Traumatic Brain Injury in Veterans: Social Determinants, Survival and Costs

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1 **TITLE**

2 Traumatic Brain Injury in Veterans: Social Determinants, Survival and Costs

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10

Abstract

BACKGROUND: Traumatic Brain Injury (TBI) is a signature injury from the Iraq and Afghanistan conflicts as well as an important contributor to morbidity and mortality in the United States. Using a cohort of over 400,000 veterans with and without TBI, odds of TBI diagnosis by socio-demographics and clinical factors, along with the association of a TBI diagnosis with veteran survival were estimated for 15 years. Annual Veterans Health Administration (VHA) costs associated with a TBI diagnosis over a 14-year period were estimated per veteran.

METHODS: 291,015 veterans without TBI and 181,521 veterans with TBI were followed from FY 2000 through FY2015 for comorbidities and survival. Veterans were followed through FY2014 for costs and adjusted to 2019 for inflation. Logit models were estimated to examine the association of veteran socio-demographics and clinical factors with the odds of a TBI diagnosis. Cox proportional hazard model was estimated to examine the covariate-adjusted association of TBI with survival. Generalized linear and seemingly unrelated regression models were used to estimate the association of TBI with annual per veteran VHA costs.

RESULTS: Non-Hispanic Blacks (OR 1.85; 95% CI 1.81:1.88), Hispanic (OR 1.94; 95% CI 1.88:2.00), and veterans with high numbers of mental (OR 5.83; 95% CI 5.68:5.98) and physical comorbidities (OR 2.47; 95% CI 2.42:2.52) had higher likelihood of having TBI. Veterans with TBI were 1.2 times more likely to die and had higher total annual costs by \$19,808 (95% CI \$13,900: \$25,715), with a similar pattern for all component cost categories.

CONCLUSIONS: Racial/Ethnic minorities have a higher likelihood of TBI. TBI is associated with increased death and annual health care costs. These results will inform decision-making by military leaders and policymakers regarding the harmful health impacts and higher health care services burden of TBI that may affect a large portion of military personnel.

KEYWORDS: traumatic brain injury, patient characteristics, costs, mortality, survival

36 Background

37 Traumatic brain injury (TBI) is a physical force to the brain sufficient to cause structural
38 alteration or physiological disruption of brain function that results in altered consciousness,
39 amnesia, change in mental state, neurological deficits, or intracranial lesions [1]. TBI is a
40 signature injury occurring in military operations such as the conflicts in Iraq and Afghanistan [1].
41 TBIs can commonly occur following blasts as well as from a range of other mechanisms like
42 direct exposure to an over-pressurization wave, impact from blast-energized debris, being
43 physically thrown into environmental hazards, from inhalation of gases and vapors or from
44 anoxic injuries [2]. An estimated 414,000 military service members have been diagnosed with
45 TBI between 2000 and late 2019 [1] [3]. Even outside the military context, TBI is considered a
46 leading cause of death and disability in the U.S. with about 53,000 persons (18.4 per 100,000)
47 dying from TBI related injuries annually [4]. In addition to the health burden it imposes, TBI is
48 accompanied by a substantial health services burden, with approximately 1,365,000 (80.7%)
49 emergency department (ED) visits and 275,000 (16.3%) hospitalizations annually [5]. Research
50 has shown that TBI is linked with mental health co-morbidities in the military population, as
51 well as in the civilian population, and patients with these comorbidities can incur high medical
52 costs [6] [7]. TBI, its sequelae, and associated comorbidities carry a substantial health and
53 health services burden, but to our best knowledge, there is no previous large-scale and
54 comprehensive study jointly assessing sociodemographic factors associated with TBI diagnoses
55 and the association of TBI diagnoses with adjusted all-cause mortality and adjusted health care
56 costs.

In this comprehensive study, we first examined the association between socio-demographics and clinical factors and the likelihood of having a Traumatic Brain Injury (TBI) diagnosis among veterans using the Veterans Health Administration (VHA) over a 15-year period. We then examined the association between TBI diagnoses and veterans' survival odds in a covariate-adjusted model. Finally, we estimated the annual 2019 VHA total, inpatient, outpatient and pharmaceutical as well as community care (CC) costs per year for veterans with a TBI diagnosis relative to veterans who did not have a TBI diagnosis over a 14-year period.

Methods

Procedures

All veterans with a diagnosis of TBI and an age-matched cohort of veterans without a TBI diagnosis were selected from VA Informatics and Infrastructure (VINCI) inpatient and outpatient patient treatment file (PTF) databases between January 1, 2000 and December 31, 2015 [8]. Veterans with a TBI diagnosis were identified using the International Classification of Diseases, Ninth Revision (ICD-9) codes for TBI, post-concussive syndrome, and TBI-related late effects, in accordance with the Military Health System and Defense Health Agency Traumatic Brain Injury (TBI) DoD Standard Surveillance Case Definition for TBI Adapted for AFHSB Use [9]. This definition has been used by Chronic Effects of Neurotrauma Consortium (CENC) studies [10] [11]. We linked the VA's Vital Status and Health Economics Resource Center (HERC) files to PTF files using a scrambled social security number for calculating monthly survival and identifying VHA annual costs from FY2000-2014, the last available per annual per veteran costs. Data on pre/post Gulf-War status, socio-demographics and co-morbidities were obtained from

inpatient and outpatient PTF files. Unadjusted and adjusted individual veteran VHA and CC costs of TBI diagnosis, relative to no TBI was estimated using FY2000-FY2014 data and adjusted for inflation to 2019 dollars. All study procedures followed a protocol approved by the Stanford Institutional Review Board and VA Palo Alto Health Care System Research and Development Committee.

Measurements

Clinically diagnosed TBI: Veterans were considered diagnosed with TBI if they had an ICD-9 code for TBI in an inpatient hospitalization or outpatient encounter of 310.2, 850.xx, 851.xx, 852.xx, 853.xx, 854.xx, 800.xx, 801.xx, 803.xx, 804.xx, 950.1x, 907.0, 959.01, and V15.xx, based on the Military Health System and The Defense Health Agency guidelines [11] [9].

Death Status: Veterans' death status and dates of death were obtained from the VHA's Vital Status files.

VHA Health Services Costs: Annual per veteran total, inpatient, outpatient pharmaceutical, and Community Care (CC) costs were obtained from HERC files for FY2000-2014 [12]. VHA costs are estimated by HERC using actual cost data from VA facilities and estimates provided by Medicare as described in a detailed report by HERC [31].

From 2014 on, Veterans can also receive non-VA care through the CHOICE act [13]. The data used in this study would not include CHOICE claims data, however, since it covers the 2000-2014 time period.

Socio-demographics: Veterans' socio-demographic and clinical variables were obtained from the VINCI PTF files. Post-Gulf War (PGW) service relative to other era military service was classified as a binary indicator with a value of 1 for having a history of PGW service, and 0

otherwise. 4 age categories were used: 21-51, 52-64, 65-73, 74-99. Gender was classified as a binary indicator with a value of 1 indicating female, and 0 otherwise. The race/ethnicity variable was based upon self-report. Veterans were classified as non-Hispanic White (NHW), non-Hispanic Black (NHB), Hispanic (H) and other race (OR). Veterans who receive a greater than or equal to 50% score of service-connected disability (SCD) are waived any co-pays for VHA services. SCD status was included and was classified as a binary indicator with a value of 1 indicating service-connected disability greater than or equal to 50%, and 0 otherwise. Veteran location for all veterans except those residing in U.S. territories was classified as urban or rural based on zip code. Veterans residing in US territories were classified based on the VA medical center or community-based outpatient clinic where they received care.

Comorbid conditions: Elixhauser co-morbidities were measured as categorical variables based on ICD codes and categorized as: congestive heart failure, cardiac arrhythmias, valvular disease, pulmonary circulation disorders, peripheral vascular disorders, uncomplicated hypertension, complicated hypertension, paralysis, other neurological disorders, chronic pulmonary disease, uncomplicated diabetes, complicated diabetes, hypothyroidism, depression, liver disease, peptic ulcer disease excluding bleeding, AIDS/HIV, lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis/collagen vascular diseases, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, blood loss anemia, deficiency anemia, alcohol abuse, drug abuse, and psychoses [14]. Following established methods, the total number of physical and mental health co-morbidities were classified as categorical variables of 0, 1, 2, or 3+ for physical and 0,1,2, or 3 for mental co-morbidities [15].

121 Statistical Analyses

122 We conducted a series of preliminary analyses. We first assessed the unadjusted association
123 between TBI and PGW status, SCD $\geq$ 50 status, socio-demographics, co-morbidity categories
124 and deceased status using chi-squared tests and conducted median tests for months in cohort.

125 Next, we conducted comparisons of unadjusted total VHA+CC (VHA costs including CC), total
126 VHA, inpatient, outpatient, pharmaceutical, and CC annual VHA costs per veteran by TBI
127 diagnosis status using median tests.

128 We then estimated the association of socio-demographic and clinical factors with the likelihood
129 of a TBI diagnosis using a logit model and the covariate-adjusted association of veteran status
130 with TBI diagnosis status with veteran survival using a Cox Proportional Hazards Survival model.

131 Standard errors were bootstrapped for these analyses. We also estimated the covariate-
132 adjusted association of TBI with annual total VHA+CC using a generalized linear model with
133 gaussian family and identity link with bootstrapped standard errors and clustering on VA facility
134 [16]. As decisions regarding inpatient, outpatient, pharmaceutical and CC health services are
135 likely to be coordinated by providers within the VHA, we used seemingly unrelated regression
136 (SUR) to estimate separate but related inpatient, outpatient, pharmacy and CC cost categories,
137 which allows for correlation between cost categories [17]. The covariates used in these three
138 analyses were: age, gender, race/ethnicity, location, PGW status, SCD $\geq$ 50 status, and the
139 categories of mental and physical Elixhauser co-morbidities. Costs were converted to 2019
140 dollar values using the US Department of Labor Consumer Price Index (CPI) Inflation Calculator
141 [18]. All analyses were performed using STATA version 15.0 in VINCI. Statistical significance was
142 determined at $P < 0.05$.

Results

Table 1 shows chi-squared and median tests for unadjusted association between TBI diagnosis and sociodemographic characteristics, deceased status and months in cohort among all veterans in the cohort. 291,015 veterans had no TBI diagnosis while 181,521 had a TBI diagnosis. Veterans were distributed fairly uniformly across age groups, with a slightly higher percentage of those with TBI in the 74-99 age group (25.76%). Women veterans had their highest representation in the no TBI group (10.30%). NHW veterans had their highest representation in the no TBI group (77.21%), NHB veterans in the TBI group (16.49%), Hispanic veterans in the TBI group (7.10%), and other race veterans in the no TBI group (10.83%). Among those who died, the highest percentage were in the TBI group (29.70%), who also had a slightly higher median time in the cohort (438.67 months).

===== Insert Table 1 about here =====

As shown in Table 2, the predicted mean (\$60,579) and median (\$7,898) of annual per veteran VHA + CC costs for veterans with TBI was higher than for veterans without TBI (mean: \$23,008; median: \$439). The trend was similar for VHA costs without CC for veterans with TBI (mean: \$58,200; median: \$7,355) and no TBI (mean: \$21,391; median: \$329). For inpatient care costs for veterans with TBI (mean: \$25,367; median: \$1,260) was higher than veterans without TBI (mean: \$8,108; median: \$0), as it was for outpatient care (mean: \$25,593; median: \$1,278 vs. mean: \$8,769; median: \$0, respectively) and pharmacy (mean: \$7,241; median \$1,395 vs. \$4,514; median: \$224, respectively). For CC, mean cost for veterans with TBI (\$2,379) was higher than for veterans without TBI (\$1,617), though both had medians of \$0.

===== Insert Table 2 about here =====

Table 3 presents the association of TBI diagnoses and sociodemographic and clinical factors. As shown in Table 3, veterans of age ≥ 74 had significantly higher odds (OR 1.39; 95% CI:1.34:1.43) of having a TBI diagnosis relative to veterans of age 21-51, after adjusting for other covariates. Veterans in age categories 52-64 and 65-73 had significantly lower odds of a TBI diagnosis relative to age 21-51. Women had significantly lower odds of a TBI diagnosis compared to men. For race/ethnicity, NHB (OR 1.85; 95% CI 1.81:1.88) and Hispanic (OR 1.94; 95% CI 1.88:2.00) veterans had higher odds of a TBI diagnosis relative to NHW veterans. Veterans living in rural/highly rural areas and U.S. Territories had lower odds of a TBI diagnosis than those in urban areas. Veterans from post-Gulf War era had lower odds of a TBI diagnosis relative to Pre-Gulf War veterans, while having SCD $\geq 50\%$ was associated with higher odds (OR 1.46; 95% CI 1.45:1.48) of a TBI diagnosis. Both higher numbers of mental and physical comorbidities were associated with a higher odds of a TBI diagnosis with 3 or more mental health (OR 5.83; 95% CI 5.68:5.98) and 3 or more physical health (OR 2.47; 95% CI 2.42:2.52) having the highest odds relative to none.

===== Insert Table 3 about here =====

As shown in Table 4, there was an increasing hazard of death with a TBI diagnosis (HR 1.16; 95% CI:1.14:1.17). This is also shown in Figure 1 in the Kaplan-Meyer Survival Function. The hazard of death was also higher for those in the 52-64 and 74-99 age groups, males, NHWs, urban-dwelling, pre-Gulf War veterans, and those with SC $\leq 50\%$. The hazard of death increased with higher numbers of physical co-morbidities but not with higher numbers of mental co-morbidities.

===== Insert Table 4 about here =====

===== Insert Figure 1 about here =====

Table 5 shows the covariate-adjusted marginal impact of TBI status on annual total VHA+CC costs per veteran was \$19,808 (95% CI \$13,900:\$25,715). The marginal impact of TBI on annual inpatient VHA costs per veteran was \$10,295 (95% CI \$7,431: \$13,158) and outpatient \$9,255 (95% CI: \$6,528: \$11,981), relative to no TBI. The marginal impact of TBI on annual CC costs per veteran was \$234 (95% CI \$16: \$451), while pharmacy costs were not significant for TBI relative to no TBI. All higher age categories had significantly higher impact on all cost categories except CC where age ≥ 74 was associated with lower costs relative to age 21-51. Being male had significantly higher impact on all cost categories except community care where being female was associated with significant higher costs and there were no significant differences in pharmacy costs by gender. NHB had significantly higher impact on cost in all categories except pharmacy and community where they had significantly lower costs care relative to NHW. NHW had significantly higher cost in every category than Hispanic veterans except CC which was not significant. Other race had only significantly higher CC costs than NHW. Urban locations had significantly higher impact on all cost categories relative to rural/highly rural except pharmacy which was not significant, as well as significantly higher outpatient and pharmacy costs relative to US Territory veterans. Pre-Gulf War veterans had significantly higher costs in every category relative to Post-Gulf War. SCD $\geq 50\%$ had significantly higher costs in every category relative to SCD $< 50\%$. All cost categories increased significantly with increasing numbers of mental health co-morbidities, except for CC which was only significant for 3 more mental health comorbidities with lower costs. The impact of physical comorbidities only became significantly higher with 3

208 or more in total VHA, inpatient, and outpatient costs, while it was increasingly positive in all
209 categories for pharmacy and CC costs.

210 ===== Insert Table 5 about here =====

211 Discussion

212 To our knowledge, this is the only large-scale study using a long time-period to examine the
213 association of sociodemographic and clinical factors associated with TBI diagnoses and to
214 simultaneously examine the association of TBI diagnoses with covariate-adjusted all-cause
215 mortality and covariate-adjusted health care costs. This study has shown that: 1) veterans of
216 age ≥ 74 age, males, racial minorities, urban veterans and veterans with high numbers of
217 mental and physical comorbidities had higher likelihood of having TBI diagnoses, 2) veterans
218 with TBI were 1.2 times more likely to die, compared to veterans without TBI, and 3) veterans
219 with TBI had higher total annual VHA costs (including community care costs) by \$19,808,
220 compared to veterans without TBI.

221 Although there have been a few studies examining the health care services burden associated
222 with TBI [1] [6] [7] [19], especially among veterans, none have compared such a large cohort of
223 veterans diagnosed with TBI to veterans without TBI diagnoses. Furthermore, none of the cost
224 studies take a similarly comprehensive approach of assessing factors associated with TBI
225 diagnoses as well as assessing the impact of TBI on all-cause mortality for the cohort being
226 examined. This study leveraged strengths of rich data from the largest integrated health system
227 in the U.S. for a 14-year follow up period, examining a wide range of relevant sociodemographic
228 and clinical factors, covariate-adjusted all-cause mortality, covariate-adjusted total annual cost

229 of care, and several covariate-adjusted cost components such as inpatient, outpatient,
230 pharmacy and community care for each individual veteran in the study.

231 Study Limitations

232 A limitation of this study is that TBI diagnosis is being made based on ICD-9 diagnosis codes
233 from VHA administrative databases. Individuals who may have mild TBI may be less likely to be
234 identified and have an ICD-9 diagnosis. Conversely, a diagnosis of TBI could be assigned
235 erroneously in such large databases. A third limitation is the cost information is limited to
236 internal VHA inpatient, outpatient pharmaceutical and CC costs. This study did not include costs
237 paid by any other insurer for non-VA providers.

238 Conclusions

239 This paper robustly establishes the link between TBI and increased odds of covariate-adjusted
240 mortality, providing additional warning signs for military operations and related policy
241 regarding the harmful health impacts of TBI that may result from military activity or affect
242 military personnel. The findings also offer insights for clinical practice regarding the factors
243 associated with higher odds of TBI and for higher odds of death for TBI-affected military
244 personnel, veterans and broadly for all patients with TBI. Finally, the paper emphasizes the
245 higher costs associated with diagnoses of TBI, which can inform cost-benefit analyses, planning,
246 and decision-making by military leaders and by the VHA.

247 Future Research should examine the subset of costs by Clinic Stop Code such as neurology,
248 imaging, rehabilitation, mental health, emergency department and primary care. Also the
249 association of specific comorbidities associated with TBI. However, this study provides a
250 baseline by broad cost categories by which to compare future studies.

251 **Declarations**

252 **Ethical Approval and Consent to Participate:**

253 This work has approval by the Stanford IRB which includes a HIPAA Wavier.

254

255 **Consent for Publication:**

256 This work has consent for publication by the authors.

257

258 **Availability of Data and Materials:**

259 This work is based on data contained in the VA Informatics and Computing Infrastructure
260 (VINCI) Databases. Access to VINCI databases is regulated by the US Department of Veterans
261 Affairs Office of Research and Development.

262

263 **Competing Interests:**

264 The authors of this work declare no competing interests.

265

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286 documentation.

287

288 Author's Contributions:

289 CED designed the study, conducted the statistical analyses and contributed to all parts of the
290 manuscript. KG provided background , discussion, abstract and contributed to all aspects of the
291 manuscript. LE contributed to the study design and provided expertise on disparities content as
292 well as overall supervision of the study and manuscript.

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Figure 1: Covariate adjusted Kaplan-Meier survival estimates associated with TBI

330 **Table 1. Chi-squared and Median Tests for Unadjusted Association of TBI diagnosis status with**
 331 **Sociodemographic, Clinical characteristics, and Survival.**

	Veterans with TBI	Veterans without TBI
N	291,015	181,521
Age*		
21-51	24.53%	25.35%
52-64	26.32%	25.40%
65-73	28.06%	23.48%
74-99	21.09%	25.76%
Gender*		
Male	89.70%	93.13%
Female	10.30%	6.87%
Race*		
Non-Hispanic White	77.21%	68.28%
Non-Hispanic Black	8.00%	16.49%
Hispanic	3.97%	7.10%
Other	10.83%	8.13%
Location*		
Urban	29.07%	49.11%
Rural/Highly Rural	63.21%	48.89%
U.S. Territory	7.72%	2.00%
Post-Gulf War*		
Pre	67.47%	68.97%
Post	32.53%	31.03%
Service-Connected Disability*		
<50%	66.43%	51.62%
>50%	33.57%	48.38%
Mental Health*		
0	58.09%	28.15%
1	28.60%	39.63%
2	8.85%	18.33%
3 or more	4.45%	13.89%
Physical*		
0	31.03%	16.85%
1	22.03%	17.84%
2	17.20%	16.50%
3 or more	29.74%	48.81%
Deceased*		
No	80.66%	70.30%
Yes	19.34%	29.70%
Months In Cohort[†]		

	410.21 (426.50)	417.17 (438.67)
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332 **P* < 0.05
333 †Median test
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335 **Table 2. Unadjusted association of TBI with annual VHA costs per veteran.**

	Veterans Without TBI	Veterans With TBI
N	291,015	181,521
Total VA + Community Care*		
Predicted mean per veteran per year	\$23,008	\$60,579
Median	\$439	\$7,898
Total VA *		
Predicted mean per veteran per year	\$21,391	\$58,200
Median	\$329	\$7,355
Inpatient*		
Predicted mean per veteran per year	\$8,108	\$25,367
Median	\$0	\$1,260
Outpatient*		
Predicted mean per veteran per year	\$8,769	\$25,593
Median	\$0	\$1,278
Pharmacy*		
Predicted mean per veteran per year	\$4,514	\$7,241
Median	\$224	\$1,395
Community Care*		
Predicted mean per veteran per year	\$1,617	\$2,379
Median	\$0	\$0

336 *Significant at $P < 0.05$

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339 **Table 3. Association of TBI diagnoses with Sociodemographic and Clinical Characteristics***

	Odds Ratio of TBI (relative to no TBI)	95% CI	P-value
Age			
21-51	Reference		
52-64	0.68	0.66:0.69	0.000
65-73	0.61	0.60:0.63	0.000
74-99	1.39	1.34:1.43	0.000
Gender			
Male	Reference		
Female	0.56	0.55:0.58	0.000
Race			
Non-Hispanic White	Reference		
Non-Hispanic Black	1.85	1.81:1.88	0.000
Hispanic	1.94	1.88:2.00	0.000
Other race	1.01	0.99:1.03	0.413
Location			
Urban	Reference		
Rural/Highly Rural	0.50	0.50:0.51	0.000
U.S. Territory	0.15	0.15:0.16	0.000
Post-Gulf War			
Pre	Reference		
Post	0.95	0.93:0.98	0.000
Service-Connected Disability			
<50%	Reference		
>50%	1.46	1.45:1.48	0.000
Mental Health			
1	2.76	2.72:2.80	0.000
2	4.03	3.94:4.12	0.000
3 or more	5.83	5.68:5.98	0.000
Physical Categories			
1	1.36	1.33:1.39	0.000
2	1.59	1.55:1.62	0.000
3 or more	2.47	2.42:2.52	0.000

340 *Standard errors have been bootstrapped.

341

342 **Table 4. Covariate-Adjusted Hazard Ratios of Death by TBI Status***

	Hazard Ratio	95% CI	P-value
TBI			
Without TBI	Reference		
With TBI	1.16	1.14:1.17	0.000
Age			
21-51	Reference		
52-64	1.18	1.14:1.22	0.000
65-73	0.93	0.90:0.97	0.000
74-99	2.22	2.15:2.30	0.000
Gender			
Male	Reference		
Female	0.50	0.48:0.51	0.000
Race			
Non-Hispanic White	Reference		
Non-Hispanic Black	0.67	0.65:0.70	0.000
Hispanic	0.73	0.71:0.76	0.000
Other race	0.99	0.97:1.01	0.288
Location			
Urban	Reference		
Rural/Highly Rural	0.87	0.86:0.88	0.000
U.S. Territory	0.85	0.83:0.88	0.000
Post-Gulf War			
Pre	Reference		
Post	0.33	0.32:0.34	0.000
Service-Connected Disability			
<50%	Reference		
>50%	0.77	0.76:0.78	0.000
Mental Health			
0	Reference		
1	0.90	0.89:0.92	0.000
2	0.97	0.95:0.99	0.012
3 or more	0.92	0.89:0.95	0.000
Physical			
0	Reference		
1	1.15	1.12:1.18	0.000
2	1.31	1.28:1.35	0.000
3 or more	1.82	1.77:1.87	0.000

343 *Standard errors have been bootstrapped.

344

345 Table 5. Adjusted marginal impact of TBI on Annual VHA Costs Per Veteran*

	Total VA + Community Care	Inpatient	Outpatient	Pharmacy	Community Care
TBI					
Without	Reference				
With	\$19,808 [†] (13900:25715)	\$10,295 [†] (7431:13158)	\$9,255 [†] (6528:11981)	\$160 (-409:729)	\$234 [†] (16:451)
Age					
21-51	Reference				
52-64	\$12,897 [†] (9328:16465)	\$5,114 [†] (4202:6026)	\$4,913 [†] (4087:5739)	\$1,570 [†] (1071:2070)	\$505 [†] (325:685)
65-73	\$7,073 [†] (2667:11479)	\$2,383 [†] (631:4135)	\$2,737 [†] (782:4692)	\$1,457 [†] (894:2019)	\$-92 (-342:159)
74-99	\$14,758 [†] (7866:21650)	\$5,346 [†] (2164:8529)	\$5,447 [†] (2552:8343)	\$3,657 [†] (2140:5174)	\$-519 [†] (-796:-242)
Gender					
Male	Reference				
Female	\$-2,977 (-5756:-198)	\$-2,183 [†] (-3097:-1269)	-\$2,179 [†] (3031:-1326)	\$916 [†] (542:1291)	\$461 [†] (292:631)
Race					
NHW	Reference				
NHB	\$7,251 [†] (1603:12898)	\$4,474 [†] (2251:6698)	\$4,323 [†] (1998:6648)	\$-1,129 [†] (-1484:-774)	\$-483 [†] (-741:-225)
Hispanic	\$-5,730 [†] (-9531:-1930)	\$-2,206 [†] (-3784:-628)	-\$2,333 [†] (-3828:-838)	\$-507 [†] (-851:-163)	\$-573 (-1009:136)
Other race	\$2,492 (-2830:7813)	\$403 (-1565:2371)	\$836 (-1199:2872)	\$682 (-403:1766)	\$638 [†] (352:925)
Location					
Urban	Reference				
Rural/Highly Rural	\$-9,455 [†] (-14212:-4699)	\$-4,023 [†] (-6520:-1525)	-\$4,451 [†] (-6700:-2202)	\$-450 (-957:58)	\$-267 [†] (-449:-84)
U.S. Territory	\$-10690 (-26311:4930)	\$-3928 (-8449:-593)	-\$4657 [†] (-9293:-22)	\$-1549 [†] (-2213:-884)	\$27 (-334:388)
Post-Gulf War					
Before	Reference				
After	\$-25,550 [†] (-29661:-21438)	\$-10,292 [†] (-11595:-8988)	\$-10,484 [†] (-11808:-9160)	\$-1,839 [†] (-2353:-1324)	\$-1,855 [†] (-2037:-1673)
Service- Connected Disability					

<50%	Reference				
>50%	\$14,364 [†] (9399:19328)	\$4,465 [†] (2099:6831)	\$4,897 [†] (2605:7189)	\$2,496 [†] (1920:3071)	\$2,293 [†] (2104:2482)
Mental					
0	Reference				
1	\$8,749 [†] (3732:13766)	\$3,537 [†] (868:6205)	\$3,534 [†] (-2305:226)	\$1,804 [†] (1222:2385)	\$-20 (-205:166)
2	\$21,498 [†] (17067:25929)	\$8,610 [†] (7269:9951)	\$9,251 [†] (7858:10643)	\$3,908 [†] (1966:5949)	\$-53 (-290:184)
3 or more	\$55,204 [†] (46283:64125)	\$24,922 [†] (22154:27690)	\$28,152 [†] (22783:33521)	\$2,660 [†] (1893:3427)	\$-321 (-609: -33) [†]
Physical					
0	Reference				
1	\$-2,574 (-5800:652)	\$-1,100 (2427:226)	-\$1,039 (-2305:226)	\$647 [†] (200:1094)	\$306 [†] (117:494)
2	\$-781 (-4472:2911)	\$-1,193 (-2378:-7)	-\$396 (-1634:842)	\$2,022 [†] (1515:2529)	\$484 [†] (258:711)
3 or more	\$20,197 [†] (14902:25492)	\$6,621 [†] (4768:8475)	\$7,198 [†] (5367:9029)	\$6,814 [†] (6094:7534)	\$1,493 [†] (1280:1706)

*Standard errors have been bootstrapped.

[†]Significant at P < 0.05

Figures

Figure 1

Covariate adjusted Kaplan-Meier survival estimates associated with TBI