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Pain and psychiatric comorbidities among two groups of Iraq- and Afghanistan-era Veterans

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Abstract—This study aimed to (1) identify the prevalence and severity of pain and psychiatric comorbidities among personnel who had been deployed during Operation Iraqi Freedom (OIF), Operation Enduring Freedom (OEF), and Operation New Dawn (OND) and (2) assess whether the Department of Veterans Affairs (VA) Polytrauma System of Care and an OIF/OEF/OND registry reflect real differences among patients. Participants ($N = 359$) were recruited from two VA hospitals. They completed a clinical interview, structured diagnostic interview, and self-report measures. Results indicated pain was the most common complaint, with 87% experiencing pain during the prior week and 56% reporting moderate or severe pain. Eighty percent of participants met criteria for at least one of seven assessed comorbid problems (moderate or severe pain, postconcussional disorder, posttraumatic stress disorder [PTSD], anxiety disorder, mood disorder, substance use disorder, psychosis), and 59 percent met criteria for two or more problems. PTSD and postconcussional disorder rarely occurred in the absence of pain or other comorbidities (0.3% and 0%, respectively). The Polytrauma group had more comorbid psychiatric conditions ($\chi^2 = 48.67$, $p < 0.05$) and reported greater severity of symptoms ($p < 0.05$) than the Registry group. This study confirmed the high prevalence of pain and concurrent mental health problems among personnel returning from military deployment.

Key words: Afghanistan, anxiety, blast injuries, chronic pain, combat disorders, comorbidities, depression, Iraq, postconcussive disorder, PTSD, sleep, substance use disorder, TBI, Veterans.

Abbreviations: CES-D = Center for Epidemiological Studies-Depression Scale, DAS-SF = Dyadic Adjustment Scale Short Form, DSM-IV = Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition, DSM-IV-TR = DSM-IV-Text Revision, M = mean, MANCOVA = multivariate analyses of covariance, MFSI-SF = Multidimensional Fatigue Symptom Inventory-Short Form, MINI = Mini International Neuropsychiatric Interview, NRS = numeric pain rating scale, OEF = Operation Enduring Freedom, OIF = Operation Iraqi Freedom, OND = Operation New Dawn, PRC = Polytrauma Rehabilitation Center, PSC = Polytrauma System of Care, PTSD = posttraumatic stress disorder, SCID = Structured Clinical Interview for Diagnosis, SPQ = Sleep Problems Questionnaire, STAI = State-Trait Anxiety Inventory, SUD = substance use disorder, TBI = traumatic brain injury, VA = Department of Veterans Affairs.

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INTRODUCTION

Significant advancements in the care of U.S. military personnel wounded during combat operations has led to more than a 90 percent survival rate among those injured while deployed during Operation Enduring Freedom (OEF), Operation Iraqi Freedom (OIF), and Operation New Dawn (OND) [1]. However, this enhancement in battlefield medical care and survival rate has resulted in additional challenges for long-term medical care and rehabilitation given the severity of physical injuries and high rates of trauma-related mental health disorders that characterize this population. Concurrently, unprecedented numbers of current or former servicemembers have returned from deployment and sought care for less serious physical injuries or for numerous emotional complaints.

The Department of Veterans Affairs (VA) has responded by developing specialized comprehensive, integrated, and coordinated systems of postdeployment healthcare [2]. An OIF/OEF/OND registry of Veterans was established to facilitate tracking of the healthcare needs and services provided to this cohort. Emerging data document high rates of medical and mental health conditions among OIF/OEF/OND Veterans [3–11]. Of particular note are exceptionally high rates of painful musculoskeletal disorders, other painful medical conditions, and associated diagnoses of posttraumatic stress disorder (PTSD), traumatic brain injury (TBI), and other conditions [12].

In response to the large numbers of OIF/OEF/OND Veterans and Active Duty servicemembers who suffered moderate to severe TBI and insults to other organ systems, VA developed a Polytrauma System of Care (PSC) with specialized residential and outpatient assessment, treatment, and rehabilitation programs. The PSC began with the establishment of four inpatient Polytrauma Rehabilitation Centers (PRCs) in 2005 [13] and expanded with the development of an outpatient network of polytrauma care and a fifth inpatient PRC. The PSC strives to provide timely, comprehensive, and specialized care to those with multisystem injuries or deficits. Data from these programs similarly document the high prevalence of chronic pain, as well as TBI, PTSD, and other mental health and behavioral disorders [14–17].

One commonality between individuals receiving care in PSC settings and all other OIF/OEF/OND personnel who receive care in postdeployment care settings is the

high rate of reported pain and comorbidities [1,6,17–19]. Whether these concurrent physical and emotional problems reflect the circumstances surrounding multiple and extended deployments, cumulative exposures to blasts, the broad spectrum of wounds associated with blast injuries, and/or other factors remains speculative [20]. Regardless of etiology, the high rates of multiple problems pose significant challenges to treatment efforts. In response to this challenge, VA has sponsored a Post-Deployment Integrated Care Initiative to promote an interdisciplinary approach to care directed toward mitigating the long-term health effect of combat [21].

To date, precise estimates of the prevalence and types of co-occurring health problems among OIF/OEF/OND Veterans and Active Duty personnel remain elusive. While several studies have described high comorbidity rates [6,8–11,16], reported prevalence has been based either on diagnoses extracted from medical records or from self-reported symptom inventories. Medical record data are often incomplete or document varied diagnostic impressions that may or may not conform to accepted diagnostic nomenclatures or criteria [22]. Self-reported symptom measures provide valuable information regarding an individual's perceived functional level or emotional state, but when used alone do not confirm the presence or absence of specific diagnoses.

It is important to more precisely estimate the prevalence of physical and mental health diagnoses for several reasons. Veterans with comorbid pain and PTSD report greater frequency of health problems, utilize more healthcare, incur greater healthcare costs, and have more absenteeism from work [5]. They also report higher pain levels, greater pain-related disability, and more functional impairment [23]. Furthermore, chronic pain may result in depression, anxiety, or irritability. To cope with pain, some individuals develop maladaptive (e.g., substance use) or avoidant (e.g., inactivity) strategies. This ineffective coping among individuals with chronic pain may be due to maladaptive thoughts, such as memory biases, attentional biases, or feeling helpless about one's ability to affect change in one's life [24]. Chronic pain is often misinterpreted as ongoing damage, leading to fear of physical activities and resulting in increased sedentary behaviors and declines in physical functioning. While polytrauma and resulting symptom clusters of pain, PTSD, and TBI are common among OIF/OEF Veterans [6], treating each presenting problem sequentially has not been shown effective within the VA healthcare system

[2]. Thus, information regarding the range, clustering, and severity of multiple problem areas and diagnoses is needed to provide or develop maximally effective therapeutic approaches.

The primary objective of this study was to more precisely identify the prevalence and severity of pain and mental health comorbidities among OIF/OEF/OND Veterans and servicemembers using a structured clinical diagnostic interview and standardized surveys and questionnaires. A second objective was to compare PSC patients with those in the OIF/OEF/OND registry to assess whether there are real differences among these patients. Based on our clinical experience with this population and on limited data available, we hypothesized that pain would be the single most common complaint in our sample and that the majority of participants would meet criteria for a pain problem along with one or more mental health disorders. Additionally, assuming that the presumptions underlying the VA's bipartite system of OIF/OEF/OND care are accurate, we predicted that PSC patients would exhibit more severe symptoms and more comorbidities than the broader population of OIF/OEF/OND Veterans.

METHODS

Overview

This is a cross-sectional analysis of a prospective cohort study. The parent study examines the 1 yr incidence of pain, TBI, and emotional disorders and symptoms; adjustment; and treatment involvement of personnel deployed to OIF/OEF/OND who were receiving or had registered for VA healthcare. The current article focuses on psychiatric comorbidities and symptoms reported by participants at the time of study enrollment. The follow-up component of the study remains underway.

Study Sites

Two (one northern and one southeastern) VA facilities participated in this study. Both facilities are large, tertiary care hospitals that provide a broad range of comprehensive medical and mental health care and both maintain a comprehensive list (OIF/OEF/OND registry) of those who have applied for VA services in their region. Study methodology and informed consent procedures were approved by the two local affiliated institutional

review boards and each facility's Research and Development Committee.

Eligibility and Recruitment

Two nonstratified samples of participants were recruited from each study site. Participants were recruited from either the OIF/OEF/OND registry (Registry group) or the PSC (PSC group) between 2008 and 2010. To be eligible for the study, participants must have been deployed during OIF/OEF/OND between October 2001 and September 2010, be capable of reading and writing English and completing study forms and instruments, and be competent to provide informed consent. Participants recruited from the PSC also had to attain a Rancho Los Amigos Scale (an assessment of cognitive impairment) [25] level of 6 or higher (minimal to moderate impairment) and receive clearance from their attending physician in order to participate; surrogate consent was not accepted. A summary of the recruitment process and associated attrition is presented in **Figure 1**.

PSC participants were recruited either in person (during hospitalization or medical appointments) or by telephone (from a list of patients receiving care from local PSC clinical programs). PSC participants were eligible for enrollment at any point during their treatment. Potential Registry participants were randomly selected from the two facilities' OIF/OEF/OND registry lists based on a table of random numbers and were recruited using a three-stage process. First, those selected were mailed a letter of introduction outlining the study and informing them that they would be contacted by VA study personnel to discuss the project. Second, they were contacted by telephone to provide more information about the study and to invite them for a full screening to determine eligibility. Third, potential participants were scheduled for a face-to-face appointment. Those who met criteria and agreed to participate completed informed consent documents during this visit. While it is possible that PSC patients may also be on the Registry list, none of the potential Registry participants contacted for the current study were also receiving care through the PSC.

Procedures

To ensure consistency in study methodology between the two sites, clinical study personnel were trained in the specific study-related procedures and clinical assessments over a period of 2 mo. Training began with a 2 d training session with members of both training sites and

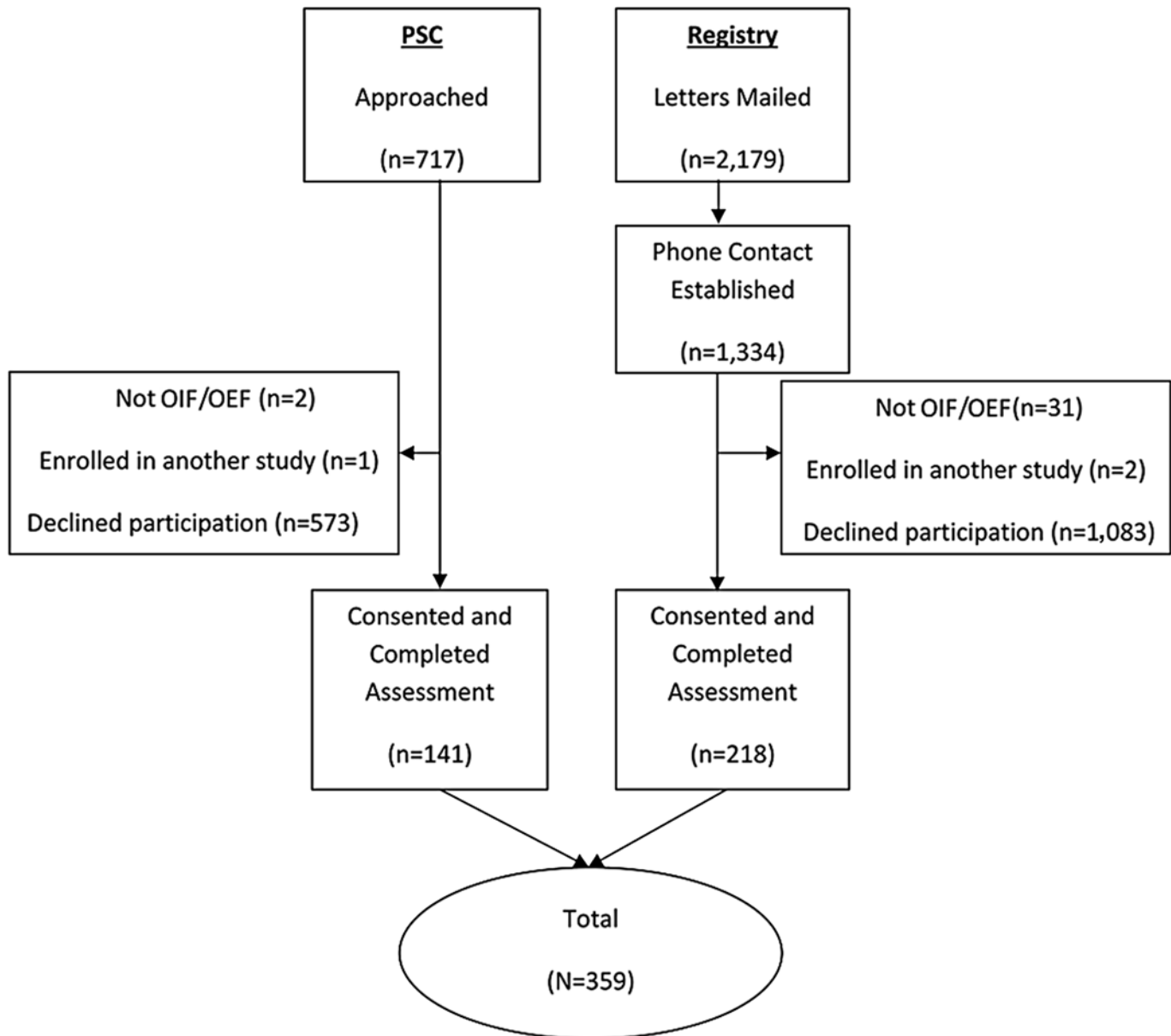


Figure 1.

Study recruitment summary. OEF = Operation Enduring Freedom, OIF = Operation Iraqi Freedom, PSC = Polytrauma System of Care.

included coding/scoring of measures, medical record data abstraction, database use, and administration of the structured clinical and diagnostic interviews. Training of diagnostic interviews was provided by one of the original developers of the test; study personnel (i.e., doctoral-level psychologists or master's-level trainees under the supervision of a licensed psychologist) were evaluated on

their administration of the measures. Training in the Mini International Neuropsychiatric Interview (MINI) continued until interrater agreement in major diagnostic categories met a kappa criterion of 0.90. Yearly in-person training updates were conducted to reassess interrater reliabilities, minimize drift in procedures, measure administration and scoring, and provide initial training to

any project staff replacements. Site coordination, communication, and problem solving were facilitated by monthly staff conference calls.

Personal history and diagnostic data were collected by study personnel using structured clinical interviews immediately preceding or following completion of the self-report measures. Participants independently completed the self-report instruments; the order of these instruments was counterbalanced across participants at both sites. To minimize missing data, study staff screened all self-report measures to identify any blank or unscorable responses. When missing or unscorable data were found, clinical staff verbally reviewed the item(s) with the participant and attempted to elicit a valid response. Participants received \$30 following the completion of the assessment. Participants who reported significant and untreated pain or mental health problems during any study contact and were interested in receiving treatment were referred to providers (e.g., primary care physicians) who could place appropriate consults.

Data Management

Data extracted from the medical record, structured clinical and diagnostic interviews, and self-report instrument results were entered into local databases by study staff. To assure data accuracy, field limits were established for all appropriate database entries. Additionally, 10 percent of database entries (selected randomly) were compared with the information entered on the original written data forms. When an entry error was discovered, an additional 10 percent were checked. This procedure was continued until no errors were encountered.

Study Measures

Health Record Data

Descriptive information was extracted from electronic health records, including physical examination details (e.g., presenting problems, injury information, symptoms) obtained from examination records at time of hospital admission (PSC group) or initial primary care evaluation following registration for VA care (Registry group), medical and psychiatric diagnoses, relevant health history data, Rancho Los Amigos Scale levels, and other information pertaining to treatment and life-adjustment issues. Information from record reviews was recorded using a standardized health record data collection form.

Structured Clinical Interviews

Structured clinical interviews were conducted to obtain data on deployment details (e.g., exposure to combat, blasts); pain history; mental health history; current, average, and least pain; emotional symptoms; concussion-related complaints or symptoms; employment status and obstacles; marital or relationship status; satisfaction with VA pain and/or mental health treatment in the last 3 mo (0 = not at all satisfied, 10 = completely satisfied); and perceived barriers to VA medical care and community reintegration (data on self-reported barriers to VA healthcare have been reported previously [26]). This interview was an expansion of one developed in 2005 to identify pain and emotional symptoms in returning combat Veterans. It was revised based on our experience with over 150 prior administrations. Each participant was asked the same questions in the same order (see [Appendix](#), available online only). This interview required approximately 45 to 60 min to administer.

Current Psychiatric Diagnoses

Current psychiatric diagnoses were obtained via the MINI [27]. The MINI is a brief, validated, structured clinical interview designed to yield reliable Axis I psychiatric diagnoses according to the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition (DSM-IV) [28]. The MINI was developed as an alternative to the longer Structured Clinical Interview for Diagnosis (SCID) [29]. An advantage of the MINI is that it requires little clinical judgment during administration, resulting in substantially higher interrater reliabilities when compared with the SCID [27]. Correspondence between MINI and SCID diagnoses of specific interest in this study have been particularly good (PTSD: 0.78; major depression: 0.84; generalized anxiety: 0.70; alcohol dependence: 0.67) [27]. Interrater reliabilities for these four diagnostic categories were also very high, ranging between 0.90 and 1.00 [27]. MINI structured interview data were used to identify the major categories of active DSM-IV Axis I diagnoses for each participant. In order to substantiate a diagnosis, participants had to meet all DSM-IV criteria as determined by the MINI interview. This interview required 15 to 20 min to administer. For the purposes of the current study, DSM-IV diagnoses were grouped into PTSD, non-PTSD anxiety disorder (e.g., generalized anxiety disorder, panic disorder with agoraphobia, panic disorder without agoraphobia, obsessive compulsive disorder, social phobia), mood disorder

(e.g., major depressive disorder, bipolar I or II disorder, dysthymic disorder), substance use disorder (SUD) (e.g., alcohol, opioid, or polysubstance abuse or dependence), and psychotic disorder (e.g., schizoaffective disorder, delusional disorder, schizophrenia, or major depressive disorder with a psychotic features specifier).

Traumatic Brain Injury Diagnosis

TBI diagnosis, which is not a formal DSM-IV diagnosis, was determined using DSM-IV-Text Revision (DSM-IV-TR) criteria for postconcussional disorder. Because the MINI interview does not cover diagnoses of postconcussional disorder, we utilized other study data sources to estimate its prevalence. According to DSM-IV-TR criteria, a diagnosis of postconcussional disorder requires (1) history of a TBI associated with “significant cerebral concussion,” (2) deficits in attention and/or memory, (3) three or more of eight associated symptoms (i.e., fatigue, sleep difficulties, headache, dizziness, irritability, affective disturbance, personality change, and apathy) that persist for 3 mo or more, (4) symptoms that begin or worsen after injury, (5) interference with social role functioning, and (6) exclusion of dementia or other disorders that account for the symptoms [28]. Lacking access to reliable Glasgow Coma Scale scores following injury, we utilized self-reported loss of consciousness following the trauma for criterion 1. Criteria 2, 3, and 5 were verified by participants’ individual responses to the concussion questions from the baseline clinical interview, life interference items administered as part of the baseline assessment, and their self-report of symptom duration obtained during the clinical interview (see [Appendix](#)). Additionally, during the clinical interview all participants linked their reported concussion symptoms specifically to a trauma (criterion 4), typically a blast exposure. Finally, alternate causes for symptoms were excluded based on a review of medical records (criterion 6).

Pain

Pain was assessed using the numeric pain rating scale (NRS). The NRS is a self-report measure of “usual” (average) pain intensity over the last week; response options range from “no pain” (0) to “worst pain imaginable” (10). NRS scales are reliable and valid methods for assessing pain intensity [30]. The “usual” scale has been found to be one of the best measures of pain intensity when compared with alternatives such as “current pain” or “worst pain.”

Fatigue

Fatigue was assessed using the 30-item Multidimensional Fatigue Symptom Inventory-Short Form (MFSI-SF) [31]. The MFSI-SF is a self-report measure designed to assess the multidimensional nature of fatigue. The five empirically derived subscales (general, physical, emotional, mental, and vigor) are each composed of six items. Subscale scores range from 0 to 24; higher scores indicate more fatigue, with the exception of vigor, for which higher scores indicate less fatigue. The subscales have been demonstrated to have good internal consistency and both convergent and construct validity [32].

Sleep

Sleep was assessed using the Sleep Problems Questionnaire (SPQ). The SPQ is a 4-item self-report measure of the most common symptoms of poor sleep in both healthy and distressed populations [33]. The scale has good internal consistency ($\alpha = 0.79$) and validity [33]. The SPQ was used as the primary measure of sleep. Total scores range from 0 to 28, with higher scores indicating worse sleep. We modified the SPQ to include one additional item asking participants to rate their overall sleep quality during the last week on a 0 (best sleep ever) to 10 (worst sleep ever) scale.

State and Trait Anxiety

State and trait anxiety were assessed using the State-Trait Anxiety Inventory (STAI). The STAI is a widely-used, 40-item self-report measure of state and trait anxiety with good psychometric properties [34]. The State scale measures the degree of anxiety symptomatology experienced at the time of assessment. The Trait scale measures anxiety-proneness or the tendency to experience anxiety in perceived stressful situations. The total score for each scale ranges from 20 to 80; higher scores indicate more anxiety. The STAI was used as the primary measure of participants’ anxiety levels.

Depressive Symptoms

Depressive symptoms were assessed using the 20-item, self-report Center for Epidemiological Studies-Depression Scale (CES-D) [35]. Total scores range from 0 to 60; higher scores indicate more depressive symptoms. The CES-D has high internal reliability in normal populations and good concurrent validity in chronic and cancer pain populations [36]. Among individuals with chronic pain, the CES-D has been found to discriminate

between those who were diagnosed with major depression and those who were not [37].

Relationship Distress

Relationship distress was assessed using the Dyadic Adjustment Scale-Short Form (DAS-SF). The Dyadic Adjustment Scale [38] is a widely-used, 32-item measure of marital adjustment and marital quality. The DAS-SF is a 7-item version that retains good agreement with total scale scores and is commonly used in research applications [39]. The scale can discriminate between distressed and adjusted relationships [39]. Total scores range from 0 to 36; lower scores indicate more relationship distress perceived by participants.

Statistical Analyses

Means, standard deviations, and percentages were calculated for demographic and descriptive data. Comparisons between the Registry and PSC groups were conducted using one-way analyses of variance for continuous data and chi-square tests for categorical data. When categorical variables included more than two categories and the overall chi-square test was significant, subsequent Bonferroni-corrected group comparisons were conducted for each category. Multivariate analyses of covariance (MANCOVAs) were used to compare the two groups on dependent measures in order to control for significant group differences between key continuous demographic variables. Results were considered significant at $p < 0.05$.

RESULTS

Demographic Characteristics

Of the 2,051 potential participants (PSC patients approached $n = 717$; Registry patients contacted by telephone $n = 1,334$), 36 were ineligible (PSC patients $n = 3$, Registry patients $n = 33$). Of the 2,015 eligible participants, 18 percent ($n = 359$) consented to participate and completed the assessment. Demographic variables were compared between the two sites (southeastern $n = 147$, northern $n = 212$) to evaluate any potential differences. The samples did not differ in sex ($\chi^2 = 0.51$, $p = 0.48$) or age ($t(357) = -1.85$, $p = 0.07$). Significant differences were found between sites in racial composition ($\chi^2 = 16.61$, $p < 0.001$) and ethnicity ($\chi^2 = 21.99$, $p < 0.001$), indicating that the southeastern facility had a higher pro-

portion of both nonwhite and Hispanic participants. Independent samples t -tests also revealed participants from the northern site were more educated (mean [M] = 14.67 ± 1.99 yr) than those from the southeastern site ($M = 14.17 \pm 1.92$ yr; $t(354) = 2.37$, $p = 0.02$). Total length of time deployed did not differ significantly between the two sites ($t(357) = 1.69$, $p = 0.09$), but participants at the northern VA ($M = 38.24 \pm 21.56$ mo) had returned from deployment more recently than participants at the southeastern VA ($M = 48.48 \pm 26.76$ mo; $t(353) = 3.82$, $p < 0.001$).

The demographic characteristics are summarized in **Table 1**. Females were underrepresented (9%) compared with their representation within the Department of Defense Armed Services between 2000 and 2009 (14.3%) [40] and slightly underrepresented compared with VA healthcare registration data for OIF and OEF Veterans from 2002 through 2012 (12%) [41]. The racial distribution of the sample reflected an overrepresentation of white individuals (88%) compared with the armed services in general during the last 10 yr (70.3%) [40].

Most participants were married or living with a partner (59%) and employed (62%). The majority had completed their service obligations at the time of study enrollment (55%), and 65 percent received some VA compensation for service-connected conditions. Regarding deployment, 18 percent were deployed to both Afghanistan and Iraq; the mean length of total deployment time approached 15 mo, reflecting the long duration of hostilities. The average time since return from deployment was 42 mo.

Regarding the Registry and PSC groups, 218 (61%) were recruited from the local OIF/OEF/OND registries (Registry), and 141 (39%) were recruited from the PSC. PSC patients were younger (PSC: $M = 32.9 \pm 8.2$ yr; Registry: $M = 36.6 \pm 10.3$ yr), had fewer years of education (PSC: $M = 13.8 \pm 1.9$ yr; Registry: $M = 14.9 \pm 1.9$ yr), deployed for longer periods (PSC: $M = 15.9 \pm 7.7$ mo; Registry: $M = 13.8 \pm 8.2$ mo), and returned from deployment more recently (PSC: $M = 34.1 \pm 20.3$ mo; Registry: $M = 47.8 \pm 25.2$ mo). A higher proportion of PSC participants were white (PSC: 94%, Registry: 83%). They were more likely to be members of the Marines (PSC: 15%, Registry: 9%) and less likely to serve in the Air Force (PSC: 4%, Registry: 12%). A greater number were deployed only to Iraq (PSC: 85%, Registry 61%), and a larger proportion were on Active Duty at time of assessment (PSC: 23%, Registry: 7%) ($p < 0.05$, **Table 1**).

Table 1.

Sample demographics.

Demographic	Overall	Registry	PSC	F or χ^2	p-Value
Age (yr), mean \pm SD	35.1 \pm 9.7	36.6 \pm 10.3	32.9 \pm 8.2	12.31	0.001
Education (yr), mean \pm SD	14.5 \pm 2.0	14.9 \pm 1.9	13.8 \pm 1.9	26.47	<0.001
Sex (%)				0.95	0.33
Male	91	90	93		
Female	9	10	7		
Race (%)				9.97	0.002
White	88	83	94		
Nonwhite	12	17	6		
Hispanic (%)				0.46	0.50
Hispanic	11	12	9		
Non-Hispanic	89	88	91	1.34	0.25
Marital Status (%)					
Married/Living with Partner	59	62	55		
Not Married/Not Partnered	41	38	45		
Employment Status (%)				2.69	0.26
Employed	62	65	58		
Not Employed	22	19	26		
Student	16	16	16		
Service Connected (%)				8.36	0.004
Yes	65	59	74		
No	35	41	26		
Duty Status at Baseline (%)				30.05	<0.001
Active Duty	13	7 ^a	23 ^b		
Inactive Reserve	11	9	14		
Active Reserve	21	19	23		
Completed Obligations	55	65 ^a	40 ^b		
Service Branch (%)				12.39	0.02
Army	49	48	50		
Navy	8	10	5		
Air Force	8	11 ^a	4 ^b		
Marine Corps	11	9 ^a	15 ^b		
National Guard	24	22	26		
Deployed From (%)				4.09	0.13
Active Duty	55	52	59		
Inactive Reserve	30	30	31		
Active Reserve	15	18	10		
Deployed To (%)				26.61	<0.001
Afghanistan Only	11	16 ^a	4 ^b		
Iraq only	71	61 ^a	85 ^b		
Afghanistan and Iraq	18	23 ^a	11 ^b		
Number of Deployments, mean \pm SD	1.52 \pm 0.93	1.57 \pm 1.06	1.45 \pm 0.68	1.47	0.23
Deployment Time (mo), mean \pm SD	14.6 \pm 8.0	13.8 \pm 8.2	15.9 \pm 7.7	6.04	0.01
Time Since Return (mo), mean \pm SD	42.4 \pm 24.3	47.8 \pm 25.2	34.1 \pm 20.3	29.23	<0.001

^{a,b} = Bonferroni-corrected group comparisons revealed significant differences between groups in this category at $p < 0.05$.

PSC = Polytrauma System of Care, SD = standard deviation.

Injury Characteristics

Injury characteristics for study participants are reported in **Table 2**. Of the 309 (87%) participants who reported an injury, 32 percent reported method of injury as blast exposure, and 28 percent also reported a history of head injury.

Regarding differences between the Registry and PSC groups, PSC patients were more likely to have experienced a combat injury (PSC: 68%, Registry: 24%), blast exposure (PSC: 55% Registry: 13%), closer distance from blasts (PSC: $M = 112.3 \pm 304.6$ ft, Registry: $505.5 \pm 1,163.0$ ft), more recent injury (PSC: $M = 3.1 \pm 1.8$ yr, Registry: 7.4 ± 13.2 yr), and head injury (PSC: 60%, Registry: 8%) ($p < 0.05$; **Table 2**).

Pain Complaints

Consistent with prior research [17,20,42], most participants (87%) reported experiencing pain during the prior week; 56 percent reported pain intensity ratings exceeding the threshold for moderate to severe pain (NRS > 3) (**Table 3**). Although back pain was the most common primary pain location (33%), it was less frequent than typically observed in other VA or community chronic pain samples [43–44]. Headaches were present in

59 percent of participants. Of patients reporting pain, fewer than half (43%) received treatment in the past 3 mo.

Compared with the Registry group, a larger proportion of PSC group members reported any pain (PSC: 94%, Registry: 82%), moderate or severe pain (PSC: 70%, Registry: 47%), and head or neck pain (PSC: 35%, Registry: 12%). They also had higher proportions of headaches (PSC: 82%, Registry: 44%), greater headache frequency (PSC: $M = 4.2 \pm 2.6$ d/wk, Registry: $M = 2.7 \pm 2.4$ d/wk), and more headache interference in life (PSC: 62%, Registry: 27%) ($p < 0.05$, **Table 3**).

Mental Health History

Data on participants' mental health history is presented in **Table 4**. The majority of participants (67%) reported past or present mental health problem. Half reported onset of mental health problems after deployment (51%) or after separating from the service (6%), 17 percent reported onset during combat, and 14 percent reported onset noncombat related during deployment. Of those with a history of mental health problems, 88 percent reported they were ongoing. Of those with ongoing problems, only 65 percent were receiving treatment.

Table 2.
Injury characteristics.

Characteristic	Overall	Registry	PSC	F or χ^2	p-Value
Injury Reported (%)				34.13	<0.001
Yes	87	79	100		
No	13	21	0		
Injury Onset (%)*				58.97	<0.001
Combat	44	24	68		
Noncombat	56	77	32		
Injury Method (%)*				61.17	<0.001
Blast	32	13	55		
Nonblast	68	87	45		
Fall	11	12	9		
Vehicular	8	6	10		
Shrapnel	2	1	4		
Gunshot Wound	1	1	1		
Other	46	67	21		
Head Injury (%)*				108.51	<0.001
Yes	28	8	60		
No	72	92	40		
Time Since Injury (yr), mean \pm SD	4.8 \pm 8.8	7.4 \pm 13.2	3.1 \pm 1.8	10.25	0.002
Closest Blast (ft), mean \pm SD	324.7 \pm 899.6	505.5 \pm 1,163.0	112.3 \pm 304.6	14.25	<0.001

*Percent of those reporting injuries.

PSC = Polytrauma System of Care, SD = standard deviation.

Table 3.
Pain complaints.

Complaint	Overall	Registry	PSC	<i>F</i> or χ^2	<i>p</i> -Value
Any Pain Present (NRS > 0), %*	87	82	94	9.89	0.002
Significant Pain (NRS > 3), %*	56	47	70	19.42	<0.001
Headaches Reported, %	59	44	82	52.32	<0.001
Headache d/wk, mean \pm SD	3.5 \pm 2.6	2.7 \pm 2.4	4.2 \pm 2.6	18.48	<0.001
Headache Interference, %	41	27	62	44.24	<0.001
Primary Pain Location, % [†]				26.69	<0.001
Back	33	34	31		
Head/Neck	22	12 ^a	35 ^b		
Other	46	55 ^a	34 ^b		
Pain Treatment in Past 3 mo, % [‡]	43	33	56	15.93	<0.001
Treatment Satisfaction, mean \pm SD [‡]	6.66 \pm 2.90	6.28 \pm 3.00	6.97 \pm 2.90	1.80	0.18

^{a,b} = Bonferroni-corrected group comparisons revealed significant differences between groups in this category at $p < 0.05$.

* Average pain during the last week.

[†] Percent of those reporting pain.

[‡] Percent of those reporting Department of Veterans Affairs pain treatment in past 3 mo.

NRS = numeric pain rating scale, PSC = Polytrauma System of Care, SD = standard deviation.

PSC patients were more likely than Registry patients to have a history of mental health problems, to report onset because of combat blast, to have received past mental health treatment, to have ongoing complaints, and to currently be receiving care. Registry participants were more likely to report preservice and predeployment onset of problems (**Table 4**).

Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition Diagnoses

The results of the MINI diagnostic interview are presented in **Table 5**; 62 percent of participants met criteria for at least one psychiatric disorder. Mood disorders (45%) and non-PTSD anxiety disorders (44%) were the most common, followed by PTSD (27%), SUD (26%), postconcussional disorder (16%), and psychotic disorder (5%).

PSC patients were more likely than Registry patients to meet criteria for one or more mental health diagnosis and exhibited higher proportions of PTSD, anxiety disorders, mood disorders, and postconcussional disorder. Interestingly, rates of SUDs and psychotic disorders did not differ between the two groups (**Table 5**).

Comorbidities

Because individuals often presented with multiple comorbidities, resulting in a variety of combinations of overlapping diagnoses across individuals, a more accu-

rate clinical picture of this sample may be provided by examining only unique problems identified through MINI interview (i.e., categorized by PTSD, non-PTSD anxiety disorder, mood disorder, SUD, or psychotic disorder; see “Current Psychiatric Diagnoses” section for specific diagnoses included in each category), DSM-IV criteria for postconcussive syndrome, and moderate or severe pain (NRS > 3). To accomplish this, all problems characterizing each individual were determined, and these exclusive combinations of diagnoses were summed across individuals. Results indicated that 20 percent of participants did not meet criteria for any of these seven problems assessed; 21 percent met criteria for one diagnosis, 15 percent for two, 15 percent for three, 15 percent for four, 8 percent for five, 5 percent for six, and 1 percent for all seven problems. PSC group members more often met criteria for multiple conditions than Registry participants ($\chi^2 = 48.67$, $p < 0.001$) (**Figure 2**).

The most common conditions are presented in **Figure 3**. Regarding those who met criteria for only one condition, moderate or severe pain (12%) and anxiety disorders other than PTSD (3%) were the most common single presentations. Of note, PTSD alone (i.e., unaccompanied by other comorbidities) was very infrequent (0.3%), and no participants met criteria for postconcussional disorder alone. Regarding comorbid conditions, moderate or severe pain, mood disorder, and non-PTSD anxiety disorder were common to all of the most frequent

Table 4.
Participants' mental health (MH) history.

History	Overall (%)	Registry (%)	PSC (%)	<i>F</i> or χ^2	<i>p</i> -Value
Current or Prior MH Problem	67	53	88	46.61	<0.001
Onset of MH Problem*				35.20	<0.001
Preservice	5	9 ^a	2 ^b		
Predeployment	7	11 ^a	3 ^b		
Combat Non-Blast Related	3	2	4		
Combat Blast-Related	14	3 ^a	24 ^b		
Noncombat/During Deployment	14	10	18		
Postdeployment	51	57	45		
Postservice	6	8	4		
Resolution of MH Problem*				10.80	<0.03
Before Deployment	1	3	0		
During Deployment	2	2	2		
After Deployment	9	14 ^a	4 ^b		
Ongoing, Not Resolved	88	82 ^a	94 ^b		
Past MH Treatment*	68	53	84	24.36	<0.001
Current MH Treatment [†]	65	50	77	16.77	<0.001
Satisfaction with VA Treatment [‡]	7.61 ± 2.29	7.32 ± 2.55	7.80 ± 2.08	1.39	0.24

^{a,b} = Bonferroni-corrected group comparisons revealed significant differences between groups in this category at $p < 0.05$.

*Percent of those reporting MH problems.

[†]Percent of those reporting ongoing (not resolved) mental health problems.

[‡]Percent of those reporting VA MH treatment in past 3 mo.

PSC = Polytrauma System of Care, VA = Department of Veterans Affairs.

multiple diagnostic combinations (**Figure 3**). As hypothesized, the majority of participants (62%) reported any pain (NRS > 1) and at least one comorbid problem; 44 percent reported moderate or severe pain (NRS > 3) and at least one concurrent problem. Comparing groups, PSC participants were more likely to report any pain plus a psychiatric comorbidity (82%) than Registry participants (50%) ($\chi^2 = 39.09$, $p < 0.001$). The PSC group was also more likely to report moderate or severe pain plus a comorbid psychiatric problem (62%) than Registry group (33%) ($\chi^2 = 28.53$, $p < 0.001$).

Symptom Severity by Group

A between-subjects MANCOVA was performed to examine potential group differences on self-report symptom measures. Adjustments were made for age and education. Results revealed that the combined symptom measures were not significantly related to age (Wilk $\lambda = 0.95$, $F(11, 306) = 1.56$, $p = 0.11$, partial $\eta^2 = 0.05$) or

education (Wilk $\lambda = 0.96$, $F(11, 306) = 1.19$, $p = 0.30$, partial $\eta^2 = 0.04$). Group membership was significantly associated with scores on the combined symptom measures (Wilk $\lambda = 0.81$, $F(11, 306) = 6.71$, $p < 0.001$, partial $\eta^2 = 0.19$). Univariate analyses indicated PSC and Registry group differences on each symptom measure. Specifically, the PSC group reported worse overall and total sleep ($p < 0.001$); more depressive symptoms ($p < 0.001$); more relationship distress ($p = 0.02$); higher rates of general, physical, emotional, and mental fatigue (p -values < 0.001); less vigor ($p < 0.001$); and higher levels of state and trait anxiety (p -values < 0.001) (**Table 6**).

DISCUSSION

Data from this study confirm and extend initial reports regarding high prevalence of pain and psychiatric disorders among OIF/OEF/OND servicemembers who

Table 5.

Frequency of Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition diagnoses.

Diagnosis	Overall (%)	Registry (%)	PSC (%)	χ^2	<i>p</i> -Value
≥1 MINI Axis I Diagnosis*	62	51	79	28.05	<0.001
PTSD	27	15	45	39.60	<0.001
Non-PTSD Anxiety Disorders*	44	36	57	15.26	<0.001
Panic Disorder without Agoraphobia	18	13	26	8.64	<0.005
Panic Disorder with Agoraphobia	29	21	40	15.63	<0.001
Social Phobia	10	10	7	2.94	ns
Obsessive-Compulsive Disorder	13	10	16	3.02	ns
Generalized Anxiety Disorder	17	12	23	7.47	<0.01
Mood Disorders*	45	35	61	22.76	<0.001
Major Depression	30	21	43	18.94	<0.001
Dysthymia	7	5	10	3.02	ns
Bipolar I or II Disorder	23	17	32	10.11	<0.005
Substance Use Disorders*	26	23	31	2.23	ns
ETOH Dependence	14	12	16	1.10	ns
ETOH Abuse	10	9	11	0.21	ns
Opioid Dependence	1	1	1	0.00	ns
Opioid Abuse	1	1	0	1.33	ns
Other Substance Dependence	3	3	4	0.19	ns
Other Substance Abuse	3	2	4	0.50	ns
Polysubstance Abuse	1	1	1	0.10	ns
Postconcussional Disorder	16	5	34	54.84	<0.001
Psychotic Disorder or MDD with Psychotic Features Specifier	5	4	7	2.11	ns

*Some individuals met criteria for more than one diagnosis.

ETOH = alcohol, MINI = Mini International Neuropsychiatric Interview, MDD = major depressive disorder, ns = not significant, PSC = Polytrauma System of Care, PTSD = posttraumatic stress disorder.

have returned from deployment [3–11]. Using two geographically diverse study sites; structured, face-to-face clinical diagnostic and history interviews; and standardized self-report measures of symptom severity, we found that 86 percent of our sample reported experiencing an injury, one-third of which were associated with blast exposure. As hypothesized, pain complaints were the most common problem reported, and more than half of participants reported pain during the past week that exceeded the threshold for moderate or severe pain. In addition, the majority of participants reported experiencing pain plus at least one psychiatric disorder. Regarding onset of problems and treatment received, more than half of participants with mental health problems reported onset postdeployment or postservice, and while the vast majority (88%) reported that mental health problems are ongoing, only 65 percent of these participants reported currently receiving treatment. Of those with pain, fewer than half (43%) reported receiving treatment in the past 3 mo. Results not only highlight the high rates of current

pain and psychiatric comorbidities, they also suggest that many of our Veterans are not receiving treatment.

Results confirmed the complexity of problems experienced by returning servicemembers. More than half of our sample met criteria for at least two problems, and nearly one-third met criteria for four or more problems. Of note, PTSD alone was very infrequent, and no participants met criteria for postconcussional disorder in the absence of pain or another psychiatric condition. The high rate of comorbidities may be explained by an integration of the fear-avoidance models of pain and PTSD and the maintenance/shared vulnerability models, which propose that chronic avoidance serves to maintain functional limitations associated not only with pain and PTSD but also with postconcussional, anxiety, and mood symptoms. This integrated model [45] emphasizes the roles of fear and avoidance in the development and maintenance of co-occurring chronic pain, posttraumatic symptoms, and functional impairments. It may be argued that a similar fear-avoidance process may be extended to the maintenance

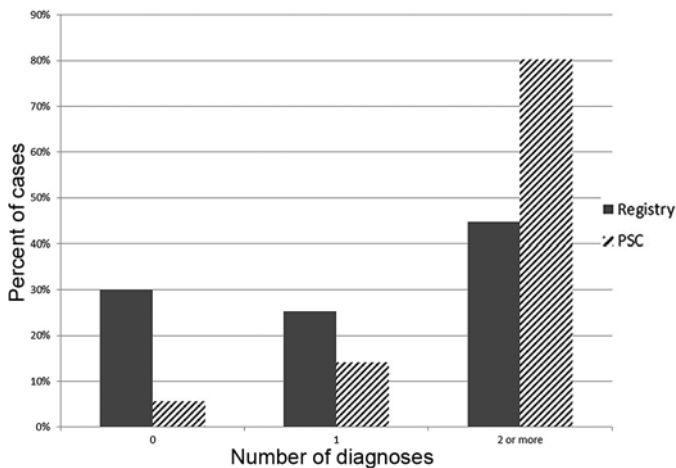


Figure 2. Frequency of comorbidities. PSC = Polytrauma System of Care.

of symptoms associated with TBI in that a belief that brain injury or cognitive problems are “permanent” may develop. This belief leads to the assumption by patients that symptoms may not be responsive to treatment, therefore treatment itself may be avoided. Moreover, as cognitive complaints may result from pain [46] or anxiety [47] in addition to or instead of history of concussion, the fear-avoidance processes that maintain anxiety or PTSD and pain ultimately serve to reinforce the cognitive difficulties reported. Thus, treatments are needed that concurrently treat pain and comorbid symptoms through decreasing avoidance.

These findings support the rationale underlying the VA’s bipartite system of care for OIF/OEF/OND servicemembers and our hypothesis that PSC patients would exhibit more complex and severe problems when compared with Registry patients. PSC patients were more likely to be injured in combat, particularly by blasts; had a higher proportion of head injuries; and more frequently experienced headaches. Diagnostically, they were significantly more likely to have more than one condition, particularly PTSD and other anxiety disorders, mood disorders, and postconcussional disorder. Indeed, rates of postconcussional disorder were seven times more common, and PTSD was three times more likely within the PSC group compared with the Registry group. Comparisons of symptom scores between groups adjusted for age and education yielded similar results: PSC patients reported greater severity of symptoms on all self-report

measures (i.e., the MFSI-SF, SPQ, STAI, CES-D, and DAS-SF).

While the findings that PSC participants had more frequent and severe mental health problems were expected, we were surprised by the extent of reported pain and mental health issues among members of the Registry group. Recall that Registry participants were recruited from a list of individuals who had registered for VA healthcare but were not necessarily actively receiving care for identified problems. Nevertheless, almost one-half of Registry subjects reported moderate or severe pain during the past week, and half also met criteria for at least one psychiatric condition.

Given the high prevalence of pain and concurrent mental health problems that we observed in our multisite sample, best clinical practice should include interdisciplinary, multidomain assessments of mental health and physical health status at the time of VA healthcare registration. This would facilitate the rapid identification of individuals with complex conditions requiring more intensive treatment. The mandatory brief screens for TBI, PTSD, SUD, and pain (5th Vital Sign) that are in national use partially fulfill this need in that they trigger more detailed second-level, problem-focused evaluations. However, success of these mechanisms depends on the availability, comprehensiveness, and follow through of subsequent evaluations and ultimately on potential treatment alternatives that result. Additionally, our data suggest that the high prevalence of headaches and sleep problems in our samples supports the need to assess all returning servicemembers enrolling for VA care during initial clinical contacts. A thorough and detailed evaluation of blast exposure history will also be essential in efforts to identify blast-related risk factors, long-term effects, and treatment alternatives.

Results also have implications for research with OIF/OEF/OND Veterans. Foremost among these are those concerning methodological issues that should be considered when investigating physical and emotional symptoms and diagnoses. There are numerous examples of published studies in recent years exploring the presentation, treatment, and presumed interactions between physical and emotional health problems in this population [48–51]. Most of these studies utilize symptom measures or diagnoses extracted from medical records to identify individuals presumed to meet criteria for two or more discrete disorders (e.g., TBI or PTSD, chronic pain or PTSD) and seek to identify differences that can differentiate

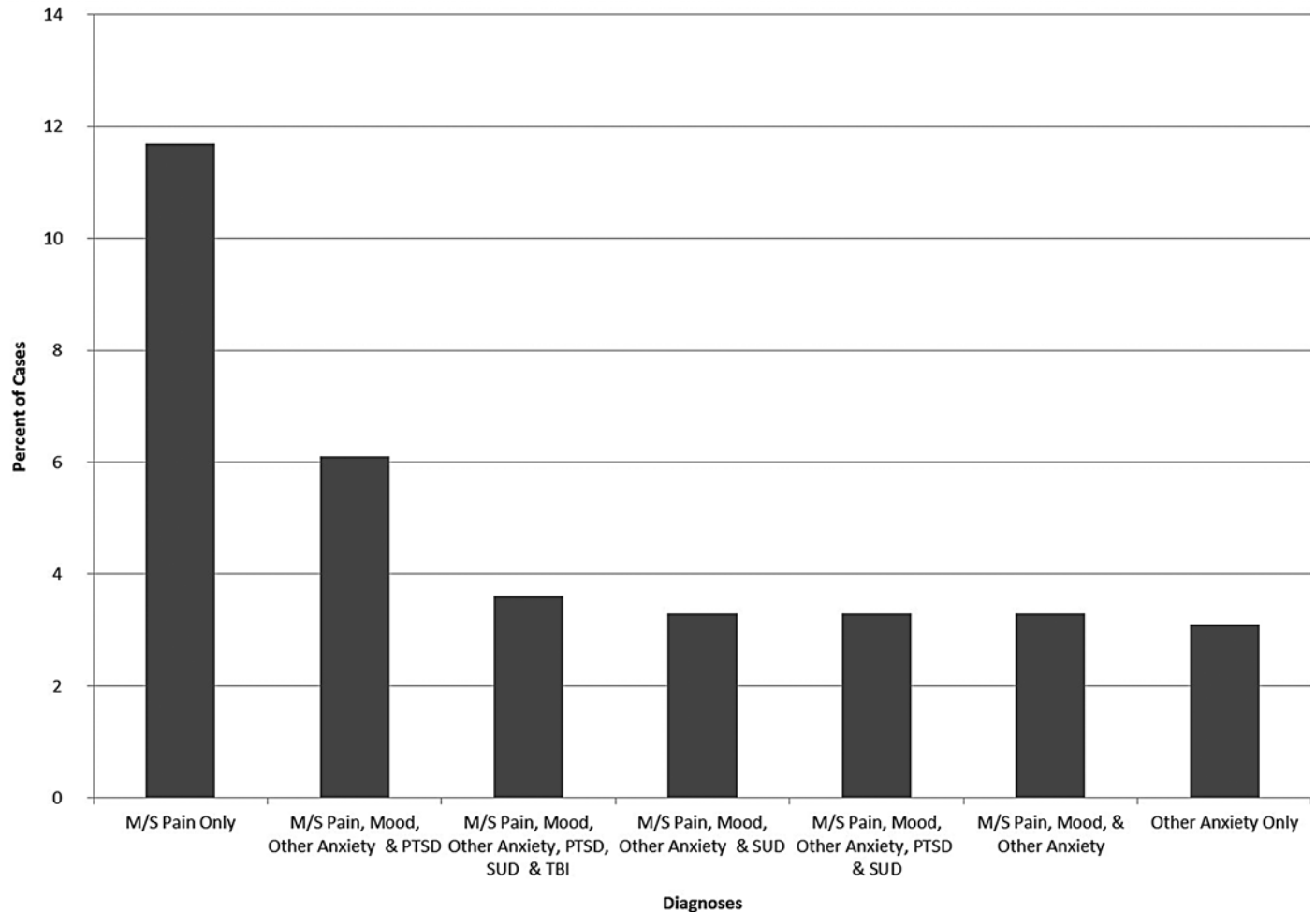


Figure 3.

Most frequent unique diagnostic categories. M/S = moderate or severe, PTSD = posttraumatic stress disorder, SUD = substance use disorder, TBI = traumatic brain injury.

between the conditions examined. There are two problems with this approach. First, scores on screening or symptom measures or diagnoses extracted from medical records do not necessarily correspond with the results of criterion-based mental health diagnostic interviews. Structured clinical interviews are the benchmark for studies examining psychiatric diagnoses. Second, given the high frequency of overlapping symptoms, problems, and diagnoses in this population, any observed group differences in studies examining only two or three of these conditions need to systematically assess and control for or equate potential differences in other comorbidities. A study by Lew et al. did evaluate the prevalence of comorbid PTSD, persistent postconcussive symptoms, and chronic pain using formal diagnoses made by a psychiat-

rist [6]; however, that study only included Veterans who were seen at a Polytrauma Network Site after a positive brief screen for TBI. A strength of the current study is that it was not limited to patients with a history of TBI; the current study also assessed for non-PTSD mental health disorders using a structured diagnostic interview.

Results of the current study support the need for empirical evaluations of alternative treatment approaches that address the broad and overlapping physical and mental health problems common among OIF/OEF/OND-era individuals. Comorbid physical and mental health conditions are associated with reduced quality of life, poorer outcomes, and early death [51–53]. Within the OIF/OEF/OND population, there is evidence indicating that a problem in one domain may predict the presence or onset of

Table 6.Univariate means for general symptom measures. Data presented as mean \pm standard deviation.

Symptom Measure	Registry	PSC	<i>p</i> -Value
Overall Sleep Rating	5.58 \pm 2.31	6.60 \pm 2.19	<0.001
Sleep Problems	13.43 \pm 9.33	19.02 \pm 8.53	<0.001
Depressive Symptoms	15.10 \pm 12.11	22.74 \pm 12.52	<0.001
Relationship Distress	23.30 \pm 5.81	21.23 \pm 7.17	0.02
General Fatigue	10.06 \pm 7.12	14.02 \pm 6.94	<0.001
Physical Fatigue	6.12 \pm 5.72	9.79 \pm 6.72	<0.001
Emotional Fatigue	7.14 \pm 6.33	11.20 \pm 6.17	<0.001
Mental Fatigue	7.38 \pm 6.03	13.60 \pm 6.11	<0.001
Vigor	12.04 \pm 5.19	9.45 \pm 4.90	<0.001
State Anxiety	37.75 \pm 13.31	46.71 \pm 14.01	<0.001
Trait Anxiety	39.38 \pm 12.59	48.60 \pm 13.33	<0.001

PSC = Polytrauma System of Care.

other unrecognized problems [54–55], a finding that parallels community sample results [56]. Indeed, the non-mental health care utilization for OIF/OEF/OND-era individuals with at least one active mental health diagnosis far exceeds utilization rates for those without concurrent psychiatric problems [57]. Yet, little is known about the nature of these observed bidirectional interactions [58] or about the combined effects of three, four, or more concurrent problem areas in the OIF/OEF/OND-era population. Research with nonmilitary community members consistently has revealed that individuals presenting with concurrent physical and mental health issues are more challenging to treat and achieve less positive outcomes than those without concurrent conditions [59–61]. Collaborative community care models that recognize the interplay of physical and mental health problems have been found to enhance treatment outcomes [62–63], and VA has been a leader in implementing these services at the primary care level. However, it is not yet known whether collaborative models can meet the combined healthcare needs of OIF/OEF/OND-era individuals, particularly those with more severe, pervasive, or complex comorbidities. Systematic evaluations of innovative treatment programs that provide comprehensive care for all presenting problems are needed.

In weighing the implications of our data, it is important to consider the limitations of this study. First, participation biases were likely given that only 18 percent of eligible participants agreed to take part in the study. While privacy restrictions did not allow us to compare participants with nonparticipants, it is conceivable that

those with more significant health problems may have been more likely to participate. Common reasons given for lack of participation were that the individual was not interested, did not have time, did not want to or could not drive to the VA, or was out of town for an extended period of time. Second, while our two study sites were geographically diverse, our sample was not representative of national distributions of Veteran and Active Duty military personnel. Furthermore, the relatively low number of female participants did not allow for comparisons by sex, and our results are more likely characteristic of men. Additionally, study measures, though elaborate, were not equally comprehensive across all possible problems. For example, we did not assess participants' cognitive functioning beyond collecting self-report data concerning symptoms of postconcussional disorder. Finally, the diagnosis of mild or moderate TBI was determined using a clinical interview with no embedded validity. It is possible that our data may reflect overreporting or underreporting of postconcussive symptoms; inaccurate recall regarding distance from closest blast is also possible. While the pathophysiology of blast-related TBI depends on blast energy and distance from the blast center [64], body position, use of body armor, number of exposures, and time interval between exposures [65–66], the precise explosive yields are not known in this study and participants may have imperfect recall of the exposures. However, current clinical guidelines for such exposures require assessment and follow-up screening to detect symptoms. There is also a limited understanding of the pathophysiology and neurological consequences of

blast injury and a need to study subclinical implications of blast exposures because the long-term consequences are not known [67]. Recent work is helping us learn more about risks related to exposures. For example, research indicates blast waves pose a risk for diffuse injury to the brain, not just isolated injury [68]. Studies are examining the effects of low-level blasts that occur below the threshold required for medical treatment [69]. In a combat setting, secondary, tertiary, and quaternary blast injuries may coexist with primary blast exposures, complicating the effects of the single blast exposure. As with co-occurring categories of blast injury, complex comorbidities make it difficult to focus solely on TBI, PTSD, or pain. While definitive diagnosis is not feasible in these complex cases, further study of various levels of blast exposures appears warranted. The present study demonstrates a high prevalence of concurrent mental health, pain, and concussion symptom endorsement following blast exposure among Veterans. These clinically relevant findings support the need for thorough assessment of blast-related risk factors for Veterans exposed to blasts prior to experiencing concussional symptoms.

CONCLUSIONS

Results of this study confirmed the high prevalence of pain and mental health problems among OIF/OEF/OND personnel returning from military deployment. Most significant among our findings was the high prevalence of moderate or severe pain, as well as the finding that over half of our sample met criteria for two or more mental health problems. While prevalence of problems and severity of symptoms was significantly greater among PSC patients, many Registry participants met criteria for at least one psychiatric condition, signifying the need for elaborate mental health screening and treatment for OIF/OEF/OND Veterans registering for VA healthcare.

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