HEATHER KRULL, CARRIE M. FARMER, STEPHANIE RENNANE,
EVAN GOLDSTEIN, PHILIP ARMOUR, TEAGUE RUDER

Trends in Department of Defense Disability Evaluation System Ratings and Awards for Posttraumatic Stress Disorder and Traumatic Brain Injury, 2002–2017

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Preface

Service members whose wounds, illnesses, or injuries call into question their ability to fulfill their military duties may be referred by a health care provider or commanding officer to the joint U.S. Department of Defense (DoD)–U.S. Department of Veterans Affairs (VA) Integrated Disability Evaluation System (IDES). During the evaluation, the military department in which the individual serves determines whether he or she is fit for duty. If the service member is found to be unfit, the service member is medically discharged from military service. Since 2001, there have been major changes to disability evaluation policies and processes, as well as policy changes related to screening, diagnosing, and treating what have become known as the "signature wounds" of the wars in Iraq and Afghanistan: posttraumatic stress disorder (PTSD) and traumatic brain injury (TBI). To explore these changes, as well as their potential effects on the numbers and characteristics of service members who are evaluated through IDES, the DoD asked the RAND National Defense Research Institute (NDRI) to assess trends in DoD Disability Evaluation System (DES) policies and awards for PTSD and TBI between 2002 and 2017. This report documents historical trends in disability evaluations and outcomes for service members with PTSD or TBI and compares those trends with those for service members with other medical conditions. A companion report (RR-3173-OSD) describes RAND NDRI's review of DES policies and changes to the way DoD screened for and identified PTSD and TBI between 2001 and 2018. The research reported here was completed in August 2019 and underwent security review with the sponsor and the

Defense Office of Prepublication and Security Review before public release.

This research was sponsored by the Psychological Health Center of Excellence and conducted within the Forces and Resources Policy Center of the RAND National Security Research Division (NSRD), which operates the National Defense Research Institute (NDRI), a federally funded research and development center sponsored by the Office of the Secretary of Defense, the Joint Staff, the Unified Combatant Commands, the Navy, the Marine Corps, the defense agencies, and the defense intelligence enterprise.

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Summary

Service members who become injured or ill while serving may seek treatment for their medical condition(s). If the medical condition(s) continues to interfere with their ability to perform their military duties, their provider may refer them for disability evaluation to determine whether they are fit to continue serving. Most of these service members are medically discharged and are awarded disability benefits for conditions that make them unfit to serve. These injuries and illnesses are often the result of the physical nature of a military career, but may be more likely to occur during periods of frequent deployment. Since October, 2001, when Operation Enduring Freedom began in Afghanistan, approximately 3 million service members have been deployed, resulting in 4,094 service members killed in action and 52,737 wounded in action (DeBruyne, 2018).[1] Over that same time period, tens of thousands of service members have been diagnosed with post-traumatic stress disorder (PTSD) and/or traumatic brain injury (TBI).

PTSD is a mental health condition that some people experience after a terrifying or life-threatening event, such as combat. People with PTSD often experience nightmares, flashbacks, and intense anxiety, with symptoms lasting for months (VA, 2019), or for some patients, throughout their lives. There are effective treatments for PTSD, including medication and psychotherapy, so ensuring that service members with PTSD are identified and treated is a priority for the military health

[1] By comparison, twice as many service members deployed during the Vietnam War; ten times as many were killed in action (40,934), and three times as many were wounded in action (153,303) (DeBruyne, 2018).

system. TBI is a serious head injury that causes temporary or permanent damage to the brain. A TBI can be mild, moderate, or severe. Mild TBIs, also known as concussions, are the most common type of TBIs (CDC, 2019). Recovery from TBI depends greatly on the severity of the injury; most of those with a mild TBI have a complete recovery, though identification and appropriate treatment are necessary.

At the same time that the U.S. military has been engaged in combat operations in Afghanistan and Iraq, the process by which service members are evaluated for disability has evolved significantly, including a complete overhaul of the Disability Evaluation System (DES) beginning in 2007. Simultaneously, DoD and the services have made policy changes and initiated other efforts to improve screening for PTSD and TBI, encourage service members to seek treatment, improve quality of care, and reduce the stigma associated with treatment for these conditions.

In this study, we conducted an empirical analysis of trends in diagnosis, treatment, and disability evaluation for PTSD and TBI. In a separate, companion report (Simmons et al., 2021), we identified and described changes that have been made to the DES between 2001 and 2018, as well as policy changes associated with identifying and treating PTSD and TBI.

Trends in Diagnosis and Disability Evaluation

Overview of Methods

To analyze trends in diagnosis and disability outcomes, we constructed a person-year file representing each year of active component (AC) service for anyone who served between FY 2002 and FY 2017. We included administrative data containing demographic and service characteristics, records of medical encounters, health assessments following deployments, and disability evaluation data. We defined diagnosis cohorts based on the first observation of a PTSD and/or TBI diagnosis during a medical encounter, and we created disability cohorts based on the presence of a disability rating for an unfitting condition. We followed diagnosis cohorts forward, and looked back in time at disability cohorts,

for three years to document disability evaluation outcomes and service experiences, respectively. We also took a multivariate approach that did not restrict the analysis to any length of time and followed the diagnosis cohorts to determine what characteristics were associated with faster time to disability evaluation following assignment to a diagnosis cohort.

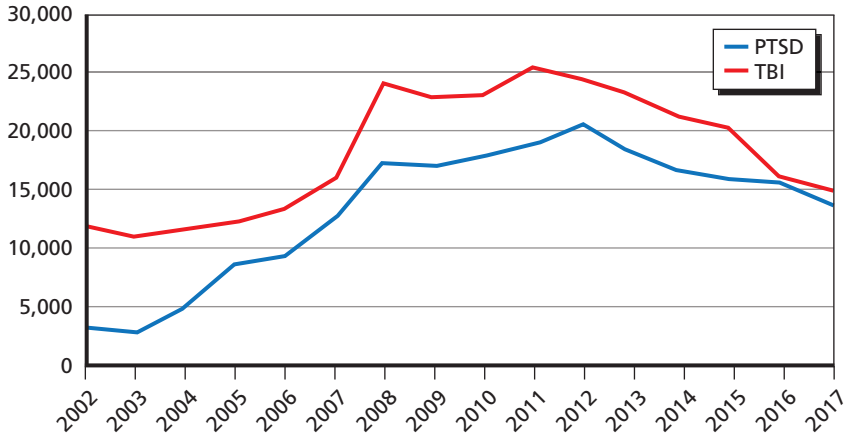
In addition to analyzing trends in diagnoses, disability outcomes, and service member characteristics for those diagnosed with or disability-rated for PTSD or TBI, as well as those with both conditions (PTSD+TBI), we also selected three comparison conditions to provide context. For example, if we see an increase in the number of service members who are medically discharged with a disability rating for one or both of these conditions, we might expect a similar pattern for all conditions if the underlying drivers of disability evaluation affect all conditions or service members in the same way. Or, there might be factors associated with one or both of these conditions, but not with other conditions, that would cause the patterns we see to be unique to PTSD and/or TBI. We selected sleep apnea, major depressive disorder, and back pain as our comparison conditions.

Diagnosis and Disability Cohorts

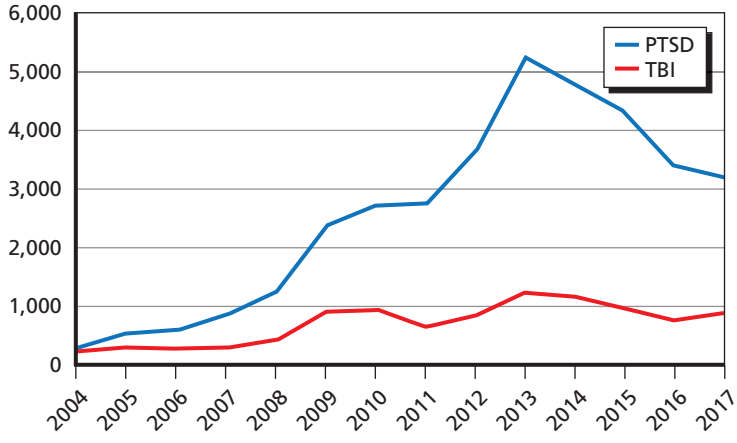
Figure S.1 shows the number of AC service members who were assigned to PTSD and TBI diagnosis and disability cohorts. The size of the cohorts grew over time, with the growth in disability cohorts lagging diagnosis cohorts because service members typically first receive treatment, and then disability evaluation, for those referred, may take a year or more. TBI diagnosis cohorts were consistently larger than PTSD cohorts, but over this time period, the number of service members with a PTSD disability rating (the size of the disability cohorts) was larger than the number with a TBI disability rating.

If the diagnosis cohort counts are scaled to the size of the total active force, the number of service members assigned to the TBI diagnosis cohort represents approximately 0.8 percent of all AC service members present in the first year of our data (FY 2002). In peak years (2008–2011), approximately 1.6 percent of the total active force was first diagnosed with TBI (and therefore assigned to the diagnosis cohort). The share of the total active force assigned to a PTSD cohort

Figure S.1
Number of Active Component Service Members in the Posttraumatic Stress Disorder and Traumatic Brain Injury Diagnosis and Disability Cohorts



(a) Diagnosis cohorts



(b) Disability cohorts

NOTES: Diagnosis cohorts defined based on the first fiscal year in which a diagnosis observed in Military Health System Data Repository (MDR) data, using the International Classification Diseases (ICD) codes documented in Tables B.9–B.10. Disability cohorts defined based on the presence of a disability rating for PTSD and/or TBI and assigned to a cohort based on the fiscal year of disability disposition. PTSD and TBI cohorts are not mutually exclusive (nor do they exclude comparison condition cohorts).

in a given year was consistently smaller than the share assigned to TBI cohorts: It started out around 0.2 percent of the total active force in 2002 and peaked at 1.3 percent in 2012 before beginning to decline.

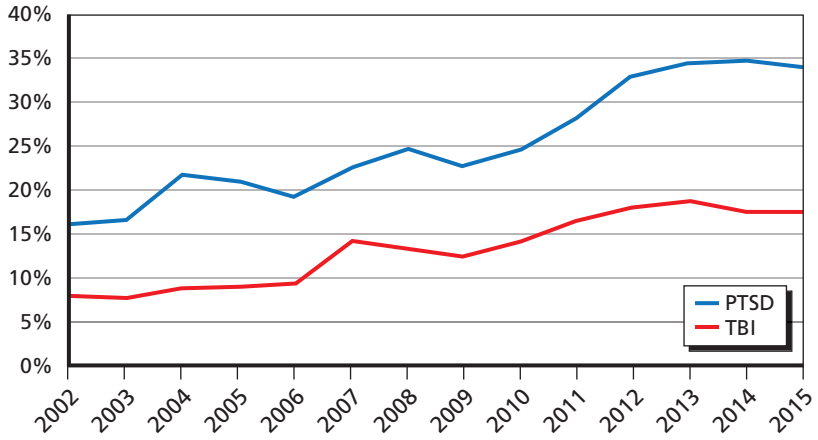
Approximately 2 percent of service members who were medically discharged in 2002 had either a PTSD and/or TBI disability rating. The share of medical discharges with a PTSD disability rating grew quickly after that, to approximately 20 percent between 2009 and 2014. The proportion of medical discharges with a TBI rating was significantly lower throughout the time period, peaking around 7 percent in 2009 and 2010 and remaining steady at around 5 percent for the rest of the observation period.

Prospective Analysis of Diagnosis Cohorts

Following diagnosis cohorts for three years, we found that the share of service members in a PTSD diagnosis cohort who were evaluated for disability more than doubled—from 16 percent in 2002 to 34 percent in 2015 (Figure S.2). Service members diagnosed with TBI experienced slower growth in the rate of disability evaluation over the time period. Since 2008, approximately 80 percent of service members in the PTSD diagnosis cohorts who had a disability evaluation were medically retired (disability rating of 30 percent or higher). The percentage of service members in the PTSD diagnosis cohorts who were evaluated for disability and received a disability rating for PTSD ranged from 40 to 60 percent. For TBI diagnosis cohorts, the share with a TBI disability rating at the conclusion of DES was even lower: Until 2008, 30 percent of the TBI diagnosis cohort also had a TBI disability rating, which declined to just more than 10 percent in the latest cohorts.

Using the same diagnosis cohorts, we conducted hazard analyses of time to disability evaluation following diagnosis. Service members diagnosed with PTSD or PTSD+ TBI were evaluated for disability sooner after their diagnosis than those diagnosed for some of the comparison conditions we analyzed. In addition, service members in more recent diagnosis cohorts were evaluated for disability sooner than service members diagnosed in earlier years, particularly those in the PTSD and PTSD+TBI cohorts.

Figure S.2
Percentage of Diagnosis Cohort with a Medical Retirement or Separation Disposition Within Three Years of First Diagnosis, Fiscal Years 2002–2015



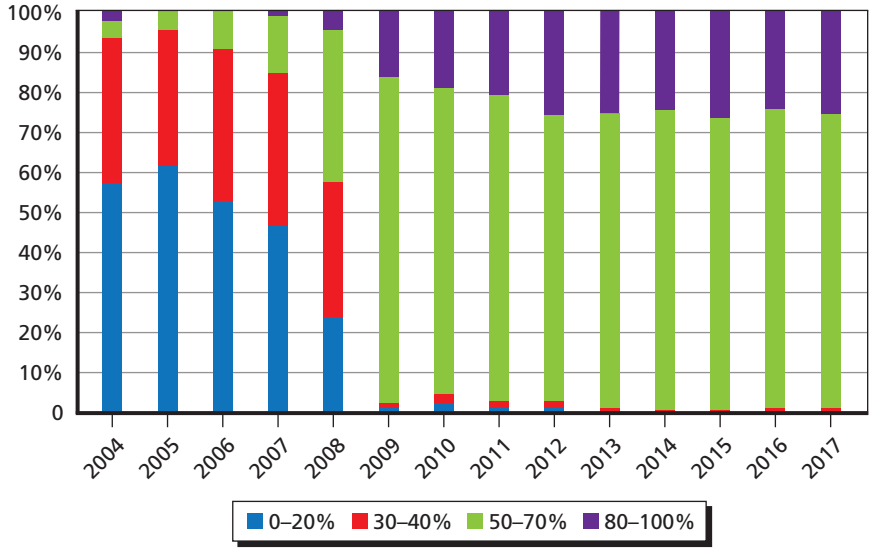
NOTES: Cohorts defined based on the first fiscal year in which a diagnosis is observed in MDR, using the ICD codes documented in Tables B.8–B.13. Diagnosis cohorts are not mutually exclusive.

Finally, we relaxed the three-year window of observation for following the diagnosis cohorts and characterized their disposition at the end of our data period in FY 2017. In FY 2002, 21 percent of the PTSD cohort was medically discharged through the DES; that rate was near double (35–39 percent) for the FY 2008–2014 cohorts. The proportion of the TBI cohorts that was medically discharged was consistently lower, peaking around 25 percent for the FY 2007–2013 cohorts. The combination of Expiration Term of Service (ETS) and retirement account for 30–40 percent of exits in the PTSD and TBI diagnosis cohorts, and less than 2 percent of service members in all disability cohorts had died by the end of the analysis period. The remainder of service members in the cohorts were administratively separated or still serving in FY 2017, and a small fraction had unknown dispositions.

Retrospective Analysis of Disability Cohorts

Using the disability cohorts, we found that approximately 90 percent of service members with a disability rating for PTSD and/or TBI

Figure S.3
Total Disability Rating Distribution Trends: Posttraumatic Stress Disorder Disability Cohorts, Fiscal Years 2004–2017



NOTES: Disability Rating is DoD total disability rating.

had a diagnosis for that condition in the previous three years. Among those with a disability rating for PTSD, 60–70 percent had a positive screen for PTSD on the post-deployment health assessment (PDHA) or post-deployment health reassessment (PDHRA). Service members who were medically discharged with a TBI disability rating between 2009 and 2012 were more likely to have a positive screen for TBI on the PDHA or PDHRA than those discharged in earlier or later years. A 2008 policy mandating that service members with a mental disorder from traumatic stress (such as PTSD) were to be awarded a minimum 50-percent disability rating was borne out in the data; in 2008, 57 percent of the PTSD cohort had a total disability rating of 0–40 percent, but by 2009, almost every member of the cohort had a rating of 50 percent or higher.

A multivariate analysis of the probability of having a PTSD or TBI disability rating at the conclusion of DES showed that deployments, occupation, service, and fiscal year of discharge were the main drivers.

The effects of all variables on the probability of receiving a PTSD rating were larger than on the probability of receiving a TBI rating.

Study Limitations

We faced analytic and data limitations in this study. First, although we are able to make associations between some of the outcomes of interest and the time period or environment in which the outcomes occurred, we are unable to make causal inferences about the outcomes. This is for of two reasons: (1) Policies are not issued in isolation, and (2) there are many factors that we cannot control for using secondary data, including service member preferences, exposures, and experiences that may lead to different outcomes and could be misattributed to the policy change.

We restricted our analysis to AC service members, because our analyses either depended upon a diagnosis or pertained to treatment for a disabling condition. Most Reserve and National Guard service members do not receive health care through the military health system or on the TRICARE purchased care network, so including them in our analysis would have been incomplete and misleading.

With respect to data, the most important limitation is that the disability data source covering the most recent years may include both fitting and unfitting conditions, whereas files covering earlier years (prior to the integration of VA and DoD in disability evaluation) include only conditions found by DoD to be unfitting (which was our intent). The consequence is that later disability cohorts (beginning in 2007 but especially 2012–2017) may be larger than intended. Additionally, not all files contained condition-specific disability ratings, so we had to use total DoD disability rating, which includes all unfitting conditions.

Policy Implications

Across analyses, we found that the number and percentage of service members with a diagnosis or disability rating for PTSD and/or TBI

increased over time until recently, although this was not true for all comparison conditions. Given that these two conditions are thought of as signature wounds of the wars in Iraq and Afghanistan, it is perhaps not surprising that as the number of service members deployed increased, so too did the incidence of these conditions. And similarly, now that a relatively small number of service members have been deployed in recent years, there has been a downward trend in the number and percentage being treated or rated for PTSD and/or TBI. We also observed some trends that align with policy. The clearest example of this is the shift toward higher total DoD disability ratings for service members in the PTSD and sleep apnea cohorts following a 2008 policy directing the services to adhere to the U.S. Department of Veterans Affairs Schedule for Rating Disabilities (VASRD) (which resulted in service members with PTSD receiving a minimum 50-percent disability rating and service members with sleep apnea being rated according to clinical criteria rather than civilian earning capacity).

While there is clearly a relationship between deployment patterns and policy and the trends observed in this study, we cannot specifically attribute the findings to deployments or any other factor. We can note that during the time period covered by these analyses, the disability system was restructured, efforts were made to raise awareness about these conditions and encourage people to seek treatment and to reduce stigma for receiving treatment, and there were many policy changes related to disability evaluation and the identification, diagnosis, and treatment of PTSD and TBI. The results in this report are likely a reflection of all of those factors.

While in general we cannot judge whether the trends we have observed or the policies put in place over this period are positive or negative, there are some outcomes that likely improved service member well-being. For example, we observed an increase in the number and percentage of service members diagnosed with PTSD and TBI. Over this time period, there was increased focus on the psychological toll of the wars, and in response, DoD made changes to how it organized psychological health resources and capabilities. Service members were encouraged to seek treatment, and there were efforts to improve screening, diagnosis, and treatment for these conditions (Simmons et al.,

2021). An increase in the number of service members treated might reflect the success of these programs and initiatives.

Coinciding with the mandatory 50-percent minimum disability rating for service members with a mental disorder resulting from a traumatic event, our results showed a clear trend toward higher ratings for service members in the PTSD (and to a lesser extent, other conditions) cohorts after the policy change. To the extent that improved financial well-being is tied to health and socioeconomic outcomes, an increase in benefits associated with higher disability ratings may enhance opportunities for medically retired service members to reintegrate into the civilian world and continue to receive necessary treatment.

In the future, DoD and the services will continue to evolve policies and practices to improve system performance and service member health. To the extent possible, the effects of those changes should be evaluated as they happen. This report documents a confluence of changes that occurred over a 16-year period, which makes it difficult to identify the impact any single policy had on an outcome such as fitness to serve or disability. But it may be possible to evaluate such changes within a narrower band of time or the effects of the changes on a subset of service members to ensure that the desired outcome is achieved.

Furthermore, with existing data, it would be possible to more formally assess veteran outcomes following medical discharge. This could be done by linking records from military service (personnel and health data) to VA health care utilization (or other benefits) data, or to Social Security Administration data on earnings. Additional data collection would be required to be able to study long-term health outcomes, as this information is not currently recorded in DoD or VA health care utilization data. These types of studies would enable an assessment of the well-being of service members whose war-related conditions affect life after medical discharge.

Acknowledgments

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Abbreviations

AAPC	American Association of Professional Coders
AC	active component
ADMF	Active Duty Master File
ADTF	Active Duty Transaction File
AFHSB	Armed Forces Health Surveillance Branch
ARC	Air Reserve Component
C&P	compensation and pension
CAPER	Comprehensive Ambulatory Professional Encounter Record
CPAP	continuous positive airway pressure
CPT	current procedural terminology
CTS	Contingency Tracking System
DCoE	Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury
DES	Disability Evaluation System
DHA	Defense Health Agency
DMDC	Defense Manpower Data Center
DoD	Department of Defense
DoDI	Department of Defense Instruction
ePEB	electronic physical evaluation board
ETS	Expiration Term of Service

ICD	International Classification of Diseases
IDES	Integrated Disability Evaluation System
ISC	Interservice Separation Code
JDETS	Joint Disability Evaluation Tracking System
LDES	Legacy Disability Evaluation System
MDD	major depressive disorder
MDR	Military Health System Data Repository
MEB	medical evaluation board
MilPDS	Military Personnel Data System
MTF	military treatment facility
PC-PTSD	Primary Care PTSD Screen
PDBR	Physical Disability Board of Review
PDCAPS	Physical Disability Case Processing System
PDHA	post-deployment health assessment
PDHRA	post-deployment health reassessment
PDRL	Permanent Disability Retired List
PDTS	Pharmacy Data Transaction Service
PEB	physical evaluation board
PH	proportional hazard
PTSD	posttraumatic stress disorder
RC	reserve component
RTD	return to duty
SADR	Standard Ambulatory Data Record
SIDR	Standard Inpatient Data Record
SPD	Separation Program Designator
TBI	traumatic brain injury
TDRL	Temporary Disability Retired List
TEDI	TRICARE Encounter Data Institutional
TEDNI	TRICARE Encounter Data Non-Institutional

VA	U.S. Department of Veterans Affairs
VASRD	Veterans Affairs Schedule for Rating Disabilities
VTA	Veterans Tracking Application
WEX	Work Experience File
YOS	years of service

CHAPTER ONE

Introduction

The United States has been engaged in multiple combat operations in Afghanistan, Iraq, and other theaters since 2001. Over 3 million service members have deployed in support of these operations (Defense Manpower Data Center [DMDC], 2018). Improvements in gear and the ability to reach injured service members quickly has considerably reduced the number of service members killed in action compared with previous conflicts. Since the start of Operation Enduring Freedom in late 2001, over 4,000 U.S. service members have been killed in action (DeBruyne, 2018). By comparison, there were twice as many deployments to Vietnam but ten times as many hostile deaths. A welcome improvement in survival rates still means that many deployed individuals returned home with injuries. Since 2001, over 50,000 service members have been wounded in action (compared with 150,000 in Vietnam). Two of those conditions, often considered the signature wounds of the conflicts, are posttraumatic stress disorder (PTSD) and traumatic brain injury (TBI). Whereas many service members recover from injuries and illnesses sustained as a result of military service, those whose conditions affect their ability to continue to serve are referred to the Department of Defense (DoD) Disability Evaluation System (DES) for evaluation for medical separation or retirement. Since the start of the wars in 2001, there have been significant changes to disability evaluation processes and policies, as well as policy changes related to the identification and treatment of PTSD and TBI. These changes are likely to have affected the number and characteristics of service members who are referred to DES.

PTSD is a mental health condition that some people experience after a terrifying or life-threatening event, such as combat. People with PTSD often experience nightmares, flashbacks, and intense anxiety, with symptoms lasting for months (VA, 2019), or for some patients, throughout their lives. There are effective treatments for PTSD, including medication and psychotherapy, so ensuring that service members with PTSD are identified and treated is a priority for the military health system. TBI is a serious head injury that causes temporary or permanent damage to the brain. A TBI can be mild, moderate, or severe. Mild TBIs, also known as concussions, are the most common type of TBIs (CDC, 2019). Recovery from TBI depends greatly on the severity of the injury; most of those with a mild TBI have a complete recovery, though identification and appropriate treatment are necessary.

The Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury[1] asked RAND to examine the trends in the number and characteristics of service members diagnosed, treated, and/or referred to the Disability Evaluation System (DES) for PTSD or TBI between 2002 and 2017,[2] as well as trends in the outcomes of those evaluations, and to document the policy changes related to diagnosis, treatment, and disability evaluation for these conditions during

[1] In 2017, the Defense Centers of Excellence for Psychological Health and Traumatic Brain Injury (DCoE) was reorganized into separate centers within the Defense Health Agency. The sponsoring office for this study became the Psychological Health Center of Excellence (PHCoE). DCoE was created in response to recommendations from the DoD Task Force on Mental Health. Its mission was "to assess, validate, oversee and facilitate prevention, resilience, identification, treatment, outreach, rehabilitation, and reintegration programs for PH and TBI to ensure DoD meets the needs of service members, veterans, military families, and communities" (DoD, 2009). To achieve its mission, DCoE partnered with DoD, VA, and a national network of military and civilian agencies, clinical experts, advocacy groups, and academic institutions to establish best practices and quality standards for addressing psychological health and TBI. PHCoE's annual reports (PHCoE, undated[a]) document the center's achievements and serve as an illustration of the organization's reach.

[2] The obvious starting point for this analysis is the beginning of Operation Enduring Freedom (OEF) following the September 11 attacks, and this is how the research question was framed. OEF began in October, 2001, which was the start of FY 2002, and that is also when our analysis begins. Therefore, this report includes service members who were serving in calendar year 2001, but our discussion is framed in terms of fiscal years, and thus the 2002 start.

this time period. This report presents our analysis of trends in diagnosis, treatment, and disability evaluations. A companion report (Simmons et al., 2021) presents our review of relevant policy changes during this time period. In the rest of this chapter, we provide an overview of the policy context for this study, describe how the Integrated Disability Evaluation System (IDES) works today and how it is different from the Legacy DES (LDES), and present our methodological approach to the trends analysis.[3]

Signature Wounds of the Wars in Iraq and Afghanistan: Posttraumatic Stress Disorder and Traumatic Brain Injury

The exact number service members who have experienced PTSD or TBI is unknown, but in 2008, Tanielian and Jaycox estimated that 18.5 percent of those who had returned from deployments to Iraq or Afghanistan reported symptoms consistent with a diagnosis of PTSD or major depressive disorder (MDD). Based on the number of troops that had deployed, that study yields a point-in-time estimate of approximately 225,000 post-9/11 veterans who met criteria for probable PTSD at the time of their study.[4] While ten years have passed since that study was published, it remains one of the only studies to use validated screening tools to assess the prevalence of current disorder among a representative sample of all those who had been deployed to support operations in either Iraq of Afghanistan. No study since has been able to calculate either the current point-in-time estimate of PTSD prevalence among all those who have deployed, or a life-time prevalence of PTSD among a representative group of post-9/11 veterans. The Tanielian and Jaycox (2008) study also estimated the incidence rate of probable TBI for those who had deployed before 2007

[3] Throughout this report, we use DES to refer to the Disability Evaluation System in general, which during some years was LDES and is now operated as IDES.

[4] This estimate is based on a deployed population (at the time) of 1.64 million service members and a weighted percentage of 13.8 according to Table 4.4. Another estimate reported in the study combines PTSD and MDD to estimate the number of service members (300,000) who may suffer from one or both.

and the number of post-9/11 veterans who had experienced a probable TBI during deployment. Based upon the self-reported screening tool in use at the time, they estimated that approximately 19.5 percent of those who had deployed, or 320,000 post-9/11 veterans, may have experienced a TBI during their deployment. While that study estimated the prevalence of PTSD and MDD and the incidence rate of TBI among the previously deployed, other studies have documented the rates of recorded diagnoses within the population or estimated prevalence of PTSD among subsamples of service members, veterans, or both (Ramchand et al., 2015). DoD has reported recorded diagnoses of PTSD among service members, as well as numbers of TBI diagnoses from reviews of medical records. Annual numbers of DoD TBI diagnoses, in particular, increased from 12,470 in 2002 to 17,841 in 2017, with a high of 32,834 in 2011 (Defense and Veterans Brain Injury Center, 2019). One possible explanation for this increase is the extensive use of improvised explosive devices in Iraq and Afghanistan, a blast-causing weapon that is often associated with a later TBI diagnosis in those who have been exposed to one (MacGregor et al., 2011). In addition, improvements in personal protective equipment have increased the number of surviving service members with injuries such as TBI who would have died from their wounds in previous conflicts (Moore et al., 2009). However, 84 percent of all TBIs reported to DoD between 2001 and 2011 were nondeployment-related (Office of the Surgeon General, 2013). With respect to PTSD, Brundage et al. (2015) report that, out of 2,279,258 active component (AC) service members deployed to Iraq/Afghanistan, there were 110,618 PTSD diagnoses within three years of returning from a war zone (4.85 diagnoses per 100 deployments). An Institute of Medicine report (2014) shows that the incidence of PTSD among service members in all components increased from 7,803 in 2004 to 27,952 in 2012.[5]

Between 2001 and 2018, DoD significantly increased its efforts to ensure that service members with PTSD or TBI received treatment, with the goal of returning as many of these service members as pos-

[5] The Institute of Medicine was renamed the Health and Medicine Division of the National Academies of Sciences, Engineering, and Medicine in March 2016.

sible to duty. As part of these efforts, DoD enacted numerous policy changes that may have influenced injured service members' propensity to seek and receive treatment. These policy changes aimed to increase screening for and treatment of PTSD and TBI and to reduce stigma and encourage care-seeking. For example, a 2011 policy intended in part to "provide guidance for balance between patient confidentiality rights and the commander's right to know for operation and risk management decisions" (Department of Defense Instruction [DoDI] 6490.08, 2011, p. 1) specifies when health care providers are required to notify commanders that a service member is receiving mental health care or substance misuse education (e.g., when the provider believes the service member may harm him- or herself or others, if the condition interferes with duty, or if the patient is admitted or discharged from an inpatient facility). A 2013 policy (DoDI 6490.12, 2013) required training of commanders, supervisors, and service members on how to recognize "service members who may require mental health evaluation" and required commanders to refer service members for mental health evaluations and recommend nonmandatory mental health treatment. However, the impact of these changes on the rates of diagnosis and treatment for these conditions is currently not well understood.

Despite effective treatments for PTSD and TBI, a full recovery is not always possible. In some cases, the symptoms of or impairments from PTSD or TBI affect service members' ability to meet the medical standards for service. Medical providers can then refer service members to DES.

The Department of Defense Disability Evaluation System

Service members who become wounded, ill, or injured while serving may seek and receive treatment for up to one year following diagnosis, or until further recovery is relatively predictable, whichever comes first. If at that point the service member's medical condition(s) prevents him or her from performing the duties of his or her office, grade, rank, or rating, or if the medical condition(s) poses a risk to the service member, a medical provider may refer the service member for disability evaluation (DoDI 1332.18, 2014b). The goal of the disability evaluation pro-

cess is to evaluate a service member's medical conditions and determine eligibility for medical retirement or separation with or without severance pay. Once referred, there are three main steps to this process: medical evaluation board (MEB) evaluation; physical evaluation board (PEB) evaluation and appellate review; and final disposition.

The disability evaluation process commences when a service member is referred by his or her provider and begins with two administrative steps: the referral stage, when the physical evaluation board liaison officer provides the service member's complete treatment record to the VA military service coordinator (MSC), and the claim development stage, when the MSC orders a medical examination. During the medical examination, a physician identifies all service-connected health conditions. Under the Legacy Disability Evaluation System, this medical exam was completed by a military physician. In IDES, this exam is completed by a U.S. Department of Veterans Affairs (VA) physician (or VA-contracted physician). The results of the exam are documented in a narrative summary that MEB uses to adjudicate the case. Each military installation with a medical facility has an MEB, which is composed of several physicians. MEB uses information from the medical exam, medical records, and a service member's commander to determine whether the service member has a medical condition that results in the service member being unable to meet medical retention standards set by military regulations. MEB then forwards its recommendation to PEB. Each service branch has a PEB, which is comprised of a mix of officers and physicians. PEB determines whether the service member's medical conditions are unfitting, meaning the service member is no longer able to fulfill the duties of his or her military occupation and rank. For medical conditions that are unfitting, PEB also determines whether the condition(s) is stable and whether or not it is eligible for disability compensation (DoDI 1332.18, 2014b). If MEB determines that the service member meets medical retention standards, or if PEB determines that the service member's conditions do not make them unfit for service, the service member is returned to duty.

As part of the PEB process, service members with unfitting conditions receive a disability rating for each condition to reflect the severity of the disability. The disability rating is based on the criteria found

in the Veterans Affairs Schedule for Rating Disabilities (VASRD) publication (DoDI 1332.39, 1996, p. 3) and 38 CFR Book C, Subpart B—Disability Ratings (U.S. Department of Veterans Affairs, 2009, Sections 4.40–4.130). Disability ratings range from 0 to 100 percent, in 10 percent increments, where 0 percent means the condition is not serious and the service member can work and perform activities of daily living without any problems, and 100 percent means the service member is completely disabled and unable to work or perform in a social setting.[6] The disability ratings for each unfitting condition are combined into a total disability rating, which is used to determine the final outcome of the disability evaluation process.

Following determination of the total combined disability rating, a service member receives a final disposition, which could be one of the following:

- *Medical Separation*: Service members with a total combined disability rating of 0, 10, or 20 percent and fewer than 20 years of service (YOS) are separated from the military and receive six months of health care benefits and a lump-sum severance payment commensurate with their length of service.[7]
- *Medical Retirement*: Service members with a total combined disability rating of 30 percent or higher (or with 20 YOS) are medically retired, which means that they receive monthly disability pay for life, as well as lifetime health care benefits.
- *Separated Without Benefits*: This affects service members with disabling conditions that PEB determines existed prior to military service and were not service aggravated. The same outcome results if PEB determines that the condition(s) were the result of the service member's own misconduct.

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[6] A more complete discussion of disability ratings for the specific conditions we focused on in this research can be found in Chapter Five.

[7] The minimum number of years required for computation purposes is six years for a disability incurred in the line of duty in a combat zone, or 3 years in the case of any other member. Prior to January 28, 2008, a maximum of 12 years and minimum of three years creditable service was used (U.S. DOD, Defense Finance and Accounting Service, July 29, 2016).

Service members who are medically retired are considered to be either permanently retired due to disability or temporarily retired due to disability. Those service members who have medical conditions that have not stabilized—for example, PTSD—are temporarily medically retired; they initially receive monthly cash and health care benefits and are periodically reevaluated for up to three years (prior to 2017, the service member could be reevaluated for up to five years). If the reevaluation finds that the service member has recovered or the severity of the condition has changed, his or her final disability rating and disposition (retirement or separation) may change. In rare cases, a service member may be found to have recovered sufficiently to be returned to duty.

Service members have a number of opportunities to appeal their disposition. For example, following MEB, service members can request to have an impartial physician review their medical evidence and present a rebuttal to the MEB findings. After PEB, which first meets informally to make a determination, a service member can request a formal PEB. Following the formal PEB decision, the service member can appeal to have the case be reviewed by his or her service appellate review authority.

Since 2001, the disability evaluation process has changed considerably. These changes are described in detail in the policy review companion report (Simmons et al., 2021) and briefly described here. Before 2007, service members who were referred to the disability evaluation system received a medical examination from DoD and then, once they had separated from the military, received a second medical examination from VA to determine eligibility for VA benefits. Having two separate medical examinations was both time-consuming and confusing, as it sometimes resulted in DoD and VA giving different ratings for the same condition. As noted above, by the mid-2000s, there was a growing awareness of the psychological and physical consequences of combat and attention to the needs of returning service members due to media reports, academic research, and eventually congressional commissions and numerous task forces. These resulted in new legislation and significant policy changes, including the establishment of the DoD-VA IDES in 2007. Under IDES, which was implemented across DoD between 2007 and 2011, VA conducts a single medical evaluation

and assigns disability ratings that are used by both departments. DoD and VA use the results of this single assessment to determine evaluation outcomes in their respective departments. In another major policy change in response to the 2008 National Defense Authorization Act, the Undersecretary of Defense for Personnel and Readiness ordered the secretaries of the military departments to abide by the VASRD with respect to disability compensation for mental disorders due to traumatic stress (to include PTSD). Prior to this policy, the military departments had greater discretion when determining disability ratings, which resulted in considerable variation. The policy change also mandated a disability rating of not less than 50 percent for service members who were determined to be unfit due to PTSD, as well as an examination within six months of discharge to evaluate whether a change in rating is warranted. Since 2008, DoD has implemented additional policy changes to improve DES and address PTSD and TBI, including policies to reduce the length of the DES process as well as policies to ensure that all service members are regularly screened for PTSD and TBI.

The effect of these changes on the number and characteristics of service members referred and evaluated by the disability evaluation system is unknown.

Organization of This Report

This report is organized into five additional chapters and several appendixes. Chapter Two describes our approach to assessing trends in disability evaluations and the data used to support those analyses. Chapter Three presents the results of a prospective analysis of service members diagnosed with PTSD, TBI, and a set of comparison conditions, including an overall description (size and percentage of force) of the number of service members diagnosed per year (diagnosis cohorts), the share of each cohort that was evaluated for disability, the outcome (fitness to serve disposition and disability rating[s]) of the disability evaluation for those evaluated within three years of diagnosis, and the discharge status at the time our data end. In Chapter Four, we describe

the results of a multivariate hazard analysis of the timing of medical discharge and final disposition, relative to the time of diagnosis. Chapter Five presents the results of a retrospective analysis of service members who received a disability rating for PTSD and/or TBI, including the size of the disability cohorts, their demographic and service characteristics, a description of their treatment prior to disability evaluation, results of their post-deployment health assessment (PDHA) and/or post-deployment health reassessment (PDHRA), and outcomes of their disability evaluation. We offer conclusions in Chapter Six. Further details about our data sources and methods are available in Appendix A. Appendix B describes key definitions used in our analyses. Additional appendixes (C through H) are available online. Appendix C contains descriptive statistics of the diagnosis cohorts. Appendix D contains additional details of and results from our prospective, hazard analysis, and retrospective analyses presented in Chapters Three through Five. Finally, we repeated select analyses from Chapters Three through Five for each of the services, and those results are contained in Appendixes E (Air Force), F (Army), G (Marine Corps), and H (Navy).

CHAPTER TWO

Methods and Data

In this chapter, we describe the analyses of trends in disability outcomes. Our focus is on PTSD and TBI, which can be addressed in two ways. First, service members can be diagnosed at any time during their military career with one of these two conditions, after which they continue to serve, may deploy, and have other service experiences that we can document. Second, service members may be referred for disability evaluation, which may result in a disability rating for PTSD and/or TBI. Since disability ratings are awarded only for service members who are found unfit and medically discharged, a disability rating for PTSD and/or TBI signals the end of the service member's military career. We use these markers for the presence of PTSD and TBI—during the career in the case of diagnoses and at the end of a career in the case of disability ratings—to frame our analysis of trends.

We begin with a description of a prospective analysis of service members who were diagnosed with PTSD and/or TBI, then present a multivariate hazard analysis of the timing of medical discharge relative to diagnosis, and then offer our final analysis, which is a retrospective examination of service members who were medically discharged through DES with a disability rating of PTSD and/or TBI. We also describe a set of comparison conditions used to benchmark the results for PTSD and TBI. Finally, we briefly describe the data we used to build an analytic file used to support the research questions.

Analytic Approach

Our analysis of trends in disability outcomes took two forms: (1) a prospective analysis of service members who had a PTSD or TBI diagnosis recorded in their medical records, and (2) a retrospective analysis of service members who were evaluated for disability and assigned a disability rating for PTSD and/or TBI. Figure 2.1 is a conceptual framework for our analyses.[1] For all service members, we had information on both individual characteristics and their military experiences (e.g., occupation, deployments). These include demographics, job-related information (e.g., pay grade, YOS, occupation, branch of service), and military service–related experiences (e.g., number of deployments, total number of months deployed). We describe the data sources for this information below.

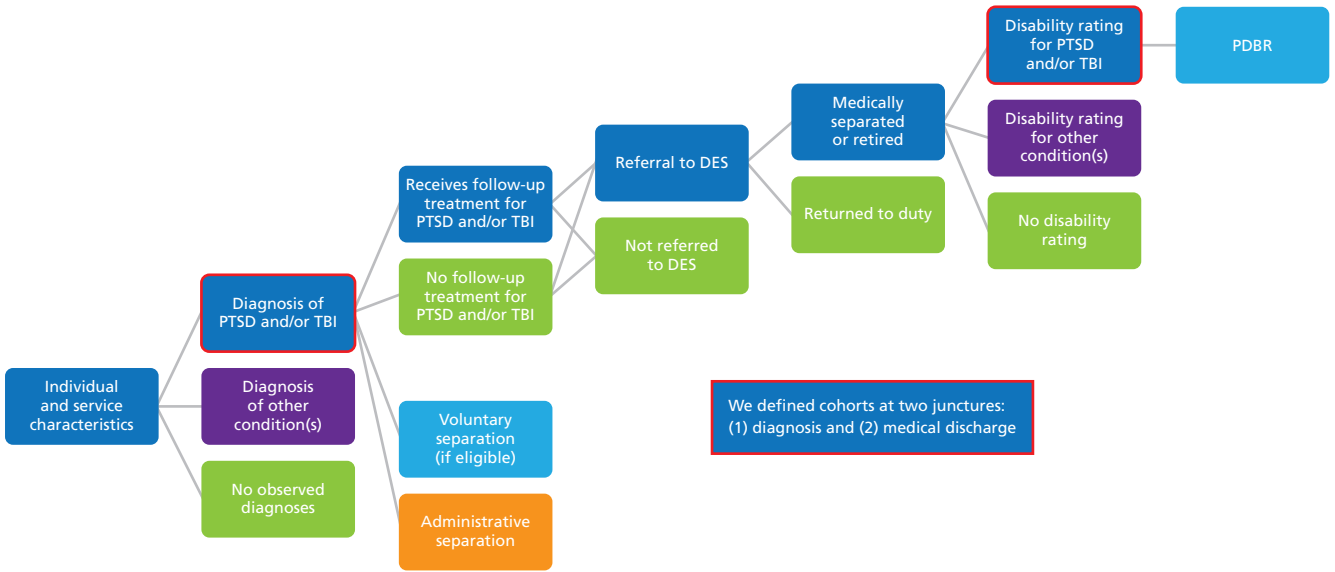
Prospective Analysis

Our prospective analysis began by identifying individuals who had a diagnosis of PTSD or TBI recorded in their medical record. Once these individuals were identified, and in order to allow for comparisons over time, we assigned them to a diagnosis fiscal-year cohort based on the first fiscal year we observed a diagnosis (second blue box from the left in Figure 2.1, with a red border). For anyone diagnosed with PTSD and/or TBI,[2] we analyzed a variety of data sources containing information on their military experience (e.g., deployments, changes in pay grade, evaluation for disability) over a period of three years following diagnosis, inclusive of the year of diagnosis. We chose three years to allow time for the service member to receive treatment for the diagnosis (for approximately one year, as was common practice

[1] We note that there are other pathways not marked in this diagram that could result in a service member being medically discharged through DES with a PTSD and/or TBI disability rating. For example, a service member could be diagnosed with, treated for, and referred to DES because of asthma. The medical exam during DES could reveal that the individual is experiencing sequelae of TBI and therefore a rating could be issued for residuals of TBI. That path would be illustrated by "Diagnosis of other condition(s)," "No follow-up treatment for PTSD or TBI," "Referral to DES," which for simplicity is not denoted in this framework.

[2] In addition to PTSD and TBI, our analyses include a small set of comparison conditions, described below. For simplicity, we refer only to PTSD and TBI here.

Figure 2.1
Conceptual Framework for Disability Trend Analyses



NOTE: Voluntary separation and administrative separation, which appear in this framework as happening after diagnosis, can in fact happen at multiple points in this framework (after diagnosis, after follow-up treatment, after referral, if RTD. For simplicity, not all paths that might lead to a disability rating for PTSD and/or TBI are denoted in this figure.

[U.S. Army, 2012]), be referred to DES, and be medically discharged (the timeliness goal for IDES over this period was 295 days). Because we observed members of the cohort for three years to see if they were medically discharged, the first cohort included service members who had a diagnosis in FY 2002, and the last cohort was those service members who had a diagnosis in 2015, whom we could follow until our data end in 2017.[3] We conducted sensitivity analyses of medical discharge rates over four- and five-year observation periods, and the result was that we captured most discharges within the three-year window. While the rates of medical discharge increase by approximately 5 percent over the five-year horizon compared with the three-year horizon, the trends in medical discharge, disability retirement, and disability ratings (overall and condition-specific) are nearly identical over the five-year time horizon. Figure D.1 shows the three- and five-year medical discharge rates for PTSD, TBI, and the comparison conditions.

Using the files compiled for individuals diagnosed with PTSD and/or TBI, we examined several outcomes, including

- whether the service member was referred to DES, and if so, what the outcome was of that evaluation (e.g., returned to duty [RTD], medically retired, medically separated)
- whether those who were medically discharged received a disability rating for PTSD and/or TBI[4]
- other conditions the service member was rated for, for those who did not have a disability rating for the condition matching their diagnosis cohort assignment (i.e., for those in the PTSD diagnosis cohort who did not have a PTSD disability rating)

[3] Even though the motivation for following individuals for three years was to hold constant the observation period, technically, we observed individuals for different amounts of time. A service member diagnosed with PTSD on October 5, 2007, was part of the same cohort (FY 2008) as a service member diagnosed with PTSD on September 25, 2008. We followed both service members through FY 2010, which for the first service member was nearly three full years and for the second was just more than two years. The analysis would have become considerably more complicated to follow individuals for exactly three years, but in effect, this is a limitation of our analytic approach.

[4] We observe follow-up treatment, but since our prospective analysis is focused on disability outcomes, we analyzed treatment as part of our retrospective analysis, discussed next.

- a small number of postdischarge outcomes, including whether the service member's case was reviewed by the Physical Disability Board of Review (PDBR) (Military Health System, Physical Disability Board of Review).[5]

Retrospective Analysis

To also understand the experiences of those who received a rating for PTSD and/or TBI, we conducted retrospective analyses of their service- and health-related data. Our retrospective analysis started on the right hand side of Figure 2.1 and worked left. We defined disability cohorts using VASRD codes.[6] If a service member was evaluated for disability and assigned a VASRD for PTSD and/or TBI, he or she became part of our disability cohort in the fiscal year of the DES disposition. We then used three prior years of data to trace their characteristics and experiences backward in time, documenting whether they were diagnosed with the condition for which they were assigned a disability rating and whether they received follow-up treatment for it.[7] We also used the retrospective analysis to document the individual and military-related service characteristics of the cohorts of service members who were assigned a PTSD and/or TBI VASRD at the time of medical discharge. Because we looked back at their service experiences in the three years prior to discharge (including the year of discharge), the earliest cohort we could include were service members who were medically discharged in 2004. Therefore, our retrospective analysis covers trends for those who were medically discharged between 2004 and 2017.

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[5] Service members who were medically separated from the U.S. military between September 11, 2001, and December 31, 2009, are eligible to request that PDBR review their case for fairness and accuracy. Information on why the PDBR was established is available in Simmons et al., 2021.

[6] See Chapter Five for a more complete discussion of how disability ratings are determined for the conditions of interest in this study.

[7] As with the prospective analysis, even though we looked back three years from the fiscal year of DES disposition, the actual observation window ranged from just more than two years (for someone whose disposition occurred early in the cohort fiscal year) to just less than three years (for someone whose disposition occurred late in the cohort fiscal year).

Hazard Analyses

The prospective and retrospective descriptive analyses described above required us to choose a fixed time period over which to observe cohorts so that we treated all cohorts the same in describing outcomes. To take advantage of the full 16 years we were able to observe service members and their outcomes, we also conducted hazard analyses of the time between diagnosis and referral. We employed two statistical models to measure time to disability evaluation. The first model, the Kaplan-Meier estimate (Kaplan and Meier, 1958; Kiefer, 1988), calculates the timing of disability evaluation across diagnosis cohorts by measuring the percentage of each cohort that has "survived" to a point in time (a certain number of years after diagnosis) by having not yet been evaluated for disability. The second model, the Cox proportional hazard (PH) model (Cox, 1972; Kiefer, 1988), allowed us to control for differences in observable characteristics across cohorts. We describe both of these models in more detail in Chapter Four and in Appendix D.

A Caveat About Causality

Throughout this report, we note how observed trends in diagnoses, treatments, and referrals in the longitudinal data file align to patterns in changes to policy. However, we have not attempted to make a causal link between changes in policy and outcomes. It is not possible to isolate specific policies to some service members and not others, so a causal analysis could not be done experimentally. We could potentially attempt to isolate the effect of a policy change to the way a specific mental health condition is treated, for example, by comparing service members with that mental health condition with service members without that condition (those without the condition would be a control group) using statistical methods. However, while a statistical model is able to control for many observable characteristics (e.g., sex, service, pay grade, deployment experiences), there are observable differences between service members that we would be unable to control for and that therefore limit our ability to draw causal conclusions. For example, the reason one service member is diagnosed with a mental health condition while an observationally equivalent service member (e.g., someone of the same gender, in the same service, with similar

deployment experiences) is not diagnosed may be the result of different decisions for seeking care, or different exposures during a deployment (that data cannot capture and therefore we cannot control for), not because of a policy change. Other approaches for attempting to isolate the effect of a specific policy change would likely be affected by similar challenges associated with unobservable characteristics and by policy changes occurring around the same time. Therefore, the conclusions we draw are about the association between characteristics and outcomes, not the causes for these outcomes.

Comparison Conditions

Understanding trends in disability outcomes among service members who have a diagnosis and/or disability rating for PTSD and/or TBI requires some context. For example, if we see an increase in the number of service members who are medically discharged with a disability rating for one or both of these conditions, we might expect a similar pattern for all conditions if the underlying drivers of disability evaluation affect all conditions or service members in the same way. Or, there might be factors associated with one or both of these conditions, but not with other conditions, that would cause the patterns we see to be unique to PTSD and/or TBI. Therefore, to put our results into context, we examined trends in disability outcomes among service members who have a diagnosis and/or disability rating for a set of comparison conditions and compared these trends with those of service members with PTSD or TBI, as well as a cohort of service members who have both PTSD and TBI diagnoses (or disability ratings) (PTSD+TBI).

The comparison conditions were chosen after careful conversations with the sponsor and key stakeholders familiar with DES in each branch of service and took into account potential co-occurring conditions and policy considerations. There are several objectives in using these comparison cohorts. First, we wanted to analyze trends in diagnoses that may share common features with PTSD or TBI but were unlikely to have been affected by changes in DES policies over time.

To accomplish this goal, we identified cohorts of individuals with a diagnosis for MDD in each fiscal year. While MDD frequently co-occurs with both PTSD and TBI (Hepner et al., 2017; Kennedy et al., 2019), especially among individuals with military experience (Bombardier et al., 2010; Rytwinski et al., 2013), rating guidance for this condition has not changed substantially over time. In addition, providers may diagnose MDD instead of PTSD because of imprecision in symptom classification into two distinct diagnoses (Flory and Yehuda, 2015), and the extent of this substitution may have changed over time as awareness and screening procedures for PTSD have increased.

Second, we wanted to analyze trends for conditions that experienced similar changes in policy. To accomplish this goal, we selected sleep apnea as a comparison condition.[8] The same policy that directed military departments to assign a minimum 50 percent rating for PTSD also resulted in changes to how sleep apnea was evaluated and rated. For sleep apnea, prior to the 2008 policy directing military departments to strictly adhere to VASRD, rating guidance was based on "civilian earning capacity," where service members with "total industrial impairment" were rated at 100 percent, and those with "mild industrial impairment" were rated at 0 percent. Under the strict application of VASRD, ratings are based on clinical criteria—for example, if sleep apnea causes a service member to not feel rested after sleeping, it is rated at 30 percent, and if the service member uses a breathing machine, such as a continuous positive airway pressure (CPAP) machine, during sleep, it is rated at 50 percent.

Finally, we selected lower back pain as our third comparison condition. Because military service is a physically demanding career regardless of one's specific occupation or experiences, musculoskeletal conditions, including lower back pain, are common diagnoses that

[8] In addition to the MDD and apnea diagnosis cohorts, we also created a broader comparison condition cohort including service members with any depression diagnosis and any sleep disorder. However, we observed only a VASRD for sleep apnea specifically and so chose to focus on the apnea cohort to ensure consistency between the prospective and retrospective analyses. Focus on the MDD comparison cohort provided additional consistency by allowing us to zero in on one specific diagnosis for comparison, rather than an aggregation of several diagnoses in a broader "any depression" category.

result from a variety of events in both training and combat settings. We chose it to serve as a benchmark condition, because it has been relatively unaffected by changes in DES policies. We also included it to attempt to capture overall trends in the rate and frequency with which cases flow into DES, independent of potential changes in prevalence, comorbidity, screening, or DES policy. Although we are treating lower back pain as a benchmark condition, we also acknowledge that prior research has shown that patients being treated for PTSD and TBI, alone or together, may also have co-occurring back pain (Bryant et al., 1999; Lahz and Bryant, 1996; Shaw et al., 2010). The explanations for the relationship between lower back pain and PTSD and/or TBI are generally related to a heightened sense of anxiety and hypervigilance that results in patients with PTSD and/or TBI to become more aware of pain (Asmundson et al., 2002; Bryant et al., 1999).

Diagnosis and Disability Cohorts

To determine whether someone was diagnosed with PTSD, TBI, or a comparison condition, we used patient-level medical encounter data for service members receiving care at a military treatment facility (MTF) (direct care) or as a claim for those receiving care on the TRICARE network (purchased care). Diagnoses were recorded according to the International Classification of Disease, Ninth and Tenth Revisions (ICD-9 and ICD-10, respectively). Tables B.8–B.13 list the specific ICD codes used to identify PTSD, TBI, and our comparison conditions. We included a service member in a diagnosis cohort if he or she had a relevant ICD code anywhere on the patient encounter record, regardless of the position of the code (first listed or later) or how many times it appeared (our criterion was one encounter with the diagnosis).[9]

[9] The literature includes different approaches to identifying individuals with medical conditions, including a requirement that the diagnosis code appear more than once. For the purposes of defining our cohorts, we elected to be both inclusive (allowing someone to be in a cohort even with just one encounter with that diagnosis) and consistent across conditions. Service members being treated for PTSD, for example, would likely have a PTSD diagnosis code on every encounter. However, for TBI, coding guidance suggests that a new

Within TBI, we are able to classify severity, which we did using the Armed Forces Health Surveillance Branch (AFHSB) case definition for TBI (Military Health System, Surveillance Case Definitions, undated). We identified diagnoses for mild TBI and for moderate, severe, or penetrating TBI, as well as cases where the severity of the diagnosis is unknown. In cases where service members received multiple TBI diagnoses over the course of our analytic file, we applied the following set of rules to ensure that service members were assigned to only one of these severity groups: If a service member was ever observed to have a diagnosis for a moderate, severe, or penetrating TBI, he or she was assigned to the cohort in the fiscal year in which this diagnosis occurred. In cases without a moderate, severe, or penetrating diagnosis, we assigned service members to the fiscal year cohort for the first diagnosis we observed in the file, regardless of whether the severity is classified as mild or unknown.

Our disability cohorts for the retrospective analysis were defined by the presence of a VASRD code during a DES evaluation. Because our disability data came from five sources (one or more file[s] from each service, plus a DoD-wide file for IDES), in different formats, and including different details about the evaluation, we used disposition date to link the evaluation to our person-year file format. The disposition date signals PEB's initial determination of the member's fitness, after which disability ratings are assigned, and the service member has an opportunity to appeal the finding(s); for anyone being medically retired or separated, a transition phase occurs during which the service member takes leave and is processed for discharge from the military. Disposition date was the only common date available across all five disability files, so we were unable to associate the DES case with any other date, such as date of separation. Therefore, the year we flag a

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diagnosis of TBI should be only used at the first onset of the condition, with history of injury codes used in subsequent encounters for follow-up care (Farmer et al., 2016). This guidance implies, therefore, that we should see only one encounter with a TBI diagnosis; a second encounter would imply a second incident. Applying this inclusive definition results in more PTSD cases than if we required there to be at least two encounters with a diagnosis. Hoge et al. (2014) examine the amount of care service members receive for PTSD, which provides insight into the implications for choosing how to define diagnosis cohorts as we have done.

DES disposition may be prior to the year of separation in our person-year file format. For ease of discussion throughout the report, we will refer to this event (disposition) as disability evaluation. Chapter Five and Appendix B contain information on the VASRD codes used to identify our disability cohorts.

It is important to note here and throughout the report that the disability data source covering the most recent years of our analysis does not differentiate between fitting and unfitting conditions.[10] Therefore, a service member might be rated for a condition that is not considered unfitting (perhaps it is a mild case that would not prevent the service member from performing their military duties), but we do include the service member in our disability cohort because we have no way of distinguishing fitting from unfitting conditions. This limitation does not affect the early years of our analysis, when we used service disability data (which records only unfitting conditions). It does affect the Air Force, Marine Corps, and Navy more than the Army even during later years since we relied primarily on Army data throughout the entire time period (disability ratings were largely missing from the source that does not distinguish between fitting and unfitting conditions). Other outcomes of the evaluation (e.g., total rating, disposition) were not affected by this limitation.

For both the diagnosis and disability cohorts, individuals were assigned according to the above criteria regardless of whether or not they had diagnoses or disability ratings for other conditions. For example, if a service member was first diagnosed with PTSD in 2005 and with MDD in 2006, he or she was assigned to the 2005 PTSD diagnosis cohort and the 2006 MDD cohort. Individuals are assigned to a condition-specific cohort only at the time of first diagnosis, so if we see another MDD diagnosis in 2010 for the same service member, he or she would still be assigned only to the 2006 MDD cohort. Similarly,

[10] After receiving disability ratings from VA, the service PEB enters VASRD codes, disability ratings, and whether the condition is fitting or unfitting into the system of record. The accuracy of the recorded data (the entry of VASRDs and the fitting/unfitting status of each condition) has not been validated. Therefore, we do not know the extent to which fitting conditions are included in our analysis.

individuals who were medically discharged with both a VASRD code for PTSD and a VASRD code for MDD appear in both the PTSD and MDD disability cohorts. The only cohort that accounts for overlap is the PTSD+TBI cohort (for diagnoses, as long as both diagnoses occur in the same three-year window, and disability).

Appendix C contains tables displaying the degree of overlap between PTSD and TBI and the comparison conditions, which we summarize briefly here. Both the PTSD and TBI diagnosis cohorts, and the combined PTSD+TBI cohort, had the highest rate of overlap with back pain. Beginning around 2008, 70–80 percent of the PTSD cohort also had a back pain diagnosis, with slightly lower rates for the TBI cohorts and slightly higher rates for the PTSD+TBI cohorts. The share of the PTSD cohort with the other conditions (TBI, MDD, and sleep apnea) ranged from 30 to 40 percent during those later years; comorbidity rates were lower across the board during earlier years. Members of the TBI cohorts generally had lower rates of comorbidity, and members of the PTSD+TBI cohorts generally had higher rates, which was especially true for sleep apnea. Among disability cohorts, the share with VASRDs for more than one of the studied conditions was generally low, with few exceptions: two-thirds of the TBI disability cohort also had a PTSD VASRD, and one-quarter to one-third of all three disability cohorts (PTSD, TBI, PTSD+TBI) also had a back pain VASRD.

Overview of Data Sources

We built a person-year file covering fiscal years 2002–2017 so that we could follow individual service members longitudinally to capture our outcomes of interest and their timing. Table 2.1 summarizes the data sources used. We provide an overview of the data in this section; additional detail, including variable definitions, is available in Appendixes A and B.

We started with personnel files from FY 2002–2017 from DMDC. Any AC service member who appeared at any time in DMDC personnel files became part of our underlying file, and we included one record

Table 2.1
Summary of Data Sources

Data Source	Content
Defense Manpower Data Center (DMDC)	Individual and service related characteristics, deployment experiences (FY 2002–2017)
Veterans Tracking Application (VTA)	Disability evaluation outcomes for all services (FY 2008–2017)
Military Personnel Data System (MilPDS)	Disability evaluation outcomes for Air Force (FY 2002–2017)
Physical Disability Case Processing System (PDCAPS)	Disability evaluation outcomes for Army (FY 2001–2013)
Electronic Physical Evaluation Board (ePEB)	Disability evaluation outcomes for Army (FY 2008–2017)
Joint Disability Evaluation Tracking System (JDETS)	Disability evaluation outcomes for Navy/ Marines (FY 2002–2016)
Military Health System Data Repository (MDR)	Diagnosis and treatment data from inpatient, outpatient, and theater settings (FY 2002–2017)
Post-Deployment Health Assessment/ Post-Deployment Health Reassessment	Post-deployment screenings (FY 2002–2017)

for every year of service.[11] DMDC data provide information on individual and service-related characteristics (e.g., sex, age, race/ethnicity; branch of service, pay grade, YOS, occupation), as well as deployment experiences. Deployment measures include the number of deployments and the total number of months deployed as of the end of the fiscal year of observation.

Disability data came from a DoD-wide system in use since the IDES began being rolled out across DoD, the Veterans Tracking Application (VTA), as well as service disability data systems: MilPDS for

[11] Our file included a record for every year of active component service for anyone who served at any time during our analysis period, FY 2002–2017. Some records represent partial YOS (e.g., service member separated in July), so our file represents total strength, and our record counts are larger than official end strength reporting.

the Air Force, Physical Disability Case Processing System (PDCAPS) and electronic physical evaluation board (ePEB) for the Army, and Joint Disability Evaluation Tracking System (JDETS) for the Navy and Marine Corps. These sources contain similar information, but the variables and format vary by data source. We ultimately created a record for each DES case and used the fiscal year of disposition (the year in which the PEB processing the case determined whether the service member would be RTD or medically discharged) to merge it to our underlying DMDC-based analytic file. It is possible for a service member to have more than one DES record if the outcome of the first evaluation was RTD, followed by a second referral. Some data systems also record the outcomes of reevaluations for service members placed on the Temporary Disability Retired List (TDRL) at the conclusion of DES. We included only DES evaluations in our analytic file; we excluded TDRL reevaluations. VTA is the source file that does not differentiate between fitting and unfitting conditions; all four service files include only unfitting conditions.

We used data from the Defense Health Agency's (DHA) Military Health System Data Repository (MDR) to observe diagnoses and treatment. MDR contains encounter-level information for outpatient and inpatient direct care—that is, the care that is delivered within the military health system's MTFs. It also contains claim-level data for care delivered on the TRICARE network (purchased care). For both direct and purchased care, we were able to observe diagnoses and procedures, as well as the date(s) of care. A detailed description of how we measured treatment is included in Chapter Five. As part of MDR, we also requested Theater Medical Data Store (TMDS) records, which allowed us to observe whether one of the diagnoses of interest occurred while the service member was deployed.

Finally, we included in our analytic file information from the service member's PDHA and PDHRA. PDHA and PDHRA are self-assessments that must be completed by the service member after returning from a deployment, and they are intended to review the service member's "health, mental health or psychosocial issues commonly associated with deployments, special medications taken during the deployment, possible deployment-related occupational/environ-

mental exposures, and to discuss deployment-related health concerns" (PHCoE, undated[a]). PDHA and PDHRA have questions that are designed to identify whether a service member may have experienced a TBI or is experiencing symptoms associated with PTSD, and screening positive may result in a referral for specialty care. We used the responses to create flags for positive screens on PDHA or PDHRA. Additional detail about these files and screening items is available in Appendix B.

Diagnoses, treatments, and positive screens for our conditions of interest were merged onto our analytic file at the person-year level. This file was then used to identify diagnosis and disability cohorts for our prospective and retrospective analyses.[12]

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[12] The resulting analytic file, comprised of person-year records for all AC service members, contains detailed information on a wide range of individual characteristics (e.g., demographic, service, health, deployment). Files were merged using encrypted identifiers in an effort to safeguard the data. We adhered to all human subjects requirements of RAND's Human Subjects Protection Committee and DoD second-level review.

CHAPTER THREE

Trends in Disability Evaluations and Medical Discharges Among Cohorts of Service Members with a Posttraumatic Stress Disorder or Traumatic Brain Injury Diagnosis

To conduct the prospective analysis, we began by identifying cohorts of service members with a recorded PTSD or TBI diagnosis, or a comparison condition diagnosis, based on ICD-9 and ICD-10 codes documented in DHA's MDR direct and purchased care records.[1] We assigned service members to a cohort based on the first fiscal year in which we observed the relevant diagnosis code in their medical record. For example, if we observed that a service member received a PTSD diagnosis at a health care visit in 2013, and had no PTSD diagnosis in any of the previous years in our file, he or she was assigned to the 2013 PTSD diagnosis cohort. PTSD and TBI diagnosis cohorts could include service members with multiple diagnoses, meaning they were not mutually exclusive. We separately identified a cohort of individuals who received *both* a PTSD and a TBI diagnosis during our observation period and assigned the service member to the fiscal year cohort in which he or she received the first of these two diagnoses. There is also overlap between PTSD and TBI and comparison condition cohorts. Although we did not create cohorts for service members who also had a diagnosis for a comparison condition, Tables C.7–C.9 show the degree of overlap between the PTSD and TBI cohorts with comparison conditions.

[1] We allowed the PTSD or TBI diagnosis to be in any diagnosis position on the record.

Once these cohorts were established, we developed summary statistics describing their demographic characteristics in the fiscal year of first diagnosis, including their age, gender, service, deployment experience, pay grade, and occupation. Next, we followed each cohort for three years, beginning in the year of diagnosis (e.g., if diagnosis occurred in 2005, we followed them through 2007), and analyzed disability outcomes of each diagnosis cohort, including

- the share who were medically discharged
- the associated dispositions (e.g., medically separated, TDRL) within three years of the first diagnosis
- the overall DoD disability rating observed at the time of medical discharge
- the distribution of ratings for PTSD, TBI, and each comparison condition.

Because our person-year file included data from FY 2002–2017, our first prospective analysis cohort included those service members who had a diagnosis in the first year, 2002, and the last cohort included those whose first diagnosis was observed in 2015. The last cohort could be observed for three full years (2015–2017); any later years would have been truncated with less than three years of data.

Finally, we continued to follow these cohorts beyond the three-year window and characterized the distribution of service members' status at the last point in which we observed them in our data: whether they exited the force through voluntary separation at the end of their term, retired (20 or more YOS), received a medical discharge or an administrative separation, or were still serving at the end of our analysis time horizon.[2] We present the details of each of these analyses in the

[2] The reasons for administrative separation are varied and both voluntary and involuntary in nature. For example, service members who separate upon completion of their term of service or who are released early to further their education are administratively separated, as are service members who are court-martialed, who are separated for unsatisfactory performance, or for whom retention is not consistent with national security interests. Procedures for administrative separations differ based on whether the service member is an officer or enlisted. Enlisted service members must be notified in writing of, for example, the reason for administrative separation, how the separation will be characterized, and their rights,

figures below. The path that we traced in this analysis is shown by the blue boxes in Figure 2.1, beginning with the second blue box (labeled "Diagnosis of PTSD or TBI").

Diagnosis Cohorts

Posttraumatic Stress Disorder and Traumatic Brain Injury Cohorts

Figures 3.1a–b show trends in the overall size of the population of service members with a first PTSD or TBI diagnosis in each fiscal year between 2002 and 2017. Figure 3.1a shows the trends in the overall count of service members with a PTSD diagnosis, any TBI diagnosis, or a diagnosis for both PTSD and TBI. The dashed lines in the figure also split the counts of TBI diagnoses into the number of TBI diagnoses that are moderate or severe and the number of mild TBI diagnoses. Figure 3.1b divides these counts by the total number of AC service members in a given fiscal year to show the counts as a percentage of the total active force.

Both figures show a sharp increase in the size of the population with both PTSD and TBI diagnoses around 2008. This is likely the result of a number of initiatives and events taking place around this time. First, the cumulative number of service members who had deployment experience grew over this period, particularly during surge years (Bonds et al., 2010). PTSD and TBI were two signature wounds of war, so we would expect a positive relationship between the number

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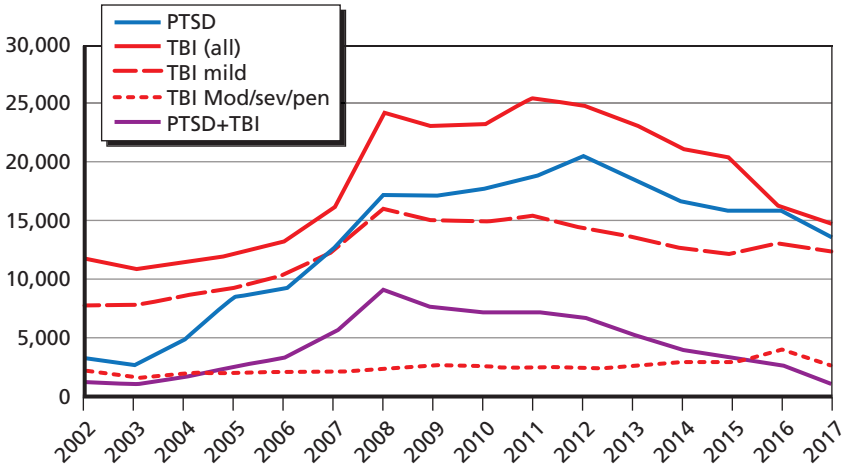
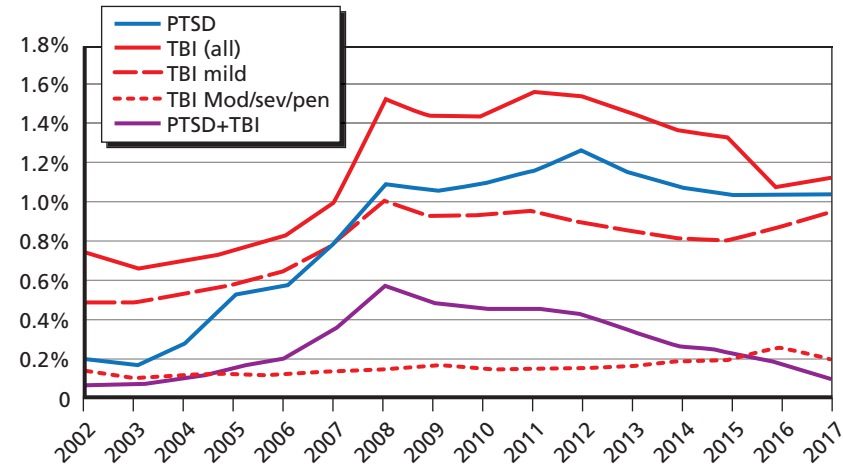
including to obtain copies of documents, to submit statements, and to consult with counsel. After receiving notification, the service member is then guaranteed a period of time, not less than two working days, to act on the notice. Procedural steps thereafter are dependent upon the type of administrative separation. Procedures for commissioned officers depend upon whether the service member is probationary or not, whether the separation action requires a board of inquiry, and whether it involves a special case (e.g., sexual assault, mental health conditions), but in general, commissioned officers are notified, have a chance to respond, and can consult counsel. As the companion policy review describes (Simmons et al., 2021), service members with a service-related PTSD diagnosis cannot be administratively separated with personality disorder or other mental disorder not constituting a physical disability, and under some conditions, service members who are being administratively separated must undergo an examination for PTSD or TBI (DoDI 1332.18, 2014b; DoDI 1332.30, 2018).

Figure 3.1
Number and Percentage of Active Component Service Members First Diagnosed with Posttraumatic Stress Disorder and/or Traumatic Brain Injury, by Fiscal Year, 2002–2017



(a) Frequency



(b) Percentage of total active force

NOTES: Cohorts defined based on the first fiscal year in which a diagnosis observed in MDR, using the ICD codes documented in Tables B.9–B.10. PTSD and TBI cohorts are not mutually exclusive (nor do they exclude to comparison condition cohorts). TBI mild and TBI moderate, severe or penetrating (TBI Mod/sev/pen) cohorts are mutually exclusive.

of service members with deployment experience and with these diagnoses. At the same time, efforts were underway to reduce the barriers to mental health care and to encourage service members to seek treatment (Acosta et al., 2014; Weinick et al., 2011).

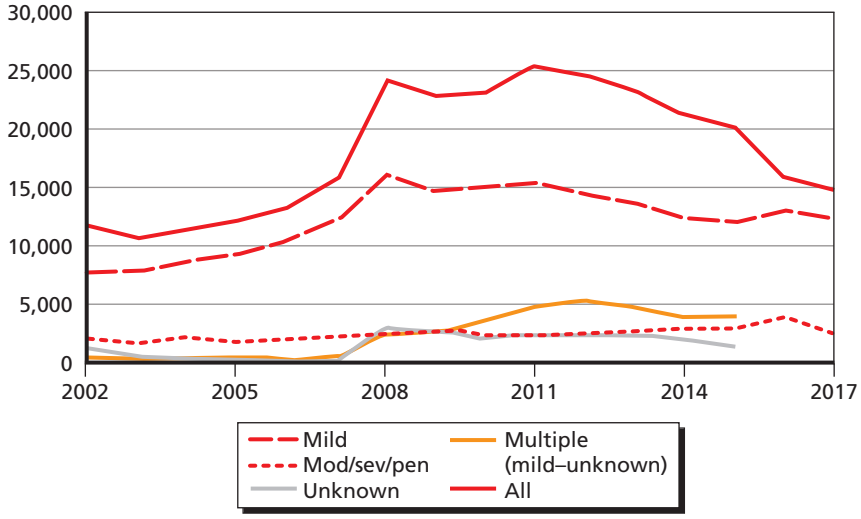
The total number of first TBI diagnoses increased from approximately 11,500 in FY 2002 to approximately 25,000 first diagnoses in 2008. In terms of the share of the total active force, this represents an increase from 0.8 percent of the total active force to 1.5 percent by 2008. These trends began to stabilize after 2008, with a slight decline in first diagnoses for TBI in the later years of our analysis period and reaching approximately 15,000 first diagnoses, or 1.1 percent of the total active force, in 2017.

Figure 3.2 provides a further breakdown of the ways the severity of a TBI diagnosis can be categorized. Approximately two-thirds of all TBI cases at the beginning of the analysis period were mild, and the increase in mild TBI was the main driver in the increase in TBI cases. Moderate, severe, or penetrating TBI cases remained relatively stable at approximately 2,000–3,000 cases per year over the analysis period. Some changes in data reporting led to an increase in TBI cases of unknown severity beginning in 2008. However, after this data change, the frequency of unknown severity cases remained stable.

While the size of the population with a PTSD diagnosis shown in Figure 3.1 was smaller than the overall TBI diagnosed population, first diagnoses for PTSD followed a similar trend. The number of first PTSD diagnoses increased from approximately 3,000 in 2002 to approximately 17,000 in 2008, and peaked at just over 20,000 in 2012. This represents an increase from 0.2 percent of the total active force having a first diagnosis for PTSD in 2002 to 1.3 percent of the total active force experiencing a first diagnosis in 2012. Because the overall size of the AC was relatively stable over the analysis period, the diagnosis trends follow a similar pattern in terms of frequency and as a percentage of the total active force.

The counts of overall TBI and PTSD diagnosed cases are not mutually exclusive, meaning they include service members with other diagnoses in addition to PTSD or TBI, as well as cases where service members were diagnosed with PTSD+TBI. The purple line in Figures

Figure 3.2
Number of Service Members First Diagnosed with Traumatic Brain Injury in a Given Fiscal Year, by TBI Severity, 2002–2017



NOTES: Fiscal year on the x-axis represents the fiscal year of first diagnosis. Cohorts defined based on the first fiscal year in which a diagnosis is observed in MDR, using the ICD codes documented in Tables B.8–B.13. Diagnosis cohorts are not mutually exclusive.

3.1a and 3.1b plots the trend for service members with PTSD+TBI diagnosis, counting the service member in the fiscal year when he or she experienced the first of those two conditions. The cohort of service members with a diagnosis of PTSD+TBI is smaller, but again demonstrates an increasing trend, from just over 1,100 in 2002 to 9,000 in 2008, an increase from 0.1 percent to 0.6 percent of the total active force.

Figures E.1, F.1, G.1, and H.1 show that the increasing trend in TBI and PTSD diagnoses occurred mainly in the Army, where TBI diagnoses peaked at just over 16,000 in 2008, and PTSD diagnoses reached nearly 14,000 in 2012. The count of both PTSD and TBI diagnoses was less than 5,000 per year in the Air Force, Navy, and Marines, and the trend in frequency of diagnosis was generally flat over the analysis period.

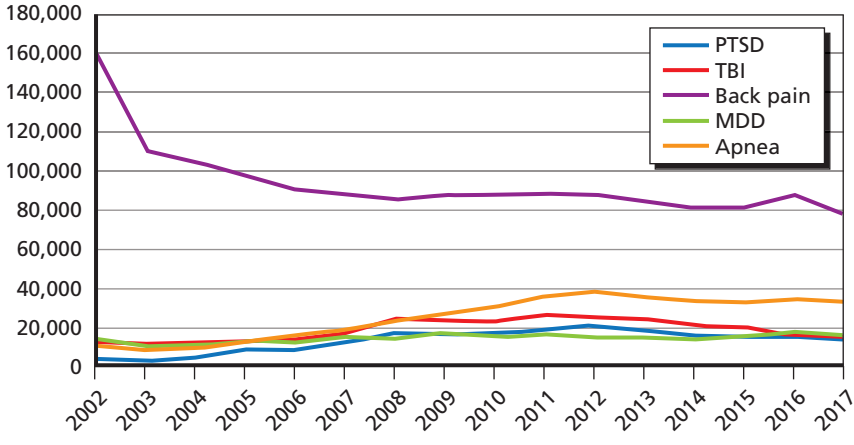
Comparison Condition Cohorts

Figures 3.3a–b show the size of the diagnosis cohorts for the comparison conditions (MDD, sleep apnea, and back pain). For comparison, these figures also show the cohort size for service members with a first diagnosis for PTSD or TBI in each fiscal year relative to the size of the cohort with a first diagnosis for each of our comparison conditions. While the PTSD and TBI cohorts experienced a sharply increasing trend over the early years of our analysis period, the overall size of the population of service members with these conditions was still significantly smaller than the share with a diagnosis for back pain. In 2002, the first year of our data, nearly 160,000 service members had a diagnosis for back pain; this number fell to approximately 90,000 per year (5.5–6 percent of the overall force) by 2006 and remained steady for the remainder of our analysis period. The significantly higher share of back pain diagnoses in 2002 reflects the fact that it is our first year of data, so our count includes anyone who had the diagnosis that year; all later years represent the number of service members with *new* diagnoses. When we do not condition on the diagnosis being new, the line (not shown) is much smoother, remaining near or above the 160,000 count over the time series. Even after the numbers stabilized around 2006, the cohort of back pain diagnoses was an order of magnitude larger than the PTSD and TBI diagnosis cohorts. Furthermore, it was quite stable over time and did not exhibit the sharp trend breaks around 2008 that we observed in Figure 3.1 for the PTSD and TBI cohorts.

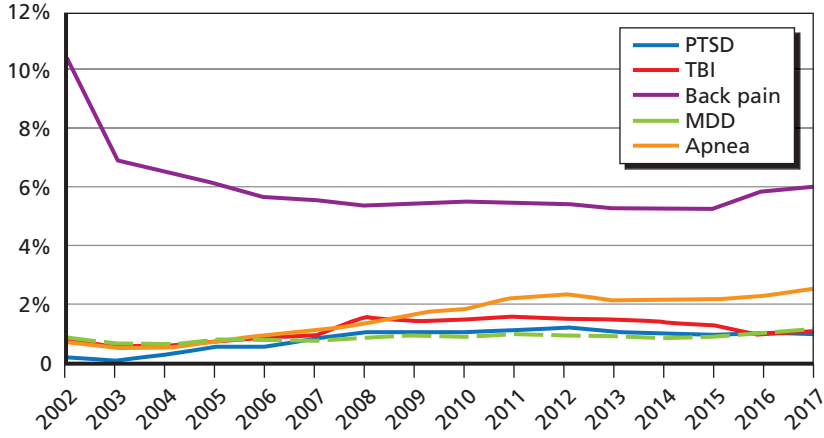
Our other two comparison conditions, sleep apnea and MDD, were more similar in size to the PTSD and TBI cohorts. The number of service members with a first diagnosis for sleep apnea increased significantly over the analysis period, from approximately 10,000 in 2002 to 33,000 at the end of the analysis period, representing an increase from 0.6 to 2.5 percent of the total active force. However, this increase was fairly steady over the time period and did not exhibit the sharp increase around 2008 that we observe for the PTSD and TBI cohorts.

Approximately 13,000 service members were first diagnosed with MDD in 2002, regardless of other conditions, which means some likely also had PTSD and/or TBI (Appendix C describes the overlap of these conditions in our analytic cohorts); they represented approxi-

Figure 3.3
Number and Percentage of Active Component Service Members First Diagnosed with a Comparison Condition, by Fiscal Year, 2002–2017



(a) Frequency



(b) Percentage of the total active component force

NOTES: Cohorts defined based on the first fiscal year in which a diagnosis is observed in MDR, using the ICD codes documented in Tables B.8–B.13. Diagnosis cohorts are not mutually exclusive. Percentages are obtained by dividing the total number of service members with a diagnosis in the fiscal year by the count of total AC for that fiscal year observed in the DMDC data.

mately 0.9 percent of the total active force. This share remained fairly stable throughout the analysis period, ranging between 10,000 and 15,000 first diagnoses for MDD per fiscal year (0.7–1.2 percent of the total active force).[3] While the frequency of MDD cases was in similar to the frequency of PTSD cases, we do not observe the same increasing trend in these diagnoses that we observe for PTSD or TBI.

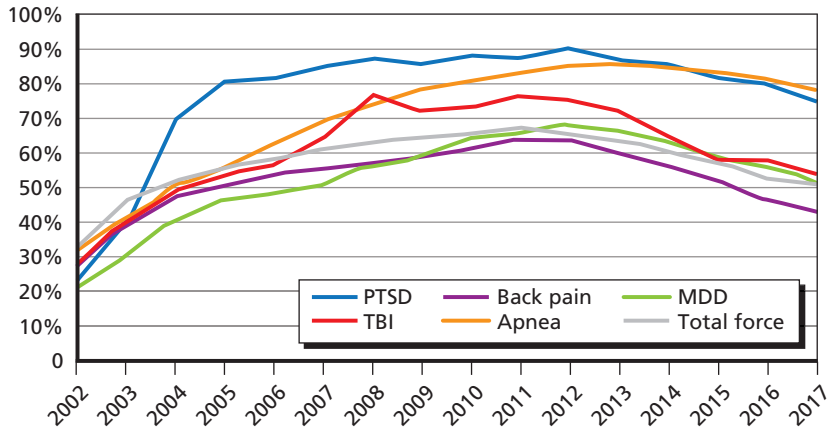
Characteristics and Experiences of Diagnosis Cohorts

Deployment Experience

Next, we analyzed the service-related characteristics of these cohorts. Figure 3.4 shows the share of service members in a particular diagnosis cohort who were ever deployed prior to their diagnosis. We plot these shares for the PTSD, TBI, and three main comparison conditions cohorts. The share of service members experiencing a deployment at any time prior to first diagnosis demonstrates an inverted-u shaped trend for each diagnosis cohort, which coincides with the overall increase and decline in deployments in the overall force during these years. Despite the similarities in trends across all cohorts, however, there were significant differences in levels. The share of the PTSD cohorts who experienced a prior deployment increased sharply during the first few years of our analysis period. By 2008, 85 percent of the PTSD diagnosis cohorts had experienced a prior deployment, compared with 76 percent of the TBI diagnosis cohort. The back pain diagnosis cohort and MDD diagnosis cohorts experienced a smaller increase: approximately 60–65 percent of the diagnosis cohorts between 2009 and 2012 expe-

[3] Appendix B describes the diagnosis codes that were used to identify cohorts for this analysis. The diagnosis coding scheme changed during our observation period, so we used a crosswalk to translate the earlier codes to later codes. In doing so, the inclusion of one code (F32.9: major depressive disorder, single episode, unspecified) created a sharp increase in the number of MDD cases beginning in FY 2016. We elected to remove that code from our algorithm, which resulted in a much smoother line. If we had included F32.9, there likely would have been a dramatic uptick in the number of service members in the FY 2016 and FY 2017 MDD cohorts. Since we were following cohorts for three years, we did not include these years in our analysis of trends, but the codes used did affect the numbers presented in Figure 3.3.

Figure 3.4
Percentage of Diagnosis Cohort Deployed Before the Diagnosis, 2002–2017



NOTES: Cohorts defined based on the first fiscal year in which a diagnosis is observed in MDR, using the ICD codes documented in Tables B.8–B.13. Diagnosis cohorts are not mutually exclusive. Deployments reflect cumulative deployments over the service member's entire career, even those prior to the analysis period.

rienced a prior deployment. However, the share of sleep apnea diagnoses with a prior deployment increased more gradually over the analysis period, from 32 percent in 2002 to approximately 85 percent by 2013, in contrast to the sharp increase for the PTSD cohorts.

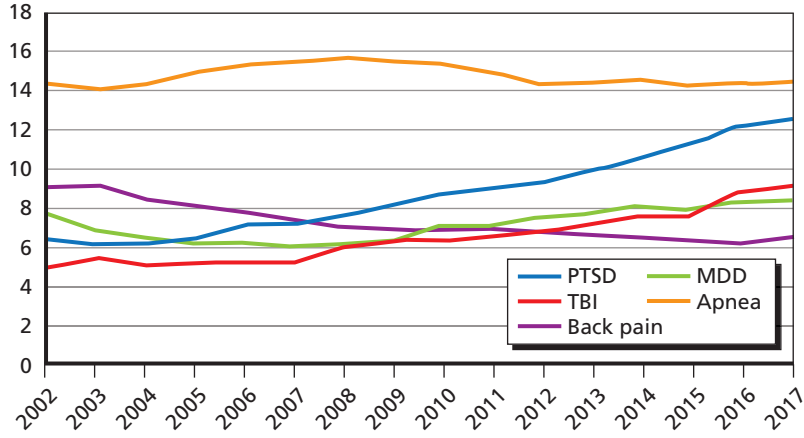
The sharp increase in the share of PTSD diagnosis cohorts who had a prior deployment could reflect a variety of factors, including increased exposure to trauma in theater during heavy periods of deployment, as exposure to combat has been found to be a strong predictor of PTSD (e.g., Dohrenwend et al., 2007; Hoge et al., 2004; Larson et al., 2008).[4] Other factors could include changes in screening procedures for PTSD after deployment, or a response to policy changes aimed at reducing barriers to treatment.

[4] In this analysis, we examined any deployment in support of the global War on Terror. We note that not all service members who deployed were exposed to combat and that the intensity and frequency of combat exposure changed over the period of time covered by this study.

Years of Service

We now turn to YOS at the time of first diagnosis. Figure 3.5 plots the average YOS at the time of first diagnosis for each cohort. The average experience level nearly doubled for the PTSD diagnosis cohort over our analysis period, from approximately six YOS on average in 2002 to 12 YOS by 2017. Even though the other conditions shown in the graph did not show changes that were as dramatic as the PTSD cohort, there were still notable changes over time. Average YOS in the TBI diagnosis cohort increased from five years in 2002 to nine years in 2017. By contrast, the experience level of the back pain diagnosis cohort fell from an average of nine YOS for the 2002 cohort to an average of 6.5 YOS by the end of our analysis period in 2017. Average YOS was relatively constant in the sleep apnea and MDD cohorts, at 14 and eight YOS, respectively. The prevalence of sleep apnea increases with age (Bixler et al., 1998), so it may not be surprising that this cohort had more YOS at diagnosis than our other diagnosis cohorts. Consistent with the increase in experience level, the pay grade of these diagnosis cohorts

Figure 3.5
Average Years of Service at the Time of the First Diagnosis, by Diagnosis Cohort, 2002–2017



NOTES: Cohorts defined based on the first fiscal year in which a diagnosis is observed in MDR, using the ICD codes documented in Tables B.8–B.13. Diagnosis cohorts are not mutually exclusive.

also increased over time. While we do not know from this analysis why there has been a shift toward more YOS at the time of first diagnosis, Table D.1 and Figure D.2 show that the YOS distribution among deployed personnel began to skew toward more senior service members over the time period studied. Since deployments and combat exposure are significant predictors of having PTSD, it stands to reason that there would be a positive correlation between YOS at the time of deployment and YOS at the time of diagnosis.

Other Characteristics

Most of the other characteristics of the service members in these cohorts were relatively stable over time (see tables C.1–C.6). Approximately 75–85 percent of PTSD diagnosis cohorts were male, and 85–90 percent of TBI diagnosis cohorts were male. These shares were broadly similar to estimates for the overall force, where approximately 85 percent of service members are male, according to our analytic file. The gender composition was similar in the back pain and sleep apnea cohorts, while a slightly lower share of MDD diagnosis cohorts was male, at approximately 70–75 percent over our analysis period. Approximately one-third of all diagnosis cohorts in the early years of the analysis period was nonwhite, although the share of diagnosis cohorts who were minorities increased to approximately one-half in more recent diagnosis cohorts. Approximately two-thirds and three-fourths of the PTSD and PTSD+TBI diagnosis cohorts, respectively, were in the Army, compared with approximately 60 percent of the TBI diagnosis cohorts and around one-half of the comparison condition cohorts. Between 20 and 30 percent of the PTSD and TBI diagnosis cohorts were infantry, compared with 30–40 percent of the PTSD+TBI diagnosis cohorts, and 10–15 percent of the comparison condition cohorts. PTSD diagnoses were also more common among medical personnel and food service, police, fuel, and drivers than in the overall force, and TBI diagnoses were more common among automotive, aircraft, and ammunition personnel than in the overall force. In Chapter Five, we explore the relationship between these characteristics and the probability of being medically discharged with a disability rating for these conditions using multivariate analysis.

Co-occurring conditions were common among those with a PTSD or TBI diagnosis (see Tables D.3 and D.4). For example, 33 percent of those in the 2015 PTSD cohort also had a TBI diagnosis, while 22 percent of those in the 2015 TBI cohort also had a PTSD diagnosis. These results are consistent with neurology research findings that show that although they are distinct conditions, PTSD and TBI often have overlapping symptoms and are increasingly found to be comorbid (Kaplan et al., 2018). In many cases experiencing a TBI, particularly during deployment, is a traumatic event that could cause PTSD.

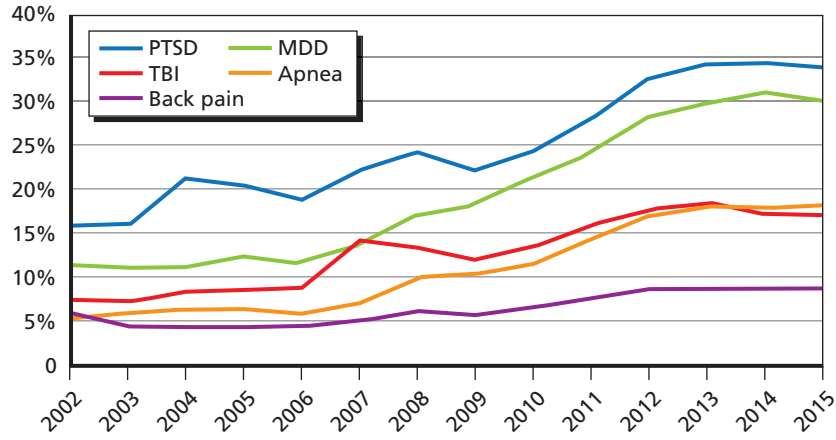
Disability Outcomes Among Diagnosis Cohorts

As noted earlier, service members whose medical conditions call into question their ability to continue serving are referred to DES. While we would have liked to analyze trends in referral to DES among our diagnosis cohorts, the data unfortunately do not include referrals. Instead, we examined trends in medical discharges—those service members who were medically retired or separated (with or without benefits) after disability evaluation. As described in Chapter One, service members who have a total disability rating of 30 percent or greater are medically retired and receive retirement benefits including a pension and health care. Those who have a total disability rating of less than 30 percent are medically separated and receive a one-time lump-sum disability payment. In the sections below, we first describe the proportion of the diagnosis cohorts who were medically discharged (either retired or separated) and then compare medical retirements with medical separations for each cohort. Finally, we describe whether those who were medically discharged received a disability rating for their cohort diagnosis, or whether they were medically discharged due to another condition.

Percentage Medically Discharged

Figure 3.6 shows the share of each diagnosis cohort who had either a medical retirement or separation disposition within three years of receiving a diagnosis. The year on the x-axis reflects the year of first diagnosis, meaning that the trends capture any medical discharge in

Figure 3.6
Percentage of Diagnosis Cohort with a Medical Retirement or Separation Disposition Within Three Years of First Diagnosis, 2002–2015



NOTES: Fiscal year on the x-axis represents the fiscal year of first diagnosis. Cohorts defined based on the first fiscal year in which a diagnosis is observed in MDR, using the ICD codes documented in Tables B.8–B.13. Diagnosis cohorts are not mutually exclusive.

the subsequent three years. For example, the data point in 2007 shows the percentage of a cohort with a medical retirement or separation disposition between 2007 and 2009 for service members with a first diagnosis in 2007. To allow for three complete years of observation in our analysis period after the diagnosis, we limited this analysis to the 2002–2015 diagnosis cohorts.

The rate of medical retirement or separation increased for all diagnosis condition cohorts over our analysis period, but to varying degrees. Once again, the PTSD diagnosis cohorts had the highest rates of increase in these dispositions. Approximately 16 percent of the 2002 PTSD diagnosis cohort was either medically retired or separated within three years, but this increased by 18 percentage points to 34 percent for the 2013 through 2015 diagnosis cohorts. The rate of medical retirement or separation was lower for the MDD diagnosis cohorts, but reached 31 percent for the 2014 cohort, a rate similar to that observed in the PTSD cohort.

Rates of medical retirement and separation were lower for the TBI diagnosis cohorts, with 7–9 percent of the 2002–2006 TBI diagnosis cohorts having had one of these dispositions within three years, and increasing to 18 percent by 2012. The 2007 TBI cohort also experienced an uptick in the rates of medical retirement and separation, which could be related to increased combat deployments around this time. The rate of medical retirement or separation among the sleep apnea diagnosis cohort followed a similar pattern as that of the TBI diagnosis cohorts. These dispositions were less frequent among back pain diagnoses and did not increase as sharply over our analysis period.

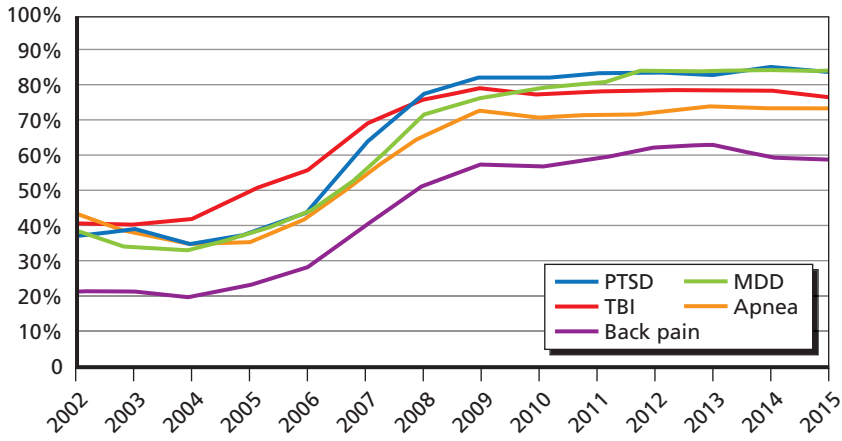
We note that since we were measuring medical discharge by the presence of a DES disposition date within the three-year observation window, the percentage of a cohort who was medically discharged depended in part upon DES processing times. In other words, the longer the process took, the more likely it was that we would not have observed a disposition, even if the service member has already been referred for disability evaluation. As the companion policy review report explains, there have been recent efforts to shorten processing times (Simmons et al., 2021), which might be a partial explanation for the increase in the percentage of service members who have been medically discharged in recent years.

As shown in Figure D.1, we also analyzed the rate of medical retirement or separation up to five years after diagnosis. The rate of medical retirement or separation within five years of diagnosis was approximately 2 to 3 percentage points higher for PTSD and TBI cohorts from 2002 to 2006, but then the gap widened to 4 to 6 percentage points higher for the 2007–2013 PTSD and TBI cohorts. The gap between the three- and five-year rates of medical retirement or separation also increased for the MDD, back pain, and sleep apnea diagnosis cohorts slightly, but the differences were smaller than for PTSD and TBI.

Type of Medical Discharge

Figure 3.7 shows the distribution of medical retirements among service members in the PTSD, TBI, and comparison condition cohorts who were medically discharged within three years of first diagnosis. Across all conditions, there was an increase in the share of service members

Figure 3.7
Percentage of Medical Discharges that Resulted in Medical Retirement Within Three Years of First Diagnosis, by Diagnosis Cohort, Fiscal Years 2002–2015



NOTES: Fiscal year on the x-axis represents the fiscal year of first diagnosis. Cohorts defined based on the first fiscal year in which a diagnosis is observed in MDR, using the ICD codes documented in Tables B.8–B.13. Diagnosis cohorts are not mutually exclusive.

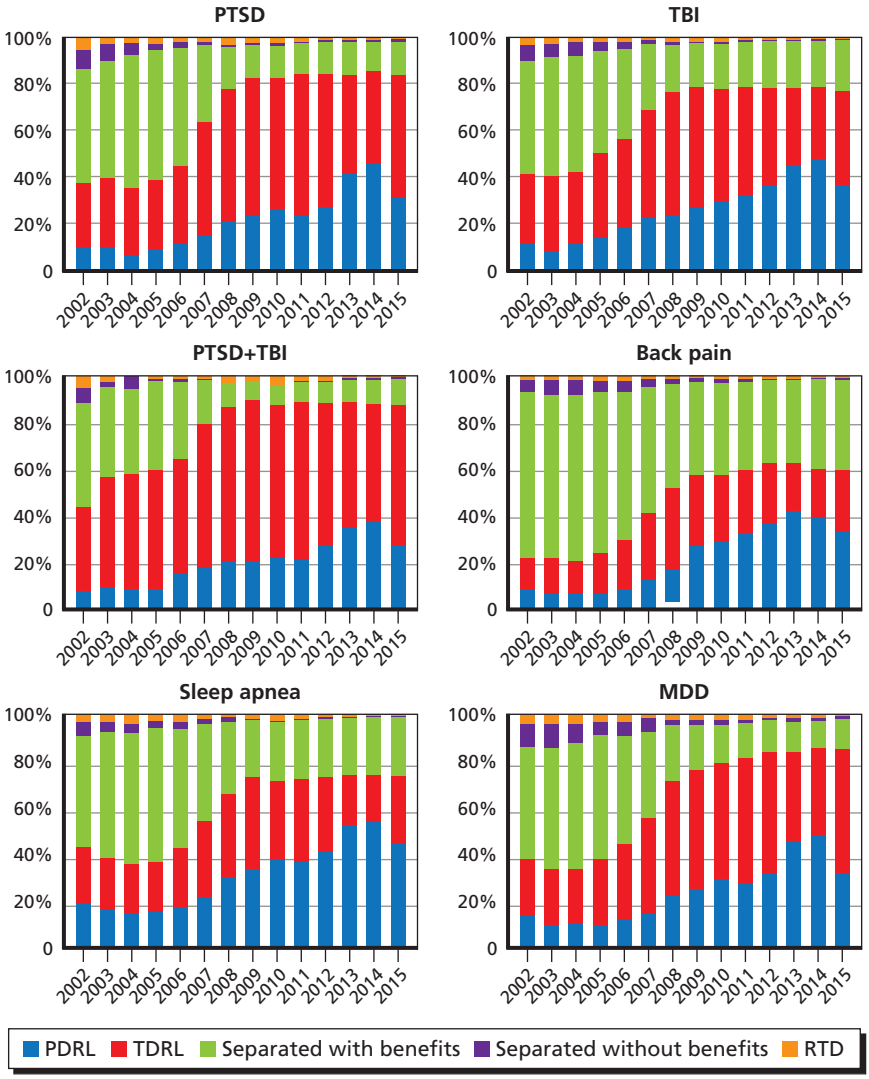
with medical retirements (either Permanent Disability Retired List [PDRL] or TDRL) over our analysis period. For the PTSD cohorts, the share of medical discharges that were medical retirements increased from approximately 35–38 percent between 2002 and 2005 to 83 percent by 2009. TBI cohorts experienced a similar increase, with the share of medical retirements increasing from 41 percent to 79 percent over the same time frame. The share of the MDD cohorts with medical retirement also followed a similar trend, increasing from 38 percent in 2002 to 85 percent by the end of the analysis period. So did medical discharges in the sleep apnea cohorts, which increased from 43 percent in 2002 to 74 percent at the end of our analysis period. While the level of medical retirements was much lower among back pain diagnoses, there was still an increasing trend in the share of medical retirements over time.

While we are unable to directly associate the rated condition with these discharge outcomes, the increasing rate in medical retirements coincides with the time period when policy changes in how the VASRD was applied meant that service members who were found to be unfit due to PTSD received an automatic minimum 50-percent disability rating and placement on TDRL, which in turn resulted in medical retirement. Tables C.7–C.9 show that there was a considerable amount of overlap between these diagnosis cohorts. Approximately one-third of service members with a PTSD diagnosis also had a diagnosis for MDD at some point in our analysis window. Not shown is the percentage of the MDD cohort who were also rated for PTSD. Between 2004 and 2009, the percentage of the MDD disability cohort who were also rated for PTSD was low—less than 5 percent. Between 2011 and 2014, 30–40 percent of the MDD disability cohort also had a rating for PTSD.

Figure 3.8 separates out all final disposition categories. PDRL and TDRL comprised 10 and 27 percent of final dispositions for the 2002 PTSD cohort, respectively, but they increased to 31 and 53 percent of final dispositions for the 2015 PTSD diagnosis cohort. The TBI cohort started out at a similar level, with 11 and 31 percent of final dispositions being PDRL and TDRL, respectively. By 2015, 37 percent of the 2015 TBI diagnosis cohort had a final disposition of PDRL, and 41 percent had a final disposition of TDRL. The rates of TDRL were in fact highest for the PTSD+TBI cohort, increasing from nearly 36 percent for the 2002 diagnosis cohort to 60 percent by the 2015 diagnosis cohort.

The trends in PDRL and TDRL dispositions for the MDD diagnosis cohorts were markedly similar to the trends for the PTSD diagnosis cohorts. The sleep apnea cohorts showed the highest rate of PDRL dispositions over the entire analysis period, increasing from over 20 percent in 2002 to approximately 45 percent by 2015. While the back pain diagnosis cohorts had the lowest rate of medical retirement, these cohorts also demonstrated a significant increase in PDRL dispositions. We note that retirement or separation is determined by overall DoD rating, which takes into account all unfitting conditions, not just the ones shown. We also do not know the reason a service

Figure 3.8
Distribution of Disposition for Service Members in Diagnosis Cohort Who Were Evaluated for Disability Within Three Years of Diagnosis, 2002–2015



NOTES: Fiscal year on the x-axis represents the fiscal year of first diagnosis. Cohorts defined based on the first fiscal year in which a diagnosis is observed in MDR, using the ICD codes documented in Tables B.8–B.13. Diagnosis cohorts are not mutually exclusive.

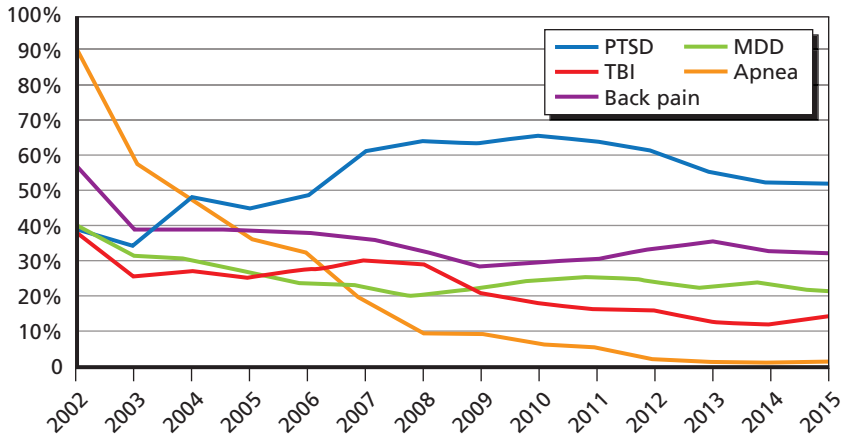
member was referred for disability evaluation. For example, a service member with a disability rating for sleep apnea who was retired may have initially been referred for depression (there is an established relationship between sleep apnea and depression; Peppard et al., 2006) rather than sleep apnea itself. One of the first stages of disability evaluation is the VA compensation and pension medical evaluation, which assesses all referred medical conditions and all those claimed by the service member and is intended to thoroughly document any medical condition that affects the service member's fitness for duty. Therefore, service members may receive ratings for medical conditions other than the referred condition(s).

Receipt of Disability Rating for the Diagnosis Cohort Condition

Service members who are medically retired or separated have a total disability rating, which is calculated based on the VASRD ratings for each condition that has been determined to be unfitting. We wanted to understand whether service members in our diagnosis cohorts who were found unfit in the initial PEB determination received disability ratings for the diagnosis cohort condition, or whether they were rated for a different condition. For example, how often did service members with a PTSD diagnosis receive a disability rating for PTSD, among those who were medically retired or separated? Figure 3.9 shows the share of service members in each diagnosis cohort who were medically discharged and received a VASRD rating for the diagnosed condition within three years of the diagnosis. Overall, we found that about half (or fewer) received a VASRD rating for the cohort condition.

The share of service members who had a medical retirement or separation disposition and a VASRD rating for the cohort condition declined over time for most conditions, except for PTSD. The share of the PTSD diagnosis cohort who were medically discharged and also had a VASRD rating for PTSD increased sharply over the analysis period, from approximately 35–40 percent in 2002 and 2003 to 46–48 percent in 2004–2006, to just over 60 percent after 2007. This share declined in the last three years of the analysis window, so that by 2017, 50 percent of those in the PTSD diagnosis cohort whose DES disposition indicated medical discharge received a VASRD rating for PTSD.

Figure 3.9
Percentage Who Received a Disability Rating for the Diagnosis Cohort Condition Within Three Years of First Diagnosis, Among Those with a Medical Discharge, by Diagnosis Cohort, 2002–2015



NOTES: Fiscal year on the x-axis represents the fiscal year of first diagnosis. Cohorts defined based on the first fiscal year in which a diagnosis is observed in MDR, using the ICD codes documented in Tables B.8–B.13. Diagnosis cohorts are not mutually exclusive.

In contrast to the notable increase in ratings for PTSD in the PTSD diagnosis cohort, the share of service members with a medical retirement or separation disposition with ratings for the diagnosed condition declined for the TBI and comparison condition diagnosis cohorts.

The share of the TBI cohort who were medically discharged with a VASRD rating for TBI declined steadily from 39 percent in 2002 to 13 percent by the end of the analysis period. As most TBIs are mild, and most of those with a mild TBI recover, it may not be surprising that so few of those in the TBI diagnosis cohort who were medically discharged had a VASRD rating for TBI. We examined this outcome for other TBI severity levels (not shown). The rate of retirement or separation among moderate, severe, or penetrating TBI cases followed a similar decline: Whereas approximately 68 percent of moderate, severe, or penetrating TBI cases were medically discharged with a rating for TBI in 2002, this share declined to 30 percent by 2015 (not shown).

The pattern for sleep apnea in particular is striking: While 90 percent of service members in the 2002 sleep apnea diagnosis cohort who were medically discharged received a VASRD rating for sleep apnea in 2002, this share fell to only 2 percent in the 2015 diagnosis cohort. This dramatic shift was driven by several factors. First, diagnoses for sleep apnea increased nearly threefold from just under 10,000 first diagnoses in 2002 to nearly 33,000 diagnoses in 2015. The share of these diagnosis cohorts who were medically discharged increased as well, from 5 to 18 percent. However, the number of service members whose sleep apnea was considered by DoD to be unfitting (and who therefore had a VASRD code and rating for sleep apnea) changed very little, and in fact, declined over the analysis period. As a result, an increasing share of service members with a sleep apnea diagnosis who were medically discharged received a rating for a condition *other than* sleep apnea. Other common VASRD ratings for this diagnosis cohort included ratings for PTSD, back pain, other mental disorders, or other musculoskeletal disorders restricting motion.

As mentioned above, the later years of data used in this analysis, beginning in 2007 but especially from 2012 to 2017 when IDES was fully rolled out, contain both fitting and unfitting conditions. This is particularly an issue for the Air Force, Marine Corps, and Navy. The consequence is that the rates reported above may have been artificially high in the later years (and not directly comparable with earlier years of analysis) because we may be including some conditions that DoD determined were not unfitting.

As shown in Figure 3.9, service members in all diagnosis cohorts who were medically discharged did not always receive a disability rating for their cohort diagnosis, meaning that they were found to be unfit for some other condition. To better understand this for the PTSD and TBI diagnosis cohorts, we examined the proportion of those who were medically discharged who received a disability rating for another condition. Tables 3.1 and 3.2 present the distribution of conditions for which service members in the PTSD and TBI cohorts, respectively, were rated. Among those in a PTSD diagnosis cohort who received any rating, approximately 35 percent received a rating for PTSD in 2002. This share increased to just over 60 percent by 2008. By contrast, over two-

Table 3.1
Condition Ratings Within Three Years for Posttraumatic Stress Disorder Cohorts

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Percentage of Diagnosis Cohort with any Rating within Three Years													
	16	17	22	21	20	23	25	23	25	28	33	34	34	33
	Percentage of Those with Any Rating Who Were Rated for the Indicated Condition within Three Years													
PTSD	35	31	45	44	47	59	61	62	61	61	59	54	51	51
TBI	4	5	5	6	8	16	20	15	11	11	10	9	8	8
Other mental disorder	66	63	67	61	64	74	74	76	74	72	71	67	65	64
Any depression	23	17	11	9	8	6	7	11	14	13	12	11	11	11
MDD	21	15	11	8	8	5	6	9	12	12	11	10	10	10
Arthritis	16	17	17	20	19	22	25	26	25	22	20	20	20	21
Back pain	13	12	14	17	18	20	24	23	23	22	25	28	28	25
Other motion condition	2	2	3	4	5	6	9	15	19	24	27	27	25	26

NOTE: "Other motion condition" includes VASRDs 5201 (arm, limitation of motion), 5215 (wrist, limitation of motion), 5251 (thigh, limitation of extension), 5252 (thigh, limitation of flexion), 5257 (knee, other impairment), 5260 (leg, limitation of flexion), 5261 (leg, limitation of extension), and 5271 (ankle, limited motion).

Table 3.2
Condition Ratings Within Three Years for Traumatic Brain Injury Cohorts

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Percentage of Diagnosis Cohort with any Rating within Three Years													
	8	8	9	9	10	15	14	12	14	16	18	18	17	17
	Percentage of Those with Rating Who Were Rated for the Indicated Condition within Three Years													
TBI	34	23	26	24	26	29	28	21	17	16	16	13	13	13
PTSD	2	4	8	15	19	39	49	49	46	44	43	40	35	33
Other mental disorder	40	32	37	39	43	56	61	61	56	54	53	51	46	45
Arthritis	20	20	19	20	20	21	26	26	24	21	20	21	23	23
Back pain	17	18	16	18	19	18	24	22	23	23	26	30	30	29
Migraine	8	6	6	5	6	6	9	12	13	13	13	12	10	11
Nervous condition	7	10	10	14	15	9	7	7	6	7	9	8	10	11
Motion condition	4	4	4	5	6	7	10	15	21	26	29	28	29	29

NOTE: "Other motion condition" includes VASRDs 5201 (arm, limitation of motion), 5215 (wrist, limitation of motion), 5251 (thigh, limitation of extension), 5252 (thigh, limitation of flexion), 5257 (knee, other impairment), 5260 (leg, limitation of flexion), 5261 (leg, limitation of extension), and 5271 (ankle, limited motion).

thirds of this group received a rating for another mental disorder consistently over the analysis period; nearly three-fourths of PTSD diagnoses with any rating received a rating for a mental disorder between 2007 and 2010. Other commonly rated conditions included arthritis, back pain, and, in the later years of our analysis period, other motion-restricting conditions (the most common of which were arm, limitation of motion; leg, limitation of flexion; and ankle, limitation of motion).[5]

While 34 percent of service members in the subset of the TBI diagnosis cohorts with any rating were rated for TBI in 2002 (Table 3.2), this share declined to 13 percent by 2015. By contrast, the share of the TBI diagnosis cohort with a rating for PTSD increased from 2 percent in 2002 to 33 percent in 2015, with nearly 50 percent of the 2008 and 2009 TBI diagnosis cohorts with ratings having received ratings for PTSD. The other most frequent conditions with ratings over the entire analysis period included other mental disorders, arthritis, and back pain. As with the PTSD cohorts, the share with motion-restricting conditions increased significantly after 2010.[6]

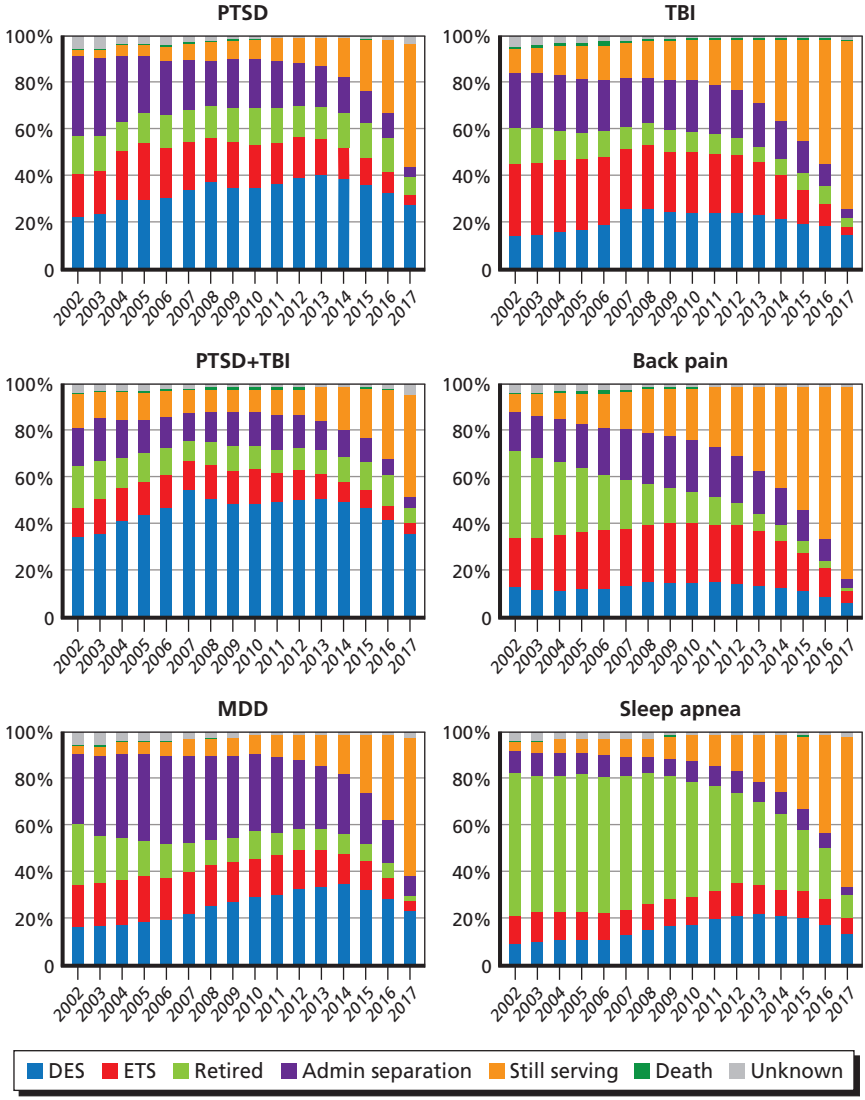
Final Status of Diagnosis Cohorts at the End of the Observation Period

We next expanded our focus from the first three years after diagnosis to final outcomes at the end of our analysis period. Figure 3.10 shows the final outcome for service members in each diagnosis cohort at the last point in time when we observed them in the dataset. We grouped these final outcomes into six broad categories: service members for whom

[5] We also considered nerve condition, migraine, asthma, amputation, sleep apnea, adjustment disorder, tinnitus, and "other" (everything not already listed). None of the specific conditions ever reached double-digit percentage points, and they did not vary over time. Nerve condition and migraine were the most common among them, appearing on as many as 9 percent of IDES cases during some years. Amputation, sleep apnea, adjustment disorder, and tinnitus frequently appeared on only 0–2 percent of cases.

[6] MDD, depression, asthma, sleep apnea, amputation, adjustment disorder, and tinnitus all appeared on less than 10 percent of IDES cases and so were excluded from Table 2.2 for the sake of simplicity.

Figure 3.10
Distribution of Diagnosis Cohort Status at End of Observation, by Fiscal Year of First Diagnosis



NOTES: Fiscal year on the x-axis represents the fiscal year of first diagnosis. Cohorts defined based on the first fiscal year in which a diagnosis is observed in MDR, using the ICD codes documented in Tables B.8–B.13. Diagnosis cohorts are not mutually exclusive.

we observed a medical discharge through DES, service members who exited after completing their term of service (Expiration Term of Service [ETS]), service members who retired after 20 YOS, service members who were administratively separated for another reason, and service members who had died by the end of the analysis period.[7] If we still observed a service member in the active duty DMDC records at the end of the analysis period, we classified him or her as still serving. If we did not observe the service member in the active duty file at the end of the analysis period, but did not have any information to classify him or her in any of the other outcome categories, we classified the outcome as unknown. Overall, we were able to identify the final outcome for 95 percent of service members in all diagnosis cohorts, meaning only a small share of cases was classified as unknown. Tables D.5–D.10 show the numbers reflected in Figure 3.10. Tables D.11–D.16 show the final status distribution among those no longer serving (i.e., removing the "still serving" category).

Among service members in the earliest PTSD diagnosis cohort (2002), 21 percent were medically discharged through DES. This share continued to increase to as high as 39 percent in the 2012 cohort and 40 percent in the 2013 cohort. The share of the diagnosis cohort medically discharged began to decline in 2015, which likely reflects the fact that first diagnoses in these later years may not yet have had time to go through the DES referral and evaluation process. The share of the PTSD cohort who reached their ETS or retired remained relatively stable, at between 15 and 20 percent for the 2002 cohorts through the 2013 cohorts. Interestingly, as the share of service members with a medical discharge increased, the share with administrative separations decreased, from approximately 34 percent in 2002 and 2003 to approximately 17 percent by 2013.[8]

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[7] DoDI 1332.14, *Enlisted Administrative Separations* (2014a) and DoDI 1332.30, *Commissioned Officer Administrative Separations* (2018), define the many ways enlisted and officer personnel may be separated from the military. These include completing a term of service, retiring, disability, and other types of separations including those that are involuntary. Appendix B describes the ways we characterized the outcomes in this analysis.

[8] As described in our companion report (Simmons et al., 2021), beginning in 2010, the services were required to assess the impact of a PTSD or TBI diagnosis on service members

Turning to the TBI cohorts, we found that a smaller share—15–17 percent—were medically discharged between 2002 and 2005. This share increased to approximately 25 percent for the 2007–2013 cohorts, before declining—again, likely due to the fact that service members diagnosed in later cohorts were still working their way through the evaluation system. The share of service members who reached their ETS declined from approximately 30 percent over the first five years of the analysis period to approximately 22 percent by 2013, and the share retired fell from 15 percent to 7 percent over the same time period. Administrative separations remained relatively stable at around 20–25 percent between 2002 and 2013. Not surprisingly, the share of these diagnosis cohorts who were still serving increased significantly over the last five years, reaching nearly 73 percent for the 2017 diagnosis cohort.

The increase in the share of diagnosis cohorts who were still serving was likely to be a reflection of a combination of factors, including the fact that it takes time for service members to be referred and discharged through DES, and service members in these recent diagnosis cohorts may be in the middle of a term of service and not yet be eligible for ETS. Figure 3.6 and Figure D.1 show that the three- and five-year medical discharge rates have been relatively stable since approximately 2012 and that in recent years, the five-year exit rates have been approximately 3–4 percentage points higher than the three-year exit rates. As a result, the end outcomes for diagnosis cohorts through approximately 2013 were more likely to reflect a stable pattern, while the trend for more recent diagnosis cohorts will likely continue to change over time.

The combination of ETS and retirement account for 30–40 percent of exits in the PTSD and TBI diagnosis cohorts. By comparison, the rates of ETS and retirement for the comparison conditions were larger, while the proportion who exited through DES was smaller. Out of the three comparison conditions analyzed here, the MDD cohorts

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prior to discharging them for misconduct. In 2014, DoD established policy that required enlisted service members undergoing administrative separation to be evaluated for PTSD or TBI to determine if there are extenuating circumstances for the separation.

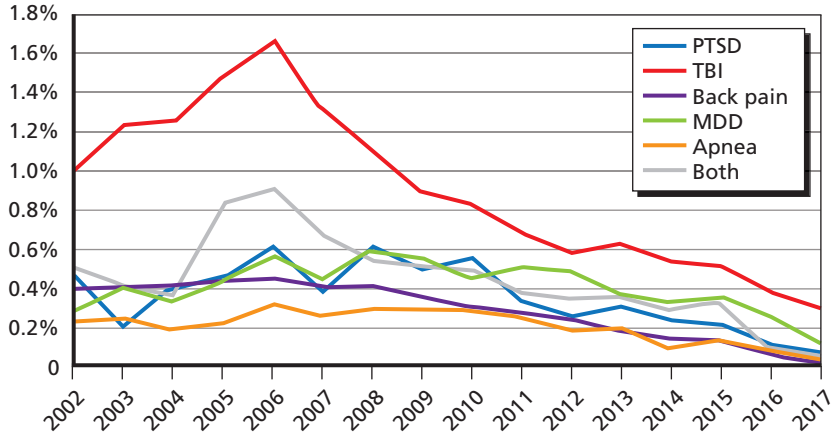
had the highest rate of medical discharge, ranging from 17 to 34 percent between 2002 and 2014. The rates of medical discharge for sleep apnea and back pain diagnoses ranged between 10 and 20 percent.

Less than 2 percent of all disability cohorts had died by the end of the analysis period. While the overall share of service members who had died was low, Figure 3.11 shows that there was a relatively higher share of service members in the TBI cohorts who died compared with the other conditions, particularly in the earlier years of the analysis period. By the end of the analysis period, 1 percent of the 2002 TBI diagnosis cohort had died; this increased to 1.6 percent by 2006 and then declined to approximately 0.3 percent by 2017. By contrast, death rates were consistently less than 0.6 percent for other condition cohorts and declined to 0.1 percent by the end of the analysis period.

An analysis of cause of death for our diagnosis cohorts is not possible due to small sample sizes. However, it is possible to characterize cause of death using our full analytic file.[9] When we do, we find that approximately 50–60 percent of all deaths were nonbattle deaths across the analysis period, with the exception of 2006 and 2007, when 45 and 36 percent of deaths were nonbattle deaths, respectively. The share of deaths resulting from battle rose and fell with conflict activity, from a low of 0.4 percent in 2016 to a high of nearly 53 percent in 2007. Finally the share of deaths with a cause not specified or with missing data on cause of death ranged between 10 and 25 percent over the analysis period.

[9] The number of deaths observed in our analytic file is consistently lower than numbers reported by Defense Manpower Data Center (DMDC), Defense Casualty Analysis System (2011). In 2002, our analytic file showed 660 deaths compared with DMDC's 1,051. In later years (2006 to the end of DMDC's reporting, 2010), our file more closely matched official numbers, showing 75–90 percent of official death counts. There are several potential explanations for these differences: (1) Our data or codes may have been different from those of DMDC (we used interservice separation codes and casualty data, as described in Appendix B); (2) we did not code a death if our data sources disagree (e.g., if interservice separation codes indicated that the service member retired but casualty data showed that the service member died, we coded it as unknown); and (3) DMDC's annual death counts are by calendar year and ours are by fiscal year.

Figure 3.11
Share of Diagnosis Cohorts Who Died by the End of Observation, 2002–2017



NOTES: Fiscal year on the x-axis represents the fiscal year of first diagnosis. Cohorts defined based on the first fiscal year in which a diagnosis is observed in MDR, using the ICD codes documented in Tables B.8–B.13. Diagnosis cohorts are not mutually exclusive.

Summary

In this chapter, we identified service members who were diagnosed with PTSD or TBI (or a comparison condition) and followed them for three years, beginning with the year of first diagnosis, to assess disability outcomes. We also characterized their discharge (medically discharged, ETS, regular retirement, administratively separated, or still serving) status at the end of our observation period.

The number and proportion of service members with a PTSD or TBI diagnosis rose significantly between 2003 and 2008; after 2008, the number of service members with these conditions began to decline. While the proportion of the total active force with deployment experience increased from 30 percent to 65 percent between the 2002 and 2011 cohorts, the proportion of service members with a PTSD diagnosis who had ever deployed rose even more significantly, so that by the 2011 cohort, 90 percent of those with PTSD had deployment experience.

Relative to other diagnosis cohorts, across all years, a larger proportion of the PTSD diagnosis cohort had a disability evaluation within three years of the initial diagnosis. The proportion of those with a PTSD diagnosis who had a disability evaluation also increased over time; in the 2012 and later cohorts, about one-third of all service members with a PTSD diagnosis had a disability evaluation, compared with about 30 percent of those with MDD and 15 percent of those with TBI or sleep apnea. Since 2008, approximately 80 percent of service members in the PTSD and MDD diagnosis cohorts who had a disability evaluation were medically retired. This is likely due to significant policy changes requiring that service members who were found unfit due to PTSD be medically retired.

For all diagnosis cohorts, only about half of those who were determined to be unfit after a disability evaluation received a disability rating for their cohort diagnosis condition, meaning that many were found unfit for some other condition. For service members in the 2015 PTSD diagnosis cohort who were determined to be unfit, 51 percent had a disability rating for PTSD, while 64 percent of the PTSD diagnosis cohort had a disability rating for "other mental disorder." For service members in the 2015 TBI cohort who were determined to be unfit, only 13 percent had a disability rating for TBI, while 33 percent of the TBI diagnosis cohort had a rating for PTSD and 45 percent had a rating for "other mental condition." While there was variation by cohort year, about 30–40 percent of exits among the PTSD and TBI diagnosis cohorts were for ETS or retirement, and about 30–50 percent exited through the disability evaluation system or were administratively separated.

There are some important limitations to the prospective analysis approach used in this chapter. First, in order to treat each cohort the same, we had to choose a period over which to follow service members after observing a diagnosis. Theoretically, we could have followed the 2002 cohort for 15 years to the end of our data (2017), but to ensure consistency in our results, we selected a three-year observation period, which meant that we observed the 2002 cohort through 2004 and that 2015 was the most recent cohort we defined. By limiting our observation period to three years, we missed disability evaluations that occurred four years after diagnosis and beyond. However, if we had

selected a longer observation period, our most recent cohort would have been earlier than 2015, limiting our ability to observe more recent trends.

Second, the descriptive trend analysis did not account for the timing of disability evaluation, as it measured only whether disability evaluation occurred within three years of diagnosis. Some service members may have been diagnosed and evaluated (to disposition) in the same year, and others may have just received their disposition by the end of the third year.

We use multivariate analyses of duration-to-DES methods to account for these issues in the next chapter.

CHAPTER FOUR

Trends in the Timing of Disability Disposition After Diagnosis

The results presented in Chapter Three were based on a descriptive analysis of trends in disability outcomes within three years of the first observed diagnosis of PTSD, TBI, or a comparison condition. That approach misses disability evaluations that occur more than three years after diagnosis and does not provide detail about when within the three-year window the evaluation occurred. In this chapter, we use multivariate analyses of duration-to-DES methods to account for both issues, which we describe briefly below. Additional details about the methods can be found in Appendix D.

Overview of Methods

Our multivariate approaches allowed us to measure the timing of disability disposition across cohorts, as well as how this timing varied for service members with different characteristics across and within cohorts. To be clear, we measured the time from diagnosis to disability disposition (the end of the disability evaluation, when the PEB determines whether the service member is fit or not). We did not include service members who are RTD, so to be precise about the outcome and since we are measuring time, we use the term *disposition* to indicate the end point.

Timing of Disability Disposition Across Cohorts

The first method we employed was Kaplan-Meier (Kaplan and Meier, 1958; Kiefer, 1988) estimation to measure time to disability disposition at the end of the disability evaluation following diagnosis, across cohorts. This model allowed us to adjust for right-censoring in our data, which happened for two reasons. First, some service members were still serving at the time our data ended in 2017, so we were unable to follow them to see if they ended up being evaluated for disability sometime after 2017. Kaplan-Meier estimation is the standard approach for dealing with this kind of data censoring.

The second reason censoring occurred in our analysis is that some service members left the military for other reasons, such as voluntary separation at the end of their term, administrative separation, or death, and therefore could no longer be referred to DES. Using the terminology for this type of estimation, service members who leave for another reason are no longer "at risk" of being referred to DES once they have left the military, so should not be included in the model after they leave active duty service.

Our model focused only on the timing of disability disposition, without consideration for what one path to separation implies about other possible paths. For example, if a service member with a PTSD diagnosis voluntarily left at the end of the term, it might mean that the service member had a mild case of PTSD or recovered from it and therefore had a small likelihood of being referred and evaluated for disability. Our approach did not attempt to measure the relationships between medical discharge and other types of discharge and instead focused on a consistent way to measure the fraction of a cohort who had not yet been evaluated for disability at each year after diagnosis.

Timing of Disability Disposition Across Service Member Characteristics

The second model we used was the Cox PH model (Cox, 1972; Kiefer, 1988), which allowed us to control for differences in observable characteristics across cohorts, in contrast with the Kaplan-Meier model, which estimates a single time to disability disposition relationship among all service members within a cohort. Hypothetically, if later

cohorts had lower average education, and lower education was positively correlated with medical discharge, such differences could lead to cross-cohort differences due only to differences in education, rather than differences in cohort health or DES policies over time. Furthermore, while our Kaplan-Meier estimates combined all service members in a given fiscal-year cohort, the Cox PH model allowed us to easily estimate differences in characteristics across cohorts. The Cox PH model included the following covariates, each measured at the individual service member level at the time of diagnosis:

- sex
- race/ethnicity
- education level
- ever deployed as of the year of diagnosis
- cumulative months deployed as of the year of diagnosis
- YOS
- pay grade
- occupation
- branch of service by year-of-diagnosis interaction terms.

Like all of our analyses in this report, the results of this model cannot be interpreted as causal. In other words, if we found a positive correlation between a covariate and the likelihood of being medically discharged, we could not conclude that larger values of that variable (e.g., months deployed) *caused* higher rates of medical discharge; we could say only that larger values were associated with higher rates of medical discharge. Appendix D discusses other assumptions built into the model and interpretations of it. Most of our assumptions are made to ensure the model is tractable and that the coefficients are easily interpretable. For example, the Cox PH approach assumes that the effect of a given covariate (e.g., education) on the likelihood of disability discharge is the same in every year of the analysis. We also simplified the model to compare service members who exited through DES with those who exited by any other means (e.g., retirement, ETS), rather than analyzing relationships between each of these alternative options. Coefficients from the models are found in Tables D.17 and D.18.

Multivariate Results

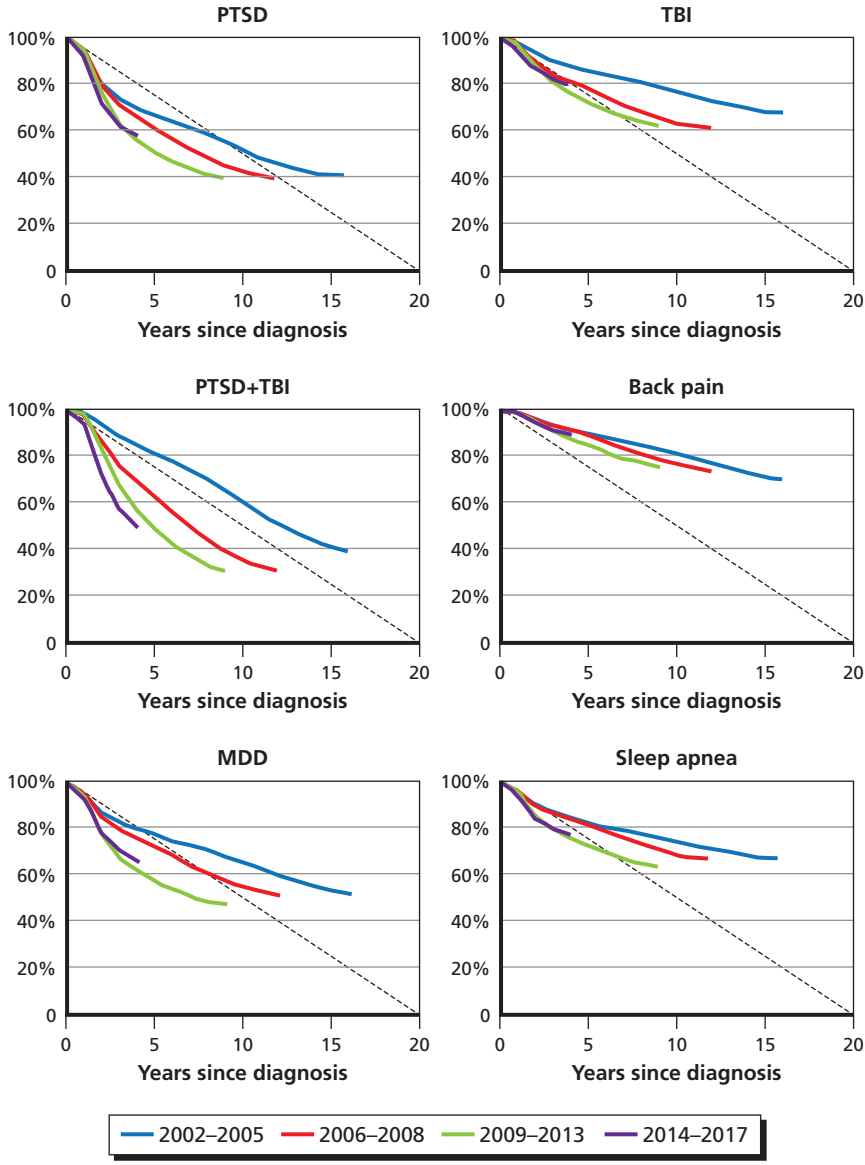
Kaplan-Meier Estimates

Figure 4.1 shows Kaplan-Meier estimates of time to disability disposition for each diagnosis group, by diagnosis cohort (measured here as a groups of diagnosis cohorts, e.g., service members diagnosed between 2002 and 2005). As mentioned above, these estimates did not control for any observable differences across diagnosis cohorts; they measured the fraction of the diagnosis cohort who *had not* had a disability disposition at annual points in time after diagnosis (on the x-axis). On the y-axis, 100 means 100 percent of the cohort had not been through the DES process (measured to date of disposition), and 0 means all service members in a cohort had been evaluated for disability. As service members began being evaluated for disability, the fraction not yet evaluated for disability shrunk, and therefore the curves slope downward. The steepness of the curve measures how quickly service members were evaluated for disability after diagnosis; a steep curve indicates service members were evaluated for disability relatively more quickly after diagnosis. We have added dashed lines to Figure 4.1 to make comparing slopes easier.

Across cohort years, there were substantial differences by condition in how quickly service members were evaluated for disability following diagnosis. Service members diagnosed with PTSD, both PTSD+TBI, or MDD underwent disability evaluation sooner after their diagnosis than those diagnosed with TBI, back pain or sleep apnea, according to the steepness of the curves in Figure 4.1. For example, at the fourth year after diagnosis, 69 percent of the 2002–2005 PTSD cohorts had not been evaluated in DES, compared with 96 percent of the 2002–2005 back pain cohorts. There were also clear cohort differences: The likelihood of being medically discharged soon after diagnosis was lower for 2002–2005 diagnosis cohorts than diagnosis cohorts in later years. However, the extent of this difference varied dramatically by condition, with relatively small effects by diagnosis year for back pain diagnoses and large effects for PTSD and PTSD+TBI diagnoses.

Although we do not know why earlier cohorts were discharged a longer period of time after diagnosis than later cohorts, we do know

Figure 4.1
Kaplan-Meier Estimate of Time to Disability Disposition, by Diagnosis and Year of Diagnosis



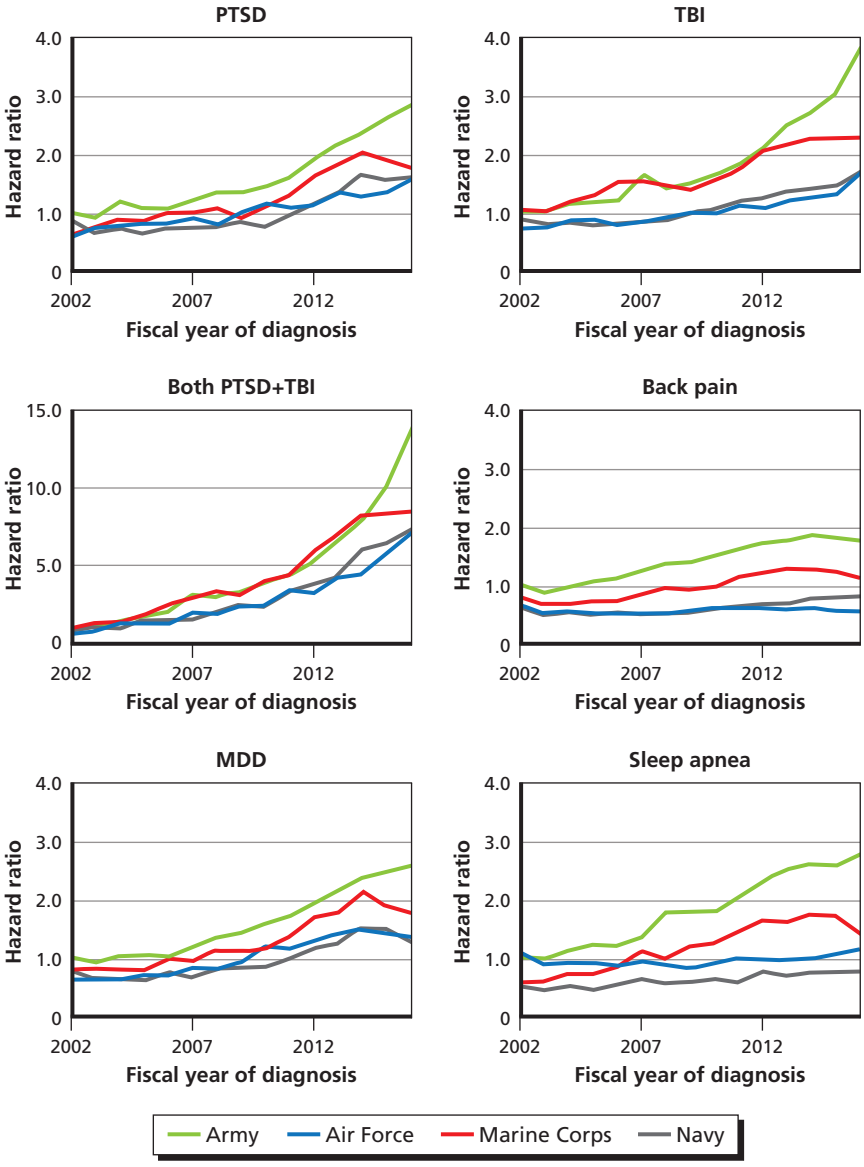
the earlier cohorts served in a very different environment than later cohorts. Until 2007, all disability evaluations were conducted under LDES and coordinated entirely by the branch of service in which the member served. The services may have had different goals and expectations for reviewing cases, and the number of staff processing cases may have been different than it is under IDES (where there are staff-to-case ratios). Even once IDES began being rolled out in 2007, the average time spent processing IDES cases often exceeded the 295-day goal; at times, it was closer to 400 days per case (GAO, 2012). As described in the companion report (Simmons et al., 2021), more recent DES policies have focused on reducing the length of the DES process with specific timeliness goals for each DES phase. In addition to these DES timeliness changes, which may have reduced the length of time between diagnosis and discharge, the amount of time a service member received treatment prior to referral may have been longer in earlier years.

We note again that these estimates do not control for service member characteristics or deployment experiences, both of which varied across the cohorts under study. However, these figures indicate that, for a given diagnosis, there were substantial differences in the timing of disability disposition by cohort (time of initial diagnosis) alone. For example, the timing of disability disposition varied considerably based on when someone joined a PTSD+TBI cohort (the curves in that figure are spread out), whereas early and later back pain cohorts had very similar time to disability disposition after diagnosis (the curves in the back pain figure are much closer together).

Cox Proportional Hazard Estimates

In our Cox PH model, we were able to control for a number of individual characteristics and service experiences, as listed above. Figure 4.2 shows the results of this analysis measured as hazard ratios. An estimate (hazard ratio) greater than 1 implies that the variable is associated with *earlier* disability disposition (i.e., the "hazard" of being evaluated for disability is higher than average); in other words, service members with these characteristics are evaluated for disability sooner than those who do not. In the context of the Kaplan-Meier curves discussed

Figure 4.2
Cox Proportional Hazard Model Estimates of the Likelihood of Disability Disposition, by Condition, Service, and Year of Diagnosis



above, these groups would have faster falling curves than the average service member, and the value of the hazard ratio is the fraction that a service member is more likely to be evaluated for disability *in every year since diagnosis* (i.e., a hazard ratio of 1.5 means a service member with that characteristic was 50 percent more likely to receive a disability disposition in the first year of his or her diagnosis compared with other service members in their first year, *and*, if he or she does not, was also 50 percent more likely to be evaluated for disability in his or her second year than other service members in their second year, and so on). Estimates of hazard ratios less than 1 imply a longer time between diagnosis and disability disposition, for which the Kaplan-Meier curves would be flatter. In a model like this, a higher or lower hazard ratio estimate needs to be interpreted in reference to a set category that is excluded from the model. In our model, the excluded category in these estimates was Army, 2002 diagnosis, which means that this estimate was set to 1, and the remaining estimates were relative to a soldier diagnosed with the condition under study in 2002. Therefore, if the hazard ratio is 2 on the y-axis, that means that, in any given year since diagnosis, individuals in that service and cohort were twice as likely to be evaluated for disability as a soldier with a 2002 diagnosis. All y-axes in Figure 4.2 are scaled the same (up to 4) for ease of comparison, except PTSD+TBI, which had much larger estimates.

Across these conditions, there were substantial cross-service differences in the likelihood of disability evaluation after diagnosis: The Army is the highest line in each figure, and Navy and Air Force are consistently lowest, which means soldiers and marines were evaluated for disability sooner after being diagnosed than sailors and airmen.

Furthermore, the trends differ in magnitude and timing, depending on the condition. In particular, the rate of medical discharge for the Army increased dramatically from 2002 to 2016, with much of the increase occurring since 2010, and the rise continuing through 2016. Similarly, for TBI, prior to 2012, the Army and Marine Corps had similar risks of earlier disposition; these were greater than the Navy and Air Force's risks of early disposition, which were similar to one another. The similarity between the Navy and the Air Force continued through 2016, but the hazard ratios of disability evaluation among soldiers

increased dramatically after 2012. Based on results presented on TBI severity in Appendix D, this difference appears to have been driven by differences in mild TBI diagnoses, including a dramatic recent increase in the likelihood of earlier disability disposition, whereas more severe TBI diagnoses experienced a gradual increase in the likelihood of earlier disability disposition over time. Those diagnosed with PTSD+TBI experienced the largest increase in the hazard ratio of DES rates over time, and this increase was observed across all services, although it was particularly pronounced for the Army in recent diagnosis cohorts.

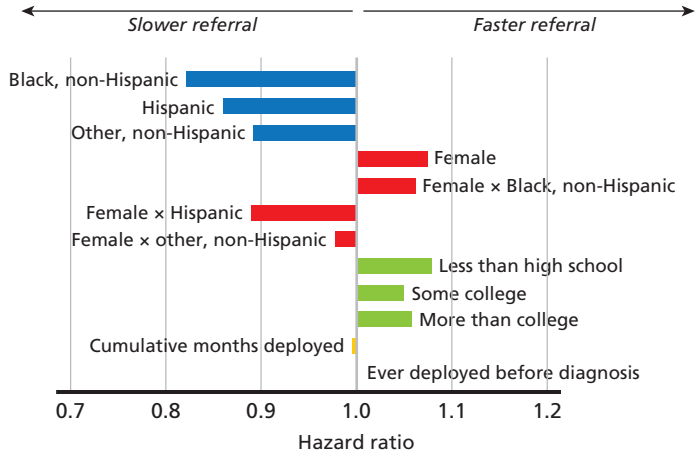
In recently diagnosed cohorts, soldiers with a back pain diagnosis were twice as likely as the reference group to be evaluated for disability. However, in prior cohorts and across the other services, service members diagnosed with back pain were not substantially more likely to be evaluated for disability than the reference group, and sailors and airmen with back pain diagnoses were less likely than the reference group to be evaluated for disability. In contrast, service members with PTSD+TBI diagnoses had a significant increase in the likelihood of earlier disability disposition over time; for example, soldiers in the 2016 PTSD+TBI cohort were nearly 14 times as likely as the 2002 Army cohort to be evaluated for disability in any year since diagnosis.

Differences by Individual and Service Characteristics

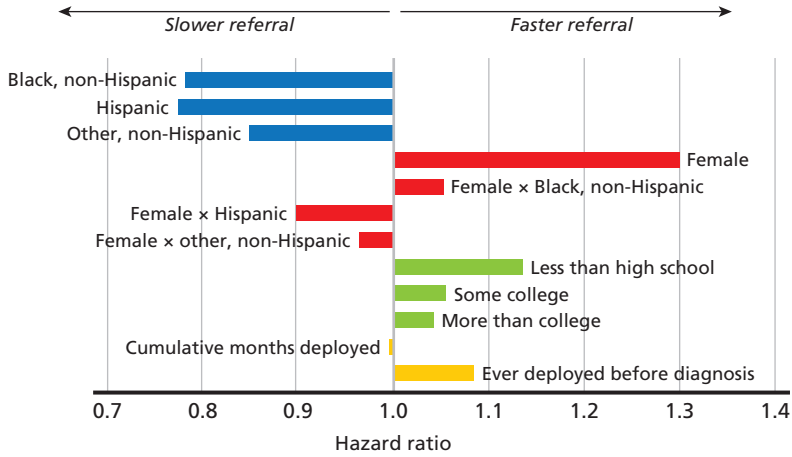
While Table D.17 contains the estimates for the other covariates included in the Cox PH regressions, Figure 4.3 displays the hazard ratios for selected variables included in the PTSD and TBI regressions. White service members were more likely than nonwhite service members to be evaluated for disability earlier across all conditions, and women were more likely to be evaluated earlier than men. Controls for race and ethnicity—black non-Hispanic, other non-Hispanic, and Hispanic—were all associated with a lower likelihood of earlier disability disposition across all conditions studied.[1] The omitted category

[1] Although we report the results from regressions that include the same set of covariates, we also explored excluding different service member characteristics to ensure our results were robust to this exclusion. One notable difference in coefficients was the estimate for female service members: Although we found that, across conditions, they have a consistently higher estimated hazard (i.e., a greater likelihood of being referred to DES sooner), the estimated

Figure 4.3
Hazard Ratios for Demographic and Deployment Characteristics in Cox Proportional Hazard Regression



(a) PTSD



(b) TBI

for education was having a high school degree. Having either less or more than a high school education tended to increase the likelihood of earlier disability disposition, with these effects consistent across all conditions except TBI diagnoses.

Deployment experiences at the time of diagnosis had strong effects on medical discharge, although not consistently across the conditions studied: Having been previously deployed at all increased the likelihood of earlier disability disposition for more severe TBI diagnoses, but was associated with a smaller likelihood for comparison conditions (see Table D.17). Cumulative months deployed had the opposite pattern: More months deployed were associated with later disability disposition for PTSD and mild TBI diagnosis, but earlier disposition for the back pain and MDD comparison conditions.

Across conditions, there was a generally consistent pattern that, controlling for pay grade, at fewer YOS at the time of diagnosis, the risk of earlier disability disposition was lower, while more YOS were associated with a higher rate of earlier disability disposition, as shown in Figure 4.4. However, for those with more than 10–12 YOS at diagnosis the rates of earlier disability disposition began declining again; this decline was large enough for PTSD and sleep apnea such that those with these diagnoses at 17 or more YOS had lower risk of earlier disability disposition than the baseline category of three YOS.

The pattern with pay grade was generally more straightforward: Controlling for YOS, relative to E4, officers and higher-ranked enlisted personnel tended to have a lower likelihood of earlier disability disposition. The omitted occupation category was "Artillery/Seaman/Air Crew/Small Boat Operator/Infantry." All other occupations generally had a lower likelihood of earlier disability disposition.

Table D.18 reports the same regressions for PTSD and TBI diagnosis, but includes additional variables based on the presence of co-diagnoses. These additional diagnoses had large, positive, and statisti-

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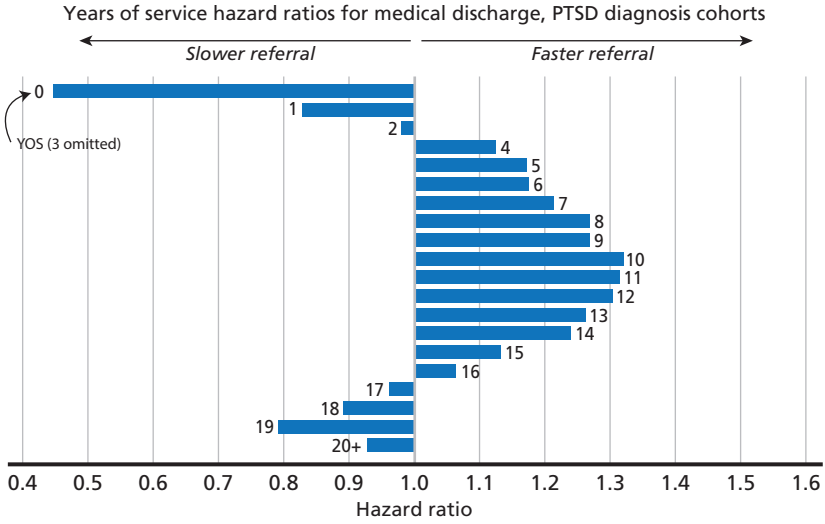
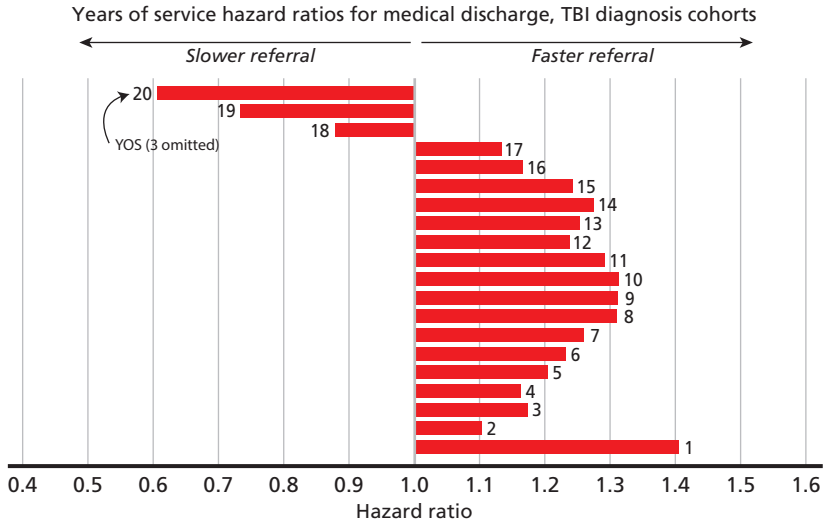
effect was in the opposite direction when we excluded occupation. That is, without controlling for occupation, female service members appear to have a lower likelihood of DES referral after diagnosis, but the different distribution of occupations by sex drove this estimate of lower DES hazard. Conditional on occupation, female service members thus generally have a higher DES referral hazard.

Figure 4.4
Hazard Ratios for Years of Service Variables in Cox Proportional Hazard Regression

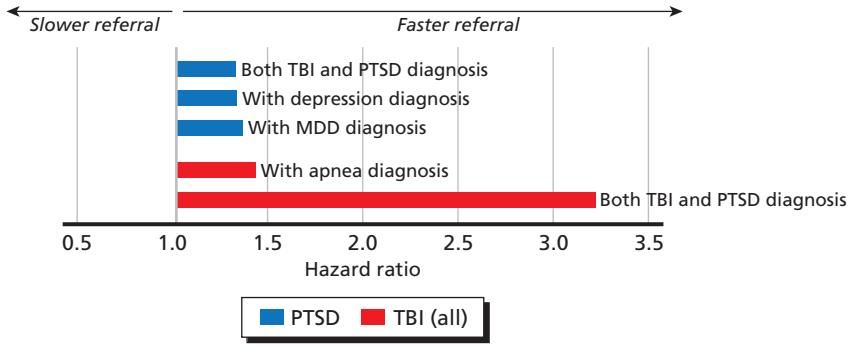


(a) PTSD



(b) TBI

Figure 4.5
Hazard Ratios of Co-Diagnoses for Medical Discharge, by Posttraumatic Stress Disorder or Traumatic Brain Injury Diagnosis Cohorts



cally significant associations with earlier disability dispositions. If one examines the baseline difference in hazards from the Kaplan-Meier estimates, PTSD diagnosis cohorts tended to have hazards approximately 2.5 times that of TBI diagnosis cohorts. However, including TBI co-diagnosis in the Cox analysis increased the risk of DES disposition by an additional 31 percent for those diagnosed with PTSD, with similar but slightly larger estimates for MDD and depression co-diagnoses. For those diagnosed with TBI, being co-diagnosed with sleep apnea increased the DES disposition hazard by 21–52 percent. For those with moderate, penetrating, or severe TBI, being co-diagnosed with PTSD increased the hazard of disposition by just over 250 percent, in line with the baseline difference between TBI and PTSD DES hazards. However, for mild TBI diagnoses, a PTSD co-diagnoses increased the DES disposition risk by 340 percent. The effects of co-diagnosis variables are displayed in Figure 4.5.

These results indicate that there have been substantial service-specific increases in the likelihood of DES referral for those diagnosed with PTSD, less severe TBI cases, and PTSD+TBI over time, especially for the Army, and at larger rates than the comparison conditions studied. There are consistent relationships between these hazards and characteristics of service members, but these trends persist despite controlling for these relationships.

Summary

The analyses in this chapter employed multivariate methods to deal with data censoring and enabled us to examine the time between diagnosis and receiving a DES disposition without imposing a window over which to observe these outcomes. We used two models: The first is typically used for right-censoring of data and allowed us to measure the fraction of a cohort who had not yet been evaluated for disability at each year after diagnosis; the second allowed us to control for differences in observable characteristics across cohorts.

These models produced a number of findings. First, service members diagnosed with PTSD, PTSD+TBI, or MDD were evaluated for disability sooner after their diagnosis than those diagnosed for TBI, back pain or sleep apnea. Second, service members in more recent cohorts were evaluated for disability sooner than service members diagnosed in earlier years. This is especially true for PTSD and PTSD+TBI; in recent years, service members with these diagnoses were evaluated for disability much more quickly after diagnosis compared with service members diagnosed in earlier years. In general, since 2002, there have been, over time, service-specific increases in the likelihood of earlier disability disposition for those diagnosed with PTSD, mild TBI, and PTSD+TBI relative to comparison conditions; this is especially true for the Army and for those diagnosed with both PTSD and TBI. Finally, there are consistent relationships between disability evaluation rates and service member characteristics (e.g., female service members are more likely to be evaluated earlier for disability), but the observed trends in earlier disability disposition for service members with PTSD, mild TBI, and PTSD+TBI persisted despite controlling for these relationships.

CHAPTER FIVE

Trends Among Cohorts of Service Members with a Posttraumatic Stress Disorder or Traumatic Brain Injury Disability Rating

This chapter focuses on cohorts of service members who were medically discharged through DES and looks retrospectively at the characteristics and experiences that preceded discharge. During DES, VA assigns a VASRD code (e.g., PTSD has a VASRD code of 9411) and a condition-specific disability rating for every referred and claimed condition for service members found unfit by PEB. Therefore, cohorts for the retrospective analysis were defined by the presence of a VASRD code on a disability record.[1] Although in theory a condition can receive a 0–100 percent rating, in 10-percent increments, there are specific instructions for rating each condition, discussed below.

Disability Ratings

Posttraumatic Stress Disorder and Major Depressive Disorder

PTSD and MDD are both considered by VA to be "mental disorders" and use the same rating guidance, as follows:

- 100 percent for "total occupational and social impairment, due to symptoms" from the disorder (VA, 2009, p. 2)

[1] As in the prospective analysis, we included individuals in the disability cohort regardless of the position of the VASRD of interest (i.e., if PTSD was the first VASRD on the record or the last).

- 70 percent for "occupational and social impairment, with deficiencies in most areas, such as work, school, family relations, judgment, thinking, or mood, due to symptoms" from the disorder (VA, 2009, p. 2)
- 50 percent for "occupational and social impairment with reduced reliability and productivity due to symptoms" from the disorder (VA, 2009, p. 2)
- 30 percent for "occupational and social impairment with occasional decrease in work efficiency and intermittent periods of inability to perform occupational tasks (although generally functioning satisfactorily, with routine behavior, self-care, and conversation normal), due to symptoms" from the disorder (VA, 2009, p. 2)
- 10 percent for "occupational and social impairment due to mild or transient symptoms which decrease work efficiency and ability to perform occupational tasks only during periods of significant stress, or; symptoms controlled by continuous medication" (VA, 2009, p. 2)
- 0 if the "condition has been formally diagnosed, but symptoms are not severe enough either to interfere with occupational and social functioning or to require continuous medication" (VA, 2009, p. 2).

Recall that even though PTSD falls within the general category of mental disorders, and would normally be rated accordingly, the 2008 policy guidance that required the military departments to adhere strictly to the VASRD effectively resulted in a minimum 50-percent rating for all medically discharged service members whose PTSD was considered unfitting.

Traumatic Brain Injury

For the purposes of defining a TBI disability cohort, we used two codes, 8045 (residuals of TBI) and 9304 (described by VA as both "dementia due to head trauma" [VA, 2009] and "major or mild neurocognitive disorder due to traumatic brain injury" [VA, 2018]). VASRD code 9304 is considered a mental disorder like PTSD and MDD and is rated according to the same schedule, described above (VA, 2009).

VA evaluates VASRD code 8045, residuals of TBI, according to three areas of dysfunction: cognitive, emotional/behavioral, and physical. The evaluation involves an assessment of ten "facets":

1. memory, attention, concentration, and executive functions
2. judgment
3. social interaction
4. orientation
5. motor activity (with intact motor and sensory system)
6. visual spatial orientation
7. subjective symptoms
8. neurobehavioral effects
9. communication
10. consciousness

Each facet receives a score, generally but not always, ranging from 0 (normal/no complaints) to 3 (moderately to severely impaired), and sometimes including a "total" impairment option. If one or more facets receives a "total" impairment score, the service member is assigned a condition-specific rating of 100 percent. If the service member is not totally impaired on any of the 10 facets, he or she receives a condition-specific rating of 70 percent if 3 is the highest score for any facet, 40 percent if the highest score is 2, 10 percent if the highest score is 1, and 0 percent if the highest score on a facet is 0. Therefore, residuals of TBI can take on five possible disability ratings: 0, 10, 40, 70, or 100 (VA, 2014).

Sleep Apnea

Sleep apnea syndromes, including obstructive, central, or mixed sleep apnea, can take on four possible disability ratings: 100 percent if the condition is chronic respiratory failure with carbon dioxide retention or cor pulmonale, or if the individual requires a tracheostomy; 50 percent if the condition requires the use of a breathing assistance device, such as a CPAP machine; 30 percent for persistent day-time hypersomnolence; or 0 percent if the condition is asymptomatic but with documented sleep disorder breathing (VA, 2006).

Back Pain

Back pain, as measured by the VASRD codes we used to define back pain disability cohorts, is rated as 100 percent for unfavorable ankylosis of the entire spine, or 10–50 percent depending upon the degree of ankylosis and/or forward flexion. One particular VASRD code (5243: intervertebral disc syndrome) uses a separate rating formula based on the duration of incapacitating episodes and can take on values of 10, 20, 40, or 60 percent (VA, 2015).

Even though each VASRD code takes on a specific set of possible ratings, as described earlier in the report, we were not able to observe these condition-specific ratings consistently across our data sources. Therefore, in this chapter, as elsewhere, we report total DoD rating.

Cohort Definitions

We defined cohorts for PTSD, TBI, PTSD+TBI, and our three comparison conditions, MDD, sleep apnea, and back pain. To assign a medically discharged service member to a fiscal year cohort, we used the one date that was available across all five sources of disability information: disposition date. The disposition date signals the end of the initial PEB phase, after which the service member may appeal the findings of PEB or the disability rating and eventually goes through a transition phase before being discharged. For ease of discussion, we describe the outcome measured at the time of disposition simply as disability evaluation. Because our definition of a cohort relies on the presence of a VASRD code, we do not include in our retrospective analysis service members who were evaluated for disability and RTD (only service members who are found unfit for duty are assigned VASRD codes and disability ratings). Table 5.1 summarizes the VASRDs used to define our cohorts.

For each disability cohort, we looked back at trends in service member characteristics and experiences over two time periods: (1) three years, including the year of disposition, and (2) for some characteristics, over the entire career, starting in 2002. Because our full analytic file included per-year observations between 2002 and 2017, our disability cohorts ranged from FY 2004 (three-year analysis includes 2002–

Table 5.1
Veterans Affairs Schedule for Rating Disabilities Condition Cohort Definitions

VASRD Condition Cohort	VASRD Code	Description
PTSD	9411	Posttraumatic stress disorder
TBI	8045 or 9304	Residuals of TBI or dementia due to head trauma/major or mild neurocognitive disorder due to traumatic brain injury
PTSD+TBI	9411 and either 8045 or 9304	Concurrent PTSD and TBI
MDD	9434	Major depressive disorder
Sleep apnea	6847	Sleep apnea
Back pain	Pre–FY 2004: 5285–5295 FY 2004+: 5235–5243, minus 5242	Back/spine conditions, excluding arthritis

NOTE: Our TBI cohort definition included dementia due to head trauma/major or mild neurocognitive disorder due to traumatic brain injury (code 9304). Some research indicates that only VASRD 8045 should be used (The National Academies of Sciences, Engineering, and Medicine, 2019). In the early cohorts, the inclusion of 9304 made an impact, but since 2009, less than 1 percent of the individuals in the TBI cohort had only 9304 (and not 8045).

2004) through FY 2017 (three-year analysis includes 2015–2017). As an additional sensitivity analysis, we also analyzed the data using one- and two-year look-back periods. The two-year rates were very similar to the three-year rates, and the trends were very similar regardless of how many previous years we included.

In the next sections, we describe the trends we observed in the size and characteristics of these disability cohorts between FY 2004 and FY 2017. We describe these cohorts' use of medical care prior to DES referral, including treatment for the cohort condition. Finally, we demonstrate how total disability ratings and, accordingly, final dispositions for these cohorts changed over the observation period. The path to receipt of a disability rating involves diagnosis of a condition, treatment for that condition, referral to DES, the disability evaluation

(which takes 200+ days today and at some points during this analysis, took much longer), and finally, a disability outcome. Therefore, being assigned to a cohort in one fiscal year likely implies that the injury or illness occurred at least two to three years prior. Injuries resulting from combat—even in the earliest years—may not result in a medical discharge until around 2005.

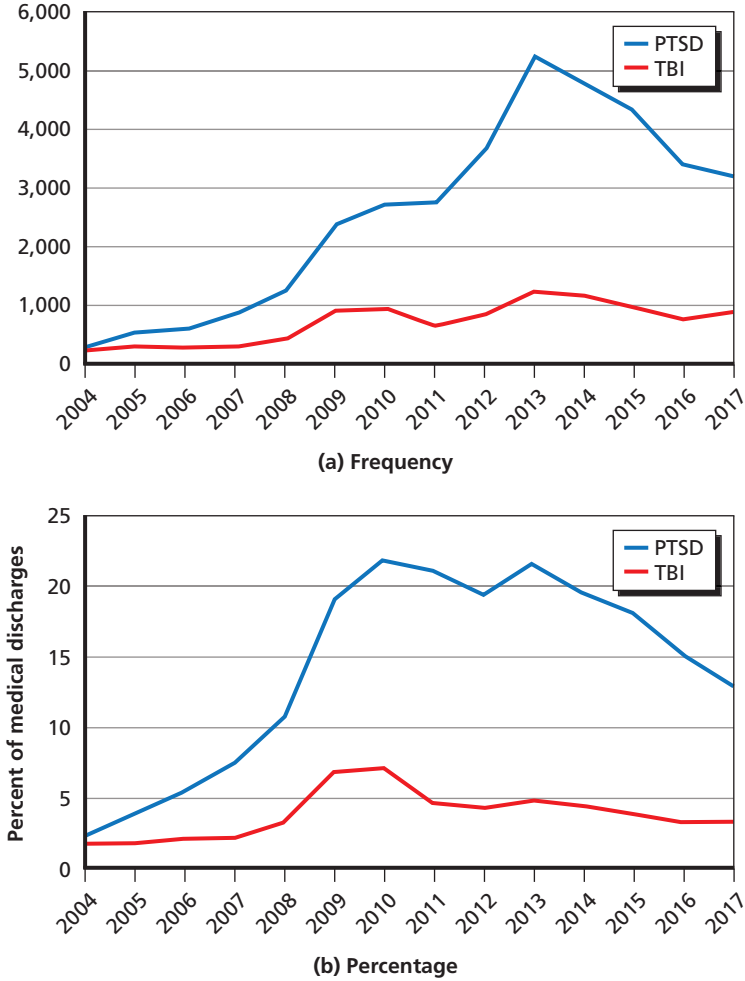
As a reminder, the VASRD codes in VTA covering the latest years of analysis (beginning in 2007 but especially 2012–2017) may include conditions that DoD considers fitting. Therefore, our cohorts may be too large in the later years, in the sense that we may have included service members in our cohorts who received a disability rating for one of these conditions but DoD does not consider it an unfitting condition.[2] All of the service members included in our cohorts were found unfit by DoD and were medically discharged, but they may have been found unfit for other conditions. The issue of including in our cohorts service members whose condition(s) is not unfitting primarily affects the Air Force, Marine Corps, and Navy, because VASRD codes are largely missing for the Army in VTA, and we therefore relied on Army data (which contain only unfitting conditions) to define cohorts.

Trends in the Size and Characteristics of Posttraumatic Stress Disorder, Traumatic Brain Injury, and Comparison Condition Disability Cohorts

Figure 5.1 shows the number of AC service members in the PTSD and TBI disability cohorts (a) and the proportion of all medical discharges that contained PTSD and/or TBI VASRD codes (b). In 2004, approximately 200 medically discharged service members had a PTSD and/or TBI VASRD, representing approximately 2 percent of medical discharges that year. The number of service members in the PTSD

[2] Recall that VA rates all conditions identified during the compensation and pension (C&P) exam, including both referred and claimed conditions. DoD includes only unfitting conditions in its fitness and compensation determinations. Our intent would have been to include in our cohorts only service members whose condition is unfitting, but VTA data do not make that distinction.

Figure 5.1
Number of Service Members in Each Disability Cohort, Fiscal Years 2004–2017



NOTE: Individuals are assigned to a cohort according to the fiscal year of disposition.

cohort grew rapidly, reaching approximately 5,000 in 2013. At the same time, the number of medical discharges more than doubled (see Table A.3). More than 20 percent of medical discharges in 2013 had a PTSD VASRD. Both the size and proportion of the PTSD cohort

began to decline in 2014 and continued declining until the end of our study period.

The size of the TBI disability cohort also grew over this period, although not as significantly as the PTSD cohort. The number of medical discharges with a TBI VASRD peaked in 2013 at over 1,000, representing approximately 5 percent of all disability evaluations that year. There was also an uptick in the size and proportion of the TBI cohorts in 2009 and 2010.[3]

Figures E.5 (Air Force), F.5 (Army), G.5 (Marine Corps), and H.5 (Navy) show the number of service members in the PTSD and TBI disability cohorts by service. Sample sizes become small once service records are used to display other characteristics of the cohorts, so these are the only service-specific figures we display for the retrospective analysis.

Figure 5.2 repeats the information in Figure 5.1 and adds in the comparison cohorts. The MDD, sleep apnea, and PTSD+TBI cohorts generally look similar to TBI in terms of size and proportion of all discharges. The number of service members rated for back pain started out much higher than all other cohorts—3,000 service members per year and 25 percent of all medical discharges. Beginning in 2011, the number of DES discharges with a back pain–related VASRD started to increase dramatically, peaking at 7,000 service members in 2015 and representing 30 percent of all discharges, before beginning to decline. It is not surprising that a large share of service members medically discharged through DES have back problems given the physically demanding nature of military service. While some of this increase could be an artifact of the inclusion of both fitting and unfitting VASRD codes in the later years, the majority of medical discharges were soldiers (discussed below), and the Army is the service least affected by this data issue.

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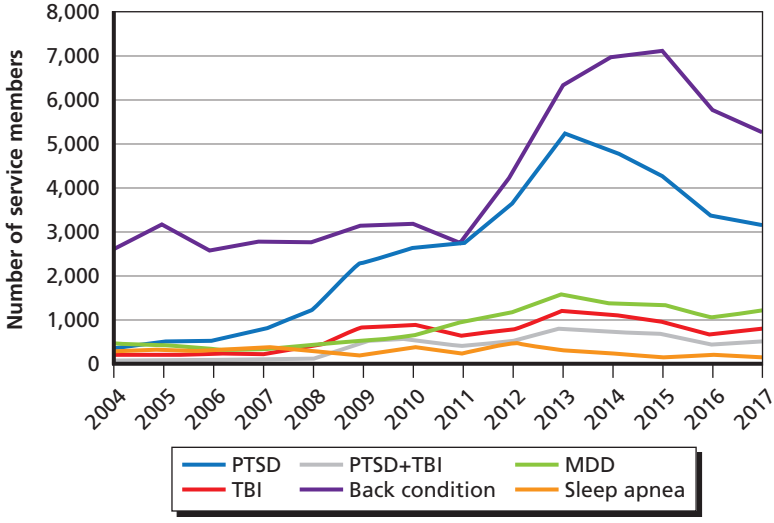
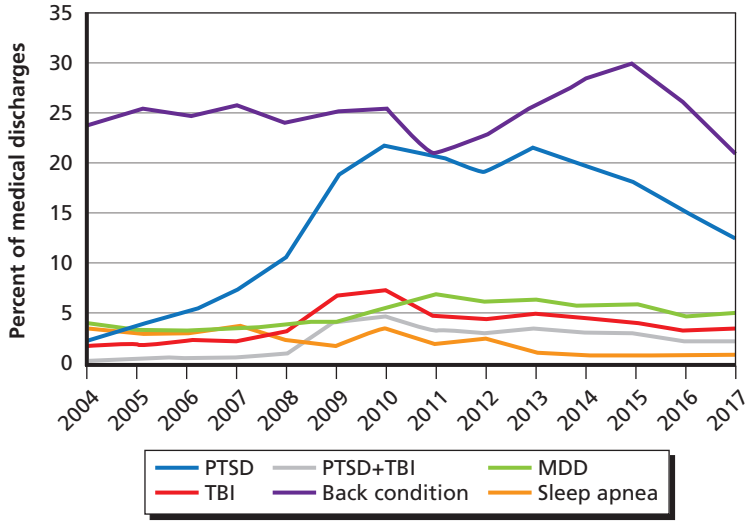
[3] As mentioned in the note below Table 4.1, the inclusion of VASRD code 9304 in our TBI definition had a negligible impact in the later cohorts, but it made more of a difference in the earlier cohorts. For example, our 2004 TBI cohort contained 177 service members, but we would have had only 159 if we excluded 9304, a difference of 10 percent. In 2008, we included 361 service members, but only 345 had VASRD 8045. Beginning in 2009, the inclusion of 9304 resulted in a less than 1 percent difference in the size of the cohort (at most ten additional service members).

Figure 5.2
Disability Cohort Sizes as Percentage of Total Medical Discharges on Initial Evaluation per Fiscal Year, 2004–2017



(a) Frequency



(b) Percentage

NOTE: The total share of the six VASRD condition cohorts do not total 100 percent, as not all VASRD conditions are represented in this analysis, and the PTSD, TBI, and PTSD+TBI disability cohorts are not mutually exclusive.

With the exception of Figures 5.9, 5.10, 5.16, and 5.17, the numbers in Figure 5.2a represent the denominator for all figures in this chapter. Figures 5.9 and 5.10 use the PTSD and TBI disability cohorts as a denominator, as well as all medically discharged AC service members as a point of comparison. Figures 5.16 and 5.17 includes all medically discharged AC service members.

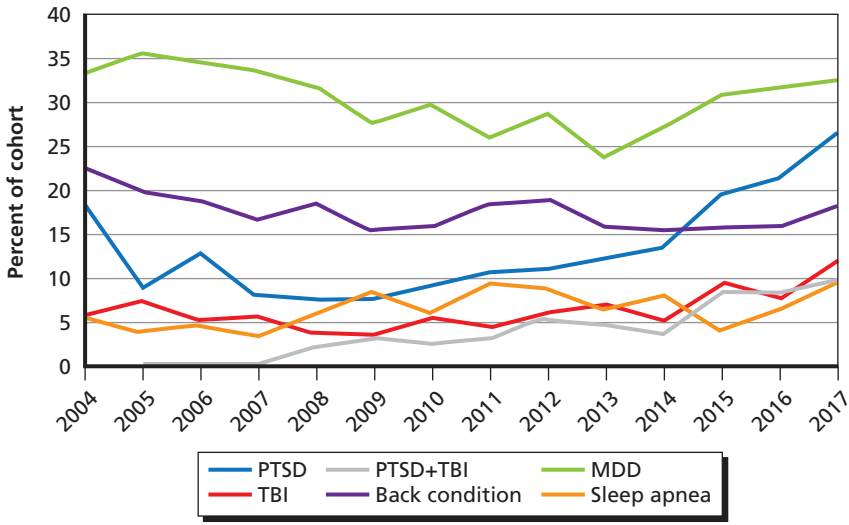
Demographic and Service Characteristics of Disability Cohorts

Demographic Characteristics

In this section, we describe the demographic characteristics of the service members in our disability cohorts. We observed little variation over time in race and ethnicity across the disability cohorts, which generally reflected the force as a whole. Just over 60 percent of the force is white, non-Hispanic according to our analytic file; the remaining 40 percent of the force is black, non-Hispanic (17 percent), Hispanic (11 percent), and small proportions of other race/ethnicity groups. Similar proportions were observed in the PTSD, TBI, MDD, and back pain disability cohorts, although the share of black, non-Hispanic service members in the PTSD disability cohort nearly doubled over the study period—from 11.9 percent in 2004 to 21.5 percent in 2016. The sleep apnea disability cohort included a larger share of black, non-Hispanic service members (23 percent) than the total active force.

Figure 5.3 shows how the proportion of female service members in each diagnosis cohort has changed over time. As a reference point, over the time period studied, the AC was approximately 17–19 percent female. There is substantial variation across disability cohorts and over time in gender distribution. Some cohorts—sleep apnea and PTSD+TBI—were relatively stable over time. Others, such as cohorts comprised of medically discharged service members with an MDD or back pain VASRD code, were more predominantly comprised of female service members. The TBI cohort had a smaller share of female service members than the overall force, while the PTSD cohort had a similar proportion of female service members as the overall force.

Figure 5.3
Percentage of Disability Cohort Who Are Female, 2004–2017



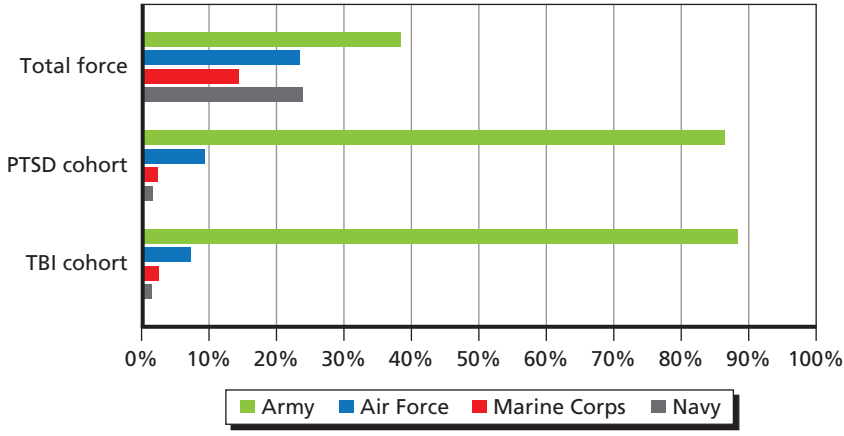
We also examined trends in age at the time of disability evaluation for each of the six cohorts, which can be found in Figure D.6.

Service Characteristics

Branch of Service

The service distribution of those being evaluated in DES did not change considerably over time (see Tables C.10–C.12), so Figure 5.4 shows the service distribution of the total active force and of the PTSD and TBI cohorts over the study period. In the AC total active force represented by our analytic file, 39 percent of service members from 2002–2017 were in the Army, 23 percent in the Air Force, 14 percent in the Marine Corps, and 24 percent in the Navy. However, among members of the PTSD and TBI disability cohorts, service was heavily skewed toward Army, representing nearly 90 percent of all AC DES cases. The remaining 10 percent of DES cases were 7–9 percent Air Force, 2–3 percent Marine Corps, and 1–2 percent Navy.

Figure 5.4
Service Distribution of the Total Active Force and Posttraumatic Stress Disorder and Traumatic Brain Injury Disability Cohorts, 2004–2017

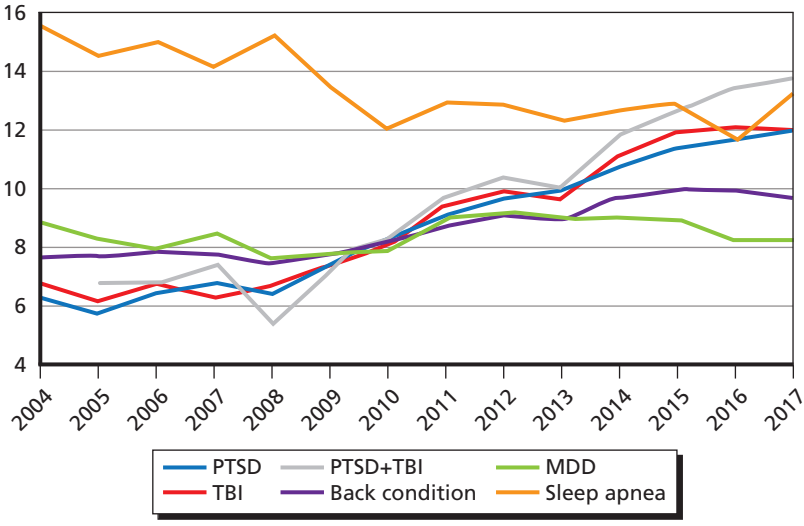


Years of Service

YOS at the time of disability evaluation have changed considerably over the time period 2004–2017, as shown in Figure 5.5. The 2004 PTSD and TBI disability cohorts had approximately six YOS at the time of disability evaluation. By 2017, average YOS among these cohorts had doubled to 12 years.[4] The back pain and MDD disability cohorts had slightly more YOS (8–9 years) in the beginning of our study period, which generally remained stable through 2017. The sleep apnea disability cohort looks very different: in 2004, among service members evaluated through DES, YOS averaged nearly 16 years, double the other cohorts. By the end of our study period, average YOS among the sleep apnea cohort was similar to PTSD and TBI, around 13 years.

[4] We explore this pattern in more detail below. It is also worth mentioning that stop loss, a force management program that allows DoD to retain service members beyond their contractually agreed-upon separation date, was used during some of this time period when the U.S. military needed service members for deployments (Henning, 2009). That policy may have contributed to an expansion of YOS at the time of all military discharges, including medical discharge.

Figure 5.5
Mean Years of Service by Disability Cohort, 2004–2017



Pay Grade

The distribution of pay grade among PTSD and TBI cohorts is similar to the pattern of increasing YOS over the study period, especially among enlisted personnel, who represented nearly 90 percent of all DES cases. In 2005, approximately 55 percent of both cohorts were ranked E1–E4, but that dropped to 20–25 percent by 2016. At the same time, the percentage of service members in the disability cohorts in pay grades E5–E9 rose from approximately 30 percent to nearly 70 percent. Like YOS, the sleep apnea disability cohort was much more senior at the beginning of our study period (70 percent were E5–E9 in 2004), but it looked more similar in terms of pay grade to the PTSD and TBI disability cohorts by 2014. The remainder of the disability cohorts were approximately 2 percent for O1–O3, 1 percent for O4–O6, and less than 1 percent for warrant officers.

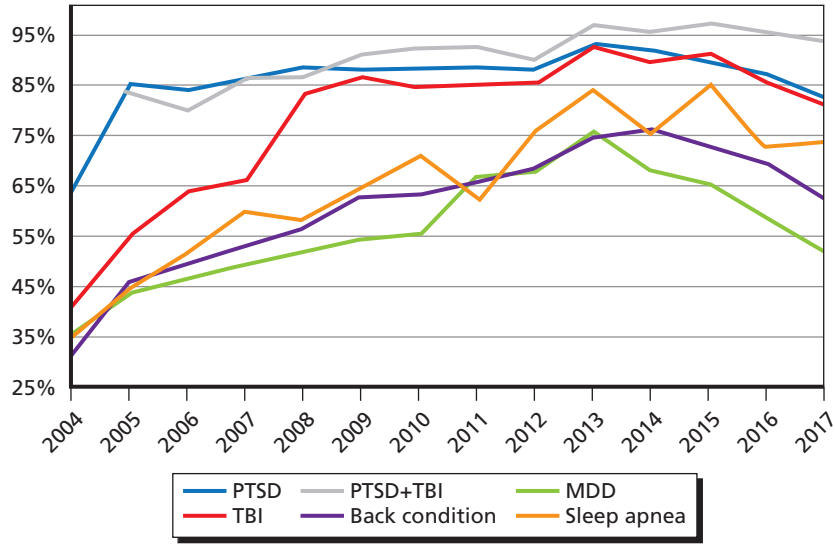
Deployment Experience

Our analytic file included a flag for whether the service member deployed in each year of observed service. For the purposes of captur-

ing deployment experience for the disability cohorts, we looked over all previous periods and created an indicator for whether the service member ever deployed prior to disability evaluation. Figure 5.6 shows the percentage of each cohort who had ever deployed as of the year of disability evaluation.

Most members of the PTSD and TBI disability cohorts had a history of deployment. By 2008, 85 percent or more of the service members discharged with a PTSD or TBI VASRD had previously deployed. Already by 2005, the PTSD cohorts had reached that level. Among cohort members with a deployment history, the cumulative months deployed more than doubled from 8.6 months among PTSD disability cohort members in 2004 to a peak of 24.7 months in 2017, while among TBI disability cohort members with a deployment history, the cumulative months deployed more than tripled between 2004 and 2017 (from 7.8 to 24.8 percent). As Figure 5.6 illustrates, the MDD, sleep apnea, and back pain disability cohort members all experienced similar trends in deployment history from 2004 to 2017, including a

Figure 5.6
Percentage of Cohort Ever Deployed by Disability Cohort, 2004–2017



steep increase from 2004 through approximately 2013, followed by a leveling off or decline in the latest years of our data. However, over the entire time period, the percentage of service members in the PTSD and TBI cohorts with deployment experience was consistently higher than all of the comparison conditions.

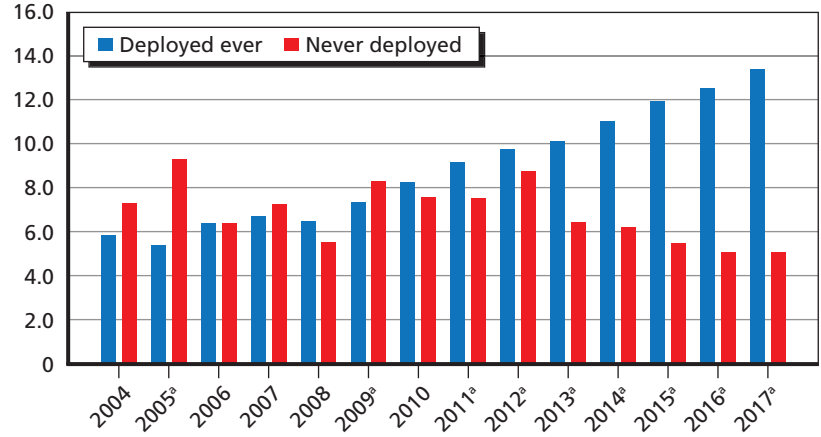
The trend in deployment experience among service members in the PTSD and TBI disability cohorts warrants closer examination of the relationship between deployment and PTSD- and TBI-related DES evaluation. In this section, we describe trends in the differences in service characteristics among PTSD and TBI disability cohort members by deployment history, comparing cohort members who had a deployment with cohort members who had never deployed as of the time of medical discharge. We begin with YOS because of the strong upward trend across all cohorts (except sleep apnea) over this time period.

Over time, deployment history became increasingly associated with longer service tenure at the time of DES evaluation. Figure 5.7 shows that, among members of the early PTSD cohorts, YOS at the time of medical discharge was similar (with the exception of the 2005 cohort) for those who did and did not have deployment experience. However, beginning in 2011, PTSD disability cohort members with deployment experience ended up with significantly more YOS at the time of medical discharge. By 2017, members of the PTSD cohort who had deployment experience had more than twice the YOS as those who did not deploy.

Figure 5.8 shows that members of the TBI disability cohorts experienced a very similar trend over time, though the trend started earlier in the TBI disability cohorts. Beginning in 2009, TBI disability cohort members with a deployment consistently served significantly more years prior to DES evaluation, on average, than the TBI disability cohort members who never deployed prior to DES evaluation. By the end of the study period, the average TBI disability cohort member with deployment history served three times longer prior to DES evaluation than the average TBI disability cohort member with no deployment history.

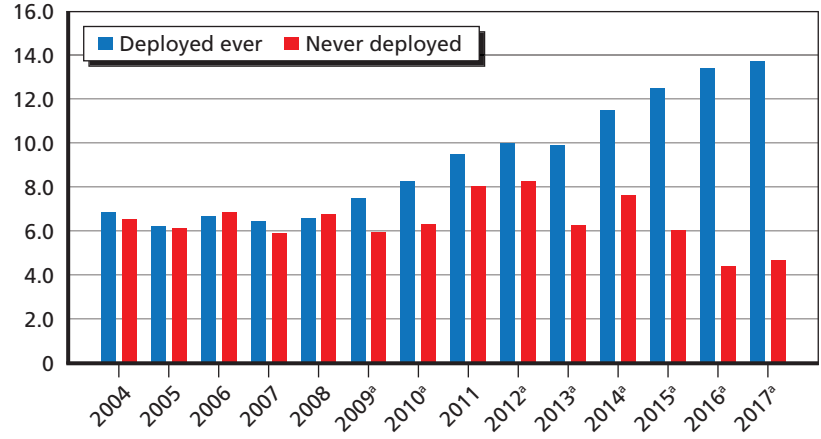
Not surprisingly, both PTSD and TBI disability cohort members with deployment history were also significantly more likely to have achieved higher rank in the later study cohorts. In the later years of the

Figure 5.7
Average Years of Service, Posttraumatic Stress Disorder Disability Cohort, by Deployment Status, 2004–2017



NOTE: [a] denotes a statistically significant difference, $P < 0.05$.

Figure 5.8
Average Years of Service, Traumatic Brain Injury Disability Cohort, by Deployment Status, 2004–2017



NOTE: [a] denotes a statistically significant difference, $P < 0.05$.

study, both PTSD and TBI disability cohort members with a history of deployment were two to three times more likely to be ranked E5–E9 than E1–E4 at DES evaluation, compared with the cohort members without a history of deployment.

One possible explanation for these findings is the "healthy warrior effect" (Haley, 1998; Larson et al., 2008), which is the notion that service members who are unfit or unhealthy are forced to end their military careers earlier, resulting in a systematically healthier deploying force. The loss of unfit personnel earlier in their careers means healthier service members are able to serve longer and achieve higher pay grades.

Multivariate Analysis of the Probability of Being Assigned to a Disability Cohort

Similarly, Figure 5.5 shows that for most conditions, YOS at the time of disability evaluation increased over time. Figures 5.7 and 5.8 also show that for PTSD and TBI disability cohorts, service members who deployed prior to disability evaluation had many more YOS at the time of discharge than those who had never deployed. These patterns raise the question: If the population of service members deployed in a given year has become more senior over time, and if exposure to combat is related to the probability of having some of these conditions, are deployments the main driver of the trends we have observed among disability cohorts in this chapter?[5]

To examine this question, we ran a multivariate analysis of the probability of being assigned a PTSD or TBI VASRD at the conclusion of the disability evaluation. More precisely, in using all medically discharged service members in a given year as the population, the binary outcome variable we are attempting to measure is set to 1 if the service member has a disability rating for PTSD (TBI) at the conclusion of DES and 0 if not. In other words, what characteristics and military

[5] The pattern for other variables shown above, including race/ethnicity and pay grade, were broadly similar to the trends in these variables among deployed personnel.

experiences explain whether a medically discharged service member is assigned to the PTSD (TBI) cohort or not?

We used a linear probability regression model to predict the probability of having a PTSD (TBI) VASRD.[6] We controlled for the following set of variables in each regression:

- cumulative number of months deployed at the time of disability evaluation
- indicators for whether the service member deployed during four time periods: FY 2002–2003, FY 2004–2007, FY 2008–2011, and FY 2012–2017
- sex
- race/ethnicity (white, non-Hispanic; black, non-Hispanic; Hispanic; other)
- YOS
- personnel status × YOS interactions (enlisted × YOS; officer × YOS; warrant officer × YOS)
- occupation
- service × fiscal year of disability evaluation disposition indicators.

The deployment era variables (2002–2003, 2004–2007, 2008–2011, and 2012–2017) were created to represent the relative danger of different periods of the conflicts. Figure A.1 plots the number of service members killed in action (in our analytic file, as described in Appendix B) divided by the number of service members deployed in that year. The peak years were 2004–2007; the spike in 2017 is a consequence of a huge decline in the number of service members deployed (small denominator). Conveniently, these eras also correspond to changes in disability evaluation, as described in the companion report (Simmons et al., 2021). Fiscal years 2002–2003 and 2004–2007 were years when LDES was in place, 2008–2011 were the years when IDES

[6] Linear and logistic models often yield similar and consistent results when modeling dichotomous outcome variables (Hellevik, 2009), though the linear probability model approach uses a noniterative estimation method that is computationally efficient and eases the interpretation of the estimated coefficients.

was being rolled out across DoD, and by 2012, IDES was fully implemented across DoD.

Table D.19 reports the full set of results for the PTSD and TBI regressions.

Figure 5.9 illustrates the regression results for a subset of the statistically important characteristics. A bar in Figure 5.9 represents the difference in the probability that a medically discharged service member had a PTSD VASRD conditional on having a specific characteristic, relative to medically discharged service members who did not have that characteristic, holding all other variables in the model constant. For example, the "Female" bar shows that, on average, the probability that a female medically discharged service member had a PTSD VASRD is 1.49 percentage points higher than a male medically discharged service member, controlling for the other variables in the regression model. We evaluated the cumulative months deployed variable at 12 and 24 months. Until 2007, most medically discharged service members had approximately one year or less of deployment experience, but deployment experience grew after that, with later cohorts having approximately two years of cumulative months deployed. Evaluated at these two levels, cumulative months deployed was the largest predictor of having a PTSD VASRD at the time of medical discharge.

Sex, race/ethnicity, YOS, and YOS interacted with personnel type (e.g., officer, enlisted) were statistically significantly associated with the probability of having a PTSD VASRD, but the magnitudes were the smallest among all the predictors. Relative to service members in infantry, service members in other all occupations except medical were less likely to be assigned a PTSD VASRD during DES. The service × fiscal year interactions were also important. Relative to the excluded category (Navy × 2002), there was a negative correlation (approximately five percentage points) between the service × fiscal year interactions and the probability of having a PTSD VASRD, at least through 2009 for all services. Over those years (2003–2009), there was not much variation from year to year across services or within a service. After 2009, being in the Army was correlated with a higher probability of having a PTSD VASRD, relative to being in the Navy in 2002.

Figure 5.9
Select Regression Coefficients from a Linear Probability Model Measuring the Probability of Having a Posttraumatic Stress Disorder Disability Rating, Conditional on Being Medically Discharged

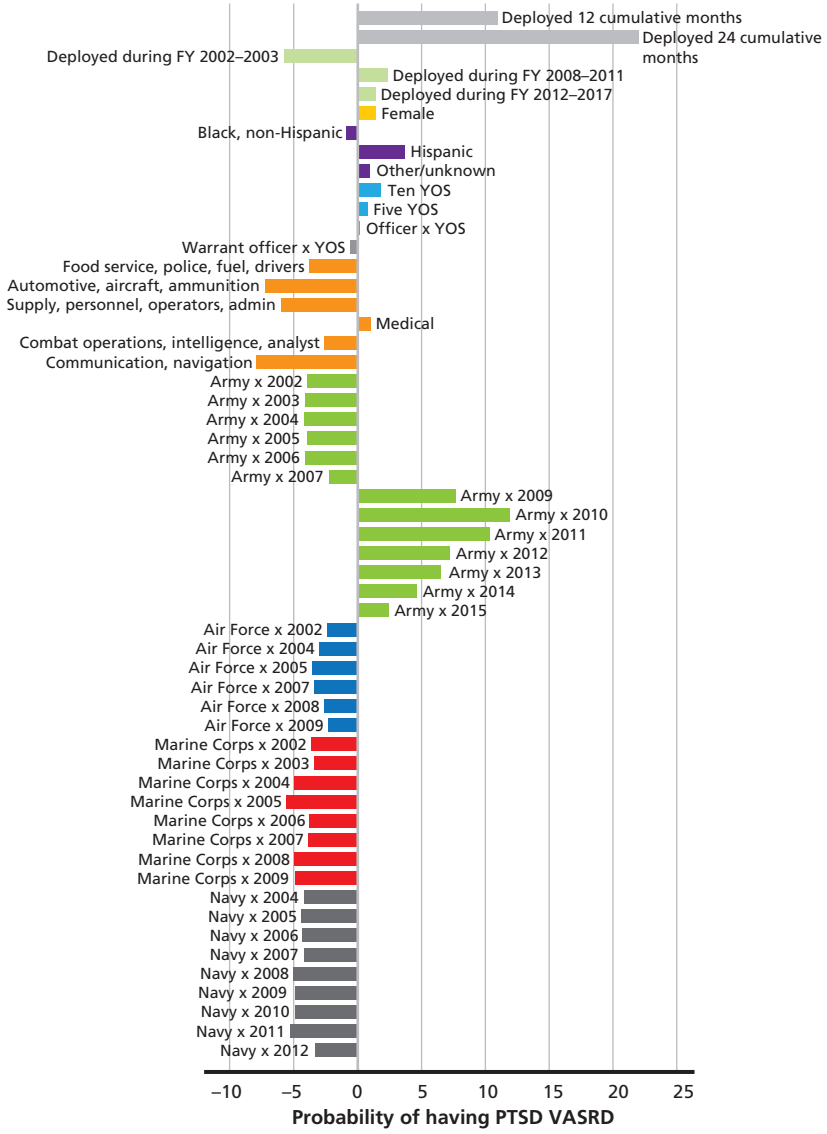
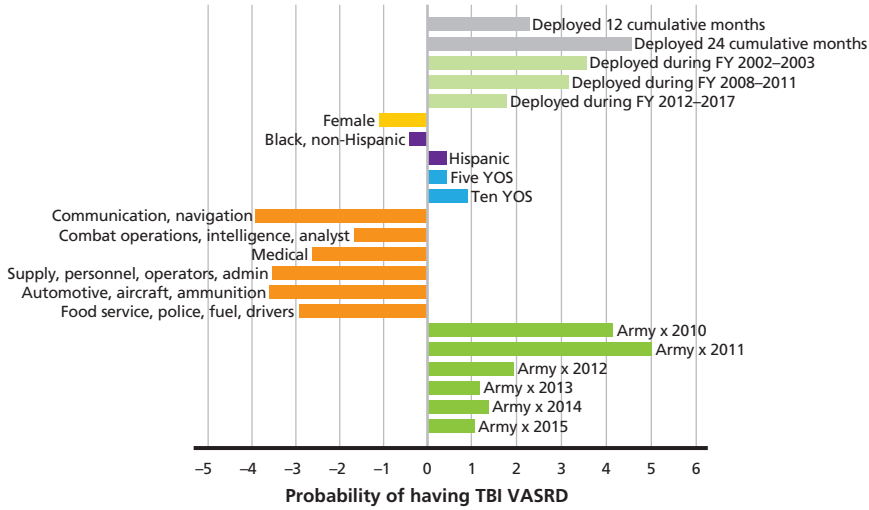


Figure 5.10 shows most of the variables that are statistically significantly correlated with the probability of having a TBI VASRD at the conclusion of DES. Many of the patterns are similar to the PTSD regression results, but the effects are much smaller. Having 12 months of deployment experience prior to disability evaluation was associated with an increased likelihood of having a TBI VASRD at the conclusion of DES, but the percentage point increase was 2 percent compared with 10 percent for PTSD. The effect sizes for 24 months of cumulative deployment experience were 4.5 percentage points for TBI and 22 percentage points for PTSD. This is consistent with PTSD being highly correlated with combat exposure, whereas a majority of TBIs occur outside the deployed setting (e.g., car accidents). Demographic characteristics again had small effects, and service members in all occupations had a lower probability of having a TBI VASRD compared with those in infantry. The service × fiscal year interactions were generally not statistically significant, except for the Army in later

Figure 5.10
Select Regression Coefficients from a Linear Probability Model Measuring the Probability of Having a Traumatic Brain Injury Disability Rating, Conditional on Being Medically Discharged



years, where there was an increased probability of being assigned a TBI VASRD during DES.

Surprisingly, having deployed between FY 2004 and 2007, which were some of the most dangerous war years as measured by the percentage of deployed personnel who were killed in action, was not correlated with an increased probability of having a PTSD or TBI VASRD at the conclusion of DES (point estimates were small in both regressions).

We now turn to an analysis of treatment prior to medical discharge.

Trends in Receipt of Medical Care Prior to Medical Discharge Across Disability Cohorts

In this section, we look retrospectively to see whether members of the disability cohorts had received treatment for the condition for which they received a disability rating, as well as treatment for other conditions. Our data sources contained information on all medical care provided by military treatment facilities and the TRICARE network while the service member was stationed in garrison, as well as care provided during a deployment.[7] We begin with matching conditions—for example, the percentage of service members in the PTSD disability cohort who received treatment for PTSD within three years of a medical retirement or separation disposition.

Treatment Received in the Military Health System

We observed whether service members in each disability cohort had any health care encounter with an ICD-9 or ICD-10 diagnosis for their cohort condition in the three years prior to disability evaluation. The percentage of service members in both the PTSD and the TBI disability cohorts who received treatment for their cohort condition

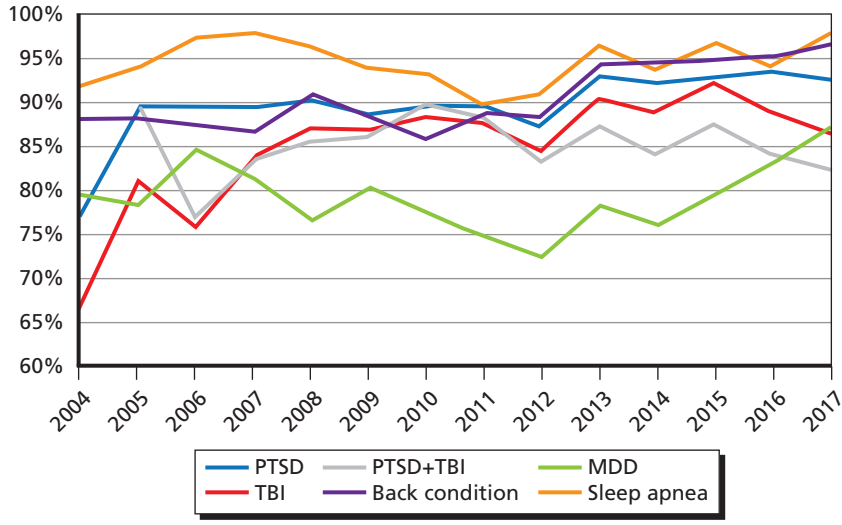
[7] The data would have allowed for other types of analyses, including differentiating between direct and purchased care or by type of treatment (e.g., residential treatment programs versus inpatient psychiatric hospitalization), but because treatment is generally not a focus of this study, we performed a higher-level analysis. Understanding more about where and what type of treatment medically discharged service members received is a potential area for future study.

increased over time (Figure 5.11). At the beginning of the study period, in 2004, 77 percent of PTSD disability cohort members had a health care encounter during which a PTSD diagnosis was recorded in the three years prior to medical discharge; this rate jumped to 89 percent in 2005 and plateaued through 2017, with only one more small increase in 2013. The percentage of TBI disability cohort members who received treatment for a TBI diagnosis within three years of medical discharge generally increased over time, from 67 percent of cohort members in 2004 to 92 percent of cohort members in 2015.

In general, the percentage of the comparison disability cohorts who had received treatment for the cohort condition within the three years prior to disability evaluation remained flat from 2004 to 2017. The MDD cohort had a lower rate than the others; at some points over this time period, only three-quarters of service members with an MDD VASRD had received previous treatment for MDD.

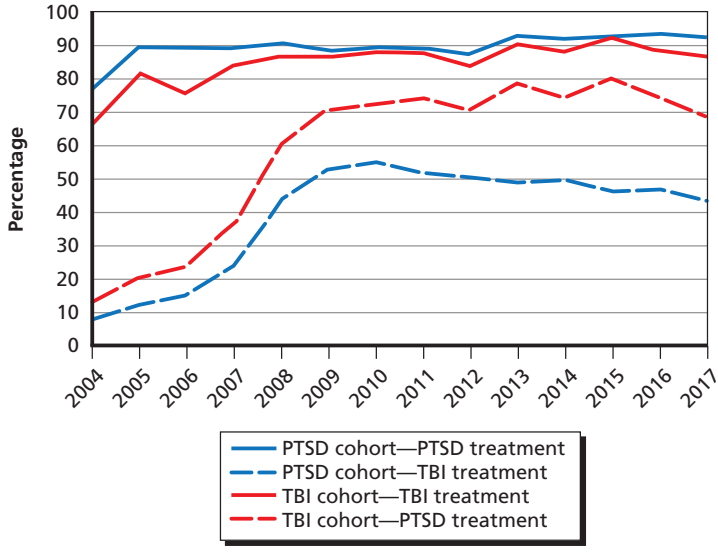
As other studies have demonstrated, TBI frequently co-occurs with behavioral health conditions (Carlson et al., 2011; Farmer et al.,

Figure 5.11
Percentage of Disability Cohort Who Received Treatment for the Cohort Condition Within Three Years of Disability Evaluation, 2004–2017



2016), while PTSD and TBI comorbidity has become increasingly more prevalent in the military population (e.g., Bryan et al., 2013; Stein et al., 2015; Tanielian and Jaycox, 2008). The dashed lines in Figure 5.12 show the percentage of the PTSD and TBI cohorts who had received treatment for the other condition (e.g., percentage of PTSD cohort who had received treatment for TBI in the three years prior to disability evaluation). The earliest cohorts had low rates of cross-treatment; 8 percent of the 2004 PTSD cohort had received treatment for TBI, and 13 percent of the TBI cohort had received treatment for PTSD. Around 2006, the rates began to climb steadily, and by 2009, more than half of both cohorts had received treatment for the other condition. Over the full time period, the TBI cohort was more likely to have received treatment for PTSD than the reverse. For context, the matching treatment rates are also shown (these solid lines repeat from Figure 5.11 above).

Figure 5.12
Receipt of Posttraumatic Stress Disorder and Traumatic Brain Injury Treatment Within Three Years of Disability Evaluation, Posttraumatic Stress Disorder and Traumatic Brain Injury Disability Cohorts, 2004–2017



Treatment Received During Deployment

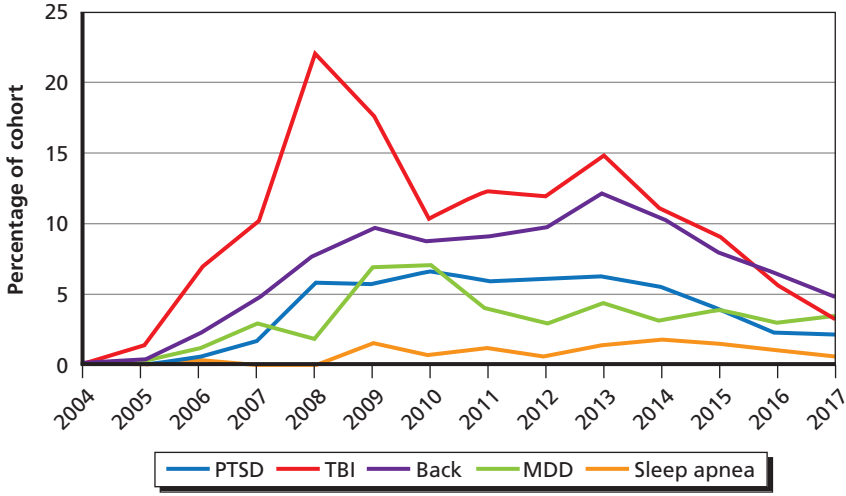
MDR, which was the source of our information above on diagnoses that occurred in garrison, also contains information on medical encounters that occur in theater. These data provide some insight into whether service members received treatment in theater for the conditions of interest in this study, but they are not complete. We do not have a full understanding of what proportion of medical care that occurs in theater is recorded in the data we received, but conversations with stakeholders indicate that information is likely not recorded until the service member reaches a relatively sophisticated level of theater care.

The path of care that a wounded or ill service member takes in theater can generally be described as one of increasing capability from the point of injury to or including evacuation out of theater. According to stakeholders, medical encounters captured in the theater data we received likely only includes care delivered in role 3 or higher facilities (treatment facilities capable of handling emergency and specialty surgery, intensive care, medical specialty care, and extended holding capacity with ancillary support).[8] In terms of the overall force, the theater data used in our analysis included diagnoses for 7.8 percent of all service members and 2.2 percent of all members of our disability cohorts.

Figure 5.13 shows the percentage of each disability cohort who received treatment in theater for the primary corresponding medical condition (e.g., percentage of the PTSD disability cohort who received treatment for PTSD in theater) within three years of disability evaluation. From 2004 to 2008, the percentage of service members in the TBI cohort who received treatment for TBI in theater spiked to 22

[8] The lowest level of care, role 1, occurs at or near the point of injury and includes medical treatment, initial trauma care, and forward resuscitation. Patients who need additional care are transported to role 2 for advanced trauma management, emergency surgery, and resuscitative care. Role 3 capabilities include emergency and specialty surgery, intensive care, medical specialty care, and extended holding capacity and with ancillary support. Care beyond role 3, for service members who are evacuated out of theater, includes the full range of care found in U.S. hospitals and robust overseas facilities (U.S. Department of Defense, Joint Chiefs of Staff, 2017). Specific behavioral health capabilities may include a behavioral health technical or medic at role 1, a psychologist or social worker at role 2, and a psychiatrist or neurologist and possibly inpatient medical hold at role 3.

Figure 5.13
Receipt of Cohort-Concordant Medical Diagnosis in Theater Within Three Years of Disability Evaluation, by Disability Cohort, 2004–2017



percent. Beginning in 2008, approximately 5 percent of the PTSD disability cohorts received treatment for PTSD in theater. This is not surprising given that symptoms associated with exposure to a traumatic event generally present *after* the time of the event, which means the PTSD diagnosis likely usually occurs after the service member returns home. Although the levels differed by condition, all cohorts saw a rise in the share of those who received treatment in theater until 2008 or 2009; then the percentage of each cohort with treatment in theater began to decline as of the 2013 cohort through the end of the data period. Some of these trends may be explained by changing medical capabilities in theater over this time period.

Recall that the three-year window of observation for the 2008 diagnosis cohort was 2006–2008. That rates of treatment in theater climbed from 2006 to 2008 before plateauing is consistent with other research showing an increase over this time period in both the number of service members deployed (in support of surges) and the number of service members wounded (Bonds et al., 2010; Goldberg, 2010; O'Bryant and Waterhouse, 2008).

Types of Medical Care Received Prior to Disability Evaluation System Discharge

In this section, we describe the settings in which service members in the PTSD, TBI, and comparison disability cohorts received care over time, including outpatient and inpatient services. While rates of inpatient care were generally stable across the study period, over time, study cohort members were more likely to receive outpatient treatment.

For the purposes of this analysis, we defined outpatient treatment in two ways: (a) at least one outpatient encounter, regardless of diagnosis and (b) at least one outpatient encounter with a cohort-specific diagnosis (e.g., PTSD diagnosis during an outpatient encounter for the PTSD disability cohort). Similarly, we defined inpatient treatment as: (a) any inpatient admission regardless of diagnosis, and (b) any inpatient admission with a cohort-specific diagnosis.

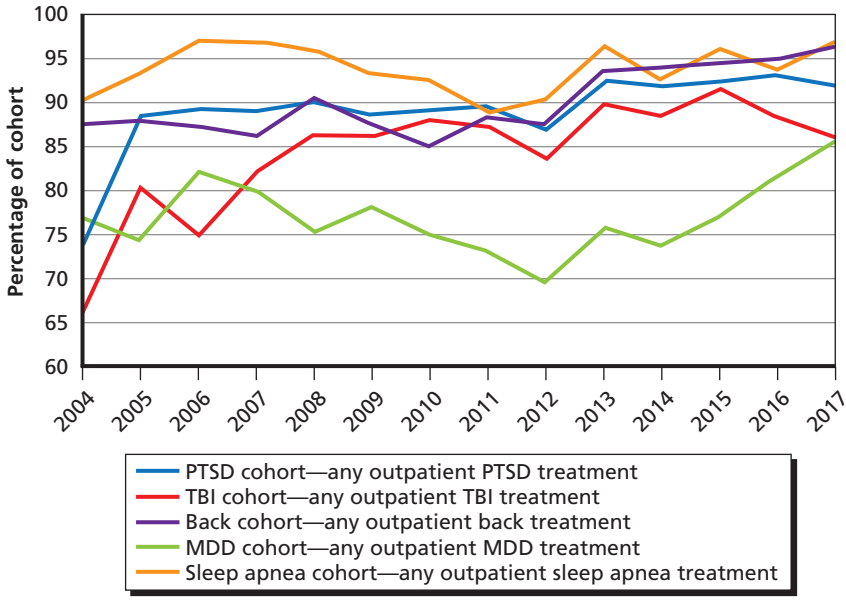
Outpatient Treatment

Nearly all service members across cohorts and across years received some outpatient treatment for any condition in the three years prior to disability evaluation. Over the study period, the proportion of service members in the PTSD and TBI disability cohorts who received PTSD-specific outpatient treatment in the three years prior to disability evaluation was similar to those who received any outpatient treatment—nearly all service members in the PTSD disability cohort had at least one outpatient encounter with a PTSD diagnosis (Figure 5.14). For the TBI disability cohorts, most had at least one outpatient visit with a TBI diagnosis, although the proportion in each year is smaller than for the PTSD cohorts. Among comparison conditions, the sleep apnea and back pain cohorts look quite similar to the PTSD and TBI cohorts. However, a smaller proportion of the MDD cohort (only about three-fourths) had an outpatient visit with a MDD diagnosis in the three years prior to disability evaluation.

Inpatient Treatment

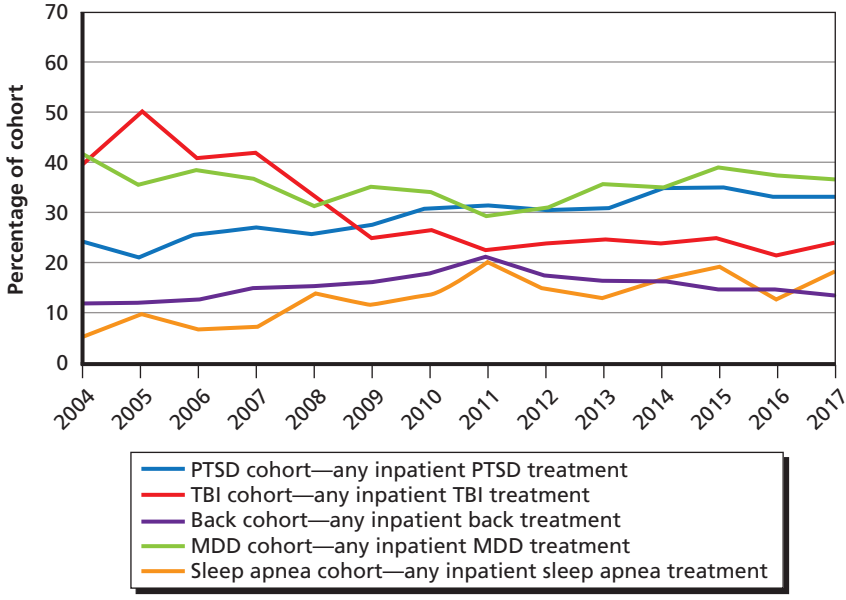
Over the observation period, the proportion of service members in the PTSD cohort with an inpatient admission for PTSD in the three years prior to disability evaluation increased from about 25 percent to 35

Figure 5.14
Receipt of Cohort-Concordant Outpatient Treatment Within Three Years of Disability Evaluation, by Disability Cohort, 2004–2017



percent (Figure 5.15). In the early years, the share of the TBI cohorts receiving any inpatient treatment was almost double the rate for PTSD cohorts; about 40 percent had an inpatient admission for TBI in the three years prior to disability evaluation. Starting in 2009, fewer service members in the TBI disability cohort (about 25 percent) had an inpatient admission for TBI in the three years prior to disability evaluation. While the rates of any inpatient treatment increased over time for the sleep apnea and back pain cohorts (not shown), only about 10–20 percent had an inpatient admission for the cohort condition in the three years prior to disability evaluation. The share of the MDD disability cohort with an inpatient admission for MDD was similar to PTSD; across all years, about 35–40 percent had an inpatient admission for MDD in the three years prior to disability evaluation.

Figure 5.15
Receipt of Cohort-Concordant Inpatient Treatment Within Three Years of Disability Evaluation, by Disability Cohort, 2004–2017



Trends in Post-Deployment Medical Screening Results Among Disability Cohorts

Service members who are preparing for a deployment, or who have recently returned from one, are required to complete deployment health assessment forms designed to "monitor, assess, and prevent disease and injury, to control or reduce occupational and environmental health risks, to document and link exposures with deployed personnel, and to record the daily locations of deployed personnel" (PHCoE, undated[b]). The specific timeframes for completion of these reports have changed over time, with revisions to the screening tools in 2005, 2006, 2008 and 2011. However, in general, PDHA (or Department of Defense [DD] form 2796) must be completed within 30 days after a service member returns from deployment, while PDHRA (or DD form 2900) must typically be completed 90–180 days after a service member's return from

deployment. The deployment health assessments are required for service members who deploy in support of any contingency operation to a location outside the continental United States without a fixed MTF for a period of 30 days or more (U.S. Army Reserve, undated), and they are used to review "each deployer's current physical health, mental health or psychosocial issues commonly associated with deployments, special medications taken during the deployment, possible deployment-related occupational/environmental exposures, and deployment-related health concerns" (PHCoE, undated[c]). Some questions on these forms are used to screen for PTSD or TBI, among other conditions, and screening positive may result in a referral for specialty care. Our companion report (Simmons et. al., 2021) describes these screening assessments and changes over time in more detail.

Because results of PDHA and PDHRA are part of a service member's medical record, they may be considered during disability evaluation. In this section, we describe PDHA and PDHRA responses for our disability cohorts, focusing on experiences that could be associated with a medical discharge for PTSD or TBI. Our analytic file contained PDHA and PDHRA responses from 2001–2017, covering several versions of each form as changes were made over time. In Appendix B, we discuss some of the data challenges associated with changes to the forms and completion rates.[9] Given the low completion rates observed in the data, we limited our analysis to service members with PDHA/PDHRA observations. In other words, rather than comparing members of the disability cohorts with PDHA/PDHRA data with those without PDHA/PDHRA data, we compared members of the cohorts who had PDHA/PDHRA data with all service members in DES with PDHA/PDHRA data.[10] Moreover, because the PDHA/PDHRA forms changed over time, we focused on a limited set of outcomes: (1) ser-

[9] As a sensitivity check, we tested whether there was a significant difference between study cohort members with deployment history and a recorded PDHA/PDHRA and study cohort members with deployment history but without a recorded PDHA/PDHRA. While there were no significant differences in gender, age, or YOS among the two TBI VASRD subgroups, statistically significant differences emerged within the PTSD disability cohorts.

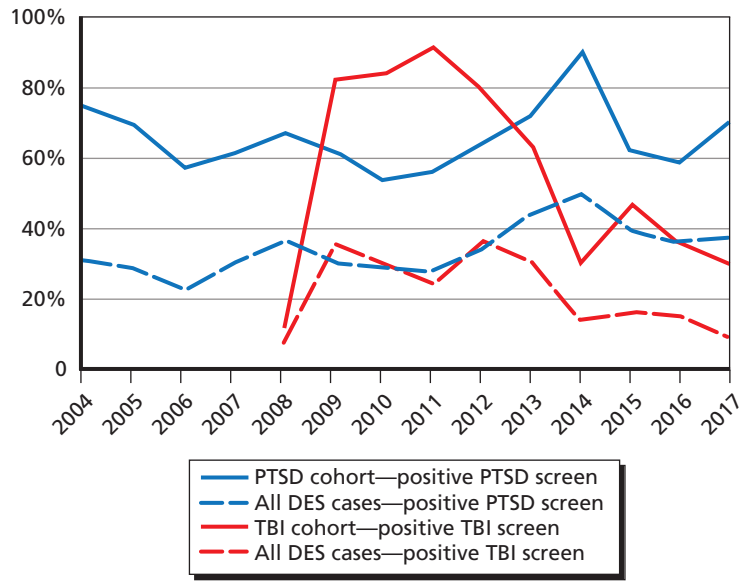
[10] Implicitly, this comparison assumes that service members with and without PTSD and/or TBI had the same noncompliance rate at a point in time.

vice members with a positive screen for PTSD or TBI on the PDHA/PDHRA, (2) service members identified on the PDHA/PDHRA as at risk for suicide, and (3) service members whose PDHA/PDHRA indicated that they had incurred an injury during deployment.

Positive Screen for Posttraumatic Stress Disorder or Traumatic Brain Injury

Service members who were medically discharged with a VASRD for PTSD or TBI were significantly more likely to screen positive for those conditions on PDHA/PDHRA than the population of all service members medically discharged in the same year, although the time trends were similar between the two groups (Figure 5.16). In most years, 60–70 percent of service members medically discharged with a

Figure 5.16
Percentage of Medically Discharged Service Members Who Screened Positive for Posttraumatic Stress Disorder or Traumatic Brain Injury on Post-Deployment Health Assessments, Disability Cohorts, Compared with All Medically Discharged Service Members with Completed Post-Deployment Health Assessments

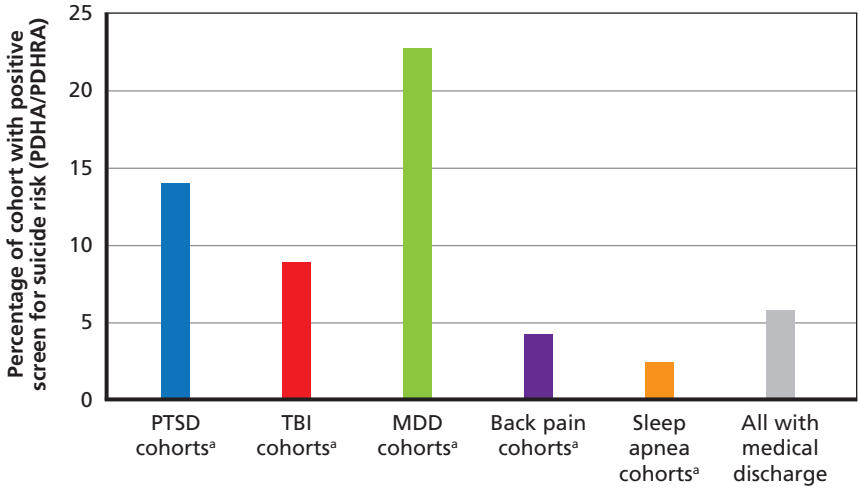


VASRD for PTSD had screened positive for PTSD on the PDHA and/or PDHRA, compared with 20–30 percent of all service members who were medically discharged. The difference in positive screens for TBI was even more stark, especially for cohorts whose disability evaluation occurred between 2009 and 2013.

Suicide Risk and Injury During Deployment

We also examined the percentage of service members across cohorts who screened positive for suicide risk or reported having been injured during a deployment and compared these percentages with all service members who had a disability discharge and a completed PDHA/PDHRA (Figure 5.17). Service members in the PTSD and TBI cohorts

Figure 5.17
Average Rates of Suicide Risk for Disability Cohorts versus All Medically Discharged Service Members with Completed Post-Deployment Health Assessments, 2004–2017



NOTE: This chart shows the average annual percentage of PTSD, TBI, MDD, back pain, and sleep apnea disability cohort members from 2004–2017 who screened positive for suicide risk on a PDHA/PDHRA versus the average percentage of all service members with an initial DES evaluation and a completed PDHA/PDHRA who were ever flagged for suicide risk on a PDHA/PDHRA. The sleep apnea and MDD disability cohorts had fewer than 20 observations with a completed PDHA/PDHRA in all years.
[a] denotes a statistically significant difference at $P < 0.05$.

were overall more likely than all services members evaluated in DES (not conditional on having had a VASRD) to have had a positive screen for suicide risk. Higher still was the rate of a positive screen for suicide risk among members of the MDD cohort.

The trends in the percentage of these groups who experienced an injury during deployment, as reported on PDHA/PDHRA, were similar. The injury rate increased from 2004 to 2010 for all groups, followed by a few years of relatively constant injury rates, after which injuries rates began to fall (2013–2016). Comparing across cohorts, injury rates were highest for the TBI cohort (73 percent), followed by back pain (60 percent), PTSD (58 percent), all DES cases (47 percent), and finally the MDD cohort (34 percent).

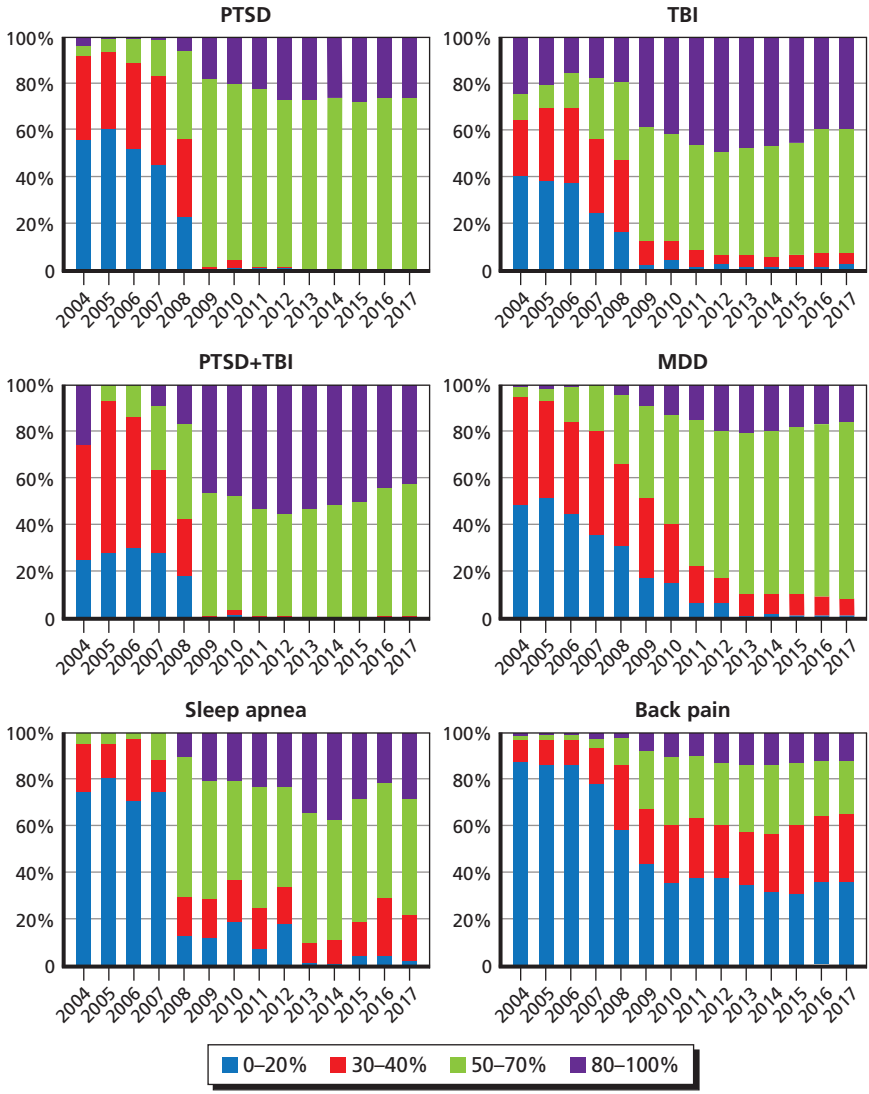
Trends in Disability Ratings for Service Members in Disability Cohorts

Trends in Total Disability Ratings

Recall from Chapter Three that condition-specific disability ratings were not available on all disability data sources. However, we were able to show the distribution of total DoD disability ratings among members of the disability cohorts. We grouped overall ratings into four categories: 0–20 percent, 30–40 percent, 50–70 percent, and 80–100 percent. The first category, 0–20 percent, represents medical separations. The others result in medical retirement, but we cut the data at key points. Beginning in 2008, DoD issued policy guidance requiring the military departments to consistently apply the VASRD such that service members who were determined to be unfit because of "mental health disorders due to traumatic stress" (e.g., PTSD) were to receive a minimum 50-percent disability rating, be placed on TDRL, and be reevaluated within six months (DoD, 2008). In addition, if their total disability rating was 80 percent or higher, they were to be permanently retired (placed on PDRL). Therefore, our categories were defined by those two ratings: 50 and 80 percent.

Figure 5.18 shows a clear shift in the distribution of disability ratings around the time of the 2008 DoDI, with the percentage of

Figure 5.18
Total Disability Rating Distribution Trends for Posttraumatic Stress Disorder Disability Cohorts, 2004–2017



service members with a PTSD VASRD (the PTSD and PTSD+TBI cohorts) receiving less than a 50-percent rating dropping to nearly zero. We see the same pattern for the TBI and MDD cohorts, although MDD shifted more slowly, and some service members in these cohorts still received less than a 50 percent overall rating. After 2009, approximately 20 percent of the PTSD and MDD cohorts received a rating of 80 percent or higher, and an even larger share (more than 40 percent) of the TBI and PTSD+TBI cohorts had an 80–100 percent overall rating. Even though guidance for rating MDD did not change during this time period, there is overlap between the PTSD and MDD cohorts, which likely explains the shift in disability ratings for the MDD cohorts. Appendix C reports the percentage of the PTSD disability cohort who were also rated for MDD. It is important to keep in mind that Figure 5.18 shows total DoD disability rating. Some service members in the MDD cohort who did not have a PTSD rating may have been rated for other conditions, thus pushing the total rating above what it would have been for MDD alone.

The 2008 guidance to consistently use the VASRD also affected ratings for service members whose sleep apnea made them unfit for service. Prior to 2008, rating guidance was based on "civilian earning capacity," whereby service members with "total industrial impairment" were rated at 100 percent, and those with "mild industrial impairment" were rated at 0 percent. Under the new policy, service members were rated for sleep apnea as follows:

- 100 percent for service members with chronic respiratory failure with carbon dioxide retention or an abnormal enlargement of the right side of the heart, or if the service member requires a tracheostomy
- 50 percent if the service member requires use of a breathing assistance device such as a CPAP machine
- 30 percent if the service member does not feel rested after sleeping
- 0 percent if the condition is asymptomatic but with documented sleep disorder breathing (VA, 2006).

Figure 5.18 shows a dramatic shift from 2007 to 2008 in the percentage of service members with sleep apnea receiving a 50 percent or higher overall disability rating. In 2007, 75 percent of service members medically discharged had a 0–20 percent rating (medical separation); they received a lump-sum disability severance payment and six months of health care benefits. In 2008, that number shrunk to 13 percent, with another 17 percent receiving an overall disability rating of 30–40 percent, and the rest of the sleep apnea cohort being rated 50 percent or higher. This pattern continued for all remaining cohorts.

Finally, the distribution of overall DoD rating shifted for the back pain cohort, but the change was not as pronounced. From 2007 to 2009, a growing share of the back pain cohort received an overall rating of 30 percent or higher, with the biggest gain seen among the 50–70 percent group. At the same time, the share that was medically separated shrunk from nearly 90 percent to one-third of the cohort.

Trends in the Number of Rated Conditions

One important analysis that we were unable to conduct with the data we had access to for this study was an examination of the trend in the number of conditions medically discharged service members were rated for. While we had VASRD information on all five of our disability data files, the format of those fields did not support this analysis. In particular, VASRD codes are often accompanied by "analog" codes, which may serve two purposes: (1) The service member's condition does not have a VASRD code but is similar to an existing code, in which case the VASRD field would end in "99" and the analog code is the best approximation of the condition, or (2) VASRD represents the service member's primary condition, and the analog code represents a secondary, ratable condition directly related to the primary condition. In some of our files, VASRD and analog codes appear as pairs in a single field (e.g., an eight-digit code that appears as VASRD1-analog1), so we could count each populated field as a single rated condition. However, in other files, all of the VASRD and analog codes appear as a string in a single field, which prevents us from differentiating between VASRD and analog codes and how they pair up and would likely result in overcounting.

The Accession Medical Standards and Research Activity produces an annual report on disability evaluation, and their analysis contains some information on the number of conditions per DES evaluation (Walter Reed Army Institute of Research, 2019; see Table 3).[11] Examining their reports over time, we generally see an increase in the number of VASRDs per evaluation for the Army (an increase from two to three VASRDs per evaluation, on average, between 2005 and 2017), but relatively stable numbers for the other services (1.5–2 VASRDs per evaluation, on average).

Summary

In this chapter, we defined disability cohorts based on the presence of a VASRD code at the conclusion of disability evaluation for anyone found unfit to continue serving. We then looked back over three years (and in some cases, over the service member's entire career) to document trends in: the number of service members in each cohort; their demographic and service characteristics; treatment for the unfitting condition; any positive screens post-deployment for PTSD, TBI, or suicide risk; and the distribution of DoD disability rating for each disability cohort. An important caveat regarding these results is that later cohorts may have included service members who had a VASRD for the condition of interest, but that particular condition may not have been found by DoD to be unfitting. We do not know the extent of this problem because the data have not been checked for accuracy (by the services or DoD), but the effect on our analysis may be larger cohorts in later years than we intended to include. All other outcomes of DES are unaffected (we used total DoD disability rating and disposition, which only include unfitting conditions).

We found that the number of service members with a disability rating for PTSD increased over time, from approximately 200 in 2004 to a peak of more than 5,000 in 2013. Over time, YOS at the time

[11] Whereas we focused on initial evaluations that result in discharge or RTD, their analysis of the average number of VASRDs per evaluation also included TDRL reevaluations).

of disability evaluation increased, especially for the PTSD, TBI, and PTSD+TBI cohorts. Most (approximately 90 percent) service members with a disability rating for PTSD or TBI were treated for that condition in the previous three years. This rate was lower for the MDD cohorts and for the PTSD+TBI cohort (not all members had diagnoses for both PTSD and TBI). Over time, it became very common for service members with a disability rating for PTSD or TBI to have received treatment for the other condition in the three years prior to disability evaluation (this is true for more than 50 percent of the cohorts). Among those with a disability rating for PTSD, 60–70 percent had a positive screen for PTSD on PDHA or PDHRA. Those with a disability rating for TBI were more likely to have a positive screen for TBI on PDHA/PDHRA in the middle years our analysis (2009–2012); this result may reflect the fact that after this time, more TBIs were experienced in garrison rather than during a deployment and they are not reported on a PDHA or PDHRA. Starting in 2008, when DoD implemented significant policy changes to how VASRD was applied, there was a large shift in the total disability rating for service members with a PTSD or sleep apnea disability rating. After the policy change, no service members with a PTSD disability rating had less than a 50-percent rating, and most of those with a sleep apnea disability rating had a 50 percent or greater rating.

CHAPTER SIX

Conclusions

Since 2001, over 3 million service members have deployed in support of multiple combat operations in Afghanistan, Iraq, and other theaters, with some service members returning from war with injuries and illnesses, including PTSD and TBI. Many service members with PTSD and/or TBI receive treatment, recover, and successfully complete their military term of obligation. Some, however, continue to experience symptoms that interfere with their ability to perform their military duties and are referred for disability evaluation through DES. The vast majority of service members who are evaluated for disability are medically retired or separated, after which they transition out of the military and receive disability benefits. The process by which service members are evaluated for disability has evolved significantly since 2001. At the same time, DoD and the services have made policy changes and initiated other efforts to improve screening for PTSD and TBI, encourage service members to seek treatment, improve quality of care, reduce the stigma associated with treatment for these conditions, and increase compensation for those medically discharged.

The goal of this study was to conduct an empirical analysis of trends in diagnosis, treatment, and disability evaluation for PTSD and TBI, as well as describe policy changes associated with identifying and treating PTSD and TBI and the changes that have been made to the DES since 2001. Changes to policy are documented in a companion report (Simmons et al., 2021).

Trends in Diagnosis and Disability Evaluation

In our empirical analysis, we found that 211,428 AC service members were diagnosed with PTSD between fiscal years 2002 and 2017, and 291,057 were diagnosed with TBI. For both conditions, the number diagnosed each year (for the first time) grew steadily from 2002 to 2008 before leveling off and beginning to decline again around 2012. This pattern coincides with the percentage of the force that had deployment experience over this time period. Among those diagnosed with these conditions, an increasing share was medically discharged and received a disability rating for the diagnosed condition. This is especially true for PTSD, which is not surprising given that exposure to combat is the best predictor of experiencing PTSD among service members who have deployed.

Over the time period, we observed 35,408 medical discharges with a PTSD disability rating and 9,000 with a TBI disability rating. There was a period of sharp growth in the number rated for PTSD beginning in 2012. A majority of service members with a disability rating of PTSD and/or TBI had deployment experience, had screened positive for these conditions on PDHA and/or PDHRA, and had received treatment for these conditions prior to being evaluated for disability.

The findings from this analysis provide stakeholders with longitudinal information about the number of service members diagnosed with, or disability-rated for, two of the signature wounds of the conflicts that began in 2001, and may be used to set goals for diagnosing, treating, and evaluating wounded, ill, or injured service members of future conflicts.

Limitations of the Study

A number of limitations of this study must be acknowledged. First, while we are able to make associations between some of the outcomes of interest and the time period or environment in which the outcomes occurred, we are unable to draw any conclusion about what caused the outcomes. For example, we see a clear shift in total DoD disability

ratings for service members discharged with a PTSD or sleep apnea VASRD, and it happens immediately after DoD issued a policy directing the military departments to adhere to the VASRD that specifically dealt with PTSD and sleep apnea. However, how much of the rise in the number of service members diagnosed with, or disability-rated for, PTSD and/or TBI is the result of a policy change instead of deployment patterns, a reduction in stigma around the need for mental health treatment, or something else is not something we can determine using the results of this study. As we will discuss later, the trends that we observed can probably be attributed to all of the factors mentioned above, as well as others.

In addition, we did not identify any statistical methods that would allow us to test whether a specific policy had an effect on an outcome of interest. This is because of two reasons: (1) Policies are not issued in isolation, and (2) there are many factors that we cannot control for using secondary data. Regarding the first, policy changes occur constantly, and many that we would want to test in this study happened around or at the same time. Even if we could control for everything about a service member's experiences, we would not be able to isolate the effects of any single policy because the timing of their effects are likely overlapping. Regarding the second, two service members who are observationally equivalent based on the data we used in this study may have very different preferences, exposures, and experiences that may lead to different outcomes (e.g., different diagnoses or DES outcomes). We cannot attribute differences in outcomes to policy changes because we cannot control for behavior, preferences, and exposures.

Another limitation of the study is that it excluded members of the National Guard and Reserve. The main reason for this is that much of our analysis either depended upon or was about medical diagnoses. Our prospective analysis began with cohorts of service members who were observed to have a PTSD or TBI diagnosis. An entire section of our retrospective analysis centered on whether service members in disability cohorts received treatment for the condition for which they were rated. Because most National Guard and Reserve service members do not use the military health system or the TRICARE purchased care network for their health care, it was not possible to include them in our study.

We also faced data limitations. Most importantly, VTA may include both fitting and unfitting conditions, whereas service disability files include only conditions found by DoD to be unfitting (which was our intent). The consequence is that later disability cohorts (beginning in 2007 but especially 2012–2017) may be larger than intended. All service members in the cohort were found to be unfit and were medically discharged, but they may not have been found unfit for the conditions in our analysis. Other outcomes of DES are not affected, only the size of the disability cohorts and the percentage of the diagnosis cohorts with a disability rating for the same condition, as we noted when we presented those results. In addition, there were inconsistencies across some data sources. We used five sources of disability data: VTA, which covers IDES cases and is complete beginning in FY 2012, and four department-specific files that cover PEB and discharge information. They started recording information at different points in the process (VTA begins with referral, and the service files begin when a case reaches the PEB) and contain different dates. The only date common to all files was date of disposition. Ideally we would have captured all disability evaluation referrals or measured discharges as of the date of separation, but we instead used a date that occurs near the end of the evaluation but prior to discharge. Similarly, not all files contained condition-specific disability ratings, so we had to use total DoD disability rating, which includes all unfitting conditions.

Finally, PDHA and PDHRA forms changed over time, which meant we could not measure all screeners or other indicators consistently over time. Compliance rates on these two assessments also varied considerably over time and by service, so in some cases our results reflect only a small fraction of all service members who had deployed.

Policy Implications

Across analyses, we found that the number and percentage of service members with a diagnosis or disability rating for PTSD and/or TBI increased over time until recently, although this was not true for all comparison conditions. Given that these are two conditions that are

thought of as signature wounds of the wars in Iraq and Afghanistan, it is perhaps not surprising that as the number of service members deployed increased, so too did the incidence of these conditions. And similarly, now that a relatively small number of service members have been deployed in recent years, there has been a downward trend in the number and percentage being treated or rated for PTSD and/or TBI.

We also observed some trends that align with policy changes. The clearest example of this is the shift in total DoD disability ratings for service members in the PTSD and sleep apnea cohorts. In response to the 2008 National Defense Authorization Act, the Undersecretary of Defense for Personnel and Readiness issued a policy mandating a disability rating of not less than 50 percent for service members who were determined to be unfit for mental disorders resulting from traumatic stress, including PTSD. The same policy changed the way sleep apnea was evaluated and rated, such that service members who did not feel rested after sleeping received a 30-percent rating, and those using a breathing machine, such as a CPAP machine, during sleep received a 50-percent rating. Figure 5.18 shows that total DoD ratings of less than 50 percent essentially disappeared beginning in 2009 for service members in the PTSD disability cohort. And from 2007 to 2008, the percentage of service members in the sleep apnea cohort who received an overall disability rating of 0–20 percent dropped from 57 percent to 9 percent. Even though other factors were at play, it is impossible to ignore the timing of the policy relative to changes in outcomes such as these.

While there is clearly a relationship between deployment patterns and policy and the trends observed in this study, we cannot specifically attribute the findings to deployments or any other factor. Instead, during the time period covered by these analyses, the disability system was restructured, and efforts were made to raise awareness around these conditions, to encourage people to seek treatment, and to reduce stigma for receiving treatment, and there were many policy changes related to disability evaluation and the identification, diagnosis, and treatment of PTSD and TBI. The results in this report are likely a reflection of all of those factors.

While in general we cannot judge whether the trends we observed or the policies put in place over this period are positive or negative, there are some outcomes that likely improved service member well-being. For example, Chapter Three reported an increase in the number and percentage of service members diagnosed with PTSD and TBI. Over this time period, there was increased focus on the psychological toll of the wars, and in response, DoD made significant changes to how it organized psychological health resources and capabilities. Service members were encouraged to seek treatment, and policy changes intended to improve screening, diagnosis, and treatment for these conditions were made (Simmons et al., 2021). An increase in the number of service members treated might reflect the success of these programs and initiatives.

Coinciding with the mandatory 50-percent minimum disability rating for service members with a mental disorder resulting from a traumatic event, our results in Chapter Five showed a clear trend toward higher ratings for service members in the PTSD cohorts (and to a lesser extent, other condition cohorts) after the policy change. Insofar as improved financial well-being is tied to health and socioeconomic outcomes, an increase in benefits associated with higher disability ratings may enhance opportunities for medically retired service members to integrate into the civilian world and continue to receive necessary treatment. It is possible that changes to benefits associated with higher disability ratings could have undesirable outcomes as well, including increased costs to DoD and potential mixed incentives for veteran employment. Future DoD research should examine the positive and negative consequences of rating changes that affect large groups of service members.

In the future, DoD and the services will continue to evolve policies and practices to improve system performance and service member health. To the extent possible, the effects of those changes should be evaluated as they happen. This report documents a confluence of changes that occurred over a 16-year period, which makes identifying the impact any single policy had on an outcome such as fitness to serve or disability difficult. But it may be possible to evaluate such changes within a narrower band of time, or the effects of the changes

on a subset of service members, to ensure that the desired outcome is achieved.

Furthermore, with existing data, it would be possible to more formally assess veteran outcomes following medical discharge. Service members who are medically retired through DES are eligible for lifetime health benefits for themselves and their dependents through TRICARE. The same patient encounter data that we accessed from the MDR for the AC population could be pulled for the retiree population. We could then link records from time in service to postservice health care encounters to observe utilization and treatment patterns. Similarly, data for care received from VA could be linked to data from time in service to look at health care utilization and health outcomes from care provided by VA. Because these data, along with other data collection efforts such as the Millennium Cohort Study and the Million Veteran Program, do not contain information on outcomes for veterans receiving health care, new data collection efforts would be needed to fully understand how service experiences and processes such as disability evaluation are correlated with longer-term health outcomes.

Other similar analyses could be done with data on other types of DoD or VA benefits, such as utilization of the post-9/11 GI bill or VA home loans. Some studies have also linked service member records to Social Security Administration data to observe employment outcomes of veterans, and the same could be done for this population. These types of studies would enable an assessment of the well-being of service members after their medical discharge who have war-related conditions.

APPENDIX A

Creating the Analysis File

We created a person-year file consisting of one record for every year of AC service for every individual who was observed in the AC at any time from FY 2002 to FY 2017. We used personnel files from DMDC, disability data from DoD and the services, medical encounter data from DHA, and PDHA and PDHRA data.

Defense Manpower Data Center Data

The base of our analysis file is composed of five (DMDC) files limited to AC service members from FY 2001 to FY 2017: Active Duty Master File (ADMF), Active Duty Transaction File (ADTF), Contingency Tracking System (CTS), and Work Experience File (WEX).

We received quarterly summary ADMF files covering FY 2001–2017. We use the file for some basic demographics and service characteristics such as age, sex, marital status, race/ethnicity, pay grade, and YOS. To generate a person-year file we retained the service member's observation at the end of each fiscal year or last month available in the fiscal year.

We then combine this file with annual summary ADTF files from the end of FY 2001 to FY 2017 (i.e., dated from September of each year). These files have been limited to loss/separation records and contain information on the date of separation along with variables classifying the separation.

Sometimes there is not an ADMF that matches with ADTF separation record. To deal with missing demographic values, we impute

forward these variables from the last record. To do this, we keep the same last recorded value for most variables and account for the time change for time by varying variables like age and YOS.

Next, we combined this file with data from CTS. This file contains a listing of individual active duty deployments from September 2001 to June 2016. We collapsed this file to the person-year level by counting the number of deployments and deployed months as of the end of the fiscal year.

Finally, we added WEX to obtain occupation, service, and component variables. The WEX file combines information from AMDF, ADTF, and similar files for reserve forces to create a longitudinal record for all service members covering March 1990–September 2016. A new record is created each time there is a change in the service member's record. We use all of this information to create a single flag indicating any AC during this time period.

Disability Data

For information about the disability system, we combined data from five different sources: VTA, PDCAPS, ePEB, MilPDS, and JDETS. The VTA file combines data from all services into a single system starting around 2008. Prior to that point, each service had its own system, and thus its own data files.

Table A.1
Summary of Disability Data Sources

File	Description	FY
VTA	All services disability summary	2008–2018
PDCAPS	Army legacy disability transactions	2001–2013
ePEB	Army disability transactions	2008–2018
MilPDS	Air Force legacy disability transactions	2001–2017
JDETS	Navy and Marine Corps legacy disability transactions	2001–2016

Unless otherwise noted, these files contained similar information. The service-specific files record more information, with multiple records for each disability case transaction. The VTA file collapses all the information into a single summary record. All files contain information on the status of the disability case, dates, conditions, and disability ratings.

After reading in the files we perform some basic cleaning (for example, VTA and ePEB are stored as relational databases that need to be merged, and MilPDS comes as separate files that need to be stacked). Then, for each file we separately derive a common set of variables: disposition, dates, initial/reevaluation, and diagnosis flags. After deriving variables, we collapse to the person-year level and combine all disability data into a single file.

Disposition is grouped into six categories: TDRL, PDRL, separated with benefits, separated without benefits, RTD, and other (see Appendix B for details on our key definitions). While the VTA files contain a single, final disposition, the other files can contain individual observations recording dispositions at various points in time. For example, if a service member is initially placed on TDRL, but then is reevaluated and placed on PDRL, we observe one record for each of these transactions. We checked these files for consistency in the combination and timing of the dispositions.

All of the disability files contained various dates recording the different steps of the disability process. The one date that was common across all five disability files was date of disposition, so we use it to mark the end of the evaluation, acknowledging that there is an administrative transition step that occurs after disposition and before separation.[1]

Because the focus of our analysis is on initial evaluations, not reevaluations of service members placed on TDRL, we needed to differentiate between the two types of records in the disability files. The PDCAPS and ePEB files both contain a CASE_TYPE variable that

[1] As a check on dates across files, we used separation date (when available) in the disability files to compare with the date of separation available in ADTF. Most of the VTA dates were not missing and agreed with the ADTF date over 93 percent of the time. However, the MilPDS dates were often missing, and only 43 percent of the recorded values matched the ADTF date.

flags these two types of observations. For PDCAPS, CASE_TYPE = A is an initial and CASE_TYPE = B is a reevaluation. For ePEB the values are MEB and TDRL respectively. The MilPDS file has a similar variable TDRL_CURRENT_STATUS. However, this variable was attached only to observations with a TDRL disposition and was missing for almost half of the TDRL observations. Instead, we sorted the data by the disposition date and considered the first record for each person to be an initial observation and all subsequent records to be reevaluations. These flags get reset for cases that are separated by an RTD. For example, if someone is placed on TDRL, returns to duty from that TDRL, and then is placed on TDRL at a later date, then that second TDRL is flagged as the outcome of an initial evaluation. JDETS does not contain any variables related to case type, so we use the same process on that file.

We performed testing to compare values when there was overlap between VTA and the other files. Our goal was to use VTA as the primary source of information after the 2008 conversion. Most of the time, when there was overlap between files there was consistency in fiscal year and disposition. However, VTA was often missing information found in the other files. It records only the summary information, so we have more transactional information from the other files. More importantly, the VTA files were often missing condition information, especially for the Army. This was improved dramatically by including the ePEB data.

Military Health System Data Repository Utilization Data

MDR files record individual encounters in the direct care system and claims from the purchased care system. Each observation contains information on dates of service, provider specialty, diagnoses, and procedures performed. The observations are split into several different claims/encounter files: Comprehensive Ambulatory Professional Encounter Record (CAPER), Standard Ambulatory Data Record (SADR), Standard Inpatient Data Record (SIDR), TRICARE Encounter Data Non-Institutional (TEDNI), TRICARE Encounter Data Institutional (TEDI), and Pharmacy Data Transaction Service (PDTS).

Table A.2
Summary of Health Care Utilization Files

File	Description	FY
CAPER	Direct care ambulatory and professional encounters	2004–2017
SADR	Direct care ambulatory and professional encounters	2001–2003
SIDR	Direct care inpatient encounters	2001–2017
TEDNI	Purchase care ambulatory and professional claims	2001–2017
TEDI	Purchase care inpatient claims	2001–2017
PDTS	Prescription claims	2002–2017

We use these data for two tasks: to identify cohorts for different conditions for the forward-looking analysis and to summarize a service member's health care utilization in each fiscal year. To do this, we build a file one year at a time, flag conditions and utilization, and then summarize at the person-year level.

Flagging conditions in the MDR files is similar to doing so in the disability files, but they use ICD-9 diagnosis codes prior to FY 2016 and ICD-10 diagnosis codes beginning in FY 2016. Each claim line can have up to 25 diagnosis codes. We could flag in a similar way to the disability files, but instead we use a slightly different method that uses a format to crosswalk the diagnosis code to a new value.

To generate our utilization measures, we first need to collapse our utilization data into episodes of care. Our utilization measures (i.e., outpatient days and any inpatient stays) are broad enough that our collapsing process does not need to be very complex. Additional complexity would be introduced if we were trying to identify unique outpatient visits, because patients can visit different providers on the same day. It can be difficult to distinguish multiple visits from single visits where more than one provider may have been seen. Similarly, it can be difficult to identify the start and end dates of an inpatient stay due to multiple claims and transfers into and out of different facilities.

For identifying care, the three steps performed are: (1) remove utilization unrelated to an actual visit, (2) flag care as inpatient or outpatient, and (3) collapse to the person-year level.

The first step in removing unrelated care is dropping the PDTS file. Of the remaining files, the TEDNI file is the main source of unrelated care. It contains a wide variety of charges including prescriptions, Durable Medical Equipment (DME), laboratory, ambulance services, and other nonvisit claims. We removed the following five types of records to remove these observations:

1. prescription claims
2. DME utilized at home
3. ambulance
4. independent laboratory
5. other undefined product line.

Note that we do not remove these observations from the diagnosis flagging. Many of these nonvisit claims do contain diagnosis codes that can be used to create diagnosis cohorts. In particular, we noted that a large percentage of the population flagged with sleep apnea were being identified by diagnosis codes associated only with a TEDNI DME purchase, more specifically, the current procedural terminology (CPT) codes for CPAP machines (E0470, E0471, E0472, E0571, E0562, E0601).

We consider all utilization in the SIDR and TEDI files to be inpatient care. The CAPER, SADR, and TEDNI files contain a mix of inpatient professional claims and outpatient claims. Inpatient TEDNI claims are identified with the place of service codes (21 = inpatient hospital and 51 = inpatient psychiatric facility).

To identify inpatient professional claims in CAPER and SADR, we utilize the claim Medical Expense Performance Reporting System (MEPRS) code. The MEPRS system is a uniform reporting methodology for financial and performance management. Every claim contains a four-digit MEPRS code, which can be used to identify different facilities and work centers. MEPRS codes with "A" as the first digit is considered inpatient care.

Finally, we collapse the flagged files to the person-year level. The MDR utilization data is organized by fiscal year, so we simply collapse to the person level within each of the files. To get a count of the days of outpatient care, we first collapse to the person-encounter date

level, and then count up all days with care in a single fiscal year. For inpatient flags, we take the max value of an indicator variable created within the fiscal year file.

Theater Medical Data Store Utilization Data

TMDS contains utilization data for care provided in-theater. It is stored in several different relational files including the encounter, diagnosis, and people files. The encounter file contains information about each encounter and is used as the base for our analysis file. These encounters have dates starting around year 2000, but the volume is low until around 2005.

The diagnosis file contains up to 26 ICD-9/10 diagnosis codes for each encounter. We transformed the structure of this file from long format to wide format and merged with the encounter file. Finally, the people file is used to crosswalk the TMDS unique person identifier into a Social Security number (which is later crosswalked to the encrypted identifier for the purposes of merging files).

The TMDS files are missing important variables that would allow us to identify the AC population, so we require this information from an external source. Fortunately, the MDR utilization files described above (e.g., CAPER, SIDR) do have a variable identifying AC. We combine all of the MDR utilization data to identify the set of AC individuals. We then subset the TMDS file to just those individuals.

We use the TMDS files only to flag conditions. To do this, we use the same process defined above for flagging conditions in the MDR utilization files. We then collapse the files to person-year level by taking the max value of the condition indicators.

Post-Deployment Health Assessment and Post-Deployment Health Reassessment Data

PDHA and PDHRA data are stored on six different files based on the version of the form used to collect the data:

1. PDHA Form DD2796 effective April 2003
2. PDHA Form DD2796 effective January 2008
3. PDHA Form DD2796 effective September 2012
4. PDHRA Form DD2900 effective June 2005
5. PDHRA Form DD2900 effective January 2008
6. PDHRA Form DD2900 effective September 2012.

We use the PDHA/PDHRA data to derive four measures: screened positive for PTSD, screened positive for TBI, screened positive for suicide risk, and indicator that an injury occurred during deployment.

PTSD Screen. The PDHA and PDHRA include the Primary Care PTSD Screen (PC-PTSD) instrument (Prins et al., 2003). The PC-PTSD is a four-item screen. The respondent is asked four yes/no questions about the effects of exposure to a traumatic event. The questions posed take the form of "Have you ever had an experience that was so frightening/horrible/upsetting in the past month that you

1. have had nightmares about it or thought about it when you did not want to?" (yes/no)
2. tried hard not to think about it or went out of your way to avoid situations that remind you of it?" (yes/no)
3. were constantly on guard, watchful, or easily startled?" (yes/no)
4. felt numb or detached from others, activities, or your surroundings?" (yes/no)

Screening positive for PTSD was defined as reporting "yes" to two or more of these questions. All versions of the PDHA and PDHRA included the same wording and version of the PC-PTSD.

TBI Screen. Some versions of PDHA and PDHRA asked respondents about experiences during deployment related to a potential brain injury. We defined a positive TBI screen if the service member reported experiencing a blast, accident, wound, or fall accompanied by an immediate loss of consciousness, feeling dazed, or loss of memory. These questions were not part of the 2003 PDHA, 2005 PDHRA, or 2012 PDHRA, so we were not able to construct the measure for observations using those assessments. Additionally, the set of questions was

slightly different in the 2012 PDHA, although the difference is not likely to affect comparability.

Suicide risk. We identified service members who screened positive for suicide risk based on responses to a question about having "thoughts that you would be better off dead or hurting yourself in some way." In the 2003 PDHA the question asked about how often the respondent had been bothered by these thoughts over the last two weeks and has possible responses for "none," "some," and "a lot." We defined positive suicide risk as having a response of "some" or "a lot." The remaining five PHDA and PDHRA assessments ask if these thoughts occurred during the past month and have a yes/no response. We defined positive suicide risk as having a "yes" response.

We identified service members who reported a deployment-related injury based on "yes" responses to a question asking if the respondent was "wounded, injured, assaulted or otherwise hurt during this deployment." This question was not part of the 2003 PDHA.

There were several issues with the PDHA and PDHRA data. First, because the forms changed over time, we had some limitations in terms of perfectly crosswalking variables and creating the same set of measures across the full study period. Second, there was not a PDHA and PDHRA for every deployment for every service member who deployed. For the 2004–2017 disability cohorts, among those who deployed in the previous fiscal year, 31.8 percent had a recorded PDHA or PDHRA. Over our full analytic file (not just the disability cohorts), 40.3 percent of those who deployed had a PDHA record.

The missing data issue can be explained in a number of ways. First, compliance rates increased over time; 23.1 percent of service members assigned to a 2004 disability cohort had a PDHA or PDHRA, compared with 37.8 percent among 2015 cohorts. Second, PDHA/PDHRA data were significantly more complete among soldiers and airmen in the disability cohorts than among marines and sailors. We confirmed these rates with AFHSB, which provided the data to us. Therefore, we were not missing data; rather, not everyone who deployed completed the PDHA and PDHRA. Government Accountability Office (2009) previously studied this issue and identified documentation deficiencies occurring in the Navy and Marine Corps.

Combining Defense Manpower Data Center, Disability, and Defense Health Agency Data

At this point in the analysis file creation process we had five files: DMDC data, disability data, MDR utilization and condition flags, TMDS file, and PDHA/PDHRA file.

As a first step, we performed another round of imputation on the DMDC data. The first round was to fill in information on separation records without a corresponding ADMF record. This round imputed all DMDC variables for disability records that occur after the end of the DMDC records. This occurred for around 17 percent of the person-year observations with a disability file record. These observations were almost all reevaluations—most of them with a PDRL disposition. To impute, we simply carried forward the last valid DMDC record up to 2018. Again, most values were given the same value as the last record and age and YOS were advanced by the difference in years.

We then merged the DMDC file with the disability file at the person-year level. As a separate step we merged in the AC indicator derived from the WEX files at the person level.[2] At that point we limited the file to those observations where the WEX file has any record of AC service.

As a final step, we merged this active duty DMDC-disability with the MDR, TMDS, and PDHA files at the person-year level. Observations were limited to those in the DMDC-disability file.

Table A.3 shows the total number of AC service members in our final analytic file at any time during that fiscal year. The number of individuals in our file in a given year is larger than official end strength counts because our numbers reflect total strength, not end strength. In other words, individuals present for even part of a year are counted, not just those present at the end of the fiscal year (September). Table A.3 also shows the number of service members whose DES disposition in that fiscal year indicated TDRL, PDRL, separated with benefits, or

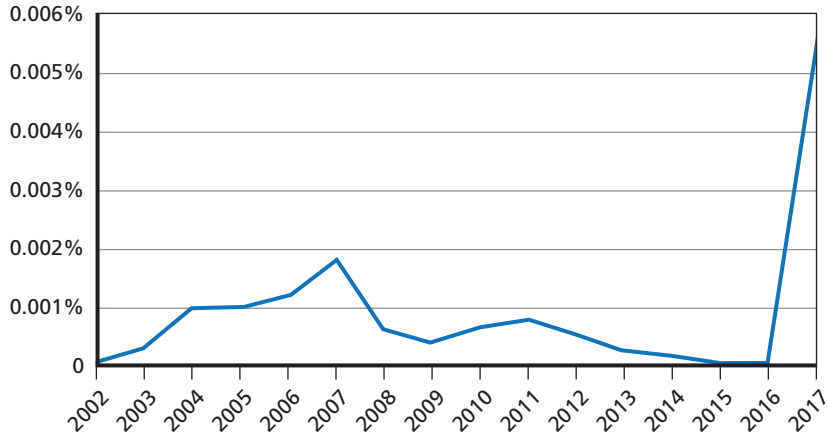
[2] More specifically, we looked through all transactions in the WEX file for a service member and flagged him or her as being active duty if that service member ever had any active duty component status (COMPONENT = "R").

Table A.3
Number of Active Component Service Members in the Analytic File and Number Medically Discharged (Measured by Date of Disposition), by Fiscal Year

FY	Number of AC Service Members	Number of Medically Discharged Service Members	Number of Service Members Deployed	Number of Service Members Killed in Action
2002	1,540,599	8,497	270,969	17
2003	1,589,319	8,741	478,839	143
2004	1,610,413	10,785	453,202	442
2005	1,582,111	12,531	439,672	448
2006	1,567,078	10,381	468,254	565
2007	1,564,734	10,657	516,647	935
2008	1,563,416	11,394	548,643	351
2009	1,573,698	12,367	536,050	237
2010	1,588,453	12,304	526,576	352
2011	1,592,766	13,036	513,775	408
2012	1,585,762	18,864	429,957	234
2013	1,572,478	24,424	339,203	93
2014	1,530,676	24,535	276,037	50
2015	1,496,878	23,575	215,362	8
2016	1,474,540	22,010	157,256	3
2017	1,300,651	24,851	4,691	25

NOTE: The numbers in this table are larger than the number of official AC service members as reported by end strength. That is because the analysis file includes total strength, not end strength. Someone who serves part of a fiscal year but is no longer present at the end of the year is in our file but is not counted in end strength numbers (see, for example, the Center for Naval Analyses' Population Representation in the Military Services for end strength). Furthermore, the number of medically discharged service members will not match official counts that are based on date of discharge. These numbers are based on the year of disposition, the only DES date common across all of our disability files.

Figure A.1
Percentage of Service Members Killed in Action, by Fiscal Year



separated without benefits (i.e., medical discharges), the number who deployed each fiscal year, and the number killed in action.

Figure A.1 shows the percentage of service members killed in action (as measured by our analytic file) per year. This trend is used to define deployment eras for the multivariate analysis in Chapter Five.

APPENDIX B

Key Definitions

Disability System Disposition

Each of the disability files contains codes for the outcome of the disability process. We recoded these into a single, consistent scheme with the following six values, with any missing values dropped. Table B.1 shows the final disposition variables used in our analysis, and the following five tables show how individual variables on each file mapped to these dispositions.

Disability System Dates

Of the three dates we considered using to identify that a disability evaluation occurred (MEB referral date, disposition date, date of separation), only one was available across all five files: disposition date. Therefore, when collapsing to the person-year-level analysis file, we use this variable to identify the year and flag the disposition on that year. Table B.7 shows the name of the disposition date on each of the five disability files.

Table B.1
Disposition Outcomes on Disability File

Disposition Category	Description
tdrl	Temporary Disability Retired List (TDRL)
pdrl	Permanent Disability Retired List (PDRL)
sep_ben	Separated with benefits
sep_noben	Separated without benefits
rtd	Returned to duty
other	Other

NOTE: The purpose of this table is to crosswalk dispositions to the disposition codes in the following tables (B.2–B.6). For example, "tdrl" means Temporary Disability Retired List (TDRL), and we mapped one code, labeled "TDRL" in VTA (Table B.2), to it.

Table B.2
Disposition Variables on the Veterans Tracking Application File

Final Disposition (final_disposition)	#	%	Disposition Category
Found fit and RTD	9,668	5.7	rtd
Nondisability retirement	110	0.1	other
PDRL	61,913	36.3	pdrl
Separated with benefits	49,813	29.2	sep_ben
Separated without benefits	1,720	1.0	sep_noben
TDRL	46,640	27.3	tdrl
Unfit, but RTD	857	0.5	rtd
Missing	26,135		

NOTE: This table describes the disposition codes that appear in VTA data and how we mapped each code to a common set of dispositions defined in Table B.1.

Table B.3
Disposition Variables on the Physical Disability Case Processing System File

Disposition (dispositn)	Description	#	%	Disposition Category
A	Separated from the service without disability benefits	15,917	5.4	sep_noben
f	Referred for case disposition under RC regulations	3	0.0	other
F	Returned to duty as fit	31,674	10.7	rtd
P	Permanent disability retirement	53,243	18.0	pdrl
PP		66	0.0	other
pp		108	0.0	other
r		1	0.0	other
R	Retained on temporary disability retired list	12,306	4.2	tdrl
S	Separated with severance pay if otherwise qualified	136,122	46.1	sep_ben
T	Placed on temporary disability retired list	45,776	15.5	tdrl
u	Referred for case disposition under RC regulations	1	0.	other
X		2	0.0	other
Z	Miscellaneous administration termination	332	0.1	other
	Missing	1,100		

NOTE: This table describes the disposition codes that appear in PDCAPS data and how we mapped each code to a common set of dispositions defined in Table B.1.
RC = reserve component.

Table B.4
Disposition Variables on the Electronic Physical Evaluation Board File

Final Result (final_result)	#	%	Disposition Category
Active duty fit	122	0.1	rtd
Continuation of active duty	120	0.1	other
Deceased	32	0.0	other
Miscellaneous administrative termination	626	0.6	other
Non-duty fit	3	0.0	other
Non-duty unfit	5	0.0	other
Permanent disability retirement	53,969	47.9	pdrl
Retained on TDRL	570	0.5	tdrl
Revert to retired status	4	0.0	other
Separated with benefits	29,908	26.5	sep_ben
Separated without benefits	561	0.5	sep_noben
TDRL	26,724	23.7	tdrl
TDRL removal temporary early retirement authority (TERA)	3	0.0	other

NOTE: This table describes the disposition codes that appear in ePEB data and how we mapped each code to a common set of dispositions defined in Table B.1.

Table B.5
Disposition Variables on the Joint Disability Evaluation Tracking System File

Disposition (disposition)	Description	#	%	Disposition Category
admnr	Administrative removal (cases where the service member was removed without an additional adjudication)	6,150	1.50	other
fit	Fit for duty	40,604	10.00	rtd
fittdr	Fit from TDRL (condition resolves and member can return to service if he or she passes accession standards)	2,727	0.70	rtd
limdu	Limited duty	2,716	0.70	other
noact	No action (terminated case without completion of the DES process)	13,851	3.40	other
nochng	No change	1	0.00	other
npq	Not physically qualified (determination for a non-drilling reservist who is found unqualified to maintain within the reserve structure; this is when a reservist injures him- or herself outside the line of duty)	598	0.10	other
pdr	PDRL	29,154	7.20	pdrl
pdrtdr	PDRL from TDRL	72,306	17.90	pdrl
pq	Physically qualified (reservist found physically qualified to be retained in the reserves)	1,210	0.30	other
rtntdr	Return to duty	38,635	9.50	rtd
sep	Separated with benefits	77,747	19.20	sep_ben
septdrl	Separated with benefits from TDRL	14,587	3.60	sep_ben
sepwob	Separated without benefits	7,828	1.90	sep_noben
sepwobtdrl	Separated without benefits from TDRL	32	0.00	sep_noben
tdrl	TDRL	96,882	23.90	tdrl
	Missing	21		

NOTE: This table describes the disposition codes that appear in JDETS data and how we mapped each code to a common set of dispositions defined in Table B.1.

Table B.6
Disposition Variables on the Military Personnel Data System File

Final Disposition (final_disp)	Description	#	%	Disposition Category
0	Fit from the TDRL discharge without benefits to reserves	5	0.00	other
1	Temporary retirement or retain on TDRL	7,855	19.90	tdrl
2	Permanent retirement	17,098	43.40	pdrl
3	Discharge with severance pay	8,445	21.40	sep_ben
4	Return to duty	2,850	7.20	rtd
6	Discharge without benefits expiration of 5 years on TDRL	95	0.20	sep_noben
7	Fit from TDRL and service retirement	3	0.00	other
9	Fit from TDRL, discharged without benefits, no obligation/no desire RTD	3	0.00	other
L	Discharge misconduct law 1207	15	0.00	other
N	Dual action term 36-3212	270	0.70	other
P	Discharge under other than Chap 61	691	1.80	other
S	Fit–Air Reserve Component (ARC) non-duty related impairments	414	1.10	other
T	Unfit–ARC non-duty related impairments	1,632	4.10	other

NOTE: This table describes the disposition codes that appear in MilPDS data and how we mapped each code to a common set of dispositions defined in Table B.1.

Table B.7
Disposition Date Variables on Disability Files

Disability File	Variable Name
Physical Disability Case Processing System (PDCAPS)	result_d
Electronic Physical Evaluation Board (ePEB)	final_result_date
Military Personnel Data System (MilPDS)	final_disp_date
Joint Disability Evaluation Tracking System (JDETS)	max(date_board_voted, dt_order_req)
Veterans Tracking Application (VTA)	final_disposition_date

Diagnosis and Disability Cohort Definitions

In the analysis we focused on the following conditions: PTSD, TBI, MDD, sleep apnea, and back pain. In the disability files we identified these conditions using VASRD codes. The MDR files used ICD-9 until FY 2016, when they switch over to using ICD-10 diagnosis codes. The following sections list out the VASRD, ICD-9, and ICD-10 codes used to define the different conditions.

Posttraumatic Stress Disorder

As mentioned earlier, PTSD is a mental health condition that some people experience after a terrifying or life-threatening event. Patients suffering from PTSD frequently relive the event through flashbacks, memories, or dreams, and they prefer to avoid circumstances that remind them of the traumatic event. Sometimes the individual is unable to recall important aspects of the period when he or she was exposed to the stressor, or he or she experiences symptoms including difficulty with sleep, irritability, difficulty concentrating, panic attacks, suicidal feelings, substance abuse, and depression, among others (CDC, undated; Center for Substance Abuse Treatment, 2014). The individual may experience these symptoms relatively soon after the traumatic event, but onset may also be delayed. There was one ICD-9 code for PTSD that crosswalks to three ICD-10 codes, which, along with the VASRD code, are presented in Table B.8.

Table B.8
Definitions of Posttraumatic Stress Disorder ICD-9, ICD-10, and VASRD Codes

Type of Code	Code	Description
ICD-9	309.81	Posttraumatic stress disorder
ICD-10	F43.10	Posttraumatic stress disorder, unspecified
ICD-10	F43.11	Posttraumatic stress disorder, acute
ICD-10	F43.12	Posttraumatic stress disorder, chronic
VASRD	9411	Posttraumatic stress disorder

SOURCES: ICD-9 codes from World Health Organization (1977). ICD-10 codes from World Health Organization (2004). VASRD codes from VA (1946).

Traumatic Brain Injury

To code TBI diagnoses, we made use of the AFHSB case definition for TBI.

Major Depressive Disorder

The ICD-9 and ICD-10 definitions for MDD come from two sources. We used the ICD-9 definition presented in Hepner et al., 2017.

The ICD-10 definition uses values generated by crosswalking the ICD-9 codes using the American Association of Professional Coders (AAPC) crosswalks (Advancing the Business of Healthcare, undated). However, both the ICD-9 codes 296.20 and 311 (depressive disorder, not elsewhere classified) are crosswalked to F32.9 (major depressive disorder, single episode, unspecified). Because 311 is not considered MDD and is a commonly used code, including F32.9 resulted in a sharp increase in MDD cases when converting to ICD-10 codes in FY 2016. Removing F32.9 and F33.9 results in a smoother series. See Figure B.1 for an illustration of how including F32.9 affects the number of service members identified as having a diagnosis of MDD (solid line), and how removing F32.9 and F33.9 affects the number (dashed line). To define our cohorts, we used the dashed line (without F32.9 and F33.9) to identify MDD diagnoses.

Table B.9
Definitions of Traumatic Brain Injury Codes

Type of Code	Severity/ Description	Code(s)
ICD-9	Mild	310.2, 850.0, 850.1, 850.11, 850.5, 850.9, 959.01, V15.5_2, V15.5_7, V15.5_C, V15.52_2, V15.52_7, V15.52_C, V15.59_2, V15.59_7, V15.59_C
ICD-9	Moderate	800.00, 800.01, 800.02, 800.03, 800.06, 800.09, 800.10, 800.11, 800.12, 800.13, 800.16, 800.19, 800.20, 800.21, 800.22, 800.23, 800.26, 800.29, 800.30, 800.31, 800.32, 800.33, 800.36, 800.39, 800.40, 800.41, 800.42, 800.43, 800.46, 800.49, 801.00, 801.01, 801.02, 801.03, 801.06, 801.09, 801.10, 801.11, 801.12, 801.13, 801.16, 801.19, 801.20, 801.21, 801.22, 801.23, 801.26, 801.29, 801.30, 801.31, 801.32, 801.33, 801.36, 801.39, 801.40, 801.41, 801.42, 801.43, 801.46, 801.49, 803.00, 803.01, 803.02, 803.03, 803.06, 803.09, 803.10, 803.11, 803.12, 803.13, 803.16, 803.19, 803.20, 803.21, 803.22, 803.23, 803.26, 803.29, 803.30, 803.31, 803.32, 803.33, 803.36, 803.39, 803.40, 803.41, 803.42, 803.43, 803.46, 803.49, 804.00, 804.01, 804.02, 804.03, 804.06, 804.09, 804.10, 804.11, 804.12, 804.13, 804.16, 804.19, 804.20, 804.21, 804.22, 804.23, 804.26, 804.29, 804.30, 804.31, 804.32, 804.33, 804.36, 804.39, 804.40, 804.41, 804.42, 804.43, 804.46, 804.49, 850.12, 850.2, 851.00, 851.01, 851.02, 851.03, 851.06, 851.09, 851.20, 851.21, 851.22, 851.23, 851.26, 851.29, 851.40, 851.41, 851.42, 851.43, 851.46, 851.49, 851.60, 851.61, 851.62, 851.63, 851.66, 851.69, 851.80, 851.81, 851.82, 851.83, 851.86, 851.89, 852.00, 852.01, 852.02, 852.03, 852.06, 852.09, 852.20, 852.21, 852.22, 852.23, 852.26, 852.29, 852.40, 852.41, 852.42, 852.43, 852.46, 852.49, 853.00, 853.01, 853.02, 853.03, 853.06, 853.09, 854.01, 854.02, 854.03, 854.06, 854.09, V15.5_3, V15.5_8, V15.5_D, V15.52_3, V15.52_8, V15.52_D, V15.59_3, V15.59_8, V15.59_D
ICD-9	Penetrating	800.50, 800.51, 800.52, 800.53, 800.54, 800.55, 800.56, 800.59, 800.60, 800.61, 800.62, 800.63, 800.64, 800.65, 800.66, 800.69, 800.70, 800.71, 800.72, 800.73, 800.74, 800.75, 800.76, 800.79, 800.80, 800.81, 800.82, 800.83, 800.84, 800.85, 800.86, 800.89, 800.90, 800.91, 800.92, 800.93, 800.94, 800.95, 800.96, 800.99, 801.50, 801.51, 801.52, 801.53, 801.54, 801.55, 801.56, 801.59, 801.60, 801.61, 801.62, 801.63, 801.64, 801.65, 801.66, 801.69, 801.70, 801.71, 801.72, 801.73, 801.74, 801.75, 801.76, 801.79, 801.80, 801.81, 801.82, 801.83, 801.84, 801.85, 801.86, 801.89, 801.90, 801.91, 801.92, 801.93, 801.94, 801.95, 801.96, 801.99, 803.50, 803.51, 803.52, 803.53, 803.54, 803.55, 803.56, 803.59, 803.60, 803.61, 803.62, 803.63, 803.64, 803.65, 803.66, 803.69, 803.70, 803.71, 803.72, 803.73, 803.74, 803.75, 803.76, 803.79, 803.80, 803.81, 803.82, 803.83, 803.84, 803.85, 803.86, 803.89, 803.90, 803.91, 803.92, 803.93, 803.94, 803.95, 803.96, 803.99, 804.50, 804.51, 804.52, 804.53, 804.54, 804.55,

Table B.9—Continued

Type of Code	Severity/ Description	Code(s)
		804.56, 804.59, 804.60, 804.61, 804.62, 804.63, 804.64, 804.65, 804.66, 804.69, 804.70, 804.71, 804.72, 804.73, 804.74, 804.75, 804.76, 804.79, 804.80, 804.81, 804.82, 804.83, 804.84, 804.85, 804.86, 804.89, 804.90, 804.91, 804.92, 804.93, 804.94, 804.95, 804.96, 804.99, 851.10, 851.11, 851.12, 851.13, 851.14, 851.15, 851.16, 851.19, 851.30, 851.31, 851.32, 851.33, 851.34, 851.35, 851.36, 851.39, 851.50, 851.51, 851.52, 851.53, 851.54, 851.55, 851.56, 851.59, 851.70, 851.71, 851.72, 851.73, 851.74, 851.75, 851.76, 851.79, 851.90, 851.91, 851.92, 851.93, 851.94, 851.95, 851.96, 851.99, 852.10, 852.11, 852.12, 852.13, 852.14, 852.15, 852.16, 852.19, 852.30, 852.31, 852.32, 852.33, 852.34, 852.35, 852.36, 852.39, 852.50, 852.51, 852.52, 852.53, 852.54, 852.55, 852.56, 852.59, 853.10, 853.11, 853.12, 853.13, 853.14, 853.15, 853.16, 853.19, 854.10, 854.11, 854.12, 854.13, 854.14, 854.15, 854.16, 854.19, V15.5_5, V15.5_A, V15.5_F, V15.52_5, V15.52_A, V15.52_F, V15.59_5, V15.59_A, V15.59_F
ICD-9	Severe	800.04, 800.05, 800.14, 800.15, 800.24, 800.25, 800.34, 800.35, 800.44, 800.45, 801.04, 801.05, 801.14, 801.15, 801.24, 801.25, 801.34, 801.35, 801.44, 801.45, 803.04, 803.05, 803.14, 803.15, 803.24, 803.25, 803.34, 803.35, 803.44, 803.45, 804.04, 804.05, 804.14, 804.15, 804.24, 804.25, 804.34, 804.35, 804.44, 804.45, 850.3, 850.4, 851.04, 851.05, 851.24, 851.25, 851.44, 851.45, 851.64, 851.65, 851.84, 851.85, 852.04, 852.05, 852.24, 852.25, 852.44, 852.45, 853.04, 853.05, 854.04, 854.05, V15.5_4, V15.5_9, V15.5_E, V15.52_4, V15.52_9, V15.52_E, V15.59_4, V15.59_9, V15.59_E
ICD-9	Unclassified	800.0, 800.1, 800.2, 800.3, 800.4, 800.5, 800.6, 800.7, 800.8, 800.9, 801.0, 801.1, 801.2, 801.3, 801.4, 801.5, 801.6, 801.7, 801.8, 801.9, 803.0, 803.1, 803.2, 803.3, 803.4, 803.5, 803.6, 803.7, 803.8, 803.9, 804.0, 804.1, 804.2, 804.3, 804.4, 804.5, 804.6, 804.7, 804.8, 804.9, 851.0, 851.1, 851.2, 851.3, 851.4, 851.5, 851.6, 851.7, 851.8, 851.9, 852.0, 852.1, 852.2, 852.3, 852.4, 852.5, 853.0, 853.1, 854.0, 854.00, 854.1, 907.0, 950.1, 950.2, 950.3, V15.5_1, V15.5_6, V15.5_B, V15.52_0, V15.52_1, V15.52_6, V15.52_B, V15.59_1, V15.59_6, V15.59_B
ICD-10	Mild	DOD0101, DOD0102, F07.81, S02.110, S02.110A, S02.112, S02.112A, S02.113, S02.113A, S02.8XXA, S06.0, S06.0X0, S06.0X0A, S06.0X1, S06.0X1A, S06.0X9, S06.0X9A, S06.2X9, Z87.820
ICD-10	Moderate	DOD0103, S02.0XXA, S02.10, S02.10XA, S02.111, S02.111A, S02.118, S02.118A, S02.119, S02.119A, S02.19, S02.19XA, S02.91, S02.91XA, S06.0X2, S06.0X2A, S06.0X3, S06.0X3A, S06.0X4, S06.0X4A, S06.1X, S06.1X0, S06.1X0A, S06.1X1, S06.1X1A, S06.1X2,

Table B.9—Continued

Type of Code	Severity/ Description	Code(s)
		S06.1X2A, S06.1X3, S06.1X3A, S06.1X4, S06.1X4A, S06.1X9, S06.1X9A, S06.2X, S06.2X0, S06.2X0A, S06.2X1, S06.2X1A, S06.2X2, S06.2X2A, S06.2X3, S06.2X3A, S06.2X4, S06.2X4A, S06.2X9A, S06.30, S06.300, S06.300A, S06.301, S06.301A, S06.302, S06.302A, S06.303, S06.303A, S06.304, S06.304A, S06.309, S06.309A, S06.31, S06.310, S06.310A, S06.311, S06.311A, S06.312, S06.312A, S06.313, S06.313A, S06.314, S06.314A, S06.319, S06.319A, S06.32, S06.320, S06.320A, S06.321, S06.321A, S06.322, S06.322A, S06.323, S06.323A, S06.324, S06.324A, S06.329, S06.329A, S06.33, S06.330, S06.330A, S06.331, S06.331A, S06.332, S06.332A, S06.333, S06.333A, S06.334, S06.334A, S06.339, S06.339A, S06.34, S06.340, S06.340A, S06.341, S06.341A, S06.342, S06.342A, S06.343, S06.343A, S06.344, S06.344A, S06.349, S06.349A, S06.35, S06.350, S06.350A, S06.351, S06.351A, S06.352, S06.352A, S06.353, S06.353A, S06.354, S06.354A, S06.359, S06.359A, S06.36, S06.360, S06.360A, S06.361, S06.361A, S06.362, S06.362A, S06.363, S06.363A, S06.364, S06.364A, S06.369, S06.369A, S06.37, S06.370, S06.370A, S06.371, S06.371A, S06.372, S06.372A, S06.373, S06.373A, S06.374, S06.374A, S06.379, S06.379A, S06.38, S06.380, S06.380A, S06.381, S06.381A, S06.382, S06.382A, S06.383, S06.383A, S06.384, S06.384A, S06.389, S06.389A, S06.4X, S06.4X0, S06.4X0A, S06.4X1, S06.4X1A, S06.4X2, S06.4X2A, S06.4X3, S06.4X3A, S06.4X4, S06.4X4A, S06.4X9, S06.4X9A, S06.5X, S06.5X0, S06.5X0A, S06.5X1, S06.5X1A, S06.5X2, S06.5X2A, S06.5X3, S06.5X3A, S06.5X4, S06.5X4A, S06.5X9, S06.5X9A, S06.6X, S06.6X0, S06.6X0A, S06.6X1, S06.6X1A, S06.6X2, S06.6X2A, S06.6X3, S06.6X3A, S06.6X4, S06.6X4A, S06.6X9, S06.6X9A, S06.89, S06.890, S06.890A, S06.891, S06.891A, S06.892, S06.892A, S06.893, S06.893A, S06.894, S06.894A, S06.899, S06.899A, S06.9X, S06.9X0, S06.9X0A, S06.9X1, S06.9X1A, S06.9X2, S06.9X2A, S06.9X3, S06.9X3A, S06.9X4, S06.9X4A, S06.9X9, S06.9X9A, S06.9X9S, S07.1, S07.1XXA
ICD-10	Penetrating	DOD0105, S02.0XXB, S02.10XB, S02.110B, S02.111B, S02.112B, S02.113B, S02.118B, S02.119B, S02.19XB, S02.8XXB, S02.91XB
ICD-10	Severe	DOD0104, S04.02, S04.02X, S04.02XA, S04.03, S04.031, S04.031A, S04.032, S04.032A, S04.039, S04.039A, S04.04, S04.041, S04.041A, S04.042, S04.042A, S04.049, S04.049A, S06.0X5, S06.0X5A, S06.0X6, S06.0X6A, S06.0X7, S06.0X7A, S06.0X8, S06.0X8A, S06.1X5, S06.1X5A, S06.1X6, S06.1X6A, S06.1X7,

Table B.9—Continued

Type of Code	Severity/ Description	Code(s)
		S06.1X7A, S06.1X8, S06.1X8A, S06.2X5, S06.2X5A, S06.2X6, S06.2X6A, S06.2X7, S06.2X7A, S06.2X8, S06.2X8A, S06.305, S06.305A, S06.306, S06.306A, S06.307, S06.307A, S06.308, S06.308A, S06.315, S06.315A, S06.316, S06.316A, S06.317, S06.317A, S06.318, S06.318A, S06.325, S06.325A, S06.326, S06.326A, S06.327, S06.327A, S06.328, S06.328A, S06.335, S06.335A, S06.336, S06.336A, S06.337, S06.337A, S06.338, S06.338A, S06.345, S06.345A, S06.346, S06.346A, S06.347, S06.347A, S06.348, S06.348A, S06.355, S06.355A, S06.356, S06.356A, S06.357, S06.357A, S06.358, S06.358A, S06.365, S06.365A, S06.366, S06.366A, S06.367, S06.367A, S06.368, S06.368A, S06.375, S06.375A, S06.376, S06.376A, S06.377, S06.377A, S06.378, S06.378A, S06.385, S06.385A, S06.386, S06.386A, S06.387, S06.387A, S06.388, S06.388A, S06.4X5, S06.4X5A, S06.4X6, S06.4X6A, S06.4X7, S06.4X7A, S06.4X8, S06.4X8A, S06.5X5, S06.5X5A, S06.5X6, S06.5X6A, S06.5X7, S06.5X7A, S06.5X8, S06.5X8A, S06.6X5, S06.6X5A, S06.6X6, S06.6X6A, S06.6X7, S06.6X7A, S06.6X8, S06.6X8A, S06.895, S06.895A, S06.896, S06.896A, S06.897, S06.897A, S06.898, S06.898A, S06.9X5, S06.9X5A, S06.9X6, S06.9X6A, S06.9X7, S06.9X7A, S06.9X8, S06.9X8A
ICD-10	Unknown	S02.0, S02.1, S02.11, S02.8, S02.9
VASRD	Residuals of TBI	8045
VASRD	Dementia due to head trauma/ major or mild neurocognitive disorder due to TBI	9304

SOURCES: ICD-9 codes from World Health Organization (1977). ICD-10 codes from World Health Organization (2004). VASRD codes from the VA (1946).

Table B.10
Definitions of Major Depressive Disorder Codes

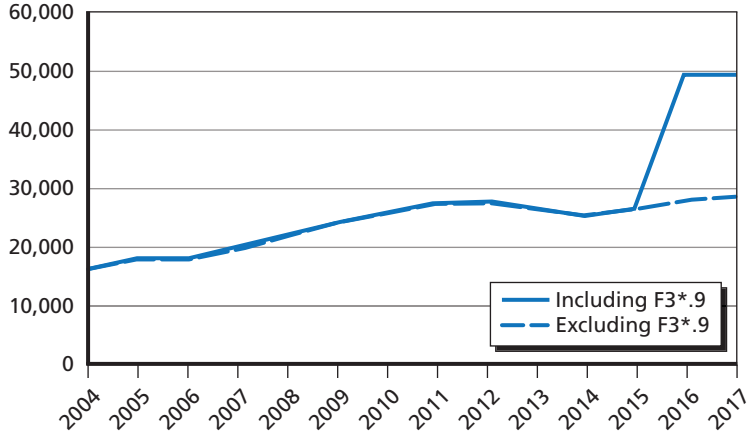
Type of Code	Code	Description
ICD-9	296.20	Major depressive disorder, single episode, unspecified
ICD-9	296.21	Major depressive disorder, single episode, mild
ICD-9	296.22	Major depressive disorder, single episode, moderate
ICD-9	296.23	Major depressive disorder, single episode, severe, without mention of psychotic behavior
ICD-9	296.24	Major depressive disorder, single episode, severe, specified as with psychotic behavior
ICD-9	296.25	Major depressive disorder, single episode, in partial or unspecified remission
ICD-9	296.26	Major depressive disorder, single episode, in full remission
ICD-9	296.30	Major depressive disorder, recurrent episode, unspecified
ICD-9	296.31	Major depressive disorder, recurrent episode, mild
ICD-9	296.32	Major depressive disorder, recurrent episode, moderate
ICD-9	296.33	Major depressive disorder, recurrent episode, severe, without mention of psychotic behavior
ICD-9	296.34	Major depressive disorder, recurrent episode, severe, specified as with psychotic behavior
ICD-9	296.35	Major depressive disorder, recurrent episode, in partial or unspecified remission
ICD-9	296.36	Major depressive disorder, recurrent episode, in full remission
ICD-10	F32.0	Major depressive disorder, single episode, mild
ICD-10	F32.1	Major depressive disorder, single episode, moderate
ICD-10	F32.2	Major depressive disorder, single episode, severe without psychotic features
ICD-10	F32.3	Major depressive disorder, single episode, severe with psychotic features
ICD-10	F32.4	Major depressive disorder, single episode, in partial remission
ICD-10	F32.5	Major depressive disorder, single episode, in full remission
ICD-10	F33.0	Major depressive disorder, recurrent, mild

Table B.10—Continued

Type of Code	Code	Description
ICD-10	F33.1	Major depressive disorder, recurrent, moderate
ICD-10	F33.2	Major depressive disorder, recurrent severe without psychotic features
ICD-10	F33.3	Major depressive disorder, recurrent, severe with psychotic symptoms
ICD-10	F33.40	Major depressive disorder, recurrent, in remission unspecified
ICD-10	F33.41	Major depressive disorder, recurrent, in partial remission
ICD-10	F33.42	Major depressive disorder, recurrent, in full remission
VASRD	9434	Major depressive disorder

SOURCES: ICD-9 codes from World Health Organization (1977); ICD-10 codes from World Health Organization (2004); VASRD codes from VA (1946).

Figure B.1
Number of Service Members with Major Depressive Disorder Diagnosis Based on the Inclusion of International Classification of Diseases-10 codes F32.9 and F33.9



Sleep Apnea

The ICD-9 definition of sleep apnea was taken from Taylor, et al. (2018). The ICD-10 definition uses values generated by crosswalking the ICD-9 codes using the Advancing the Business of Healthcare (AAPC) crosswalks (Advancing the Business of Healthcare, undated).

Table B.11
Definitions of Sleep Apnea Codes

Type of Code	Code	Description
ICD-9	327.20	Organic sleep apnea, unspecified
ICD-9	327.21	Primary central sleep apnea
ICD-9	327.23	Obstructive sleep apnea (adult)(pediatric)
ICD-9	327.27	Central sleep apnea in conditions classified elsewhere
ICD-9	327.29	Other organic sleep apnea
ICD-9	780.51	Insomnia with sleep apnea, unspecified
ICD-9	780.53	Hypersomnia with sleep apnea, unspecified
ICD-9	780.57	Unspecified sleep apnea
ICD-9	786.03	Apnea
ICD-10	G47.30	Sleep apnea, unspecified
ICD-10	G47.31	Primary central sleep apnea
ICD-10	G47.33	Obstructive sleep apnea (adult) (pediatric)
ICD-10	G47.37	Central sleep apnea in conditions classified elsewhere
ICD-10	G47.39	Other sleep apnea
ICD-10	R06.81	Apnea, not elsewhere classified
VASRD	6847	Sleep Apnea Syndromes

SOURCES: ICD-9 codes from World Health Organization (1977); ICD-10 codes from World Health Organization (2004); VASRD codes from VA (1946).

Back Pain

The VASRD codes for back and spine conditions went through a major revision starting in September 26, 2003 (VA, 2003; VA, 2015). Our current definition does not include VASRD 5242 (degenerative arthritis of the spine). This was grouped together with other arthritis VASRD codes into a flag that was not incorporated in the final analysis.

The ICD-9 definition of back pain was taken from Fritz et al. (2015). The ICD-10 definition uses values generated by crosswalking the ICD-9 codes using the Advancing the Business of Healthcare (AAPC) crosswalks (Advancing the Business of Healthcare, undated).

Table B.12
Back Pain Veterans Affairs Schedule for Rating Disabilities Codes

Pre-2004 VASRDs and Descriptions		2004-Present VASRDs and Descriptions	
VASRD	**VASRD Description**	**Note**	
5285	Vertebral fracture	5235	Vertebral fracture or dislocation
5286	Complete bony fixation	5240	Ankylosing spondylitis
		5241	Spinal fusion
5287	Cervical spine cannot move at all		
5288	Dorsal spine cannot move at all		
5289	Lumbar spine cannot move at all		
5290	Cervical spine limited in motion		
5281	Dorsal spine limited in motion		
5292	Lumbar spine limited in motion		
5293	Intervertebral disc syndrome	5243	Intervertebral disc syndrome
5294	Sacroiliac injury and weakness	5236	Sacroiliac injury and weakness
5295	Lumbosacral strain	5237	Lumbosacral or cervical strain
		5238	Spinal stenosis
		5239	Spondylolisthesis or segmental instability

SOURCES: World Health Organization (1977); World Health Organization (2004); VASRD codes from VA (1946).

Table B.13
Back Pain Codes

Type of Code	Code	Description
ICD-9	721.3	Lumbosacral spondylosis without myelopathy
ICD-9	722.1	Displacement of lumbar intervertebral disc without myelopathy
ICD-9	722.52	Degeneration of lumbar or lumbosacral intervertebral disc
ICD-9	722.73	Intervertebral disc disorder with myelopathy, lumbar region
ICD-9	722.93	Other and unspecified disc disorder, lumbar region
ICD-9	724.02	Spinal stenosis, lumbar region, without neurogenic claudication
ICD-9	724.2	Lumbago
ICD-9	724.3	Sciatica
ICD-9	724.4	Thoracic or lumbosacral neuritis or radiculitis, unspecified
ICD-9	724.5	Backache, unspecified
ICD-9	756.11	Spondylolysis, lumbosacral region
ICD-9	756.12	Spondylolisthesis
ICD-9	846.0	Sprain of lumbosacral (joint) (ligament)
ICD-9	846.1	Sprain of sacroiliac ligament
ICD-9	846.8	Sprain of other specified sites of sacroiliac region
ICD-9	846.9	Sprain of unspecified site of sacroiliac region
ICD-9	847.2	Sprain of lumbar
ICD-9	847.3	Sprain of sacrum
ICD-9	847.9	Sprain of unspecified site of back
ICD-10	M46.47	Discitis, unspecified, lumbosacral region
ICD-10	M47.817	Spondylosis without myelopathy or radiculopathy, lumbosacral region
ICD-10	M48.06	Spinal stenosis, lumbar region
ICD-10	M51.06	Intervertebral disc disorders with myelopathy, lumbar region

Table B.13—Continued

Type of Code	Code	Description
ICD-10	M51.07	Intervertebral disc disorders with myelopathy, lumbosacral region
ICD-10	M51.36	Other intervertebral disc degeneration, lumbar region
ICD-10	M51.37	Other intervertebral disc degeneration, lumbosacral region
ICD-10	M51.86	Other intervertebral disc disorders, lumbar region
ICD-10	M51.87	Other intervertebral disc disorders, lumbosacral region
ICD-10	M54.14	Radiculopathy, thoracic region
ICD-10	M54.15	Radiculopathy, thoracolumbar region
ICD-10	M54.16	Radiculopathy, lumbar region
ICD-10	M54.17	Radiculopathy, lumbosacral region
ICD-10	M54.30	Sciatica, unspecified side
ICD-10	M54.5	Low back pain
ICD-10	M54.89	Other dorsalgia
ICD-10	M54.9	Dorsalgia, unspecified
ICD-10	Q76.2	Congenital spondylolisthesis
ICD-10	S23.9XXA	Sprain of unspecified parts of thorax, initial encounter
ICD-10	S33.5XXA	Sprain of ligaments of lumbar spine, initial encounter
ICD-10	S33.6XXA	Sprain of sacroiliac joint, initial encounter
ICD-10	S33.8XXA	Sprain of other parts of lumbar spine and pelvis, initial encounter
ICD-10	S33.8XXA	Sprain of other parts of lumbar spine and pelvis, initial encounter
ICD-10	S33.8XXA	Sprain of other parts of lumbar spine and pelvis, initial encounter
ICD-10	S33.9XXA	Sprain of unspecified parts of lumbar spine and pelvis, initial encounter

SOURCES: ICD-9 codes from World Health Organization (1977); ICD-10 codes from World Health Organization (2004); VASRD codes from VA (1946).

Definitions from the Personnel Files

Occupation

Our prospective (descriptive and multivariate) analyses of trends in outcomes for service members with a PTSD or TBI diagnosis included occupation. Controlling for military occupation across services and over time is challenging because each service has a different set of codes, and they change over time; some are removed, some are added, and some are remapped to another code. To deal with these issues, we standardized military occupation over time by mapping service-specific codes to DoD occupation codes according to DMDC's April 2017 DoD Occupational Database (ODB) (DMDC, undated).

The DoD ODB lists six-digit military occupation codes, but for the purposes of our analysis, we needed them rolled up to a higher level. Therefore, we used the first two digits of the six-digit occupation code, as shown below in Table B.15, and derived labels that represented the six-digit occupations in each two-digit category. Two two-digit codes (13 and 26) were combined in our analytic file because they both represent medical occupations.

End of Analysis Period Outcomes

In Chapter Three, we characterized the service member's status at the end of the data period using the following rules:

- If the service member's record matches to any disability record, assume the service member was referred and evaluated for disability through DES.
- Assign service member to retirement, exit through ETS or administrative separation (see Table B.16 for codes).
- If the service member's record has an Interservice Separation Code (ISC) or casualty code indicating death (see below for more detail) and the service member is not already assigned to one of the prior mentioned categories, assume the service member has died.
- If the service member is still in the file at the end of the analysis period (2017) and is not already assigned to one of the prior categories, assume the service member is still serving.

Table B.14
Common Two-Digit Military Occupation Codes

Code	Army Description	Air Force Description	Marine Corps Description	Navy Description
10	Infantry, Combat, Artillery		Infantry, Armor, Artillery	Boatswain, Seaman, Artillery
11	Communication, Navigation	Communication, Electronics, Navigation	Communication, Radio, Radar, Missile	Computer, Radio, Radar, Missile, Fire Control, Sonar
12	Combat Operations, Intelligence, Analyst	Combat Operations, Intelligence, Analyst	Radio, Intelligence, Operations	Radar, Intercept, Operator, Analyst
13/26	Medical	Medical		Medical
15	Supply, Personnel, Operators, Administration	Supply, Personnel, Operators, Administration, Transportation	Supply, Personnel, Operators, Administration	Supply, Administration
16	Automotive, Aircraft, Ammunition	Automotive, Aircraft, Ammunition	Automotive, Aircraft, Lineman	Aircraft, Auxiliary, Electric, Propulsion
18	Food Service, Police, Fuel, Drivers	Food Service, Police, Fuel, Drivers	Food Service, Police, Drivers, Warehouse Equipment	Food Service, Police
22	Ground Naval Arms, Pilots	Pilots, Operations	Ground Naval Arms, Pilots	Ground Naval Arms, Pilots, Operations

NOTE: After performing an algorithm to standardize occupation codes over time and across services, we developed these descriptions to map to two-digit occupation codes.

- If the service member is not assigned to a prior category and is not in the file in the last year of the analysis period, assign as unknown.
- If the service member is assigned to both the death category and one of the non-DES outcome categories, assign as unknown.

Disability Separation

Along with the separation dates, the ADTF contains additional codes describing the separation. These include ISC, Separation Program Designator (SPD), and Military Characterization of Service (COS) Code. For the most part, SPD codes nest within ISC codes. We use the ISC codes to build categories describing the separation, similar to the way we handle disability system disposition. However, we include the additional category of "exist" for separations related to a condition existing prior to service and drop the RTD category because we have information only on separations.

Table B.15
Disability Separation Codes

Interservice Separation Code	Description	Disposition Category
1010	Condition existing prior to service	exist
1011	Disability, severance pay	sep_ben
1012	Permanent disability retirement	pdrl
1013	Temporary disability retirement	tdrl
1014	Disability, no condtn existng prior to srvce, no sev pay	sep_noben
2010	Condition existing prior to service	exist
2011	Disability, severance pay	sep_ben
2012	Permanent disability retirement	pdrl
2013	Temporary disability retirement	tdrl

NOTE: Authors manually mapped ISC to the disposition codes defined in Table B.1.

Administrative Separation

We used SPD codes to determine administrative separations, as shown in Table B.16.

Table B.16
Administrative Separation Codes

Type of Administrative Separation	Separation Program Designator Codes
Involuntary discharge, not entitled to administrative board	JCC, JDK, JDL, JDN, JFG, JFM, JKB, JKL, JNB, JGA, JNC, JND, JDA, JDG, JFB, JGH, JHJ, JFC, JKK, JKL, JKM, JKN, JKQ, JKR, JCP, JEN, JEP, JER, JFA, JFD, JKF, JCR, JKA, JKD, JDT, JDU, JFP, JFR, JGB, JHF, JHK, JHD, JRA, JRB, JRC, JBM, JFF, JFT, JFV, JFW, JFX, JPC, JPD, JBB, JBC, JDF, JFE, JFN, JFU, JFY, JFZ
Involuntary discharge, approved recommendation of administrative board	GCC, GDK, GDL, GHF, GHK, GCR, GDA, GDG, GGH, GHJ, GKF, GKK, GKM, GKN, GKQ, GDU, GFD, GFE, GFY, GFZ, GKB, GKL, GNC, GRA, GRB, GRC, GFC, GFT, GFV, GFX, GKA, GKD, GKR, GPC, GPD, GDT
Involuntary discharge, administrative board waived	HDK, HHF, HKB, HKL, HNB, HGH, HHJ, HFC, HFT, HFV, HKL, HKM, HKN, HKQ, HKR, HFY, HFZ, HDG, HRA, HRB, HRC, HCR, HDA, HFX, HKA, HKD, HKF, HKK, HPC, HPD, HDT, HDU, HFD, HFE
Involuntary release from active duty or transfer	LBB, LBC, LCC, LFH, LGJ, LGB, LHH, LND, LFR, LBM, LCR, LDG, LDN, LFF, LFT, LFV, LFW, LFX, LGA, LBD, LER, LHD, LHJ, LFC, LDL, LGC, LGH
Courts-martial	JJA, JJN, JJC, JJD, JJE, JJF
Expiration Term of Service (includes voluntary and involuntary ETS)	KBK, MBK, FBK, LBK, JBK, HBK, GBK
Voluntary discharge	KBM, KCA, KCB, KCC, KCF, KCM, KDB, KDF, KDG, KDM, KDS, KFF, KFN, KDK, KHK, KNC, KND, KFS, KFV, KBJ, KCN, KEN, KFH, KGP, KGQ, KGX, KHD, KHF, KRB, KGH, KFX, KFM, KCP, KCQ
Voluntary separation to another service	MBD, NBD, NBE, MBJ, MBM, MCA, MCK, MCN, MCQ, MDB, MDF, MDG, MDM, MFF, MGH, MGJ, MGP, MGQ, MGU, MND, MCB, MCC, MCF, MDS
Officer resignation	FBD, FBJ, FCA, FCB, FCC, FCF, BCR, BDA, FDB, FDF, BDG, BDK, FDL, BFT, BFV, FFW, BFX, BFY, FGP, FGQ, BKB, BKK, BKL, DKL, BKM, BKN, BKQ, BNB, BNC, FND, BPD, BRA, BRB, FCK, FCM, FCN, FCQ, FDM, FFF, DFS, BHF, BHJ, BHX, BKA
Retirement (includes voluntary and mandatory retirement)	Voluntary: RBB, RBC, RBD, RBE, RCC, RHK, RNC Mandatory: SBB, SBC, SBE, SCC, SCN, SGB, SHX, SNC

SOURCES: Army Regulation 600-8-24; Army Regulation 635-200, 2016; Army Regulation 600-8-24, 2011; Department of Defense, 2011; DoDI 1332.18, 2014b; DoDI 1332.30, 2018; U.S. Department of the Air Force, 2018; U.S. Department of the Navy, 2005, 2013.

Death

Finally, we used casualty data and ISC codes to determine if a service member died by the time our observation period ended. There is a variable on the casualty file that indicates death (code = D), and the ISC codes that indicate death are listed in Table B.17.

Table B.17
Death Separation Codes

Interservice Separation Code	Description
1030	Death, battle casualty
1031	Death, non battle, disease
1032	Death, non battle, other
1033	Death, cause not specified
2030	Death, battle casualty
2031	Death, non battle, disease
2032	Death, non battle, other
2033	Death, cause not specified

To reconcile these two sources of information, we used the following rules.

- If ISC and the casualty data both indicated death, assume the service member has died. If the two files indicate different years of death, use latest date.
- If ISC indicates death and the casualty file does not, assume the service member has died (service member may have died in a setting other than deployment).
- If the casualty file indicates that the service member died but ISC does not
  - code as death if ISC is missing or
  - code as unknown if ISC indicates a different type of separation.

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Since 2001, more than 3 million service members have deployed in support of multiple combat operations in Afghanistan, Iraq, and other theaters. Many have been diagnosed with the "signature wounds" of these conflicts: posttraumatic stress disorder (PTSD) and/or traumatic brain injury (TBI). During the intervening years, the process by which service members are evaluated for disability has evolved significantly, including a complete overhaul of the Disability Evaluation System (DES) beginning in 2007. Meanwhile, the Department of Defense (DoD) and the services made policy changes and initiated other efforts to improve screening for PTSD and TBI, encourage service members to seek treatment, improve quality of care, and reduce the stigma associated with treatment for these conditions.

To explore these changes, as well as their potential effects on the numbers and characteristics of service members who are evaluated through DES, the authors identify and assess trends in DES outcomes for PTSD and TBI between 2002 and 2017.

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