.93***	[0.92,0.94]
<i>Occupation characteristics</i>				
Past demotion in rank	0.01***	[0.00,0.08]	–	–
Currently serves in the reserves	0.15***	[0.13,0.17]	1.32***	[1.30,1.33]
<i>Rank and officer status</i>				
Enlisted rank E3	23.92***	[22.65,25.27]	16.67***	[16.46,16.89]
Enlisted rank E4	19.66***	[18.44,20.96]	11.47***	[11.29,11.65]
Enlisted rank E5	13.47***	[12.46,14.55]	7.60***	[7.45,7.76]
Enlisted rank E6 or higher enlisted rank	29.62***	[27.15,32.31]	12.58***	[12.28,12.89]
Officer	30.27***	[27.36,33.48]	14.67***	[14.27,15.08]
Officer rank O3	2.25***	[2.02,2.50]	1.40***	[1.35,1.45]
Officer rank O4	2.11***	[1.85,2.40]	1.51***	[1.45,1.57]
Officer rank O5	0.72***	[0.62,0.83]	0.51***	[0.49,0.53]
Officer rank O6 or higher	1.61***	[1.35,1.92]	1.09***	[1.03,1.16]
<i>Occupation categories</i>				
Engineering	0.73***	[0.68,0.78]	0.89***	[0.87,0.90]
Artillery	0.71***	[0.65,0.78]	0.87***	[0.85,0.89]
Aviation	0.69***	[0.66,0.72]	0.56***	[0.55,0.56]
Armor	0.44***	[0.39,0.49]	0.67***	[0.65,0.69]
Communications	0.86***	[0.82,0.91]	0.78***	[0.76,0.79]
Legal	0.25***	[0.22,0.28]	0.43***	[0.42,0.45]
Intelligence	0.70***	[0.64,0.76]	0.74***	[0.72,0.76]
Logistics	0.82***	[0.77,0.88]	0.66***	[0.65,0.68]

Ammunition handling	0.59***	[0.51,0.69]	0.69***	[0.66,0.72]
Other occupation	0.43***	[0.41,0.44]	0.43***	[0.42,0.43]
<i>Demographics</i>				
AFQT score 31–49	0.82***	[0.71,0.94]	0.81***	[0.78,0.84]
AFQT score 50–64	0.73***	[0.63,0.84]	0.73***	[0.70,0.76]
AFQT score 65–92	0.71***	[0.61,0.82]	0.67***	[0.65,0.70]
AFQT score 93–100	0.70***	[0.60,0.82]	0.61***	[0.59,0.64]
Male	1.78***	[1.66,1.92]	1.71***	[1.67,1.74]
Age 22–24	0.59***	[0.57,0.62]	0.68***	[0.68,0.69]
Age 25–29	0.59***	[0.56,0.62]	0.62***	[0.61,0.63]
Age 30–34	0.55***	[0.51,0.59]	0.58***	[0.57,0.59]
Age 35–39	0.58***	[0.53,0.64]	0.56***	[0.55,0.58]
Age 40+	0.16***	[0.14,0.18]	0.13***	[0.13,0.14]
Black	0.95**	[0.90,0.99]	0.89***	[0.88,0.90]
Hispanic	1.16***	[1.11,1.22]	1.13***	[1.12,1.15]
Asian	1.13***	[1.04,1.22]	1.02	[0.99,1.04]
Other race	0.72***	[0.68,0.77]	0.88***	[0.86,0.89]
Married	0.90***	[0.85,0.96]	1.09***	[1.07,1.11]
One dependent	1.01	[0.95,1.08]	1.14***	[1.12,1.16]
Two dependents	1.05	[0.98,1.13]	1.07***	[1.05,1.10]
Three or more dependents	1.22***	[1.13,1.32]	1.19***	[1.17,1.22]
Past divorce while serving in the military	0.85***	[0.77,0.93]	1.01	[0.98,1.04]
Observations	10,563,147		10,800,554	

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Omitted categories include: no enlistment waiver, enlisted rank E1–E2, infantry occupation, AFQT score 0–31, age less than 22, White race, and no dependents.

Table 3. Logistic regression comparing those deployed to OEF/OIF and HA/DR.

Sample =	Individuals who were ever deployed to HA/DR or OEF/OIF	
	Deployed to HA/DR	
Outcome =	Odds ratio	[95% CI]
<i>Past diagnoses</i>		
Past diagnosis of self-inflicted injury	0.84	[0.51,1.36]
Past diagnosis of PTSD	0.80	[0.58,1.10]
Past diagnosis of major depression	0.75**	[0.58,0.96]
Past diagnosis of substance abuse	0.77	[0.55,1.06]
Past diagnosis of bipolar disorder	0.92	[0.55,1.53]
Past diagnosis of other psychotic disorder	1.01	[0.75,1.35]
Past diagnosis of anxiety	1.00	[0.73,1.37]
Past diagnosis of other mental disorder	0.99	[0.89,1.10]
<i>Enlistment waivers</i>		
Waiver, minor non-drug-related offense	1.11*	[1.00,1.23]
Waiver, major non-drug-related offense	0.96	[0.88,1.04]
Waiver, drug use	0.60***	[0.56,0.65]
Other type of waiver	0.97	[0.94,1.01]
Past demotion in rank	1.01	[0.96,1.07]
<i>Rank at first deployment</i>		
Enlisted rank E3	1.24***	[1.19,1.29]
Enlisted rank E4	1.41***	[1.34,1.49]
Enlisted rank E5	1.62***	[1.52,1.73]
Enlisted rank E6 or higher enlisted rank	2.37***	[2.19,2.57]
Officer	2.18***	[1.99,2.38]
Officer rank O3	1.19***	[1.09,1.30]
Officer rank O4	1.17***	[1.04,1.31]
Officer rank O5	1.29***	[1.13,1.48]
Officer rank O6 or higher	1.32***	[1.12,1.56]
<i>Demographics</i>		
Male	1.20***	[1.12,1.29]
Black	1.15***	[1.11,1.20]
Hispanic	1.07***	[1.03,1.12]
Asian	1.06*	[0.99,1.14]
Other race	0.96	[0.92,1.01]
Married	0.91***	[0.86,0.96]
Past divorce while serving in the military	0.93**	[0.87,0.99]
One dependent	0.95*	[0.90,1.01]
Two dependents	1.08**	[1.01,1.15]
Three or more dependents	1.15***	[1.07,1.23]
AFQT score 31–49	0.99	[0.87,1.13]
AFQT score 50–64	0.95	[0.84,1.08]
AFQT score 65–92	0.94	[0.82,1.06]
AFQT score 93–100	0.94	[0.82,1.08]
<i>Age at first deployment</i>		
22–24 years old	0.79***	[0.76,0.81]
25–29 years old	0.81***	[0.78,0.85]
30–34 years old	0.78***	[0.73,0.84]
35–39 years old	0.67***	[0.61,0.73]
40+ years old	0.58***	[0.52,0.65]
Observations	268,270	

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Occupation category fixed effects included. Omitted categories include: no enlistment waiver, enlisted rank E1–E2, White race, AFQT score 0–31, and age 21 or less.

HA/DR to OEF/OIF deployments continued to diverge: the hazard of PTSD is 7.8 times higher among Marines returning from OEF/OIF missions compared to those never deployed, and just 1.33 times higher among those returning from HA/DR missions; the difference, 6.8, is strongly significant (p -value = 0.00).

We see similar patterns in Column 2 when analyzing suicide death, albeit with smaller magnitude. No Marines died by suicide in a quarter in which they deployed to an HA/DR mission, so we are unable to make comparisons between mission types during the deployed quarters. Furthermore, the significant odds ratio of 0.41 for suicides while on deployment to OEF/OIF compared to those never deployed

Table 4. The relationship between deployments and diagnosis of PTSD or suicide deaths.

Combat deployment =	Deployed to any OEF/OIF country				Deployed to Afghanistan or Iraq			
	All active duty person-quarters		All person-quarters, active duty and veteran		All active duty person-quarters		All person-quarters, active duty and veteran	
Sample =	Diagnosed with PTSD		Death by suicide		Diagnosed with PTSD		Death by suicide	
	(1)	(2)	(3)	(4)	(3)	(4)	(3)	(4)
Outcome =	HR	[95% CI]	HR	[95% CI]	HR	[95% CI]	HR	[95% CI]
Current combat deployment	2.26***	[2.12,2.42]	0.41***	[0.23,0.73]	1.67**	[1.56,1.80]	0.47*	[0.25,0.87]
Current HA/DR deployment	0.27***	[0.16,0.45]	–	–	0.29**	[0.17,0.50]	–	–
Past combat deployment, current active duty	7.80***	[7.39,8.23]	1.81***	[1.38,2.39]	6.64**	[6.29,7.00]	1.67**	[1.24,2.25]
Past HA/DR deployment, current active duty	1.33***	[1.15,1.55]	0.84	[0.27,2.65]	1.89**	[1.68,2.13]	1.09	[0.48,2.49]
Past combat and HA/DR deployment, current active duty	7.13***	[6.51,7.82]	2.08**	[1.10,3.93]	6.46**	[5.86,7.12]	1.12	[0.54,2.31]
Past combat deployment, current veteran	–	–	2.86***	[2.13,3.84]	–	–	2.66**	[1.93,3.68]
Past HA/DR deployment, current veteran	–	–	0.82	[0.30,2.20]	–	–	1.16	[0.54,2.46]
Past combat and HA/DR deployment, current veteran	–	–	2.20**	[1.01,4.83]	–	–	1.71	[0.62,4.72]
No combat of HA/DR deployment and current veteran	–	–	3.15***	[2.40,4.13]	–	–	2.96**	[2.25,3.91]
Past mental health diagnoses	×		×		×		×	
Demographic variables	×		×		×		×	
Occupation-related variables and fixed effects	×		×		×		×	
Observations	8,968,289		16,668,568		7,730,480		14,495,915	
<i>F-tests of equality of the deployment hazard ratios, p-values</i>								
Current combat deployment = Current HA/DR deployment	0.00		–		0.00		–	
Past combat deployment, current active duty = Past HA/DR deployment, current active duty	0.00		0.19		0.00		0.31	
Past combat and HA/DR deployment, current active duty = Past HA/DR deployment, current active duty	0.00		0.16		0.00		0.97	
Past combat deployment, current veteran = Past HA/DR deployment, current veteran	–		0.02		–		0.04	
Past combat and HA/DR deployment, current veteran = Past HA/DR deployment, current veteran	–		0.12		–		0.54	

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. HR = Hazard Ratio, which are estimated with a Cox proportional hazard model. No individuals died by suicide in a quarter they were on a HA/DR deployment. Past mental health diagnoses: PTSD, self-inflicted injury, major depression, substance abuse, bipolar disorder, other psychotic disorders, anxiety, other mental disorders. Demographic variables: gender, age, race, current marital status, past divorce, dependent quantity, AFQT score. Occupation-related variables: enlistment waiver indicators, past demotion in rank, serving in the reserves, time in service, rank, officer, time since separation, 11 occupation category fixed effects. The remaining coefficients are reported in Appendix 1 (Table A1).

echoes the findings of Shen, Cunha, and Williams (2016). However, those returning from OEF/OIF missions are 1.81 times more likely than those never deployed to die by suicide while they were still active duty, and the hazard increases to almost 3 after they left the military. In contrast, the hazard of suicide death is comparable between those that deployed to HA/DR only and the non-deployed Marines. The large and significant hazard of suicide (3.15, p -value < 0.05) among never deployed veterans re-iterates

the finding of Shen, Cunha, and Williams (2016), who show that many of these suicides are among service members who did not complete their first enlistment contract, serving for only a few months.

The Marines that deployed under OEF/OIF were stationed in nine countries in the Middle East region (Afghanistan, Iraq, Bahrain, Djibouti, Jordan, Kyrgyzstan, Kuwait, Kazakhstan, Qatar, and Turkey), all of which were officially designated as combat zones during our study period. It is likely that combat experience is more intense in Iraq and Afghanistan, and so we re-estimated our model defining combat deployments as those in Iraq and Afghanistan only. The results are reported in columns 3 and 4 of Table 4, and they are very similar to those in columns 1 and 2 which use the broader definition of combat deployments as all OEF/OIF countries. This similarity is partly reflecting the fact that over 75 percent of the Marines deployed under OEF/OIF were deployed for at least one quarter to either Iraq or Afghanistan.

We tested the robustness of analysis to several changes in model specification. First, among those who deployed to both HA/DR and OEF/OIF, we found that there the hazards of PTSD and suicide are the same regardless of whether the HA/DR mission happened before or after the OEF/OIF mission. Second, we explored whether longer exposure to deployment might explain the differences between the OEF/OIF and HA/DR effects, since OEF/OIF deployments typically lasted more than one quarter. Specifically, we modeled OEF/OIF deployment quarters as cumulative and categorize the observations into cumulative deployment categories (1, 2, 3, 4, 5–6, 7–8, or 9+ quarters). We did not model HA/DR deployment as cumulative because we do not have information on the exact length of HA/DR missions (although personal communications with Marine officers indicated that a person involved in HA/DR mission typically completed his rotation within one quarter). In this alternative specification, we continue to observe statistically significant diverging effect between those deployed to HA/DR and those who deployed to OEF/OIF for only one quarter. Third, even when we controlled for both past and contemporaneous mental health diagnoses (which could be the result of deployment) in an alternative model, our results on the effects of deployment remained robust.

Our analysis should be interpreted as estimating the overall effect of the two deployment types on PTSD and suicide death. While we do not have the ability to empirically assess the underlying mechanisms that drive the divergence in adverse outcomes from HA/DR and OEF/OIF missions, several theories seem plausible. First, Marines who are subjected to the destruction associated with a HA/DR operation possibly become more grateful for their lives in the U.S. and thus lead a mentally healthier lifestyle. This idea, traditionally known as resilience and more recently referred to as post-traumatic growth, suggests that a positive psychological change can occur following a difficult, stressful, or potentially traumatic life event (Calhoun and Tedeschi 2006). Marines experiencing post-traumatic growth can start relating better with others, look for new healthy opportunities, and become more spiritually connected.

Second, the diverging results between the two types of deployment could be partly due to the different natures of the deployments. Marines deployed to either an HA/DR operation or an OIF/OEF operation can be subjected to trauma; however, the nature of the trauma and the method by which it is inflicted vary drastically between combat and humanitarian assistance/disaster relief. When deployed as a humanitarian, Marines are in place to help devastated communities and assist local populations in overcoming the traumatic event. In combat, a Marine is primarily exposed to – and may potentially be the means behind – traumatic events for others, whether intentionally or not.

Finally, the lower hazard rates for Marines on HA/DR missions may be reflecting the fact these individuals were exposed for shorter periods of time, and the likelihood of PTSD or suicide is a function of the length of exposure: OEF/OIF deployments typically last six months or longer, while HA/DR missions are often shorter. While our sensitivity analysis partially addresses this issue, without actual data on the length of HA/DR missions, we cannot rule out this explanation for our results.

Conclusion

Our analysis reveals several important insights. We show that Marines who deploy to either combat of HA/DR missions are different from those who do not deploy: in particular, they have lower instances of mental health diagnoses. However, among those deployed, there are almost no observable differences

in the mental health diagnoses across those deployed to different mission types, which suggests that the difference in incidence of PTSD and death by suicide across mission type is reflecting the causal impact of the missions. After controlling for prior mental health conditions, detailed occupational categories, and other demographic and service characteristics, the hazard of PTSD and death by suicide are quite different between Marines during and returning from HA/DR missions and those from OEF/OIF missions.

Research into the effects of combat on the mental health of Marines has been widely studied over the last 15 years; however, research into the effects different deployment types have on the mental health of Marines is extremely limited. With the end of sustained combat in Iraq and Afghanistan, research into HA/DR participation should be readdressed. Furthermore, it would be extremely useful to have more detailed data on the types of experiences that military personnel experience while on any deployment.³ Without this level of detail, we do not know whether Marines were involved in dangerous and traumatic operations, or were in more relatively safe environments behind the front lines.

Notes

1. Several reasons explain why the military is used, and will continue to be used, to conduct HA/DR operations instead of non-military governmental agencies, such as the U.S. Agency for International Development (USAID). As Ritchie and Mott (2003) write, 'These agencies may not be structured to handle massive humanitarian requirements without military assistance. Few organizations outside of the military have the capacity to quickly move materiel, establish secure routes for aid delivery, develop command and control mechanisms, and provide direct assistance.' Although the physical architecture provided by the military when conducting an HA/DR operation is of undeniable value, there often exists a political ulterior motive in governments' deploying relief troops. 'The deployment of military forces to assist with a foreign emergency is a very visible show of support for a foreign government and its people' (Ritchie and Mott 2003). In theory, a population given some form of humanitarian assistance by US military units will be more likely to support a U.S. military presence in the future, therefore furthering U.S. national interests abroad.
2. The hazard ratios of the other covariates in our models can be found in Appendix 1 (Table A1). They largely confirm the prior literature that explores the covariates of PTSD and death by suicide.
3. While the post-deployment health assessment (PDHA) contains more detailed information about a Marine's actual experience and exposure to combat intensity, this database is not available to be linked to the rest of the administrative data; furthermore, Marines returning from HA/DR missions to their MEU do not routinely filled out this assessment.

Disclosure Statement

No potential conflict of interest was reported by the authors.

References

- Britt, T. W., and A. B. Adler. 1999. "Stress and Health during Medical Humanitarian Assistance Missions." *Military Medicine* 164 (4): 275–279.
- Calhoun, L. G., and R. G. Tedeschi. 2006. *The Handbook of Posttraumatic Growth: Research and Practice*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Cesur, R., and J. J. Sabia. 2016. "When War Comes Home: The Effect of Combat Service on Domestic Violence." *Review of Economics and Statistics* 98 (2): 209–225.
- Cesur, R., J. J. Sabia, and E. Tekin. 2013. "The Psychological Costs of War: Military Combat and Mental Health." *Journal of Health Economics* 32 (1): 51–65.
- Connorton, E., M. J. Perry, D. Hemenway, and M. Miller. 2011. "Humanitarian Relief Workers and Trauma-Related Mental Illness." *Epidemiologic Reviews* 34: 145–155.
- Department of Defense. (2013). Department of Defense Instruction 1304.32.
- Executive Order 11965 – Establishing the Humanitarian Service Medal. 1977. "Appeared at 42 Federal Register 4329, 3 Code of Federal Regulations, Section 578.35." January 19. <https://www.gpo.gov/fdsys/pkg/CFR-2008-title32-vol3/xml/CFR-2008-title32-vol3-sec578-35.xml>
- Garbern, S. C., L. G. Ebbeling, and S. A. Bartels. 2016. "A Systematic Review of Health Outcomes among Disaster and Humanitarian Responders." *Prehospital and Disaster Medicine* 31 (6): 635–642.
- Hoge, C. W., J. L. Auchterlonie, and C. S. Milliken. 2006. "Mental Health Problems, Use of Mental Health Services, and Attrition from Military Service after Returning from Deployment to Iraq or Afghanistan." *JAMA* 295 (9): 1023–1032.

- Holloway, J., and G. S. Everly Jr. 2009. "Mental Health Considerations for Military Humanitarian Aid Personnel." *International Journal of Emergency Mental Health* 12 (3): 193–198.
- LeardMann, C. A., T. M. Powell, T. C. Smith, M. R. Bell, B. Smith, E. J. Boyko, Tomoko I. Hooper, and Gary D. Gackstetter. 2013. "Risk Factors Associated with Suicide in Current and Former US Military Personnel." *JAMA* 310 (5): 496–506.
- Lyle, D. S. 2006. "Using Military Deployments and Job Assignments to Estimate the Effect of Parental Absences and Household Relocations on Children's Academic Achievement." *Journal of Labor Economics* 24 (2): 319–350.
- Negrusa, S., B. Negrusa, and J. Hosek. 2014. "Gone to War: Have Deployments Increased Divorces?" *Journal of Population Economics* 27 (2): 473–496.
- Norris, F. H., M. J. Friedman, P. J. Watson, C. M. Byrne, and E. K. Diaz. 2002. "60,000 Disaster Victims Speak: Part I. an Empirical Review of the Empirical Literature, 1981–2001." *Psychiatry: Interpersonal and Biological Processes* 207–239.
- NPR Staff. 2014. *For U.S. Vets, Iraq's Newest Conflict Awakens Complex Emotions*, June 29. Accessed from National Public Radio <https://www.npr.org/2014/06/29/326702940/for-u-s-vets-iraqs-newest-conflict-awakens-complex-emotions>.
- Ramchand, R., J. Acosta, and R. M. Burns. 2011. *The War within: Preventing Suicide in the US Military*. Santa Monica, CA: Rand Corporation.
- Reger, M. A., D. J. Smolenski, N. A. Skopp, M. J. Metzger-Abamukang, H. K. Kang, T. A. Bullman, Sondra Perdue, and G. A. Gahm. 2015. "Risk of Suicide among US Military Service Members following Operation Enduring Freedom or Operation Iraqi Freedom Deployment and Separation from the US Military." *JAMA Psychiatry* 72 (6): 561–569.
- Ritchie, E. C., and R. L. Mott. 2003. "Ch 25 – Military Humanitarian Assistance: The Pitfalls and Promise of Good Intentions." In *Military Medical Ethics*, edited by D. Lounsbury and R. Bellamy, 805–830. Washington, DC: Office of the Surgeon General, Department of the Army.
- Seal, K. H., D. Bertenthal, C. R. Miner, S. Sen, and C. Marmar. 2007. "Bringing the War Back Home." *Archives of Internal Medicine* 167 (5): 476–482.
- Shen, Y., J. Arkes, B. Kwan, L. Tan, and T. V. Williams. 2010. "Effects of Iraq/Afghanistan Deployments on PTSD Diagnoses for Still Active Personnel in All Four Services." *Military Medicine* 175 (10): 763–769.
- Shen, Y. C., J. Arkes, and T. V. Williams. 2012. "Effects of Iraq/Afghanistan Deployments on Major Depression and Substance Use Disorder: Analysis of Active Duty Personnel in the US Military." *American Journal of Public Health* S80–S87.
- Shen, Y. C., J. M. Cunha, and T. V. Williams. 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 (11): 1039–1048.
- Talton, T. 2010. "24th MEU Joining Haiti Relief." *Marine times*, January 23.
- Tanielian, T., and L. H. Jaycox. 2008. *Invisible Wounds of War*. Santa Monica, CA: Rand Corporation.

Appendix 1

Table A1. Remaining coefficient estimates from the model in Table 4.

Sample =	Deployed to any OEF/OIF country				Deployed to Afghanistan or Iraq			
	All active duty person-quarters		All person-quarters, active duty and veteran		All active duty person-quarters		All person-quarters, active duty and veteran	
	Diagnosed with PTSD		Death by suicide		Diagnosed with PTSD		Death by suicide	
Outcome =	(1)		(2)		(3)		(4)	
	HR	[95% CI]	HR	[95% CI]	HR	[95% CI]	HR	[95% CI]
<i>Past diagnoses</i>								
Past diagnosis of PTSD	–	–	0.73	[0.50, 1.07]	–	–	0.80	[0.53, 1.21]
Past diagnosis of self-inflicted injury	0.64 ⁺	[0.37, 1.08]	2.36 ^{**}	[1.43, 3.91]	0.56 ⁺	[0.31, 1.02]	2.00 [*]	[1.14, 3.52]
Past diagnosis of major depression	0.89	[0.71, 1.10]	1.41 ⁺	[0.98, 2.04]	0.90	[0.71, 1.13]	1.43 ⁺	[0.96, 2.14]
Past diagnosis of substance abuse	0.62 ^{**}	[0.43, 0.89]	1.77 ^{**}	[1.20, 2.60]	0.65 [*]	[0.44, 0.96]	1.68 [*]	[1.10, 2.55]
Past diagnosis of bipolar disorder	0.69	[0.42, 1.13]	1.54 ⁺	[0.94, 2.54]	0.65	[0.38, 1.13]	1.56	[0.91, 2.66]
Past diagnosis of other psychotic disorder	0.87	[0.69, 1.10]	1.34	[0.89, 2.02]	0.83	[0.64, 1.08]	1.48 ⁺	[0.96, 2.28]
Past diagnosis of anxiety	1.05	[0.79, 1.38]	1.37	[0.93, 2.01]	1.05	[0.78, 1.42]	1.43 ⁺	[0.95, 2.16]
Past diagnosis of other mental disorder	0.67 ^{**}	[0.60, 0.74]	2.37 ^{**}	[1.91, 2.95]	0.67 ^{**}	[0.60, 0.75]	2.18 ^{**}	[1.73, 2.76]
<i>Enlistment waivers</i>								
Waiver for minor, non-drug-related offense	1.13 ⁺	[0.99, 1.29]	1.11	[0.64, 1.93]	1.22 ^{**}	[1.06, 1.41]	1.17	[0.66, 2.09]
Waiver for major, non-drug-related offense	1.07	[0.97, 1.18]	1.06	[0.72, 1.54]	1.09	[0.98, 1.21]	1.07	[0.71, 1.61]
Waiver for drug use	1.00	[0.92, 1.09]	1.29 ⁺	[0.97, 1.70]	1.01	[0.92, 1.11]	1.23	[0.91, 1.66]
Other type of waiver	1.06 [*]	[1.01, 1.11]	0.74 [*]	[0.58, 0.95]	1.07 [*]	[1.02, 1.13]	0.83	[0.64, 1.06]
<i>Occupation characteristics</i>								
Past demotion in rank	1.58 ^{**}	[1.45, 1.72]	1.21	[0.80, 1.81]	–	–	1.47 [*]	[1.00, 2.17]
Currently in the reserves	0.54 ^{**}	[0.51, 0.58]	0.33 ^{**}	[0.20, 0.56]	0.55 ^{**}	[0.51, 0.59]	0.32 ^{**}	[0.18, 0.55]
Separated within 2 quarters	0.04 ^{**}	[0.02, 0.08]	1.50 ⁺	[0.93, 2.43]	0.04 ^{**}	[0.02, 0.08]	1.39	[0.86, 2.25]
Time in service 2 qtrs to 2 yrs	1.88 ^{**}	[1.70, 2.09]	1.38 ^{**}	[1.10, 1.73]	1.83 ^{**}	[1.65, 2.03]	1.32 [*]	[1.05, 1.66]
Time in service 2 to 4 years	3.36 ^{**}	[3.17, 3.55]	0.98	[0.77, 1.25]	3.18 ^{**}	[2.98, 3.39]	0.92	[0.71, 1.20]
Separated for 2–3 years	–	–	0.81 ⁺	[0.65, 1.02]	–	–	0.86	[0.67, 1.09]
Separated for 4–5 years	–	–	0.56 ^{**}	[0.43, 0.73]	–	–	0.57 ^{**}	[0.43, 0.77]
Separated for 6+ years	–	–	0.46 ^{**}	[0.35, 0.62]	–	–	0.45 ^{**}	[0.33, 0.62]
<i>Rank and officer status</i>								
Enlisted rank E3	3.25 ^{**}	[3.03, 3.49]	1.09	[0.88, 1.36]	3.76 ^{**}	[3.49, 4.05]	0.99	[0.79, 1.25]
Enlisted rank E4	2.37 ^{**}	[2.19, 2.56]	0.76 [*]	[0.59, 0.98]	2.70 ^{**}	[2.49, 2.93]	0.71 [*]	[0.55, 0.93]
Enlisted rank E5	2.01 ^{**}	[1.85, 2.19]	0.68 [*]	[0.51, 0.92]	2.33 ^{**}	[2.13, 2.54]	0.66 ^{**}	[0.48, 0.90]
Enlisted rank E6 ⁺	1.17 ^{**}	[1.06, 1.30]	1.03	[0.70, 1.53]	1.40 ^{**}	[1.26, 1.56]	0.99	[0.65, 1.50]
Officer	0.55 ^{**}	[0.45, 0.68]	0.65	[0.28, 1.53]	0.62 ^{**}	[0.50, 0.77]	0.44	[0.16, 1.24]
Officer rank O3	1.01	[0.81, 1.27]	1.35	[0.45, 4.04]	1.14	[0.89, 1.45]	1.81	[0.50, 6.47]

(Continued)

Table A1. (Continued).

Sample =	Deployed to any OEF/OIF country				Deployed to Afghanistan or Iraq			
	All active duty person-quarters		All person-quarters, active duty and veteran		All active duty person-quarters		All person-quarters, active duty and veteran	
	Diagnosed with PTSD	Death by suicide	HR	[95% CI]	Diagnosed with PTSD	Death by suicide	HR	[95% CI]
	(1)		(2)		(3)		(4)	
Officer rank O4	0.78*	[0.61,1.01]	2.73*	[0.94,7.89]	0.83	[0.63,1.11]	3.35+	[0.95,11.78]
Officer rank O5	0.55**	[0.40,0.74]	0.35	[0.04,2.94]	0.60**	[0.43,0.84]	0.56	[0.06,5.06]
Officer rank O6+	0.80	[0.58,1.11]	2.31	[0.64,8.31]	1.01	[0.71,1.43]	3.81*	[0.94,15.43]
<i>Occupation categories</i>								
Engineering	0.74**	[0.69,0.79]	0.98	[0.71,1.37]	0.76**	[0.71,0.82]	0.83	[0.56,1.23]
Artillery	0.67**	[0.61,0.74]	1.35	[0.92,1.97]	0.70**	[0.63,0.77]	1.46+	[0.99,2.15]
Aviation	0.34**	[0.32,0.37]	0.74*	[0.57,0.95]	0.35**	[0.32,0.37]	0.74*	[0.57,0.97]
Armor	0.69**	[0.62,0.76]	1.28	[0.85,1.94]	0.66**	[0.58,0.74]	1.26	[0.80,1.96]
Communications	0.61**	[0.57,0.65]	0.64**	[0.46,0.87]	0.61**	[0.57,0.65]	0.63**	[0.45,0.88]
Legal	0.75**	[0.68,0.83]	0.62+	[0.37,1.06]	0.75**	[0.67,0.84]	0.54*	[0.30,0.97]
Intelligence	0.51**	[0.45,0.58]	0.75	[0.43,1.30]	0.50**	[0.44,0.58]	0.82	[0.47,1.42]
Logistics	0.46**	[0.41,0.51]	0.80	[0.51,1.28]	0.47**	[0.42,0.53]	0.79	[0.48,1.31]
Ammunition handling	0.80**	[0.70,0.92]	0.65	[0.27,1.58]	0.84*	[0.72,0.98]	0.46	[0.15,1.44]
Other occupation	0.67**	[0.64,0.69]	1.11	[0.92,1.34]	0.67**	[0.64,0.70]	1.10	[0.91,1.34]
<i>Demographics</i>								
AFQT score 31–49	0.89*	[0.79,1.01]	0.80	[0.43,1.46]	0.90	[0.78,1.03]	0.95	[0.47,1.94]
AFQT score 50–64	0.80**	[0.71,0.91]	0.87	[0.48,1.61]	0.80**	[0.70,0.93]	1.06	[0.52,2.16]
AFQT score 65–92	0.65**	[0.57,0.74]	0.84	[0.46,1.55]	0.66**	[0.57,0.76]	1.07	[0.53,2.17]
AFQT score 93–100	0.46**	[0.39,0.54]	0.78	[0.40,1.55]	0.45**	[0.38,0.54]	1.05	[0.49,2.27]
Male	0.39**	[0.37,0.41]	4.56**	[2.67,7.77]	0.37**	[0.35,0.40]	4.56**	[2.62,7.93]
Age 22–24	1.15**	[1.10,1.21]	1.47**	[1.19,1.81]	1.20**	[1.13,1.26]	1.49**	[1.20,1.86]
Age 25–29	1.22**	[1.15,1.29]	1.38*	[1.07,1.78]	1.28**	[1.20,1.36]	1.41*	[1.08,1.84]
Age 30–34	1.34**	[1.23,1.45]	1.02	[0.68,1.53]	1.37**	[1.25,1.50]	1.02	[0.66,1.57]
Age 35–39	1.55**	[1.40,1.71]	0.98	[0.58,1.66]	1.54**	[1.38,1.72]	0.95	[0.54,1.68]
Age 40+	1.61**	[1.46,1.78]	0.78	[0.57,1.08]	1.59**	[1.43,1.76]	0.76	[0.55,1.06]
Black	0.77**	[0.73,0.82]	0.70**	[0.54,0.92]	0.77**	[0.73,0.82]	0.64**	[0.48,0.86]
Hispanic	0.78**	[0.73,0.82]	0.56**	[0.41,0.76]	0.78**	[0.73,0.82]	0.52**	[0.38,0.73]
Asian	0.73**	[0.66,0.82]	0.52*	[0.30,0.90]	0.73**	[0.65,0.82]	0.54*	[0.30,0.95]
Other race	0.92*	[0.86,0.99]	0.79	[0.57,1.10]	0.96	[0.89,1.04]	0.85	[0.59,1.21]
Married	1.36**	[1.27,1.45]	1.24	[0.93,1.67]	1.35**	[1.26,1.45]	1.23	[0.90,1.69]
One dependent	1.20**	[1.12,1.28]	1.06	[0.78,1.44]	1.21**	[1.13,1.30]	1.10	[0.79,1.52]
Two dependents	1.31**	[1.22,1.41]	0.84	[0.58,1.20]	1.35**	[1.24,1.45]	0.80	[0.54,1.19]
Three or more dependents	1.47**	[1.36,1.58]	1.08	[0.75,1.56]	1.52**	[1.40,1.65]	1.12	[0.76,1.66]
Past divorce while active duty	–	–	1.32	[0.90,1.94]	1.59**	[1.45,1.74]	1.19	[0.77,1.85]
Observations	–	8,968,289	–	16,668,568	–	7,730,480	–	14,495,915

Notes: * $p < 0.05$, ** $p < 0.01$. No individuals who were diagnosed with PTSD in a quarter after they were demoted in rank. Omitted categories include: No enlistment waiver, time in service less than 1 year, enlisted rank E1–E2, Infantry occupation, AFQT score 0–31, age less than 22, White race, and no dependents.