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PTSD Improvement and Substance Use Disorder Treatment Utilization in Veterans: Evidence from Medical Record Data

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Abstract

Background: Clinical trials reveal posttraumatic stress disorder (PTSD) improvement leads to decreased substance use among patients with comorbid substance use disorder (SUD). Using administrative medical record data, we determined whether clinically meaningful PTSD Checklist (PCL) (≥20 points) score decreases were positively associated with SUD treatment utilization.

Methods: We used a retrospective cohort of Veterans Health Affairs (VHA) medical record data (2008–2015). PTSD Checklist (PCL) scores were used to categorize patients into those with a clinically meaningful PTSD improvement (≥20 point decrease) or not (<20 point decrease or increase). PTSD and SUD were measured by ICD-9 codes. Propensity score weighting controlled for confounding in logistic and negative binomial models that estimated the association between clinically meaningful PTSD improvement and use of SUD treatment and number of SUD clinic visits.

Results: The 699 eligible patients were, on average, 40.4 (±13.2) years old, 66.2% white and 33.1% were married. After controlling for confounding, there was a 56% increased odds of any SUD treatment utilization among those with a PCL decrease ≥20 vs < 20 (OR=1.56; 95%CI=1.04–2.33) but there was no association with number of SUD treatment visits.

Conclusions.—Clinically meaningful reductions in PTSD symptoms were associated with any SUD treatment utilization but not amount of utilization. Improvement in PTSD symptoms, independent of the treatment modality, may enable SUD treatment seeking.

Keywords

posttraumatic stress disorder; alcohol dependence; drug dependence; cohort; epidemiology; veteran health services

1. Introduction

Substance use disorders (SUD) are common comorbid conditions in patients with posttraumatic stress disorder (PTSD) (Emerson et al., 2017; Seal et al., 2011). Analysis of National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) data indicate PTSD is associated with 1.4 times risk for developing alcohol use disorder (AUD) and any DSM-5 drug use disorder was associated with 70% odds of past year PTSD diagnoses (Goldstein et al., 2016). Analysis of the National Health and Resilience in Veterans Study showed that 16.8% of those with probable PTSD had probable AUD (Norman et al., 2018), and among Veterans of the Iraq and Afghanistan wars who used Veterans Health Affairs (VHA) health care, PTSD was present in 63% of those with AUD, in 63.4% with drug use disorder (DUD), and in 76.1% with both AUD and DUD (Seal et al., 2011). Comorbid SUD and PTSD is associated with greater impairment, homelessness and worse psychosocial functioning as well as lower income and lower likelihood of being married or partnered (Norman et al., 2018; Riggs et al., 2008; Simpson et al., 2019). Compared to remitted PTSD, those with persistent PTSD have consistently worse SUD outcomes (Ouimette et al., 1998; Read et al., 2004).

The standard of care for patients with comorbid PTSD+SUD used to be to address substance use prior to PTSD, at least in part due to clinical beliefs that asking patients who are actively using substances to process traumatic memories may lead to increased substance use or symptom exacerbation (Becker et al., 2004; Pitman et al., 1991). Yet, treatment trials and observational studies suggest that improvements in PTSD tend to precede improvements in substance use. One treatment trial found that improvements in PTSD during the first 6 weeks of treatment were associated with improvements in SUD at one year post-treatment, but that the reverse relationship was not true (Hien et al., 2010). Another study that examined week-to-week symptom change during treatment among patients with PTSD+AUD found that PTSD symptom reduction in one week was associated with lower alcohol use the subsequent week and vice versa, but that the relationship of PTSD symptoms to subsequent alcohol use was stronger (Tripp et al., 2020). These studies suggest the importance of treating PTSD even when an SUD is present as it can help lead to recovery from both disorders.

Why PTSD symptom severity at one time point is associated with later substance use is not fully understood. The self-medication hypothesis posits that people use alcohol and drugs to cope with PTSD symptoms and other sources of chronic stress, thereby contributing to the high prevalence of comorbid PTSD-SUD (Khantzian, 1977). For example, substance use may numb psychological distress, induce sleep, or help someone get through stress inducing activities. This model would suggest that treating PTSD could relieve the need to medicate symptoms with substances. Evidence suggests that PTSD symptom improvement may be associated with decreased craving in those with comorbid PTSD-SUD (Coffey et al., 2005; Saladin et al., 2003), which may be another pathway by which treating PTSD reduces subsequent substance use. It is also possible that as PTSD improves and patients become less avoidant, they are better able to engage in SUD treatment which then helps them successfully reduce use.

Some evidence indicates trauma focused psychotherapy with integrated or concurrent substance abuse treatment is beneficial for patients with comorbid PTSD-SUD (Norman et al., 2019; Roberts et. al. 2015). It is not known if PTSD improvement, independent of the type of PTSD psychotherapy received, is associated with seeking SUD treatment. It is also not yet known if results from clinical trials generalize to clinical practice, especially given that some patients with PTSD may not have access to novel treatments for comorbid PTSD-SUD. Clinical trials may not represent the actual delivery of health care because they exclude patients too ill to participate, under-represent groups less likely to participate in research and treatment is highly structured which is not always the case in clinical care. Therefore, we have little information on how improvements in PTSD are associated with SUD treatment utilization in clinical care. Large observational cohort studies using medical record data can elucidate the association between PTSD improvement and SUD treatment utilization in the context of the whole range of patients who seek care. When PTSD and SUD treatment is offered concurrently but independently (e.g. someone attends individual therapy for PTSD and group therapy for SUD), patients may drop out of one form of treatment or the other. Thus, it is important to know if improvement in PTSD is associated with engagement in SUD treatment. Additionally, access to integrated PTSD and SUD treatment is not universal and it remains important to know whether PTSD improvement alone has a positive impact on SUD treatment seeking.

We analyzed medical record data from a large cohort of VHA healthcare users with PTSD to determine whether those with vs. without a clinically meaningful improvement in PTSD were more likely to seek treatment for a SUD and have more SUD treatment visits.

2. METHODS

Retrospective cohort study data for fiscal years (FY) 2008 to 2015 (10/1/2007 through 9/30/2015) was obtained from VHA administrative medical record data. Medical record data included outpatient and inpatient encounters, type of care received, ICD-9-CM diagnostic codes, prescription fills, laboratory results, vital signs, mental health measurements, and demographic measures. The study procedures were approved by Institutional Review Boards of participating institutions. VHA administrative data contains files specific to mental health screeners. We used PTSD Checklist (PCL) scores supplemented with chart abstracted data because administrative data may not capture PCL scores stored in the written chart. Details of chart abstraction conducted by Abt Associates' (www.abtassociates.com) have been previously reported (Salas et. al., 2020; Scherrer et. al. 2019a; Scherrer et. al., 2019b).

A random selection of 5,916 patients from all possible VHA patients 18–70 years of age with PTSD and ≥ 2 visits to any of five PTSD specialty care clinics in FY2008–2012 (to allow adequate follow-up information through FY2015) were selected. We used a random sample, instead of all eligible VHA patients, to make it feasible to manually abstract PCL scores to supplement those available in administrative data. One-sample tests (t-tests, chi-square tests, z-tests) were conducted to compare demographic distributions between the total and random samples. Age, gender, marital status, race, and insurance status distributions were similar between the random and overall sample. Additional details about the random sampling approach are presented in Appendix A.

PTSD was identified if an ICD-9-CM diagnostic code was present on ≥ 2 separate outpatient visits in a 12-month period or ≥ 1 inpatient stay. This algorithm has good positive predictive value and agreement, compared to gold standard clinical interviews for lifetime diagnosis and PCL scores ≥50 (Gravely et al., 2011; Holowka et al., 2014).

Eligible patients had a PCL ≥ 50 in FY2008–2014, which allowed for an 'exposure year' to measure PCL change, substance abuse/dependence, and SUD treatment use in the 12-months after the index PCL (first occurring PCL ≥ 50). The PCL≥ 50 represents probable PTSD (Monson et al., 2008; National Center for PTSD, 2012). Patients were further required to have ≥1 PCL in the 'exposure year' at least 8 weeks after the index PCL≥50 and the occurrence of diagnostic codes for any SUD (any illicit drug or alcohol abuse/dependence). This left a final analytic sample of 699. See Figure 1 for detailed sample selection.

2.1 Variables

Appendix B includes detailed information on variable definitions.

2.1.1 Exposure: PCL Change—A clinically meaningful reduction in PCL scores from index PCL≥50 to the last PCL in the 'exposure year' was defined using a binary variable

indicating a ≥20-point decrease versus <20-point decrease/increase. The PCL measures PTSD symptoms on a 17-item self-report measure based on DSM-IV criteria (Weathers et al., 1991), with scores ranging from 17 to 85. The PCL has been shown to have good internal consistency, test-retest reliability, and convergent validity (Blanchard et al., 1996; Ruggiero et al., 2003). A 10-point threshold had been suggested to indicate a clinically meaningful improvement, but a ≥20 decrease is consistent with a large, clinically meaningful PTSD improvement (Monson et al., 2008) that has been shown to be associated with lower risk of type 2 diabetes (Scherrer et al., 2019b), increased adherence to antidepressant medication treatment (Salas et al., 2020), and use of weight loss programs (Scherrer et al., 2019a).

2.1.2 Outcome: SUD Treatment Utilization—VHA primary and secondary clinic stop codes indicate type of care received during an encounter. These codes were used to measure SUD treatment utilization. The primary outcome was SUD treatment in the 'exposure year', defined as the presence of a primary or secondary clinic stop code for SUD treatment (see Appendix B). We excluded codes indicating smoking cessation or opioid substitution. We did not include opioid substitution treatment because we were interested in SUD psychotherapy use. In addition, measuring the number of SUD visits would be biased if we included daily methadone dosing with psychotherapy visits. A secondary outcome was the number of unique SUD treatment encounters in the 'exposure year' among those with any SUD treatment utilization.

2.1.3 Covariates—Covariates were selected if they have been previously shown, or theoretically proposed, to be associated with PTSD and SUD treatment utilization. Sociodemographic variables available in administrative medical record data included age, race, gender, marital status, and access to non-VHA health insurance. Access to non-VHA health insurance serves as a proxy for economic resources, and also helps control for detection bias as use of non-VA providers is correlated with less screening for PTSD and SUD. A 'missing' category was included for demographic variables to retain all cases. Of the demographic variables, only race (3.1%) was missing.

Because a common pathway to SUD treatment begins with referral from primary care, we controlled for this potential bias by adjusting for the volume of primary care utilization. This approach also adjusts for detection bias. The volume of primary care use was measured by the number of primary care visits per month. The distribution of mean visits per month was divided into the top 25th percentile (high use) vs. the bottom 75th percentile (low use).

ICD-9 codes were used to measure comorbid psychiatric and physical conditions. We measured comorbid conditions from the start of available data (10/1/2007) to the end of the 'exposure year' and included depression, other anxiety disorders, sleep disorders, smoking, and the Charlson-Romano comorbidity index (Romano et al., 1993).

We used pharmacy data to measure minimally adequate antidepressant medication (ADM) treatment from 10/1/2007 to the end of the exposure year. Minimally adequate ADM treatment was defined by ADM prescription fills for ≥12 weeks (National Committee for Quality Assurance, 2018). Prior SUD treatment was the presence of clinic stops for SUD

treatment prior to the 'exposure year.' Adequate PTSD psychotherapy was measured only in the 'exposure year' and was defined as ≥ 9 visits in any 15-week period (Seal et al., 2010). Type of SUD in the exposure year was classified as alcohol only, drug only, or both alcohol and drug. Finally, severe PTSD, based on the index PCL≥50, was defined as ≥70 versus 50–69.

2.2 Propensity Score Methods

Primary outcome analyses used propensity scores (PS) and inverse probability of exposure weighting (IPEW) to balance the distribution of potential confounders between patients with and without a clinically meaningful PCL decrease. The PS is calculated from a binary logistic regression model estimating the probability of PCL decrease ≥ 20 points, given covariates (Rosenbaum and Rubin, 1983). The PS and marginal probability of exposure (actual probability of exposure in the overall sample) are used to compute stabilized weights (Austin and Stuart, 2015). Stabilizing weights reduces bias associated with extreme weights. Stabilized weights should have a mean close to one and a maximum < 10, thus, any weights ≥10 should be trimmed (Sturmer et al., 2014). Covariate balance is indicated when standardized mean difference (SMD%) for means or proportions across PCL decrease ≥20 versus < 20 groups is < 10% (Austin and Stuart, 2015).

2.3 Analytic approach

All analyses were performed using SAS v9.4 (SAS institute, Cary, NC) at an alpha level of 0.05. Bivariate chi-square tests and independent samples t-tests with measures of effect size and balance using SMD% assessed the relationship of potential confounders with PCL decrease ≥ 20 versus < 20 in crude (unweighted) and IPEW weighted data. Unweighted and weighted binary logistic regression models assessed the relationship of meaningful PCL decrease with the utilization of any SUD treatment in the 'exposure year' using odds ratios and 95% confidence intervals. Among those with any SUD treatment, differences in the average number of unique SUD treatment encounters were compared between PCL decrease ≥ 20 versus < 20 using rate ratios and 95% confidence intervals calculated using unweighted and weighted negative binomial regression models. Negative binomial models were used instead of Poisson count models to account for over-dispersion. In weighted models, robust, sandwich-type variance estimators were used to calculate confidence intervals and p-values.

2.4 Sensitivity analysis

Our measure of SUD treatment utilization included stop code 519 which indicates a visit to an integrated PTSD and SUD treatment clinic. To determine if seeking integrated care explained our results, we computed sensitivity analysis by removing this stop code from our definition of SUD utilization. In weighted data, clinically meaningful PCL improvement was compared between patients with SUD treatment that included stop code 519 vs. those who did not have encounters in these integrated settings using a chi-square test. We also conducted sensitivity analyses using different thresholds for PCL decrease. We used a 10-point cut-off (i.e. ≥10 points versus <10 points) and we assessed a three level PCL decrease variable with levels defined as increase or < 10 point decrease, 10–19 point decrease, and ≥20 point decrease. Weights and inverse probability of exposure weighted outcome models were re-calculated based on the new thresholds

3. RESULTS

On average, patients were 40.4 (SD = 13.2) years old, 66.2% were white, 33.1% were married, and 21.3% had a clinically meaningful decrease in PCL score. The most common SUD diagnoses were alcohol abuse/dependence (45.5%) only, followed by both alcohol and drug abuse/dependence (42.4%) and drug abuse/dependence (12.2%) only. Average first PCL was 65.3±9.0 and 34.2% had a severe initial score. Older age and female gender were positively associated with PCL decrease ≥ 20 ($p<0.05$). Adequate PTSD psychotherapy was about 1.4 times more prevalent in the PCL decrease ≥ 20 versus < 20 groups (55.7% vs. 40.7%; p=0.001). Average initial PCL was slightly higher in the PCL decrease ≥20 group (mean=67.0) than the < 20 group (mean=64.9) (p=.012). A severe PCL (PCL≥70) was almost two times more prevalent in the PCL ≥20 (41.6%) versus < 20 (23.2%) (p=0.03) group. Last PCL change was almost twice as large in the PCL decrease < 20 (mean=62.9) versus ≥20 group (mean=35.9) ($p<0.0001$). No other significant differences were found. (See Table 1.)

Although some potential confounders were not significantly related to PCL decrease in crude analyses, age, gender, high primary healthcare utilization, severe PCL scores, type of SUD, adequate PTSD psychotherapy, and comorbidity index showed significant imbalance between groups (SMD%≥10%). After applying IPEW, all confounders were balanced between groups (all SMD < 10%). See Table 2. Stabilized weights ranged from 0.36 to 3.95 with a mean=1.00 (±0.25) and median=0.96 (iqr=0.90–1.05). No weights were trimmed.

Descriptive outcome results are shown in Table 3. Overall, 53.7% of the sample utilized SUD treatment, with an average of 27.0±30.9 unique treatment encounters (among the 375 utilizing treatment). Utilization of SUD treatment was more prevalent among the PCL decrease ≥20 (62.4%) versus < 20 (51.3%) group (p=0.016). Among those with any treatment encounters, average number of SUD treatment episodes did not differ between groups (p=0.863).

Table 4 shows results of crude and weighted logistic and negative binomial models. In weighted models, the PCL decrease ≥20 group had a 1.56 times higher odds of SUD treatment utilization than the < 20 group (OR=1.56; 95% CI=1.04–2.33). Among those with any treatment, PCL decrease ≥20 had a 16% higher average number of unique SUD treatment encounters than the < 20 group, although this was a non-significant difference (RR=1.16; 95% CI=0.83–1.61).

Sensitivity analyses showed that out of the 375 patients in SUD treatment, 131 had at least one treatment occasion indicating integrated care (stop code 519; 42 had only integrated care and 89 also had other types of SUD treatment encounters). When removing stop code 519 from the outcome definition, there were 333 patients with a SUD treatment visit (47.6% of overall sample). Weighted models with SUD treatment defined after excluding stop code 519 produced results similar to original models (weighted OR = 1.55; 95% CI=1.05–2.30 and weighted RR = 1.11; 95% CI=0.79–1.55). Also, there was no difference in the proportion of PCL decrease ≥20 between patients with SUD treatment who did and did not have a stop code for integrated treatment (25.9% vs. 24.2%, p=0.705).

Sensitivity analyses using a cut-off of a 10-point PCL decrease showed that 269 (38.5%) patients had a ≥10 point decrease and 430 (61.5%) had an increase or < 10 point decrease in PCL scores. Using weighted data in which covariates balanced between the two PCL change groups, we observed that ≥10 point decrease vs. an increase or < 10 point decrease was unrelated to SUD treatment utilization (OR=1.13; 95% CI=0.82–1.55) and number of treatment visits (RR=1.15; 95% CI=0.85–1.54).

Sensitivity analyses using a categorical exposure variable showed that 430 (61.5%) patients had an increased PCL score or < 10 point decrease, 120 had a 10–19 point decrease (17.2%), and 149 (21.3%) had ≥20 point decrease. After balancing covariates between the three PCL change categories using weighted data, we observed that compared to the group with an increased PCL or < 10 point decrease, a 10–19 point decrease was unrelated to treatment utilization (OR=0.91; 95% CI=0.57–1.44) and number of visits (RR=0.95; 95% CI=0.65–1.39). However, a ≥20 point decrease compared to PCL increase or <10 point decrease was associated with a 52% higher odds of SUD treatment (OR=1.52; 95% CI=1.01–2.29) but not number of visits (RR=1.22; 95% CI=0.86–1.72).

4. Discussion

In this retrospective cohort study of administrative medical record data, we found VHA patients with PTSD who experienced clinically meaningful PTSD improvement, compared to those who did not, were 56% more likely to have any SUD treatment visits. There was no significant association between PTSD improvement and the number of SUD treatment sessions. The link between PTSD improvement and seeking SUD treatment was independent of a general orientation to seek mental health care and independent of numerous comorbid psychiatric disorders, physical comorbidities and demographic factors. Smaller decreases in PTSD severity were not significantly associated with SUD treatment use, therefore large improvements (e.g. ≥ 20 PCL point decrease) may be necessary to enable SUD treatment seeking.

Our results are consistent with clinical trial studies that suggest PTSD improvement can occur in patients with active SUD (Hien et al., 2018), and consistent with evidence that improvement in PTSD can facilitate SUD improvement (Coffey et al., 2005; Hien et al., 2010; Saladin et al., 2003; Tripp et al., 2020). Our findings are novel in that the relationships between PTSD improvement and SUD treatment seeking were observed in data obtained from real world clinical care. Results expand on clinical trials designed to evaluate novel therapies that integrate PTSD and SUD treatment (Foa et al., 2013; Hien et al., 2010; Hien et al., 2018; McGovern et al., 2011; Norman et al., 2019; Tripp et al., 2019).

PTSD improvement of >20 points was associated with greater likelihood of engaging in SUD treatment, suggesting that PTSD may be a barrier to patients seeking SUD treatment. Even if PTSD improvement is associated with less craving and less substance use, those who are dependent on substances will still require treatment for long-term recovery.

Several PTSD symptoms may interfere with SUD treatment engagement such as avoidance, distrusting others and hyperarousal. As these symptoms improve, patients may feel greater

self-efficacy to change their substance use. PTSD improvement is associated with increased self-efficacy (Cusack et al. 2019). Health behavior theories such as social cognitive theory suggests that success in one area can build self-efficacy to try to adopt additional healthy behaviors (Conner and Norman 1995), which may enable engagement in SUD treatment. As to why a greater amount of improvement may be needed for patients to engage in treatment seeking, we suggest this may be due to the effects on functioning more generally. Schnurr and Lunney (2016) found that larger versus smaller improvement in PTSD symptoms following treatment was associated with substantially increased likelihood of attaining good endpoints in quality of life and social, occupational, and physical functioning.

We did not find an association between PTSD improvement and number of SUD sessions. It is not clear if more SUD treatment was required for these patients and we lack data to draw robust conclusions regarding PTSD improvement and need for longer term SUD treatment.

Chen and colleagues (2018) reported that PTSD compared with no PTSD is not a barrier to SUD treatment; however, they defined PTSD as a single occurrence of an ICD-9 code. This would likely lead to misclassifying PTSD and inclusion of less severe cases as compared to our PTSD diagnostic algorithm. We believe the present study is unique in revealing the association between PTSD improvement and use of SUD services in a cohort in which 34.2% had severe PTSD at baseline. Because PTSD improvement was associated with SUD treatment seeking after controlling for receipt of minimally adequate duration of PTSD psychotherapy, we speculate that any large symptom reduction, whether through treatment or spontaneous improvement, is associated with increased SUD treatment seeking. Therefore, treatment modality may be less important than PTSD symptom reduction, and the magnitude of PTSD symptom reduction, for patients with comorbid PTSD-SUD. While we are unable to confirm the type of PTSD psychotherapy used by patients in this sample, trauma focused treatments are most effective in reducing PTSD symptoms (Watts et al., 2013) and this is also true for patients when SUD is present (Norman et al., 2019; Roberts et al., 2015). If these treatments are most likely to reduce PTSD symptoms, findings of this study and the extent literature would suggest they may also be most likely to reduce downstream substance use. In fact, a meta-analysis found that patients with comorbid PTSD-SUD, who received trauma focused treatments had lower substance use at 6–12 months post-treatment as compared to those who received other types of treatments (Roberts et al., 2015). More work is needed to confirm this hypothesis.

Despite evidence for the efficacy of trauma focused therapy in those with comorbid SUD and PTSD, we note that 44% of patients in our study experienced large improvements before receiving the minimum duration and number of psychotherapy sessions. Some patients may have spontaneously improved and some could be rapid treatment responders. Although we do not know if rapid responders were more often those in trauma focused therapy, further research is warranted to determine the speed of PTSD improvement in patients with SUD and how that may contribute to SUD treatment seeking.

4.1 Limitations:

Patients were eligible if they had at least two PTSD specialty mental health care visit at one of five VHA medical centers across the United States. This means results may not generalize

to all VHA patients and may not generalize to civilians who may have less access to evidence based PTSD treatment. We do not have measures of traumatic events and individual PTSD symptoms which may have unique associations with SUD treatment outcomes. Use of SUD treatment sought outside the VHA, such as 12-step programs, could have led to underestimating the amount of SUD treatment received. Although we controlled for many confounding factors, residual confounding may be present. We did not have a large enough sample size to test reciprocal relationships between PTSD and SUD treatment use, specifically whether SUD treatment was associated with PTSD improvement. However, we computed preliminary post-hoc analysis in a sample of 443 eligible patients. A weighted logistic regression model suggests SUD treatment is not associated with a PCL decrease ≥20 (OR=0.98, 95% CI=0.58–1.65). However, this finding needs to be confirmed in a larger cohort.

4.2 Conclusions:

Among VHA patients with PTSD, those with vs. without a clinically meaningful decrease in PTSD symptoms were more likely to use any VHA SUD treatment. Our results suggest large improvements in PTSD may enable SUD treatment utilization even when patients do not receive integrated PTSD-SUD treatment modalities. Thus, patients who do not have access to integrated care should be encouraged to seek SUD treatment following improvement in PTSD. Using larger cohorts, future research should investigate whether PTSD improvement and SUD treatment use have a bi-directional association.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Large improvements in PTSD associated with SUD treatment seeking
- Large improvements in PTSD not associated with amount of SUD treatment
- PTSD improvement, regardless of treatment type, may improve SUD

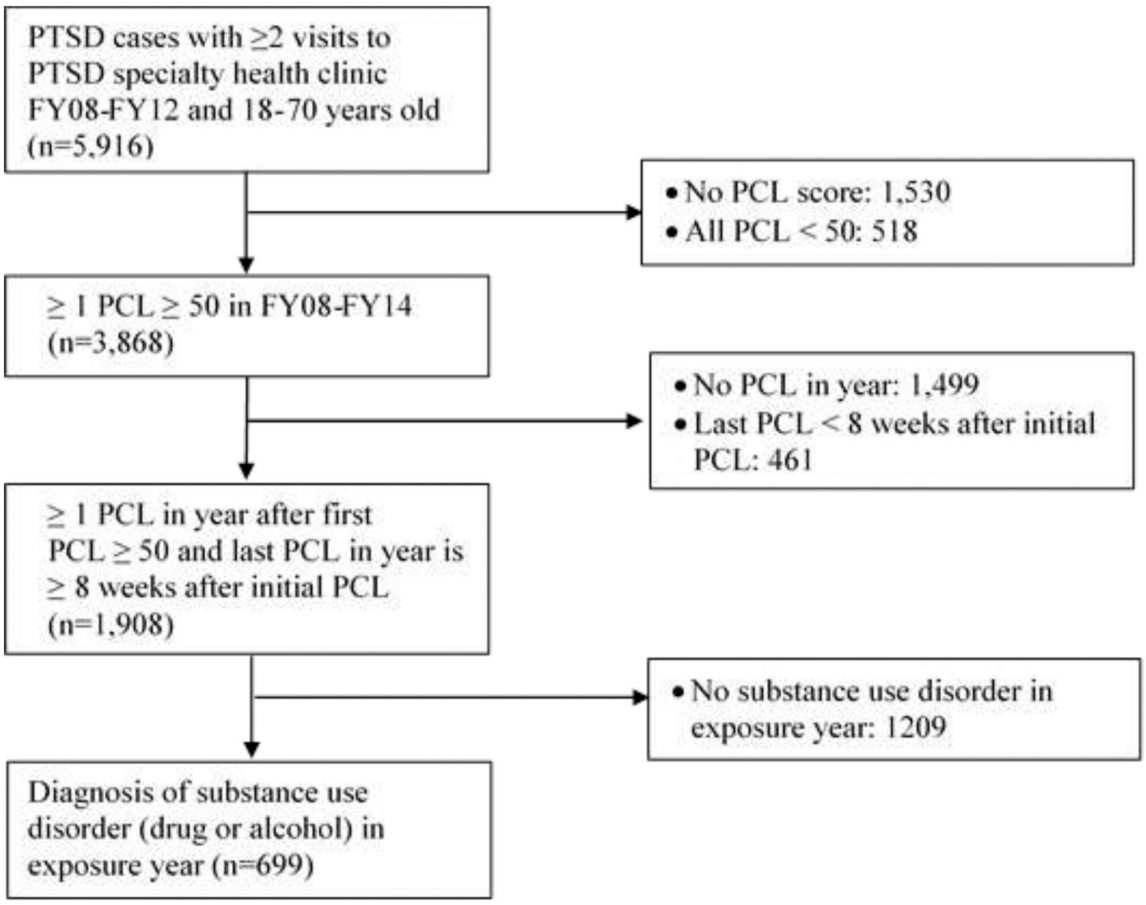

Figure 1.
Sample selection

Table 1.

Sample characteristics overall and by PCL decrease for PTSD cases, veterans age 18–70 years with a substance use disorder (SUD) (n=699)

Variable, n(%) or mean (±sd)	Overall (n=699)	PCL dec < 20 (n=550)	PCL dec ≥ 20 (n=149)	p-value
Age (years), mean (±sd)	40.4 (±13.2)	39.7 (±13.2)	43.3 (±12.8)	.003
Male gender, n(%)	630 (90.1)	506 (92.0)	124 (83.2)	.001
Race, n(%)				
White	463 (66.2)	363 (66.0)	100 (67.1)	
Black	177 (25.3)	135 (24.6)	42 (28.2)	.202
Other	37 (5.3)	34 (6.2)	< 5	
Missing	22 (3.2)	18 (3.3)	< 5	
Married, n(%)	231 (33.1)	180 (32.7)	51 (34.2)	.730
VHA only insurance, n(%)	515 (73.7)	405 (73.3)	110 (73.8)	.963
High primary HCU, n(%)	175 (25.0)	132 (24.0)	43 (28.9)	.225
First PCL severe (≥70), n(%)	239 (34.2)	177 (23.2)	62 (41.6)	.031
First PCL, mean (±sd)	65.3 (±9.0)	64.9 (±9.0)	67.0 (±9.0)	.012
Last PCL, mean (±sd)	57.2 (±15.9)	62.9 (±11.7)	35.9 (±10.2)	<.0001
Type of SUD, n(%)				
Drug only	85 (12.2)	62 (11.3)	23 (15.4)	
Alcohol only	318 (45.5)	257 (46.7)	61 (40.9)	.272
Drug and alcohol	296 (42.4)	231 (42.0)	65 (43.6)	
Comorbidities and treatments[a]				
Depression, n(%)	555 (79.4)	434 (78.9)	121 (81.2)	.538
Other anxiety, n(%)[b]	207 (29.6)	162 (29.5)	45 (30.2)	.859
Sleep disorder, n(%)	328 (46.9)	256 (46.6)	72 (48.3)	.700
Any Smoking, n(%)[c]	493 (70.5)	388 (70.6)	105 (70.5)	.986
Adequate PTSD psychotherapy, n(%)[d]	307 (43.9)	224 (40.7)	83 (55.7)	.001
Adequate ADM treatment, n(%)[e]	557 (79.7)	437 (79.5)	120 (80.5)	.771
Prior SUD treatment, n(%)	307 (43.9)	237 (43.1)	70 (47.0)	.396
Comorbidity index, n(%)				
0	437 (62.5)	351 (63.8)	86 (57.7)	
1 – 2	160 (22.9)	128 (23.3)	32 (21.5)	.051
≥ 3	102 (14.6)	71 (12.9)	31 (20.8)	

PTSD=posttraumatic stress disorder; PCL=PTSD checklist (range: 17–85); FY=fiscal year; DEC=decrease; HCU=healthcare utilization; ADM=antidepressant

[a]Comorbidities occur from start of FY2008 to end of exposure year

[b]Composite of panic disorder, obsessive compulsive disorder, social phobia, generalized anxiety disorder, anxiety not otherwise specified.

[c]Health factors or ICD-9-CM code

[d]Measured in exposure year. Presence of at least 9 psychotherapy visits in any 15 week period.

[e] At least 12 weeks of continuous ADM fills prior to the end of the exposure year

Table 2.

SMD unweighted and weighted for potential confounders

Variable	Unweighted	Weighted
Age (years)	28.0%	4.1%
Male gender	−26.9%	−1.0%
Race		
White	2.4%	−1.2%
Black	8.3%	3.9%
Other	−21.1%	−2.5%
Missing	−3.5%	−3.7%
Married	3.2%	−1.6%
VHA only insurance	0.4%	3.1%
High primary HCU	11.0%	−2.5%
First PCL severe (≥70)	19.6%	1.8%
Type of SUD		
Drug only	12.3%	−0.0%
Alcohol only	−11.7%	−4.8%
Drug and alcohol	3.3%	4.8%
Depression	5.8%	−6.8%
Other anxiety	1.6%	0.7%
Sleep disorder	3.6%	−1.2%
Any Smoking	−0.2%	2.0%
Adequate PTSD psychotherapy	30.3%	−0.7%
Adequate ADM treatment	2.7%	−2.2%
Prior SUD treatment	7.8%	6.0%
Comorbidity index		
0	−12.5%	−0.2%
1 – 2	−4.3%	0.1%
≥ 3	21.2%	0.2%

Table 3.

Crude comparisons – SUD treatment

	Overall (n=699)	PCL dec < 20 (n=550)	PCL dec ≥ 20 (n=149)	p-value
Any SUD treatment, n(%)	375 (53.7%)	282 (51.3%)	93 (62.4%)	.016
# treatment encounters, mean (±sd)[1]	27.0 (±30.9)	27.2 (±30.2)	26.5 (±33.3)	.863

[1]Among 375 the patients that had any SUD treatment. Crude negative binomial model.

Table 4.

Results from outcome models estimating the association of PCL decrease and SUD treatment encounters

	Model 1 - Crude	p-value	Model 2- Weighted	p-value
Any SUD treatment	OR (95% CI)		OR (95% CI)	
PCL dec ≥ 20	1.58 (1.09–2.29)	.016	1.56 (1.04–2.33)	.030
# treatment encounters[1]	RR (95% CI)		RR (95% CI)	
PCL dec ≥ 20	0.98 (0.74–1.28)	.863	1.16 (0.83–1.61)	.432

PCL=PTSD checklist; PTSD=posttraumatic stress disorder; OR=odds ratio; RR=rate ratio; OR=odds ratio

[1]Among 375 the patients that had any SUD treatment encounters. Negative binomial model