

# Demographic Profile and Service-Connection Trends of Posttraumatic Stress Disorder and Traumatic Brain Injury in US Veterans Pre- and Post-9/11

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**Introduction:** This study seeks to understand the demographic changes in the active-duty service member profile, both prior to and following September 11, 2001 (9/11). The study analyzed diagnosis of posttraumatic stress disorder (PTSD) and traumatic brain injury (TBI) and measures of severity of those diagnoses as recorded in service-connection ratings (percent disability).

**Methods:** A retrospective cohort-study of military veterans who received care at Veterans Health Administration medical centers between December 1998 and May 2014 was conducted based on clinical data recorded and stored within the Corporate Data Warehouse.

**Results:** A cohort of 1,339,937 veterans received an inpatient or outpatient diagnosis of PTSD and/or TBI. The cohort was divided into 4 service period groups and 3 diagnosis categories. The service periods included pre-9/11 (n = 1,030,806;

77%), post-9/11 (n = 204,083; 15%), overlap-9/11 (n = 89,953; 7%), and reentered post-9/11 (n = 15,095; 1%). The diagnosis categories included PTSD alone (n = 1,132,356; 85%), TBI alone (n = 100,789; 7%) and PTSD+TBI (n = 106,792; 8%). Results of the post-9/11 group revealed significant changes, including (1) increase of veterans with PTSD+TBI; (2) increase of female veterans with PTSD+TBI; and (3) increase of severity level of diagnosed PTSD/TBI as evidenced by higher service-connected disability pensions at younger age in the post-9/11 group. Additionally, data revealed unequal distribution of veterans with PTSD+TBI across geographic areas.

**Conclusions:** The veteran of the post-9/11 service period does not mirror the veteran of the pre-9/11 service period. Findings are valuable for policy making, allocation of resources, and for reconsidering the prevailing paradigm for treating veterans with PTSD and/or TBI.

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The nature of combat and associated injuries in Operation Iraqi Freedom (OIF), Operation Enduring Freedom (OEF), Operation New Dawn (OND), and Afghanistan War is different from previous conflicts. Multiple protracted deployments with infrequent breaks after September 11, 2001 (9/11) have further compounded the problem.

Posttraumatic stress disorder (PTSD) and traumatic brain injury (TBI) are the signature wounds of recent wars, with a higher incidence among the veterans of OEF and OIF compared with those from previous conflicts.<sup>1,2</sup> More than 2.7 million who served in Iraq and Afghanistan suffer from PTSD.<sup>3,4</sup> Symptoms of PTSD may appear within the first 3 months after exposure to a traumatic event or after many months and, in some cases, after a delay of many years and continue for life.<sup>5</sup> Although delayed onset of PTSD in the absence of prior symptoms is rare,<sup>6,7</sup> its incidence rises with increasing frequency of exposure to traumatic events<sup>8,9</sup> and over time.<sup>10</sup>

According to the Brain Injury Associ-

ation of America, TBI is “an alteration in brain function, or other evidence of brain pathology, caused by an external force.”<sup>8</sup> TBI is often associated with increased risk of PTSD, depression, and posttraumatic headache,<sup>11-13</sup> which may lead to broader cognitive, somatic, neurobiological, and psychosocial dysfunctions.<sup>14-17</sup> According to Veterans Health Administration (VHA) data, 201,435 veterans from all eras enrolled with the US Department of Veterans Affairs (VA) have a diagnosis associated with TBI and 56,695 OEF/OIF veterans have been evaluated for a TBI-related condition.<sup>2</sup> According to the Defense and Veterans Brain Injury Center (DVBIC), > 361,000 veterans have been diagnosed with TBI, with a peak of 32,000 cases in 2011.<sup>1,18</sup> Moreover, the reported incidence and prevalence of PTSD and TBI among US veterans are not consistent. The incidence of PTSD has been estimated at 15% to 20% in recent wars<sup>3,19</sup> compared with 10% to 30% in previous wars.<sup>3,19,20</sup>

When PTSD or TBI is deemed “related” to military service, the veteran may

**TABLE 1** Relative Distribution of Veterans by Gender and Age Among Service Period Groups and Diagnostic Category

Service Periods	No. (%)	Average Age (SD), y	Diagnostic Categories	Veterans, No. (%)	Male, No. (%)	Age, Mean (SD), y
Pre-9/11	1,030,806 (77)	66.3 (11.2)	PTSD only	906,343 (88)	852,762 (94.1)	66.1 (10.9)
			TBI only	83,538 (8)	79,427 (95.1)	69.7 (14.0)
			PTSD+TBI	40,925 (4)	37,754 (92.2)	63.0 (11.1)
Post-9/11	204,083 (15)	36.1 (8.7)	PTSD only	145,373 (71)	125,227 (86.1)	36.6 (9)
			TBI only	11,389 (6)	10,435 (91.6)	34.4 (8.1)
			PTSD+TBI	47,321 (23)	44,713 (94.5)	35.1 (7.9)
Overlap	89,953 (7)	41.4 (8.2)	PTSD only	69,542 (77)	57,027 (82)	41.7 (8.4)
			TBI only	5,273 (6)	4,690 (88.9)	41.7 (8.4)
			PTSD+TBI	15,138 (17)	14,116 (93.2)	40.1 (7.2)
Reentered	15,095 (1)	46.9 (9.2)	PTSD only	11,098 (74)	9,447 (85.1)	47.4 (9.3)
			TBI only	589 (4)	529 (89.8)	46.3 (9.5)
			PTSD+TBI	3,408 (22)	3,168 (93)	45.4 (8.6)

Abbreviations: PTSD, posttraumatic stress disorder; TBI, traumatic brain injury.

receive a service-connected disability rating ranging from 0% (no life-interfering symptoms due to injury) to 100% (totally disabling injury). The percentage of service connection associated with an injury is a quantifiable measure of the debilitating effect of injury on the individual. A significant majority (94%) of those who seek mental health services and treatment at VHA clinics apply for PTSD-related disability benefits.<sup>21</sup> The estimated cost related to PTSD/TBI service-connected pensions is \$20.28 billion per year and approximately \$514 billion over 50 years.<sup>22</sup> The cost of VA and Social Security disability payments combined with health care costs and treatment of PTSD is estimated to exceed \$1 trillion over the next 30 years.<sup>22</sup>

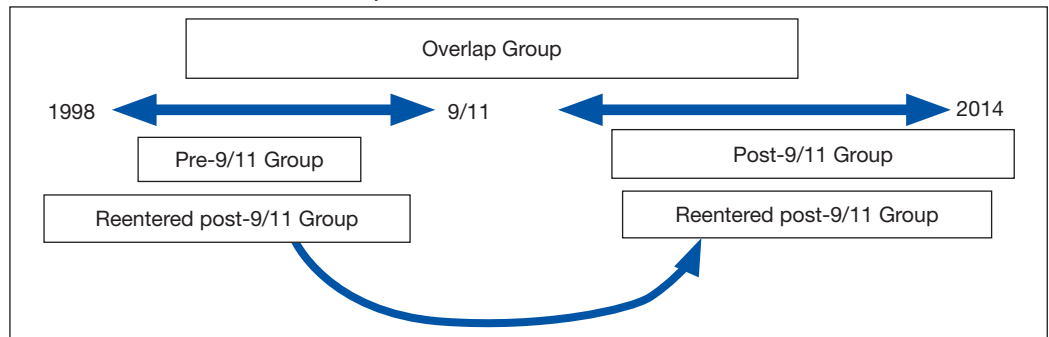
The National Vietnam Veterans Readjustment Study (NVVRS) provided valuable information on prevalence rates of PTSD and other postwar psychological problems.<sup>23</sup> Meanwhile, there have been no recent large-scale studies to compare the demographics of veterans diagnosed with PTSD and TBI who served prior to and after 9/11. A better understanding of demographic changes is considered essential for

designing and tailoring therapeutic interventions to manage the rising cost.<sup>22</sup>

The present study focused on identifying changing trends in the demographics of veterans who served prior to and after 9/11 and who received a VA inpatient or outpatient diagnosis of PTSD and/or TBI. Specifically, this study addressed the changes in demographics of veterans with PTSD, TBI, or PTSD+TBI seen at the VHA clinics between December 1, 1998 and May 31, 2014 (before and after September 11, 2001) for diagnosis, treatment and health care policy issues.

## METHODS

This study was approved by the Kansas City VA Medical Center Institutional Review Board. VHA data from the Corporate Data Warehouse (CDW) and the National Patient Care Database were extracted using the VA Informatics and Computing Infrastructure (VINCI) workspace. CDW uses a unique identifier to identify veterans across treatment episodes at more than 1,400 VHA centers organized under 21 Veterans Integrated Service Networks (VISNs). These sources of VA data are widely used for retrospective longitudinal studies.

**FIGURE 1** Service Period Groups With Reference to 9/11

### Study Population

The study population consisted of 1,339,937 veterans with a VA inpatient/outpatient diagnosis of PTSD or TBI using *International Statistical Classification of Diseases and Related Health Problems, Ninth Revision* (ICD-9) codes between December 1, 1998 and May 31, 2014. Demographic (gender classification, race, ethnicity, marital status, age at date of data extraction, and date of death if indicated), service-connection disability rating, and geographic distribution within VISN data on each veteran were then extracted.

Veterans in the cohort were assigned to 1 of 4 US military services period groups. The pre-9/11 group included veterans who entered and left the military prior to September 11, 2001. This group mostly included veterans from World War II, Korean War, Vietnam War, and the first Gulf War (1990-1991). The post-9/11 group included veterans who first entered military services after September 11, 2001. The overlap group included veterans who entered military services prior to 9/11, remained in service and left after September 11, 2001. The reentered group included veterans who entered and left service prior to September 11, 2001, and then reentered military service after September 11, 2001 (Figure 1). Using ICD-9 codes, veterans also were placed into the following categories: PTSD alone (ICD-9 309.81 only), TBI alone (ICD-9 850.0-859.9, V15.52), and PTSD+TBI (any combination of ICD-9 codes from the other categories).

### Statistical Analysis

Descriptive statistics were applied using proportions and means. Relationships between variables were examined using  $\chi^2$  tests,

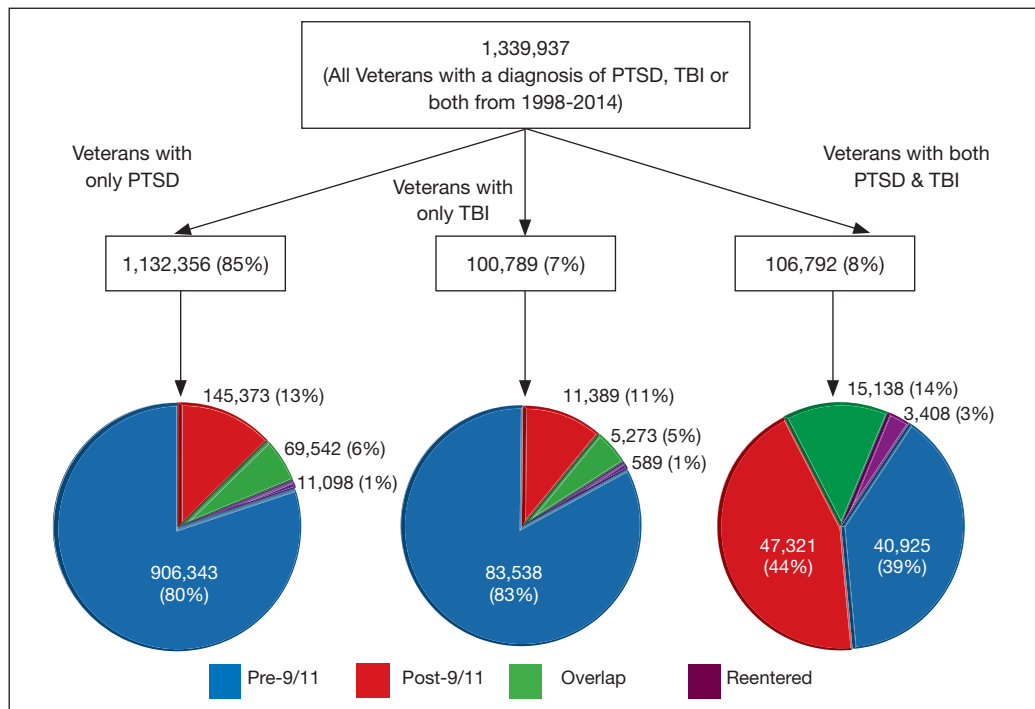
*t* tests, analysis of variance, and nonparametric tests. All hypotheses were 2-sided at 95% CI. Results are presented as absolute numbers.

### RESULTS

PTSD only ( $n = 1,132,356$ , 85%) was the predominant diagnosis category followed by PTSD+TBI ( $n = 106,792$ , 8%) and TBI only ( $n = 100,789$ , 7%) (Figure 2). Most of the veterans in the study served pre-9/11 (77%), followed by post-9/11 (15%); 7% were in the overlap group, and 1% in the reentered group (Table 1). It is notable that the proportion of veterans diagnosed with PTSD decreased from pre-9/11 (88%) to post-9/11 (71%), overlap (77%), and reentered (74%) service periods. Increases were noted in those with PTSD+TBI diagnosis category from pre-9/11 (4%) to post-9/11 (23%), overlap (17%), and reentered (22%) service periods (Figure 3). In general, the relative distribution of diagnostic categories in all the service periods showed a similar trend, with the majority of veterans diagnosed with PTSD only. Across all service periods, significantly smaller proportions of veterans were diagnosed with TBI only ( $P < .001$ ).

### Distribution by Gender and Age

The cohort was 92% male ( $n = 1,239,295$ ), but there was a marked increase in the percentage of nonmale veterans in post-9/11 groups. Study population ages ranged from 18 to 99 years based on date of birth to the date data were obtained; or date of birth to date of death, for those who were reported deceased at the time the data were obtained. The average (SD) ages for veterans in the pre-9/11 group were significantly older (66.3 [11.2] years) compared with the ages

**FIGURE 2** Relative Distribution of Veterans Diagnosed With PTSD, TBI, or Both

of veterans in the post-9/11 group (36.1 [8.7] years), the overlap group (41.4 [8.2] years), and the reentered group (46.9 [9.2] years), respectively.

#### Distribution by Race and Marital Status

The cohort identified as 65.7% white and 18.2% African American with much smaller percentages of Asians, American Indian/Alaska Natives (AI/AN) and Native Hawaiian/Pacific Islanders (Table 2). The relative proportion of AI/AN and Native Hawaiian/Pacific Islanders remained constant across all groups, whereas the number of Asians diagnosed with PTSD, TBI, or PTSD+TBI increased in the post-9/11 group. The number of African Americans diagnosed with PTSD, TBI, or both markedly increased in the overlap and reentered groups when compared with the pre-9/11 group, yet it went down in the post-9/11/group.

Half the cohort identified themselves as married ( $n = 675,145$ ) (Table 3). A slightly larger proportion of those diagnosed with PTSD alone were married (51.7%), compared with those diagnosed with TBI only (40.3%), or PTSD+TBI (45.8%). Veterans in the post-9/11 group were less likely to iden-

tify as married (45.2%) compared with the pre-9/11 (51.2%), overlap (52.6%), or reentered (53.2%) groups. Divorce rates among pre-9/11 group, overlap group, and reentered group were higher compared with that of the post-9/11 group in all diagnosis categories.

#### Geographic Distribution

Veterans diagnosed with PTSD, TBI, or both were not evenly distributed across the VISNs. VISNs 7, 8, 10, and 22 treated the most veterans, whereas VISN 9 and 15 treated the fewest. Taken together, the top 3 VISNs accounted for 27% to 28% of the total while lowest 3 accounted for 8% to 9% of the total cohort.

#### Service-Connected Disability

Of 1,339,937 veterans in the cohort, 1,067,691 had a service-connected disability rating for PTSD and/or TBI (Table 4). Most were diagnosed with PTSD ( $n = 923,523$ , 86.5%) followed by both PTSD+TBI ( $n = 94,051$ , 8.8%). Three-quarters of the veterans with a service-connected disability were in the pre-9/11 group. Nearly 80% of veterans with a service-connected disability rating had a rating of > 50%. The average (SD) age of veterans with PTSD+TBI and a

**TABLE 2** Relative Distribution of Veterans by Race

Service Periods											
Pre-9/11 (n = 1,030,806)			Post-9/11 (n = 204,083)			Overlap (n = 89,953)			Reentered (n = 15,095)		
PTSD Only 906,343 (88)	TBI Only 83,538 (8)	PTSD + TBI 40,925 (4)	PTSD Only 145,373 (71)	TBI Only 11,389 (6)	PTSD + TBI 47,321 (23)	PTSD Only 69,542 (77)	TBI Only 5,273 (6)	PTSD + TBI 15,138 (17)	PTSD Only 11,098 (74)	TBI Only 589 (4)	PTSD + TBI 3,408 (22)
Race, White, No. (%)											
579,465 (63.9)	55,929 (67.0)	28,412 (69.4)	105,489 (72.6)	8,815 (77.4)	37,176 (78.6)	41,150 (59.2)	3,389 (64.3)	10,309 (68.1)	6,904 (62.2)	402 (68.3)	2,472 (72.5)
Race, African American, No. (%)											
171,378 (18.9)	12,772 (15.3)	7,339 (17.9)	21,776 (15.0)	1,052 (9.2)	4,337 (9.2)	18,352 (26.4)	1,005 (19.1)	2,765 (18.3)	2,879 (25.9)	103 (17.5)	564 (16.6)
Race, American Indian/Alaska Native, No. (%)											
11,879 (1.3)	727 (0.9)	735 (1.8)	2,137 (1.5)	148 (1.3)	826 (1.8)	1,058 (1.5)	78 (1.5)	322 (2.1)	175 (1.6)	9 (1.5)	59 (1.7)
Race, Native Hawaiian/Pacific Islander, No. (%)											
10,221 (1.1)	654 (0.8)	452 (1.1)	1,818 (1.3)	129 (1.1)	641 (1.4)	993 (1.4)	59 (1.1)	249 (1.6)	124 (1.1)	6 (1.0)	46 (1.4)
Race, Asian, No. (%)											
4,807 (0.5)	400 (0.5)	197 (0.5)	2,606 (1.8)	241 (2.1)	835 (1.8)	1,514 (2.2)	151 (2.9)	297 (2.0)	168 (1.5)	19 (3.2)	39 (1.1)
Race, unknown, No. (%)											
128,593 (14.2)	13,056 (15.6)	3,790 (9.3)	11,547 (7.9)	1,004 (8.8)	3,506 (7.4)	6,475 (9.3)	591 (11.2)	1,196 (7.9)	848 (7.6)	50 (8.5)	228 (6.7)

Abbreviations: PTSD, posttraumatic stress disorder; TBI, traumatic brain injury.

> 50% service-connected disability was 66.3 (11.2) years in the pre-9/11 group compared with 36.1 (8.7) years in the post-9/11 group.

**DISCUSSION**

The demographic profile of veterans diagnosed with PTSD+TBI has changed across the service periods covered in this study. Compared with pre-9/11 veterans, the post-9/11 cohort: (1) higher percentage were diagnosed with PTSD+TBI; (2) higher proportion were nonmale veterans; (3) included more young veterans with > 50% service-connected disability; (4) were more racially diverse; and (5) were less likely to be married and divorced and more likely to be self-identified as single. Additionally, data revealed that veterans tended to locate more to some geographic regions than to others.

The nature of the warfare has changed remarkably over the past few decades. Gunshot

wounds accounted for 65% of all injuries in World War I, 35% during Vietnam War, and 16% to 23% in the First Gulf War.<sup>24</sup> In post-9/11 military conflicts, 81% of injuries were explosion related.<sup>24,25</sup> Although improvements in personal protective gear and battlefield trauma care led to increased survival, several factors may have contributed to increased reporting of TBI, which peaked in 2011 at 32,000 cases.<sup>24-26</sup>

**Increases in PTSD Diagnosis**

Increasing media awareness, mandatory battlefield concussion screening programs instituted by the US Department of Defense (DoD), and stressful conditions that exacerbate mild TBI (mTBI) may have all contributed to the increase in numbers of veterans seeking evaluations and being diagnosed with PTSD and/or TBI in the post-9/11 groups. Additionally, the 2007 National

**TABLE 3** Relative Distribution of Veterans by Marital Status

Service Periods											
Pre-9/11 (n = 1,030,806)			Post-9/11 (n = 204,083)			Overlap (n = 89,953)			Reentered (n = 15,095)		
PTSD Only	TBI Only	PTSD + TBI	PTSD Only	TBI Only	PTSD + TBI	PTSD Only	TBI Only	PTSD + TBI	PTSD Only	TBI Only	PTSD + TBI
906,343 (88)	83,538 (8)	40,925 (4)	145,373 (71)	11,389 (6)	47,321 (23)	69,542 (77)	5,273 (6)	15,138 (17)	11,098 (74)	589 (4)	3,408 (22)
Marital status, married, No. (%)											
477,640 (52.7)	33,194 (39.7)	16,694 (40.8)	65,783 (45.3)	4,504 (39.6)	21,991 (46.5)	36,388 (52.3)	2,585 (49.0)	8,337 (55.1)	5,863 (52.8)	289 (49.1)	1,877 (55.1)
Marital status, divorced, No. (%)											
237,433 (26.2)	24,525 (29.4)	13,734 (33.6)	24,390 (16.8)	1,551 (13.6)	8,190 (17.3)	14,571 (21.0)	1,053 (20.0)	3,191 (21.1)	2,505 (22.6)	145 (24.6)	752 (22.1)
Marital status, separated, No. (%)											
35,649 (3.9)	3,041 (3.6)	2,001 (4.9)	7,182 (4.9)	432 (3.8)	2,511 (5.3)	3,207 (4.6)	213 (4.0)	797 (5.3)	548 (4.9)	24 (4.1)	180 (5.3)
Marital status, single, No. (%)											
85,526 (9.4)	11,814 (14.1)	5,524 (13.5)	45,380 (31.2)	4,626 (40.6)	14,014 (29.6)	13,439 (19.3)	1,241 (23.5)	2,555 (16.9)	1,825 (16.4)	118 (20.0)	523 (15.4)
Marital status, widowed, No. (%)											
47,811 (5.3)	9,183 (11.0)	2,083 (5.1)	461 (0.3)	33 (0.3)	111 (0.2)	342 (0.5)	20 (0.4)	45 (0.3)	81 (0.7)	3 (0.5)	28 (0.8)
Marital status, unknown, No. (%)											
22,284 (2.5)	1,781 (2.1)	889 (2.2)	2,177 (1.5)	243 (2.1)	504 (1.1)	1,595 (2.3)	161 (3.1)	213 (1.4)	276 (2.5)	10 (1.7)	48 (1.4)

Abbreviations: PTSD, posttraumatic stress disorder; TBI, traumatic brain injury.

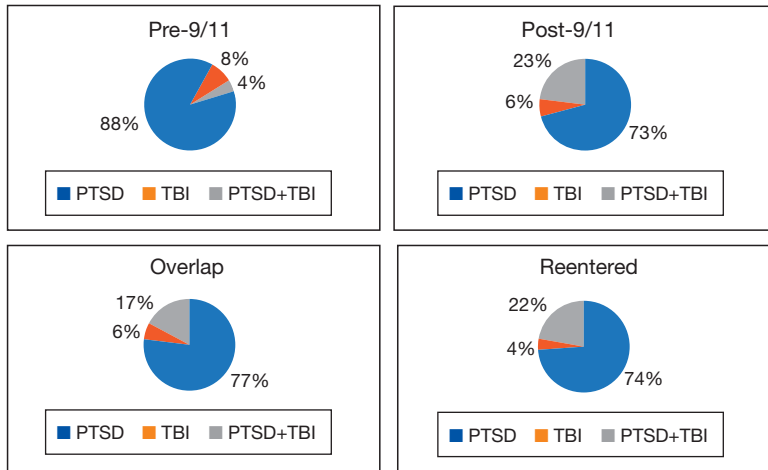
Defense Authorization Act requested the Secretary of Defense to develop a comprehensive, systematic approach for the identification, treatment, disposition, and documentation of TBI in combat and peacetime. By a conservative estimate, significant numbers of veterans will continue to be seen for mTBI at about 20,000 new cases per year.<sup>25-27</sup>

More frequent diagnosis of mTBI may have contributed to the increase in veterans diagnosed with PTSD+TBI in the post-9/11 groups. A recent study found that almost 44% of US Army infantry soldiers in Iraq did not lose consciousness but reported symptoms consistent with TBI.<sup>14</sup> Compared with veterans of previous wars, veterans of the post-9/11 conflicts (OIF, OED, and OND) have experienced multiple, protracted deployments with infrequent breaks that can have a cumulative effect on the development of PTSD.<sup>8-10</sup>

The findings from the NVVRS study led to creation of specialized PTSD programs in the late 1980s. Since then, there has been an explosion of knowledge and awareness about PTSD, TBI, and the associated service-connected disability ratings and benefits, leading to an increased number of veterans seeking care for PTSD. For example, media coverage of the 50th anniversary of the D-day celebrations resulted in a surge of World War II veterans seeking treatment for PTSD and a surge of Vietnam veterans sought treatment for PTSD during the wars in Iraq and Afghanistan.<sup>28</sup> An increased number of veterans reporting PTSD symptoms prompted the DoD to increase screening for PTSD, and to encourage service members to seek treatment when appropriate.

The VA has instituted training programs for clinicians and psychologists to screen and provide care for PTSD. Beginning in



**FIGURE 3** Distribution of Veterans Diagnosed With PTSD, TBI, or Both

2007, the VA implemented mandatory TBI screening for all veterans who served in combat operations and separated from active-duty service after September 11, 2001. The 4-question screen identifies veterans who are at increased risk of TBI and who experience symptoms that may be related to specific event(s).<sup>29</sup> A positive screen does not diagnose TBI but rather indicates a need for further evaluation, which may or may not be responsible for inflated reporting of TBI. Renewed research also has led providers to recognize and study PTSD resulting from noncombat trauma and moral injury. The possibility of delayed onset also drives up the number of veterans diagnosed with PTSD.<sup>5-7</sup>

### Prevalence

A wide variability exists in the reported prevalence of PTSD among US war veterans with estimates ranging from 15% to 20% of veterans from recent conflicts<sup>3,20</sup> and 10% to 30% of veterans from previous wars.<sup>3,19</sup> These rates are higher than estimates from allied forces from other countries.<sup>19</sup> Meta-analyses suggest that the prevalence of PTSD is 2% to 15% among Vietnam War veterans, 1% to 13% among first (pre-9/11) Gulf War veterans, 4% to 17% among OEF/OIF/OND veterans; these veterans have a lifetime prevalence of 6% to 31%.<sup>3,11,19,30-38</sup> The prevalence of PTSD is 2 to 4 times higher among the US veterans<sup>19,39</sup> when compared with that of civilians.<sup>40,41</sup> According to one study, concomitant PTSD and TBI appears to be

much higher in US war veterans (4%-17%) compared with United Kingdom Iraq War veterans (3%-6%).<sup>19</sup>

This study's finding of an increase in nonmale soldiers with PTSD and/or TBI was not surprising. There is a paucity of data on the effect of war zone exposure on women veterans. Recently, women have been more actively involved in combat roles with 41,000 women deployed to a combat zone. Results of this study indicate a 2- to 3-fold increase in veterans identifying themselves as nonmale in post-9/11 groups with a higher proportion diagnosed with either PTSD alone or PTSD and TBI. Women are at a higher risk for PTSD than are men due in part to exposure to abuse/trauma prior to deployment, experience of higher rates of discrimination, and/or sexual assault.<sup>31-33</sup>

One study involving First Gulf War female veterans reported higher precombat psychiatric histories as well as higher rates of physical and sexual abuse when compared with that of men.<sup>31</sup>

In this study, the average age of veterans adjudicated and compensated for PTSD and/or TBI pre-9/11, was 66 years compared with 36 years for post-9/11 veterans. Sixty-six percent of veterans from the post-9/11 group had  $\geq 50\%$  service-connected disability at age 36 years; 75% of veterans from the overlap group had  $\geq 50\%$  service-connected disability at age 41 years; and 76% veterans from the reentered group had  $\geq 50\%$  service-connected disability at age 46 years. Younger age at diagnosis and higher rates of disability not only pose unique challenges for veterans and family members, but also suggest implications for career prospects, family earnings, loss of productivity, and disease-adjusted life years. Also noted in the results, this younger cohort has a higher percentage of single/unmarried veterans, suggesting familial support systems may be more parental than spousal. Treatment for this younger cohort will likely need to focus on early and sustained rehabilitation that can be integrated with career plans.

For treatment to be effective, there must be evidence for veterans enrolling, remaining, and reporting benefits from the treatment. Limited research has shown currently advocated evidence-based therapies to have low enrollment rates, high drop-out rates, and mixed outcomes.<sup>42</sup>

**TABLE 4** Relative Distribution of Veterans with Service-Connected Disability Ratings

Service Period Groups, No. (%)	Average Age (SD), y	Diagnosis Categories	Service Connection Disability Rating, No. (%)						
			0%	10-20%	30-40%	50-60%	70-80%	90-100%	50-100%
Pre-9/11 797,285 (74.7)	66.3 (11.3)	PTSD only	18,534	53,043	64,654	92,684	207,574	292,106	592,364 (74)
		TBI only	3,672	8,205	4,773	4,574	5,150	10,318	20,042 (2.5)
		PTSD+TBI	1,015	2,468	2,130	3,083	8,134	15,168	26,385 (3.3)
Post-9/11 174,134 (16.3)	36.1 (8.7)	PTSD only	2,104	9,391	18,476	26,839	36,775	27,850	91,464 (52.5)
		TBI only	293	1,439	1,621	1,734	1,776	1,628	5,138 (3.0)
		PTSD+TBI	326	1,528	3,816	7,301	13,641	17,596	38,538 (22.1)
Overlap 82,450 (7.7)	41.4 (8.2)	PTSD only	860	4,026	7,522	11,416	18,110	21,506	51,032 (61.9)
		TBI only	119	541	694	794	1,024	1,261	3,079 (3.7)
		PTSD+TBI	105	433	929	1,882	4,017	7,211	13,110 (15.9)
Reentered 13,822 (1.3)	46.9 (9.2)	PTSD only	220	651	1,019	1,613	2,974	3,576	8,163 (59.0)
		TBI only	19	82	66	63	98	173	334 (2.4)
		PTSD+TBI	29	88	157	362	792	1,840	2,994 (21.7)

Abbreviations: PTSD, posttraumatic stress disorder; TBI, traumatic brain injury.

Results showing a gradual increase in the proportion of nonwhite, non-African American veterans diagnosed with PTSD alone, TBI alone, or both, likely reflect the changing demographic profile of the US as well as the Army. However, the reason that more African Americans were diagnosed with PTSD and/or TBI in the overlap and reentered groups when compared with the pre-9/11 group could not be ascertained. It is possible that more veterans identified themselves as African Americans as evident from a decrease in the number of veterans in the unknown category post-9/11 when compared with the pre-9/11 group. In 2016, the American Community Survey showed that Hispanic and African American veterans were more likely to use VA health care and other benefits than were any other racial group.<sup>40</sup> Improved screening for PTSD and TBI diagnoses, increased awareness, and education about the availability of VA services and benefits may have contributed to the increased use of VA benefits in these groups.

Data from this study are concordant with data from the National Center for Veterans Analysis and Statistics reporting on the

younger age of diagnosis and higher rates of initial service-connected disability in veterans with PTSD and PTSD+TBI.<sup>43</sup> One study analyzing records from 1999 to 2004 showed that the number of PTSD cases grew by 79.5%, resulting in 148.7% increase in benefits payment from \$1.7 billion to \$4.3 billion per year.<sup>44</sup> In contrast, the compensation cost for all other disability categories increased by only 41.7% over this period. This study also revealed that while veterans with PTSD represented only 8.7% of compensation recipients, they received 20.5% of all compensation payments, driven in large part by an increase in > 50% service-connected disability ratings.<sup>44</sup>

Thus, from financial as well as treatment points of view, the change in the demographic profile of the veteran must be considered when developing PTSD treatment strategies. While treatment in the past focused solely on addressing trauma-associated psychiatric issues, TBI and PTSD association will likely shift the focus to concurrent psychiatric and physical symptomatology. Similarly, PTSD/TBI treatment modalities must consider that the profile



of post-9/11 service members includes more women, younger age, and a greater racial diversity. For instance, younger age for a disabled veteran brings additional challenges, including reliance on parental or buddy support systems vs a spousal support system, integrating career with treatment, selecting geographic locations that can support both career and treatment, sustaining rehabilitation over time. The treatment needs of a 35-year-old soldier with PTSD and/or TBI, whether male or female, Asian or African American are likely to be very different from the treatment needs of a 65-year-old white male. Newer treatment approaches will have to address the needs of all soldiers.

### Limitations

Our study may underestimate the actual PTSD and/or TBI disease burden because of the social stigma associated with diagnosis, military culture, limitations in data collection.<sup>45-50</sup> In addition, in this retrospective database cohort study, we considered and tried to minimize the impact of any of the usual potential limitations, including (1) accuracy of data quality and linkage; (2) identifying cohort appropriately (study groups); (3) defining endpoints clearly to avoid misclassifications; and (4) incorporating all important confounders. We identified veterans utilizing medical services at VA hospitals during a defined period and diagnosed with PTSD and TBI using ICD-9 codes and divided in 4 well-defined groups. In addition, another limitation of our study is to not accurately capture the veterans who have alternative health coverage and may choose not to enroll and/or participate in VA health care. In addition, some service members leaving war zones may not disclose or downplay the mental health symptoms to avoid any delay in their return home.

### CONCLUSIONS

This study highlights the changing profile of the soldier diagnosed with PTSD and/or TBI who served pre-9/11 compared with that of those who served post-9/11. Treatment modalities must address the changes in warfare and demographics of US service members. Future treatment will need to focus more on concurrent PTSD/TBI therapies, the needs of younger soldiers, the needs of women injured in combat, and the needs of

a more racially and ethnically diverse population. Severe injuries at a younger age will require early detection and rehabilitation for return to optimum functioning over a lifetime. The current study underscores a need for identifying the gaps in ongoing programs and services, developing alternatives, and implementing improved systems of care. More studies are needed to identify the cost implications and the effectiveness of current therapies for PTSD and/or TBI.

### Acknowledgments

This study was supported by VA Medical Center and Midwest BioMedical Research Foundation (MBRF), Kansas City, Missouri. The manuscript received support, in part, from NIH-RO1 DK107490. These agencies did not participate in the design/conduct of the study or, in the interpretation of the data.

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The authors report no actual or potential conflicts of interest with regard to this article.

### Disclaimer

The opinions expressed herein are those of the authors and do not necessarily reflect those of *Federal Practitioner*, Frontline Medical Communications Inc., the US Government, or any of its agencies.

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