

# Outcomes of Genitourinary Injury in U.S. Iraq and Afghanistan War Veterans Receiving Care from the Veterans Health Administration

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**ABSTRACT** Introduction: In the recent conflicts, unprecedented numbers of US service personnel have survived with genitourinary (GU) injury, but few reports have focused on outcomes of these injuries. Outcomes of combat-related GU injury were investigated in wounded US male veterans of Operations Enduring/Iraqi Freedom and New Dawn receiving Veterans Health Administration (VHA) care. Materials and Methods: Department of Defense Trauma Registry (DoDTR) data for male service members injured in theater were linked with VHA electronic health records (EHRs) for veterans who received VHA care at least once from October 2001 through September 2011. Abbreviated Injury Scale scores and *International Classification of Diseases-9th Revision-Clinical Modification* codes were used to identify GU injuries, severity, and outcomes. Wounded veterans with vs. without GU injury were compared. Results: A total of 12,923 injured veterans were found in both databases; 591 (4.6%) had a GU injury diagnosis in the DoDTR; 18 (3.0% of 591) had a GU injury diagnosis in VHA EHRs. Of the 591 with GU injury, 179 (30.3%) had at least one severe GU injury. The prevalence of both urinary symptoms (6.3% vs. 3.1%;  $p < 0.0001$ ) and sexual dysfunction (13.5% vs. 7.1%;  $p < 0.0001$ ) was higher among those with vs. without GU injury, respectively. Traumatic brain injury prevalence was also higher (48.0% vs. 40.0%;  $p < 0.0001$ ); post-traumatic stress disorder prevalence was similar between the two groups (51.6% vs. 50.6%). Conclusion: We identified an opportunity to improve the diagnosis and coordination of care for veterans with GU injury. Routine screening and better documentation upon transfer from DoD to VHA care should be implemented to alert multi-specialty care teams to provide care for the urinary, sexual, fertility, and psychological health problems of these patients.

## INTRODUCTION

More than 1,367 male service personnel wounded in Iraq or Afghanistan survived with genitourinary (GU) injuries.<sup>1</sup> Although this number represents a small proportion of the more

than 52,000 injured in these conflicts,<sup>2</sup> it is only slightly less than the number of male service personnel who sustained one or more extremity amputations (1,674) during the same period.<sup>3</sup>

Unlike in previous conflicts in which GU injuries were mostly renal,<sup>4</sup> in Iraq and Afghanistan nearly 75% of injuries were to the external genitalia, and one-third of those with GU injuries had at least one that was severe.<sup>2,5</sup> Although GU injuries can cause sexual, urinary, and reproductive problems,<sup>6</sup> little is known about these outcomes among veterans of Operations Enduring Freedom (OEF) in Afghanistan, and Operations Iraqi Freedom (OIF) and New Dawn in Iraq, collectively referred to as OEF/OIF.<sup>7</sup>

GU injuries often co-occur with other severe injuries, including colorectal injury, pelvic fracture, traumatic brain injury (TBI),<sup>1</sup> and extremity amputations.<sup>1,5</sup> Thus, many of the service personnel with GU injury likely needed ongoing treatment and rehabilitation at a Veterans Affairs (VA) Polytrauma Rehabilitation Center<sup>8</sup> or were otherwise enrolled in the Veterans Health Administration (VHA) care system. Unlike for patients with extremity amputation for which an extensive care network exists within VHA<sup>9</sup> or TBI for which VHA patients are routinely screened,<sup>10</sup> no VA policies have focused on the care of Iraq and Afghanistan war veterans with GU injury. Although the epidemiology has been described,<sup>1,5</sup> the outcomes of combat-related GU injury have not been reported.

Thus, the objective of our study was to investigate health outcomes in U.S. male OEF/OIF veterans with GU injury receiving VHA care.

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## METHODS

This study was conducted in accordance with a protocol approved by the University of Texas Health Science Center at San Antonio Institutional Review Board (IRB project number: HSC20100395H). We queried VHA electronic health records (EHRs) for all U.S. male OEF/OIF veteran patients receiving VHA care at least once between October 1, 2001 and September 30, 2011. Through a Memorandum of Agreement with the Department of Defense (DoD) Joint Trauma System, VHA patient identifiers were matched to identifiers in the DoD Trauma Registry (DoDTR); detailed DoDTR data for matched patients were then transferred to VHA for analysis.

From the DoDTR data, we identified the GU injury patients and obtained information about injury-related characteristics. As in previous studies,<sup>1,5</sup> GU injury was defined as having sustained one or more injuries to any organ or structure within the GU and/or reproductive system(s) as represented by any one of 50 *International Classification of Disease-9th Revision-Clinical Modification* (ICD-9-CM) diagnosis codes (Supplementary appendix). Abbreviated Injury Scale (AIS) codes were used to define a severe GU injury as either a serious GU injury (AIS severity score 3 or greater) or a major to massive laceration of any GU organ (Supplementary appendix).<sup>1,5</sup> Overall injury severity score (ISS), the setting where the injury occurred (battle vs. non-battle), the mechanism of injury (explosive vs. non-explosive), and the combat operation (OEF vs. OIF) were also obtained from the DoDTR.

From the VHA EHR data, we obtained age in 2011, date of injury (categorized as 2001–2007 vs. 2008–2011), race/ethnicity (White, Black, Hispanic or other), marital status (single vs. married in 2011), and branch of military service (Army, Air Force, Marines, or Navy/Coast Guard). Health outcome diagnoses, based on ICD-9-CM codes also obtained from VHA EHRs, included sexual dysfunction, urinary symptoms, and psychological health conditions defined as TBI, post-traumatic stress disorder (PTSD), and major depression (Supplementary appendix). PTSD was defined as having two diagnosis codes assigned at least 7 days apart; TBI and major depression were defined as having any one of the respective diagnosis codes.

Demographics, injury characteristics, and the prevalence of outcomes among injured veterans with and without GU injury were compared. All variables were categorical and were reported as numbers and percentages. Characteristics of veterans with and without GU injury were compared using a Chi-squared test, or Fisher's exact test when cell count(s) were less than 5. A type 1 error rate of 0.05 or less was considered statistically significant. Statistical analyses were performed using SAS version 9.2 (SAS Institute Inc., Cary, NC, USA). Only statistically significant *p*-values are reported in the text.

## RESULTS

From October 2001 to September 2011, 12,923 injured U.S. male OEF/OIF veterans were identified in both VHA EHRs

and the DoDTR. Of these, 591 (4.6%) had a diagnosis of combat-related GU injury in the DoDTR; only 3.0% (18 of 591) also had a GU injury diagnosis documented in VHA EHRs. A total of 179 (30.3% of 591) veterans with GU injury had at least one severe injury.

Table 1 shows the demographic and injury characteristics of U.S. male veterans with vs. without GU injury, respectively. In both groups, most of the veterans were aged 25 to 34 years in 2011 (70.4% vs. 66.3%; *p* = 0.03), white (74.6% vs. 70.1%), single (66.5% vs. 63.3%), and served in the Army (74.1% vs. 76.5%) or Marines (23.2% vs. 19.3%); most were injured relatively early in the wars, i.e., before 2008 (80.0% vs. 79.9%), and during the Iraq conflict (82.4% vs. 83.7%). More veterans with GU injury than those without GU injury sustained their injuries in battle (86.8% vs. 65.5%; *p* < 0.0001) and from explosions (70.9% vs. 52.6%; *p* < 0.0001). The proportion of veterans with GU injury who had an injury severity score in the severe or critical category (ISS ≥ 16) was four times that of veterans without GU injury (58.5% vs. 14.9%; *p* < 0.0001).

Figure 1 shows the prevalence of health outcomes among veterans with vs. without GU injury, respectively. Those with GU injury had a higher prevalence of both urinary symptoms (6.3% vs. 3.1%; *p* < 0.0001) and sexual dysfunction (13.5% vs. 7.1%; *p* < 0.0001), and a higher prevalence of TBI (48.0% vs. 40.0%; *p* < 0.0001). The prevalence of both PTSD (51.6% vs. 50.6%) and major depression (9.3% vs. 11.1%; data not shown) was similar among those with and without GU injury, respectively.

## DISCUSSION

This is the first report describing outcomes of combat-related GU injury among OEF/OIF veterans. We found that 591 (4.6%) of the 12,923 wounded veterans in our study had a GU injury diagnosis in the DoDTR, and about one-third of them had a severe GU injury. However, only 18 of 591 (3.0%) had a diagnosis in the VHA EHR. Compared to those without GU injury, four times as many wounded veterans with GU injury were severely or critically injured overall. The prevalence of both urinary symptoms and sexual dysfunction among veterans with GU injury was twice that of veterans without GU injury. Because VHA physicians may not have known the trauma history of these patients, and thus, may not have asked them about these problems, the prevalence of GU injury-related outcomes in our study is likely underestimated.

Our finding that only 3% of the 591 veterans with GU injury had this diagnosis documented in the VHA EHR shows that linkage of data from the DoDTR and the VHA EHR was the key to identifying the patients with these combat-related injuries. If plans to move to a single EHR system for DoD and VA are implemented,<sup>11</sup> veteran patients with GU injury should be more easily identified and should have a smoother transition to VHA care.

**TABLE I.** Demographics and Injury Characteristics of Wounded U.S. Male Iraq and Afghanistan War Veterans Receiving VHA Care, by GU Injury Status, October 1, 2001 to September 30, 2011

	Total (n = 12,923)	GU Injury (n = 591)	No GU Injury (n = 12,332)	$\chi^2$ Test* (p-Value)
Age, n (%) <sup>a</sup>				<b>(0.03)</b>
18–24 years	1,063 (8.2)	53 (9.0)	1,010 (8.2)	
25–34 years	8,592 (66.5)	416 (70.4)	8,176 (66.3)	
≥35 years	3,268 (25.3)	122 (20.6)	3,146 (25.5)	
Race/Ethnicity, n (%)				(0.08)
White	9,083 (70.3)	441 (74.6)	8,642 (70.1)	
Black	1,180 (9.1)	40 (6.8)	1,140 (9.2)	
Hispanic	1,462 (11.3)	62 (10.5)	1,400 (11.4)	
Other	1,198 (9.3)	48 (8.1)	1,150 (9.3)	
Marital status, n (%) <sup>b</sup>				(0.11)
Single	8,196 (63.4)	393 (66.5)	7,803 (63.3)	
Married	4,724 (36.6)	198 (33.5)	4,526 (36.7)	
Branch, n (%)				(0.06)
Army	9,866 (76.3)	438 (74.1)	9,428 (76.5)	
Air Force	174 (1.4)	<5 (0.7)	170 (1.4)	
Marine	2,516 (19.5)	137 (23.2)	2,379 (19.3)	
Navy/Coast Guard	262 (2.0)	10 (1.7)	252 (2.0)	
Other	105 (0.8)	<5 (0.3)	103 (0.8)	
Injury Year, n (%)				(0.92)
2001–2007	10,321 (79.9)	473 (80.0)	9,848 (79.9)	
2008–2011	2,602 (20.1)	118 (20.0)	2,484 (20.1)	
Theater, n (%)				(0.74)
Afghanistan	2,110 (16.3)	104 (17.6)	2,006 (16.3)	
Iraq	10,812 (83.6)	487 (82.4)	10,325 (83.7)	
Other	<5 (0.01)	0 (0.0)	<5 (0.0)	
Setting, n (%)				<b>(&lt;0.0001)</b>
Battle	8,594 (66.5)	513 (86.8)	8,081 (65.5)	
Non-battle	4,271 (33.1)	77 (13.0)	4,194 (34.0)	
Unknown	58 (0.5)	<5 (0.2)	57 (0.5)	
Injury Mechanism, n (%)				<b>(&lt;0.0001)</b>
Explosive	6,907 (53.4)	419 (70.9)	6,488 (52.6)	
Non-explosive	6,016 (46.6)	172 (29.1)	5,844 (47.4)	
Injury Severity Score, n (%) <sup>a</sup>				<b>(&lt;0.0001)</b>
0–9	8,854 (68.7)	150 (25.4)	8,704 (70.7)	
10–15	1,861 (14.4)	95 (16.1)	1,766 (14.4)	
16–24	1,209 (9.4)	145 (24.5)	1,064 (8.6)	
25–75	973 (7.5)	201 (34.0)	772 (6.3)	

<sup>a</sup><30 cases with missing data were excluded.

<sup>b</sup><5 cases with missing data were excluded.

\*p-values from Fisher's exact test for cells less than 5. Percentages may not add up to 100 due to rounding.

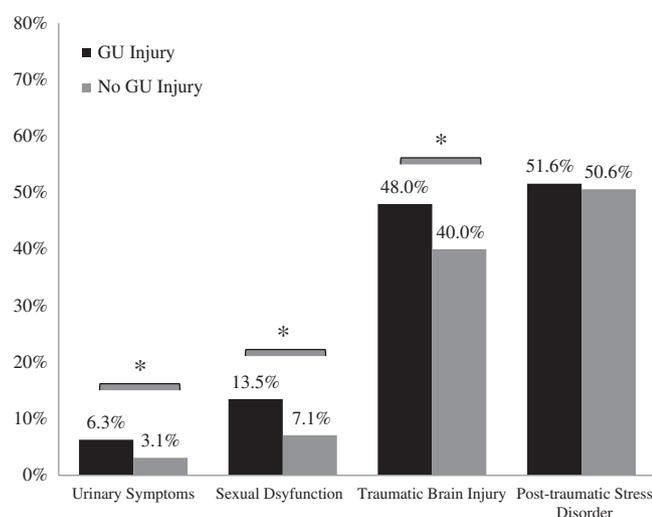
The values in bold are statistically significant (i.e. <.05).

In our study, the prevalence of urinary symptoms among injured veterans with GU injury (6.3%) was twice that of the injured veterans without GU injury (3.1%). Another large study of male Iraq and Afghanistan veterans receiving VHA health care reported a prevalence of lower urinary tract symptoms (LUTS) of 2.0%.<sup>12</sup> Overactive bladder, incontinence, and other LUTS can negatively affect health-related quality of life.<sup>13</sup> Screening for urinary problems could help identify veterans with undiagnosed GU injury who need urological care.

The prevalence of sexual dysfunction among the injured veterans with GU injury (13.5%) was nearly twice that of the injured veterans without GU injury (7.1%). The latter is similar to the prevalence of sexual dysfunction in other studies of OEF/OIF veterans receiving VHA health care, which ranged from 5.3% to 6.8%.<sup>14–16</sup> However, because veteran

patients are not routinely screened for sexual problems, these results are likely underestimated. Routine screening and therapy are needed to identify and treat veterans with sexual dysfunction, including from GU injury.

PTSD and other psychological health conditions increase the risk of both LUTS<sup>12</sup> and sexual dysfunction.<sup>16</sup> Of our patients with GU injury, more than half had a PTSD diagnosis compared with 28% among a large sample of OEF/OIF veteran VHA care users; similarly, nearly half of our patients with GU injury had a TBI diagnosis compared with only 6.7% of veteran VHA care users.<sup>17</sup> Even concussion or mild TBI is associated with decreased pituitary function,<sup>18</sup> which can lead to sexual dysfunction and compound the effects of GU injury. These comorbid conditions likely contributed to the LUTS and sexual dysfunction among veterans with GU



**FIGURE 1.** Health outcomes of U.S. male Iraq and Afghanistan war veterans by GU injury status, October 1, 2001 to September 30, 2011. \* $p < 0.0001$ .

injury in our study. Treatment for psychological health problems is crucial to improving the long-term outcomes of veteran patients, including those with GU injury.

The number of patients with fertility problems was too small to report. However, the veterans with GU injury in our study were young and in their peak sexual and reproductive years, and one-third of them were unmarried at the time of their injury; thus, fertility is an important issue. Service personnel with GU injury adjust better to life with these injuries when their fertility is preserved.<sup>19,20</sup> VA Medical Services funds can now be used to provide fertility assistance to a covered veteran or the spouse of a covered veteran, or adoption reimbursement to a covered veteran who has a service-connected disability resulting in the loss of fertility.<sup>21</sup> This assistance is vital to ensure that service personnel with GU injury have the best opportunity possible to start a family.

Our study had some limitations. First, we lacked data on male service personnel with less severe GU injuries not captured in the DoDTR and veterans receiving VHA care who sustained GU injury later in the Iraq and Afghanistan Wars, i.e., after 2011, the last year for which we had VHA data. We also lacked data on those with GU injuries who were not enrolled in VHA care. The number of veterans with GU injury in our study ( $n = 591$ ) is less than half the total number of veterans with GU injury ( $n = 1,367$ ) previously identified in the DoDTR.<sup>1</sup> The relatively small proportion of patients in our study who were injured in 2008 or later (20%) may have been because patients injured more recently had not yet enrolled in VHA care. Future studies should investigate the outcomes of GU injury in these patients to identify their health care needs and help them get care. Second, those with GU injuries were more likely to be injured by explosions, which often cause multiple injuries, or polytrauma. Among individuals with GU injury, polytrauma often includes lower extremity amputation, pelvic, and

colorectal injury,<sup>1,5</sup> which can also adversely affect sexual and urinary function. However, evaluating the contribution of these other injuries to impaired function was beyond the scope of our study. Nevertheless, patients treated in the VA polytrauma system of care should continue to be evaluated for impaired sexual and urinary function related to their complex injuries. Third, all of our study patients were identified in the Department of Defense Trauma Registry and were injured; thus, we could not use our study data to compare the prevalence of LUTS and sexual dysfunction with that for a group of uninjured veterans receiving VHA care. However, comparison with published studies showed that the prevalence of urinary symptoms and sexual dysfunction among our patients with GU injury was two to three times as high as the prevalence among OEF/OIF veterans receiving VHA health care. Fourth, because we did not identify any women with combat-related trauma with outcome data in the VA EHR during our study period, we could not report on long-term outcomes among women with these injuries. Reed et al identified 20 female OEF/OIF service personnel with GU injury in the DoDTR, including 4 who died.<sup>22</sup> Unlike for men,<sup>1</sup> when all GU injuries among the women were totaled, most were renal ( $n = 12$  of 21) and mild; no patients with uterine, ovarian or fallopian tube injury were identified. Because women are now allowed to serve in combat roles,<sup>23</sup> the prevalence of GU injury among female veterans could increase in future conflicts. Thus, women receiving VHA care should also be screened and treated for adverse outcomes of GU injury. Finally, because our study was limited to data from the VHA EHR and the DoDTR, we could not evaluate whether the transfer from DoD to VHA care and/or the initial VHA intake assessments led to under-diagnosis of GU injury. These data were also inadequate to evaluate the treatment, management, and quality of care for patients with GU injuries. Additional research on the nature of medical care and the transition of patients with GU injury from DoD to VHA care is needed to inform ways to improve communication, documentation, and care practices.

In 2015, the U.S. Department of Defense funded a longitudinal study of patient-reported outcomes of GU injury known as the Trauma Outcomes and Urogenital Health (TOUGH) project. Partners in this effort include the VHA, DoD, the University of Texas Health at San Antonio, the University of California at Davis, and collaborators from the Ministry of Defence and academia in the UK. This project will provide important information on the long-term outcomes unique to veterans with GU injury and help them get the health care they need.

## CONCLUSION

Our study showed that the diagnosis and care for veterans with GU injury could be improved by implementing routine screening and better documentation upon transfer from DoD to VHA health care. These improvements would alert multi-specialty care teams to address urinary problems, sexual

dysfunction, and the unique and often complex psychological health problems associated with GU injury. With further research, care algorithms could also be developed like those for TBI<sup>10</sup> and PTSD<sup>24</sup> that are used successfully at VHA institutions. These efforts are needed to improve the health and well-being of veterans living with GU injury.

## SUPPLEMENTARY MATERIAL

Supplementary material is available at *Military Medicine* online.

## PREVIOUS PRESENTATION

This work was previously presented at the Military Health System Research Symposium, Kissimmee, FL, USA, August 2016, and the American Urological Association Annual Meeting, Boston, MA, USA, May 2017.

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## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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