A prospective examination of health care costs associated with posttraumatic stress disorder diagnostic status and symptom severity among veterans

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Abstract:

Posttraumatic stress disorder (PTSD) is associated with increased health care costs; however, most studies exploring this association use PTSD diagnostic data in administrative records, which can contain inaccurate diagnostic information and be confounded by the quantity of service use. We used a diagnostic interview to determine PTSD diagnostic status and examined associations between PTSD symptom severity and health care costs and utilization, extracted from Veteran Health Administration (VHA) administrative databases. Using a nationwide longitudinal sample of U.S. veterans with and without PTSD (N = 1,377) enrolled in VHA health care, we determined the costs and utilization of mental health and non–mental health outpatient, pharmacy, and inpatient services for 1 year following cohort enrollment. Relative to veterans without PTSD, those with PTSD had higher total health care, B = 0.47; mental health clinic care, B = 0.72; non–mental health clinic care, B = 0.30; and pharmacy costs, B = 0.72, ps < .001. More severe PTSD symptoms were associated with mental health clinic care costs, B = 0.12; non–mental health clinic care costs, B = 0.27; and higher odds of inpatient, B = 0.63, and emergency service use, B = 0.39, p < .001–p = .012. These findings indicate that veterans' PTSD status, determined by a clinician-administered semistructured diagnostic interview, was associated with higher health care costs and increased use of mental health and non–mental health clinic services. The findings also suggest that more severe PTSD is associated with increased costs and utilization, including costly emergency and inpatient utilization.

Keywords: posttraumatic stress disorder | PTSD | veterans | health care costs

Article:

Posttraumatic stress disorder (PTSD) is a common psychiatric disorder, with an estimated lifetime prevalence rate of 6.8% in the United States (Kessler et al., 2005). Among military veterans, the prevalence of PTSD is even higher (Fulton et al., 2015). PTSD is highly comorbid with other psychiatric disorders and medical illnesses (Frayne et al., 2011; Kessler, 1995; Pacella et al., 2013; Possemato et al., 2010). Likely due in part to high rates of comorbidity, individuals with PTSD use more mental health services and medical health care services than individuals without PTSD (Cohen et al., 2010; Elhai et al.,2005; Kehle-Forbes et al., 2017; Possemato et al., 2010; Sripada et al., 2014). Comparisons of health care costs among people with and without PTSD are needed to understand the burden of disease and inform policy, budgeting, and resource allocation decisions in the Veterans Health Administration (VHA) and among private health insurers.

Studies that have used VHA administrative records to examine health care costs among veterans have determined that PTSD diagnostic status is associated with increased health care costs (Bhatnagar et al., 2015; Chan et al., 2009; Kehle-Forbes et al., 2017; Taylor et al., 2012). Specifically, these studies have suggested that relative to veterans without PTSD, those with the disorder have higher overall annual health care costs (Bhatnagar et al., 2015; Kehle-Forbes et al., 2017; Taylor et al., 2012), outpatient costs (Chan et al., 2009; Kehle-Forbes et al., 2017), medical costs (Chan et al., 2009; Kehle-Forbes et al., 2017), mental health costs (Bhatnagar et al., 2015; Chan et al., 2009; Kehle-Forbes et al., 2017), and pharmacy or medication costs (Bhatnagar et al., 2015; Chan et al., 2009). In the general population or nonveteran samples, PTSD has also been associated with higher total health care costs, outpatient costs, mental health inpatient costs, emergency room (ER) costs, and pharmacy costs (Ivanova et al., 2011; Lamoureux-Lamarche et al., 2016).

One important limitation for many prior studies with regard to associations between PTSD diagnostic status and health care costs is that these studies typically have relied upon electronic health records (EHR) or other administrative data to determine PTSD diagnostic status. Other research has demonstrated that reliance upon the EHR for PTSD diagnoses leads to considerable error and misclassification of cases and noncases. For example, Holowka et al. (2014) used a semistructured interview to confirm PTSD diagnostic status based on EHR records and found that 19.1% of veterans with an EHR PTSD diagnosis did not meet the criteria for current PTSD; further, 8.6% of the participants without an EHR PTSD diagnosis met the interview criteria. Research from other laboratories has demonstrated similar results (Magruder et al., 2005; Morgan et al., 2019). Additionally, using EHR diagnostic codes to determine the presence or absence of PTSD may bias the results because individuals who present more frequently to care are more likely to be assessed for and diagnosed with PTSD. Therefore, using a measure, such as a diagnostic interview, that is independent of the frequency of service use removes this potential confound and provides a clean examination of the relation between PTSD diagnostic status and health care costs.

Only a few studies of which we are aware have used diagnostic interviews to confirm PTSD diagnostic status while examining health care utilization administrative databases (Calhoun et al., 2002; Kartha et al., 2008; Magruder et al., 2005), and only two such studies examined veterans (Calhoun et al., 2002; Magruder et al., 2005). Although the findings from these studies suggest a robust association between diagnostic interview–derived PTSD diagnosis and mental and physical health care utilization (Calhoun et al., 2002; Magruder et al., 2005), the authors did not concurrently examine health care costs and their relation to PTSD diagnostic status. Moreover, few studies have explored whether PTSD symptom severity was associated with health care costs

and utilization (Calhoun et al., 2002; Gillock et al., 2005; Walker et al., 2003). Examining PTSD symptom severity is important because, among individuals who meet the criteria for PTSD, symptom severity may still explain variance in cost and utilization over and above the dichotomous diagnostic status. Lastly, research on PTSD symptoms and health care costs and utilization is limited. Most studies have focused on PTSD symptom clusters and mental health care utilization (Blais et al., 2014; Harpaz-Rotem et al., 2018; Rosenheck et al., 1992); only one known study has examined the utilization of non–mental health or medication services (Kaier et al., 2014). Although Kaier et al. (2014) found that reexperiencing and avoidance symptoms were differently related to mental health visits and medication use, the authors captured health care utilization at one Veterans Affairs (VA) facility and did not examine the costs of care.

To provide a more comprehensive investigation of the relation between PTSD and health care among veterans, we examined the degree to which PTSD diagnostic status derived from a diagnostic interview was associated with health care costs and utilization, using VHA administrative data among veterans in a national, longitudinal cohort study, Veterans After-Discharge Longitudinal Registry (Project VALOR). Project VALOR recruited veterans who had been deployed after September 2001 and received at least one mental health evaluation at a VHA facility. Moreover, Project VALOR oversampled women veterans and veterans with PTSD. Data in this registry include diagnostic interviews and self-report questionnaires, including a measure of PTSD symptom severity, in addition to VHA administrative data.

We hypothesized that PTSD diagnostic status based on semistructured diagnostic interviews would be associated with increased health care costs and utilization. We also expected that veterans with more severe PTSD symptoms would incur higher costs and report higher degrees of utilization than veterans with less severe PTSD symptoms. Health care costs and utilization were prospectively assessed for a 12-month period using VHA administrative data following PTSD assessment.

METHOD

Participants

Participants were a subsample of 1,377 United States Army or Marine Corps veterans enrolled in Project VALOR. To be included in the registry, veterans were required to have been deployed after September 2001 and have received a mental health evaluation at a VHA facility between July 2008 and December 2009. During participant selection, we oversampled at a 3:1 ratio veterans with probable PTSD by requiring at least two instances of a PTSD diagnosis by a mental health professional associated with two separate VHA facility visits. We recruited equal numbers of men and women (i.e., 1:1 ratio). Based on these requirements, 4,391 individuals were randomly selected and contacted by phone. Of those veterans, 2,712 (61.8%) consented to participate and 1,649 (60.8%) completed the initial Project VALOR assessment between 2009 and 2012.

The current analysis focuses on a subsample of this group, consisting of the 1,377 participants who completed the second assessment wave of the study. Time 2 was chosen because it was the first in which the PTSD criteria in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) (DSM-5) was used to assess symptoms. Time 2 data collection took place between 2013 and 2014.

Procedure

At Time 2, participants provided informed consent verbally over the telephone per the research protocol approved by the VA Boston Healthcare System Institutional Review Board and the Human Research Protection Office of the U.S. Army Medical Research and Materiel Command. Participants then completed an online questionnaire battery, followed by a telephone-based semistructured clinical interview conducted by a trained and supervised doctoral-level assessor. Participants provided consent for researchers to access and retrieve data from their VA medical records throughout the study and received $100 (USD) for the completion of the questionnaire and assessment.

Measures

Current PTSD and depression

The PTSD and Major Depressive Episode (MDE) modules of the Structured Clinical Interview for DSM-5 (SCID-5; First et al., 2015) were administered by telephone to assess exposure to a Criterion A event and measure current (i.e., past-month) and lifetime PTSD diagnostic status and the presence or absence of a current or past MDE. Interviews were digitally recorded to evaluate interrater reliability. A random subset of interviews (n = 100) was independently reviewed and coded for interrater agreement, which was excellent for both the PTSD module, $\kappa = .82$, and MDE module, $\kappa = .75$.

PTSD symptom severity

The PTSD Checklist for DSM-5 (PCL-5; Weathers et al., 2013) was used to assess PTSD symptom severity. This self-rated measure corresponds to each of the 20 core DSM-5 PTSD symptoms and asks respondents to rate how much each symptom has bothered them in the past month, scoring responses on a Likert scale ranging from 0 (not at all) to 4 (extremely). Scores range from 0 to 80, with higher scores indicating more severe symptoms. PCL-5 scores greater than or equal to 33 are indicative of a probable diagnosis of PTSD (Bovin et al., 2016). The PCL-5 is considered the "gold standard" self-report measure of PTSD symptom severity and has demonstrated good test–retest reliability (r = .84) and convergent and discriminant validity (Blevins et al., 2015; Bovin et al., 2016; Keane et al., 2014). In the current sample, PCL-5 scores demonstrated excellent internal consistency, Cronbach's $\alpha = .96$.

Mild traumatic brain injury

Participants' history of mild traumatic brain injury (TBI) was assessed using structured interview questions reflecting current classification standards (American Congress of Rehabilitation Medicine, Head Injury Interdisciplinary Special Interest Group, 1993). Participants were asked if they ever had a head injury or blast exposure and, if so, up to 5 injuries were queried. A history of at least one injury accompanied by either altered mental state ("feeling dazed, confused, or seeing stars"), loss of consciousness, and/or posttraumatic amnesia was coded as a probable mild TBI. These interview questions have been found to have excellent inter-rater agreement ($\kappa = .97$; Wisco et al., 2014).

Demographic information

We extracted participant age and sex from a Department of Defense database at the start of the study. Race, ethnicity, education level, marital status, and military branch were self-reported via an online questionnaire.

Health comorbidities

We used the Enhanced Elixhauser Comorbidity index coding system (Quan et al., 2005) to create a score for chronic health comorbidities. We created Elixhauser Comorbidity index scores based on International Classification of Diseases (ICD) diagnoses from all inpatient and outpatient encounters for 1 year following Time 2 data collection. We used codes from the ninth revision of the ICD (i.e., ICD-9) Time 2 data collection predated the publication of the tenth revision (i.e., ICD-10) codes. If veterans received at least one diagnosis within the Elixhauser Comorbidity index categories, they received 1 point for that category. Mental health indicator categories (i.e., depression, psychoses, substance abuse) were not included; therefore, the summed score across the 27 categories only captured chronic medical conditions.

Health care costs

Total health care costs

We identified total health care costs from the Managerial Cost Accounting (MCA) Office National Data Extracts (NDEs), which report costs of inpatient and outpatient encounters and pharmacy costs. These cost estimates are derived by allocating the total cost of the VHA system across patient services. Total cost was constructed for a 1-year period following the date the participant completed Time 2 Project VALOR data collection. The fiscal years ranged from 2013 to 2015 across participants. We computed the total cost from the NDE outpatient, inpatient treating specialty (TRT), and pharmacy files and summed the total fixed direct and total fixed indirect costs.

Outpatient cost and utilization

We used the MCA NDE outpatient data to construct two categories of outpatient costs and utilization—non–mental health clinic visits and mental health clinic visits—for a 1-year period. We removed pharmacy, laboratory/pathology, radiology, and telephone services from this dataset. We identified mental health clinic visits by the use of stop codes 500–599. Non–mental health clinic visits included ancillary services (e.g., physical therapy), primary care and medical services, surgical services, and "other" services (e.g., smoking cessation).

Pharmacy cost

We used MCA NDE pharmacy data to determine the total cost of inpatient and outpatient pharmacy services by summing the actual total costs and dispensing fees for a 12-month period. We created two categories of total pharmacy costs (i.e., mental health–related and non–mental health-related)

and determined whether medications were mental health–related using the VA's National Drug Formulary to identify drug classes for psychotropic medications (see Supplementary Table S1). We created a total pharmacy cost for all mental health–related medications and subtracted this from the total pharmacy cost to derive the non–mental health-related pharmacy cost.

Inpatient utilization

We used the NDE TRT file, which captures inpatient treating specialty encounters, to identify hospitalizations. We derived hospitalizations for psychiatric reasons based on whether the principal diagnosis given was a psychiatric diagnosis. All other hospitalizations were captured in general hospitalizations. Due to the low number of hospitalizations during the 1-year period, psychiatric hospitalizations and general hospitalizations were converted into dichotomous variables where (i.e., no hospitalizations or at least one hospitalization).

ER utilization

We identified ER visits in the MCA NDE outpatient date file as encounters with the stop code 130. Due to the low frequency of ER visits during the 1-year period, ER utilization was computed into a dichotomous variable (i.e., no ER visits or at least one ER visit).

Data analysis

We conducted three sets of analyses. First, we estimated models of cost and utilization outcomes on the presence of PTSD, based on the SCID-5. Second, we estimated models of the association of cost and utilization outcomes with symptom severity derived from the PCL-5. We estimated these models separately for veterans with and without PTSD. Third, we estimated models of the association of cost and utilization outcomes with PTSD cluster symptom severity scores derived from the PCL-5. For missing PCL-5 data, we imputed responses to missing items using a fully conditional specification in SAS (Version 9.4). Missing data were imputed using maximum-likelihood multiple imputation averaged over five imputations if less than 20% of the responses for the PCL were missing (i.e., three or fewer items).

For models with cost as the outcome, we estimated generalized linear models with a Poisson distribution and log-link function to account for the nonnormal distribution of cost data. We adjusted for inflation using the Bureau of Economic Analysis, National Income Product Accounts Table for Gross Domestic Product (GDP) to present cost findings in 2012 United States dollars. For analyses with utilization variables as the outcome, we conducted negative binomial regressions because utilization data are inherently count data (i.e., number of encounters), and the data were overdispersed. We reported the incidence rate ratios (IRRs), which can be interpreted as the estimated number of visits for veterans with PTSD divided by the number of visits for veterans without PTSD. We conducted logistic regressions for dichotomous outcomes (i.e., general hospitalizations, psychiatric hospitalizations, and ER visits). For all adjusted models, age, sex, race/ethnicity, education, marital status, branch of military service, mild TBI, Elixhauser Index total score, VA Veterans Integrated Service Network (VISN), and depression diagnosis on the SCID were included in the model. All analyses were conducted in SAS (Version 9.4).

RESULTS

Of the veterans (N = 1,377) included in the sample, 48.9% were male (n = 674). The overall prevalence of PTSD based on the SCID-5 was 62.5% (n = 861). Table 1 presents the demographic characteristics for the sample and descriptive statistics for covariates.

TABLE 1. Sample descriptive statistics

	No PTSD (N = 482)		**PTSD (N = 861)**	
Variable	***M***	***SD***	***M***	***SD***
Age	39.78	9.81	41.13	9.77
Elixhauser score	0.44	0.78	9.58	0.87
PCL-5 score	23.24	16.78	48.28	16.24
	%	***n***	**%**	***n***
Sex				
Male	49.2	237	51.3	442
Female	50.8	245	48.7	419
Race				
Non-Hispanic White	73.4	351	63.9	544
Non-White minority	26.6	127	36.2	307
Marital status				
Not married	46.0	221	47.8	410
Married	54.0	259	52.5	446
Educational attainment				
Less than a bachelor's degree	49.3	236	60.0	512
Bachelor's degree or higher	50.7	243	40.0	342
Military branch				
Army	89.6	236	91.3	786
Marines	10.4	50	8.7	75
Mild traumatic brain injury	4.6	22	36.2	299
Major depressive disorder	8.0	38	36.2	299

Note: N = 1,377. PTSD = posttraumatic stress disorder; PCL-5 = Posttraumatic Stress Disorder Checklist for DSM-5.

PTSD diagnostic status

PTSD diagnostic status was significantly associated with total health care costs and all categories of cost (non–mental health clinic costs, mental health clinic costs, and pharmacy costs; see Tables 2 and 3). Individuals with a PTSD diagnosis cost the VA an additional $4,580.69, 95% CI [1.94, 1.95], or 94.6% more than individuals without a PTSD diagnosis. Adjusting for patient demographic characteristics and comorbidities narrowed this difference such that a PTSD diagnosis was associated with an additional $3,221.44, 95% CI [1.55, 1.55], in VHA costs, or 54.7% more than the cost for an individual without a PTSD diagnosis. A PTSD diagnosis was associated with an additional $781.36, 95% CI [1.31, 1.32], of adjusted spending on non–mental health clinic visits, or 31.6% of the non-PTSD expected spending level. The adjusted difference in costs for mental health clinic visits was $1,067.32, 95% CI [1.98, 2.00], or almost double the cost for an individual with no PTSD diagnosis. Spending on pharmacy services also varied with PTSD

TABLE 2. Unadjusted models of posttraumatic stress disorder (PTSD) diagnostic status predicting cost and utilization

	No PTSD		PTSD							
Outcome	***EM***	***SD***	***EM***	***SD***	***IRR***	**95% CI**	***p***	x^2	***df***	***p***
Total VA cost	$4,845.94	117.19	$9,426.63	122.36	1.95	[1.94, 1.95]	< .001	24,964,940.04	1,329	< .001
Non-MH clinic cost	$2,014.91	75.57	$3,409.67	73.58	1.69	[1.89, 1.70]	< .001	9,754,926.11	1,329	< .001
MH clinic cost	$908.14	50.73	$2,220.86	59.38	2.45	[2.44, 2.45]	< .001	10,712,024.55	1,329	< .001
Non-MH pharmacy cost	$421.12	34.57	$721.48	33.84	1.71	[1.71, 1.72]	< .001	18,816,315.73	1,328	< .001
MH pharmacy cost	$190.91	23.26	$485.42	27.76	2.54	[2.52, 2.56]	< .001	2,672,703.50	1,329	< .001
Non-MH clinic visits	5.78	12.89	14.89	8.02	1.57	[1.35, 1.82]	< .001	1,762.08	1,329	< .001
MH clinic visits	3.38	10.48	8.02	18.14	2.37	[1.93, 2.92]	< .001	2,166.32	1,329	< .001

	OR	**95%CI**	***p***	***AIC***[a]	***N***[b]
General hospitalizations	0.97	[0.46, 2.05]	.931	290.86	1,331
Psychiatric hospitalizations	8.98	[2.14, 37.67]	.003	296.27	1,331
ER visits	1.39	[1.02, 1.88]	.036	1,246.45	1,331

TABLE 3. Adjusted models of posttraumatic stress disorder (PTSD) diagnostic status predicting cost and utilization

	No PTSD		PTSD							
Outcome	***EM***	***SD***	***EM***	***SD***	***IRR***	**95% CI**	***p***	x^2	***df***	***p***
Total VA cost	$5,887.23	246.78	$9,108.67	319.23	1.55	[1.55, 1.55]	< .001	182,518.15	1,253	< .001
Non-MH clinic cost	$2,469.25	168.20	$3,250.61	190.21	1.32	[1.32, 1.32]	< .001	6,748,800.64	1,253	< .001
MH clinic cost	$1,076.78	98.46	$2,144.10	159.16	1.99	[1.98, 2.00]	< .001	8,202,411.83	1,253	< .001
Non-MH pharmacy cost	$335.35	54.95	$391.41	56.69	1.17	[1.16, 1.17]	< .001	7,188,250.49	1,252	< .001
MH pharmacy cost	$267.04	50.51	$554.53	81.53	2.08	[2.06, 2.09]	< .001	2,191,937.90	1,253	< .001
Non-MH clinic visits	6.85	28.74	9.47	319.23	1.38	[1.19, 1.60]	< .001	1,553.43	1,253	< .001
MH clinic visits	3.38	21.28	7.74	190.21	2.29	[1.84, 2.85]	< .001	1,822.14	1,253	< .001

	OR	**95%CI**	***p***	***AIC***[a]	***N***[b]
General hospitalizations	1.87	[0.22, 1.30]	.169	273.34	1,285
Psychiatric hospitalizations	8.41	[1.89, 37.37]	.005	303.23	1,285
ER visits	1.19	[0.85, 1.68]	.317	1,184.91	1,285

Note: Adjusted models include age, sex, race/ethnicity, education, marital status, branch of military service, mild traumatic brain injury, Elixhauser Index total score, Veterans Integrated Service Network (VISN), and depression diagnosis on the Structured Clinical Interview for DSM-5. The adjusted model for general hospitalizations did not include VISN because the model would not converge. EM = estimated mean; IRR = incidence rate ratio; MH = mental health; OR = odds ratio; AIC = Akaike information criterion; ER = emergency room.

[a] Smaller values represent a better fit.

[b] Number of observations.

TABLE 4. Adjusted model of standardized Posttraumatic Stress Disorder (PTSD) Checklist (PCL) symptom severity predicting cost and utilization for veterans with and without a Structured Clinical Interview for DSM-5 (SCID) PTSD diagnosis

	PTSD			**No PTSD**		
Outcome	***IRR***	**95% CI**	***p***	***IRR***	**95% CI**	***p***
Total VA cost	1.37	[1.37, 1.37]	< .001	1.33	[1.33, 1.33]	< .001
Non-MH clinic cost	1.32	[1.31, 1.32]	< .001	1.18	[1.18, 1.18]	< .001
MH clinic cost	1.33	1.33, 1.34]	< .001	1.50	[1.49, 1.51]	< .001
Total pharmacy cost	1.14	[1.14, 1.15]	< .001	1.07	[1.07, 1.08]	< .001
MH Pharmacy cost	1.43	[1.42, 1.43]	< .001	1.34	[1.33, 1.35]	< .001
Non-MH clinic visits	1.32	[1.21, 1.43]	< .001	1.26	[1.11, 1.43]	< .001
MH visits	1.37	[1.22, 1.54]	< .001	1.83	[1.41, 2.37]	< .001
	OR	**95% CI**	***p***	***OR***	**95% CI**	***p***
Non-MH hospitalizations[a]	1.37	0.92, 3.02	.091	1.46	[0.72, 2.98]	.294
Psychiatric hospitalizations[b]	1.88	1.15, 3.06	.012	1.63	[0.49, 5.40]	.243
ER visit	1.48	1.20, 1.83	< .001	0.91	[0.66, 1.25]	.566

Note: Adjusted model includes age, sex, race/ethnicity, education, marital status, branch of military service, mild traumatic brain injury, Elixhauser Index total score, Veterans Integrated Service Network (VISN), and SCID depression diagnosis. IRR = incidence rate ratio; MH = mental health; ER = emergency room; OR = odds ratio.

[a] Does not control for VISN.

[b] Unadjusted model.

diagnostic status such that a PTSD diagnosis was associated with an additional $287.49 in spending for mental health pharmacy services in the adjusted model, whereas the difference for non–mental health pharmacy services was only $56.06. A PTSD diagnosis was also associated with significantly more non–mental health and mental health outpatient visits compared with no PTSD (see Tables 2 and 3).

PTSD diagnostic status was not significantly associated with the odds of general hospitalizations or ER visits in the adjusted models; however, PTSD was associated with significantly higher odds of psychiatric hospitalization (see Tables 2 and 3). In the unadjusted model, individuals with PTSD were 8.98 times more likely to be admitted for psychiatric hospitalization and 1.39 times more likely to visit an ER for any reason than those without PTSD. In the adjusted model, those with PTSD were 8.41 95% CI [1.89, 37.37], times more likely to be admitted for psychiatric hospitalization than those without PTSD.

PTSD symptom severity

The findings for outpatient utilization were similar to the results for the cost outcomes—regardless of PTSD diagnostic status, increases in PCL-5 scores related to increased use of this type of care. For a 1 standard deviation increase on the PCL-5, non–mental health clinic visits increased by 31.5% and 26.4% for individuals with and without PTSD, respectively, and mental health clinic visits increased by 37.0% and 82.8%.

Lastly, among individuals with but not without PTSD, PCL-5 scores were significantly associated with the likelihood of being admitted for psychiatric hospitalization or seeking emergent care. For participants with PTSD, a PCL-5 score increase of 1 standard deviation was associated with 1.88 higher odds of psychiatric hospitalization and 1.48 higher odds of having at least one ER visit during the 12-month period.

We also examined whether PTSD symptom cluster severity scores differently predicted health care costs and utilization. Although all symptom clusters significantly predicted costs and utilization (see Supplementary Table S2), avoidance symptoms (i.e., Cluster C) had the strongest association with increased health care costs and utilization for veterans with and without PTSD. Also, intrusion symptoms (i.e., Cluster B) and negative alterations in cognition and mood (i.e., Cluster D) were the symptom clusters most consistently associated with hospitalizations and ER visits, and Cluster B was the only symptom cluster to predict general hospitalizations for veterans with PTSD (see Supplementary Table S2).

DISCUSSION

Previous research suggests that individuals with PTSD have higher health care costs and utilization than those without PTSD; however, few studies have used diagnostic interviews to determine PTSD status, and no studies of which we are aware have examined the association between PTSD symptom severity and health care costs. We used a semistructured diagnostic interview and self-reported PTSD symptom severity to prospectively examine the costs and utilization of VHA services for 1 year in a sample of veterans with and without PTSD. Consistent with previous research (Calhoun et al., 2002; Cohen et al., 2010; Kehle-Forbes et al., 2017), veterans with PTSD had higher levels of health care utilization and higher health care costs relative to veterans without PTSD, with these increases reflecting not only mental health clinic services but also non–mental health clinic services. Specifically, adjusted overall VA costs were $4,580.69 higher for each

veteran diagnosed with PTSD, representing a cost that was 54.7% higher for veterans with versus without PTSD. The costs of outpatient mental health clinic care and non–mental health clinical care were comparable to those found in a previous study that used VHA administrative records to determine PTSD diagnostic status, in which cost differences across health care service categories ranged from approximately $100 to $600 (Kehle-Forbes et al., 2017). Notably, in comparing our adjusted and unadjusted models, it is clear that individuals with PTSD are more costly on other, non–mental health clinic services than individuals without PTSD. Additionally, more severe PTSD symptoms were related to higher costs and utilization, including the utilization of expensive emergency services (i.e., hospitalizations and ER visits) for veterans with PTSD.

Our findings are similar to previous research indicating that higher levels of PTSD symptom severity are related to increased use of mental health and non–mental health clinic services (Calhoun et al., 2002; Gillock et al., 2005; Walker et al., 2003); however, our study extends these prior findings because these studies created categories of severity (e.g., low, moderate, high) rather than using the whole range of severity scores. Our study was the first to include a continuous measure of PTSD symptom severity among veterans with and without PTSD. Importantly, we found a larger impact of PTSD symptom severity on mental health care cost and utilization for veterans without PTSD than veterans with PTSD. This finding is consistent with other research demonstrating that individuals with subthreshold or subclinical PTSD have higher degrees of functional impairment, and likely more treatment need, than those with no PTSD symptoms (Bergman et al., 2017). Our findings for symptom severity also indicate that cost differences associated with PTSD may be largely explained by differences in symptom severity.

Consistent with previous research that has examined PTSD symptom clusters, we found that all PTSD symptom clusters were associated with increased mental health clinic care (Blais et al., 2014); however, our study extended previous research by examining the associations between PTSD symptom clusters and non–mental health care, hospitalizations, and emergency care. Avoidance symptoms had the strongest association with mental health and non–mental health care. This is surprising given that previous research has found that avoidance symptoms are related to lower mental health utilization (Blais et al., 2014); however, the authors of one previous study found that avoidance symptoms were associated with a higher number of days on pain medication (Kaier et al., 2014). Veterans with more severe avoidance symptoms may be less likely to engage in mental health treatment that is focused on trauma, such as trauma-focused therapies, due to avoiding trauma disclosure (Sayer et al., 2009), but may be utilizing other types of services. Avoidance symptoms also have a robust association with functional impairment (Shea et al., 2010), which, in turn, is strongly linked to more expensive health care costs (Greyson et al., 2017).

Further demonstrating the importance of examining symptom severity, among veterans with PTSD, individuals with more severe PTSD symptoms, especially those related to intrusions and negative alterations in cognitions and mood, had an increased likelihood of emergent care use and hospitalizations. Consistent with previous research (Calhoun et al., 2002; Chan et al., 2009), we also found that PTSD diagnosis was related to psychiatric hospitalizations. Emergency department visits and psychiatric hospitalizations are likely due to higher levels of mental health need (e.g., more severe PTSD symptoms, comorbid substance use disorders, suicidality) and psychosocial factors (e.g., detoxification, homelessness), in addition to chronic medical problems (Blonigen et al., 2017; Doran et al., 2013; Stanley et al., 2021; Vujanovic et al., 2017). More specifically, PTSD is associated with an increased risk of suicidal ideation and behaviors (Jakupcak et al., 2009; Lee et al., 2018; Panagioti et al., 2012) and inpatient psychiatric admissions for suicide-related concerns (Stanley et al., 2021; Vujanovic et al., 2017); therefore, the higher

likelihood of psychiatric hospitalizations observed in our study among veterans with PTSD is likely explained in part by suicide-related admissions. Targeted interventions for PTSD and co-occurring mental health and medical problems (e.g., substance use disorders, suicidality) and psychosocial factors (e.g., homelessness) may help reduce the utilization of costly emergency services and psychiatric hospitalizations.

The finding of an association between a PTSD diagnosis, or higher levels of PTSD symptom severity, and increased non–mental health care is a consistent finding in the literature and has important implications. There are several possible explanations for why individuals with PTSD may have more medical needs. PTSD and physical conditions may have similar underlying pathophysiological factors (e.g., long-term activation of hypothalamic–pituitary–adrenal axis, poor tonic cardiac functioning) that increase the risk of psychiatric problems and medical disorders (Bourassa et al., 2021; Kendall-Tackett, 2009). For example, individuals with PTSD are at increased risk for cardiovascular disease, and poor tonic cardiac functioning is associated with both PTSD and cardiovascular disease (Bourassa et al., 2021). In addition, medical problems may be impacted by emotional, cognitive, or behavioral components of PTSD (see Kendall-Tackett, 2009, for a review). These components of PTSD may directly influence health outcomes (e.g., poor sleep negatively impacts cardiac functioning) or may impact treatment adherence and help-seeking. For example, we found that more severe intrusion symptoms were related to an increased likelihood of general hospitalizations. Intrusion symptoms have been linked to sleep problems and chronic pain (Powell et al., 2015), which may influence other health outcomes and result in a higher number of hospitalizations. These findings, along with those from prior research (see Bourassa et al., 2021, for a review), suggest that PTSD treatment may improve health outcomes and, in turn, reduce the costs associated with and utilization of medical care.

Understanding the potential cost implications of reducing PTSD symptoms is essential. Moreover, reducing PTSD symptom severity may be particularly important, as many veterans who complete evidence-based PTSD treatments report a reduction in symptom severity but may still have sufficiently severe symptoms to keep their PTSD diagnosis (Steenkamp et al., 2015). Cost-effectiveness studies on evidence-based PTSD treatments would benefit from including the measurement of PTSD symptom severity in addition to a PTSD diagnosis to determine the impact on costs and utilization of health care following treatment. Additionally, PTSD treatment studies should examine health outcomes and medical care utilization to determine whether PTSD interventions reduce the utilization of non–mental health care (Bourassa et al., 2021). Lastly, prior research indicates that medical and psychiatric comorbidities (e.g., depression, TBI) are related to higher health care costs and utilization compared with PTSD alone (Chan et al., 2009; Kehle-Forbes et al., 2017; Taylor et al., 2012). Therefore, future cost-effectiveness studies on interventions should include medical and psychiatric comorbidities to determine whether comorbidities attenuate reductions in health care costs and utilization.

This study had several strengths, including the multiwave data collection in a prospective cohort of male and female veterans, use of a gold-standard diagnostic interview to determine PTSD diagnostic status, and examination of the impact of PTSD symptom severity on cost and utilization of care. There are also some noteworthy limitations. Due to our use of VHA administrative records, the present study only captured the costs associated with and utilization of VHA services. Although most veterans enrolled in the VHA utilize VA health care (National Center for Veterans Analysis and Statistics, 2020), it is possible that some veterans in the study utilized care outside of the VHA, which would not have been captured in this study. Although the use of stop codes to determine mental health care is common in health care cost and utilization research, it is possible that veterans

received some mental health care in non–mental health clinics, such as primary care settings. Furthermore, the costs of VA services are derived from activity-based costing and may not reflect the value of those services in market transactions. Additionally, we did not include veterans' military service–connected disability (i.e., the degree of disability for military service–related conditions) in our models. Military service–connected disability can impact the utilization of VHA services (National Center for Veterans Analysis and Statistics, 2020). Although a previous study found that PTSD symptom severity was associated with increased utilization even in veterans who are non–service connected (Calhoun et al., 2002), future studies would benefit from adjusting for service connection status and disability benefits received.

Despite these limitations, the present study provides an extension of previous research on health care costs and utilization through its use of a diagnostic interview to determine PTSD status and examination of the impact of PTSD symptom severity. The present findings demonstrate that veterans with PTSD have higher costs of care and higher degrees of utilization that are not just explained by increased mental health care but also include increased non–mental health care. Our findings also suggest that reducing veterans' PTSD symptom severity, especially avoidance and intrusion symptoms, could result in a decrease in cost and utilization of care, including costly emergency services and hospitalizations. Future research should examine the cost-effectiveness of evidence-based PTSD treatments on reducing mental health and non–mental health care costs and utilization.

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