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RESEARCH ARTICLE

Associations between changes in somatic and psychiatric symptoms and disability alterations in recent-era U.S. veterans

John P. K. Bernstein[1] | **Anna Stumps**[1] | **Francesca Fortenbaugh**[1,2] | **Jennifer R. Fonda**[1,2,3] | **Regina E. McGlinchey**[1,2] | **William P. Milberg**[1,2] | **Catherine B. Fortier**[1,2] | **Michael Esterman**[1,2] | **Melissa Amick**[1] | **Joseph DeGutis**[1,2]

[1] Translational Research Center for TBI and Stress Disorders (TRACTS) and Geriatric Research, Education and Clinical Center (GRECC)VA Boston Health Care System, Boston, Massachusetts, USA

[2] Department of Psychiatry, Harvard Medical School, Boston, Massachusetts, USA

[3] Department of Psychiatry, Boston University School of Medicine, Boston, Massachusetts, USA

Correspondence
John P. K. Bernstein, VA Boston Health Care System, 150 South Huntington Ave, TRACTS/GRECC (182-JP), Boston, Massachusetts 02130.
Email: jberns16@u.rochester.edu

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Abstract

Cross-sectional work suggests that deployment-related posttraumatic sequelae are associated with increased disability in U.S. veterans deployed following the September 11, 2001 (9/11), terrorist attacks. However, few studies have examined the psychiatric and somatic variables associated with changes in functional disability over time. A total of 237 post-9/11 veterans completed comprehensive assessments of psychiatric and cognitive functioning, as well as a disability questionnaire, at baseline and 2-year follow-up. At baseline, higher levels of PTSD, depressive, and pain-related symptoms were associated with baseline global functional disability, semipartial r^2 (sr^2) = .036–.044. Changes in symptoms of PTSD, depression, pain, and sleep, but not anxiety or alcohol use, were independently associated with changes in functional disability sr^2 = .017–.068. Baseline symptoms of these conditions were unrelated to changes in disability, and cognitive performance was unrelated to disability at any assessment point. Together, this suggests that changes in psychiatric and somatic symptoms are tightly linked with changes in functional disability and should be frequently monitored, and even subclinical symptoms may be a target of intervention.

Psychiatric and somatic conditions, including posttraumatic stress disorder (PTSD), alcohol use, chronic pain, sleep disturbance, depression, and anxiety, are common in veterans who served in conflicts following the September 11, 2001, terrorist attacks (9/11). Relative to veterans of previous war eras, post-9/11 veterans are at higher risk of several such conditions and are more likely to experience difficulties with reintegration to civilian life following their military service (Parker et al., 2019). Unsurprisingly, symptoms of these conditions have demonstrated significant negative repercussions for post-9/11 veterans' everyday functioning upon returning from military service (Amick et al., 2018; Fortenbaugh et al., 2020; Lippa et al., 2015; McGlinchey et al., 2017).

Psychological assessments and interventions have traditionally targeted veterans' individual diagnoses (Maguen et al., 2019). Although exceptions to this rule exist (e.g., trauma management therapy, combined cognitive behavioral therapy and prolonged exposure; Frueh et al., 1996; Harned, 2014), several of these interventions have yet

to be widely implemented in clinical practice. A more holistic approach emphasizing the co-occurrence of these diagnoses may be necessary to provide optimal care to post-9/11 veterans given the multitude of mental health symptoms they experience and the high likelihood that these symptoms interact with one another (Amick et al., 2018; Fonda et al., 2017; Lippa et al., 2015). Consistent with this approach, Fortenbaugh and colleagues (2020) found that PTSD depressive disorder, pain diagnoses, and sleep disturbance at baseline were particularly predictive of functional disability at 2-year follow-up, and each explained unique variance in functional disability in a sample of post-9/11 veterans (Fortenbaugh et al., 2020). Other researchers have noted that the combined clinical effects of multiple conditions on disability may be greater than simply summing each condition's contributions (Amick et al., 2018; Lippa et al., 2015; Walker et al., 2010). Such findings point to a plethora of mental health conditions that independently and collectively impact post-9/11 veterans' functional disability.

PTSD and comorbid psychiatric conditions common among post-9/11 veterans have also been linked to difficulties in several cognitive domains. PTSD may be accompanied by weaknesses in aspects of attention and executive functioning, most commonly working memory (Brandes et al., 2002; Vasterling et al., 1998) and sustained attention and inhibitory control (Aupperle et al., 2012; DeGutis et al., 2015; Esterman et al., 2019). Verbal memory difficulties, particularly at the stage of initial learning, have also been reported (Brewin et al., 2007). Concurrent PTSD symptom treatment and compensatory cognitive training may lead to improvements in cognitive functioning (e.g., attention, working memory, verbal learning, and memory) and novel problem-solving as well as, notably, larger reductions in PTSD symptom severity (Jak et al., 2019; Metcalf et al., 2020). Research regarding conditions that are frequently comorbid with PTSD has yielded links with oftentimes-similar cognitive impairments. Higher levels of depressive symptom severity are broadly linked to poorer episodic memory, executive function, and processing speed (McDermott & Ebmeier, 2009), whereas chronic pain is frequently tied to deficient attention and processing speed. Poor sleep quality has been tied to reduced attention, processing speed, episodic memory, and working memory, and some research has suggested that sleep quality may partially mediate the association between PTSD and cognition in post-9/11 veterans (Fortier-Brochu et al., 2012; Schneider et al., 2004; Verfaellie et al., 2016). Among trauma-exposed veterans with an alcohol use disorder, higher degrees of alcohol consumption have been associated with poor learning and memory (Heinz et al., 2016).

Given the high comorbidity among these psychiatric and somatic conditions in the post-9/11 veteran population, some work has sought to tease apart whether particular clusters of diagnoses and/or symptoms convey a heightened risk for difficulties in individual cognitive domains. For example, Esterman and colleagues (2019) found that whereas veterans who endorsed significant comorbid pain, sleep disturbance, and a history of mild traumatic brain injury (mTBI) demonstrated higher rates of failure to engage attention, those with comorbid PTSD and a mood disorder and those with a substance use disorder were more likely to show inhibitory control failures. Cognitive difficulties may be partially responsible for increases in veterans' functional disability (Riley et al., 2019; Stika et al., 2021). In a study of post-9/11 veterans with or without cognitive dysfunction (i.e., z score of -1 on two or more measures in a domain), Riley and colleagues (2019) found that post-9/11 veterans with cognitive dysfunction were more likely to have symptoms of anxiety, depression, and PTSD and endorse more disturbed sleep, pain, and alcohol consumption than those without. Veterans with cognitive dysfunction also reported more functional disability, particularly with regard to mobility and understanding as well as communicating with others (Riley et al., 2019).

Most studies examining the contributions of somatic and psychiatric diagnoses and/or cognitive functioning to post-9/11 veterans' functional disability have been cross-sectional in design (Lippa et al., 2015; Riley et al., 2019). Although Fortenbaugh and colleagues (2020) found consistently strong associations between functional disability and PTSD, depressive disorder, pain, and sleep disturbance diagnoses at both an initial assessment and 2-year follow-up, they did not specifically examine change in functional outcomes and what measures were associated with these changes. Identifying psychiatric, somatic, and cognitive variables that change in conjunction with alterations in functional disability over this period would provide a further understanding of both the measures most closely associated with changes in functional disability as well as whether changes in measures uniquely predict such changes. These results could provide important insights into what psychiatric or cognitive measures could be targeted with interventions to improve functioning. Additionally, no studies of which we are aware have directly compared the degree to which somatic and psychiatric symptoms differ from cognitive abilities in their capacity to independently predict functional disability in this population. This is surprising given the implications that such comparisons may have for treatment targets (e.g., psychotherapy for a mood disorder vs. cognitive rehabilitation). Finally, although past studies have examined associations between diagnostic categories and functional disability in post-9/11 veterans (Fortenbaugh et al., 2020; Lippa et al., 2015), to our knowledge, none have examined the effects of continuously measured symptoms of these

diagnoses. Kessler (2002) suggests that the use of diagnostic categories is appropriate only when the associations between those categories and outcomes of interest would be expected to be constant across the range of symptom severity (Kessler, 2002). In the case of daily functioning, it is expected that even among individuals with a particular diagnosis (e.g., PTSD), a dose-effect is likely whereby those with more severe symptoms endorse higher degrees of disability. Adopting a continuous approach may also provide a more nuanced, dimensional understanding of veterans' somatic and psychiatric symptoms and would be in line with a larger field shift away from categorical diagnoses (e.g., the Research Domain Criteria Initiative [RDoC]; Insel et al., 2010).

The present study aimed to determine which baseline and changes in continuously measured psychiatric, somatic, and cognitive variables were associated with changes in functional disability over a 2-year period in a sample of post-9/11 veterans. This study used a rigorous reliable change index (RCI) approach (Duff, 2012) to better quantify whether increases or decreases in functional disability from baseline to follow-up were significant and to account for regression-to-the-mean effects. We proposed three hypotheses. First, we posited that at baseline, we would observe similar associations with functional disability as those identified by Fortenbaugh et al (2020; i.e., PTSD, depression, sleep, and pain) using continuous measures. Second, we expected that the longitudinal changes in the somatic and psychiatric symptoms outlined in our first hypothesis would also predict concurrent changes in functional disability. Finally, consistent with prior cross-sectional work, we hypothesized that (a) baseline cognitive functioning would predict baseline functional disability and (b) longitudinal changes in cognitive functioning would predict concurrent changes in global functional disability.

METHOD

Participants and procedure

Participants in the present study were post-9/11 veterans enrolled in the longitudinal cohort study at the Translational Research Center for TBI and Stress Disorders (TRACTS), a research center at the VA Boston Healthcare System. This ongoing, convenience-sample study recruits a community-dwelling cohort with a range of psychiatric diagnoses and levels of functional impairment as well as individuals with no diagnoses. The present study included 353 veterans who returned for follow-up assessment 1–2 years after their baseline visit and met the inclusion and exclusion criteria across both time points (see below). Participants enrolled in the TRACTS longitudinal study complete comprehensive psychiatric and neuropsychological assessments, including diagnostic interviews conducted by doctoral-level psychologists. This study was approved by the VA Boston institutional review board and was carried out in accordance with the World Medical Association Declaration of Helsinki.

The inclusion criteria for the TRACTS cohort were (a) deployment or anticipated deployment to a post-9/11 conflict area and (b) 18–65 years of age. Exclusionary criteria for the TRACTS cohort included (a) prior seizure disorder, cognitive disorder due to a general medical condition, or neurological illness unrelated to TBI; (b) active suicidal or homicidal ideation requiring intervention (based on clinical interview and diagnostic impressions of the psychologist); or (c) current diagnosis of bipolar disorder of psychotic disorder unrelated to PTSD. Participants were excluded from the present study if they had not been deployed to a combat zone ($n = 13$), to maintain a focus on deployment-related trauma, or if they had a history of moderate or severe TBI ($n = 12$). A total of 31 participants who did not complete the functional disability questionnaire used in the present study at either time point were further excluded. Participants were also excluded due to failure on a measure of performance validity ($n = 19$) and a measure of symptom validity ($n = 9$) at either time point (see Measures). Finally, as the aim of this study was to examine changes in functional disability, we excluded participants who reported that their functional difficulties did not interfere with their daily life across both time points ($n = 45$). Supplemental analyses including these participants are shown in Supplementary Tables S1 and S2 . Few significant differences in patterns of results were identified.

After accounting for the exclusionary criteria, the final study sample included 237 participants. Sample demographic, clinical, and cognitive characteristics are displayed in Table 1. The sample was 90.2% male, 77.1% white, and the mean participant age was 33 years ($SD = 8$). On average, participants reported educational attainment of 14 years ($SD = 2$).

Measures

Functional disability

The World Health Organization Disability Assessment Schedule II (WHODAS 2.0; World Health Organization [WHO], 2010) total score was used to assess self-reported global functional disability. For descriptive purposes, clinically meaningful functional disability was defined based on an a priori score cutoff of 32 or higher (Bovin et al., 2019). Additionally, the six WHODAS 2.0 subscales (i.e., Understanding and Communicating, Getting Around, Self-Care, Getting Along with People, Life Activities, and Participation in Society) were used to assess individual

TABLE 1 Baseline demographic characteristics

Variable	*M*	*SD*	%
Gender identity			
Male			90.3
Female			9.7
Age (years)	33.29	8.80	
Race			
Black			5.9
White			76.8
Other			17.3
Educational attainment (years)	14.09	1.96	
Estimated premorbid IQ (WTAR)	104.94	11.25	
Time since baseline (years)	2.02	1.02	
PTSD severity (CAPS-IV)	51.62	27.06	
Current PTSD diagnosis			63.3
Current mood disorder			28.7
Current anxiety disorder			19.8
Current substance use disorder			16.0
Depression severity (DASS-D)	10.06	9.71	
Anxiety severity (DASS-A)	6.94	7.25	
Antidepressant use			28.1
Military mTBI			48.1
Lifetime mTBI			65.8
Overall daily life functioning (WHODAS 2.0)[a]	27.38	19.77	
Baseline clinically significant disability			38.8
Follow-up clinically significant disability			38.0
Decline			21.1
Chronic			59.1
Improve			19.8
Overall sleep quality (PSQI)	10.31	4.43	
Average pain (McGill)	33.99	23.85	
Total lifetime drinks (weight-adjusted; LDH)	2,244.45	2,358.86	
Average drinks per month (LDH)	36.89	85.13	
Combat exposure	16.87	11.68	

Note: $N = 237$. WTAR = Wechsler Test of Adult Reading; CAPS-IV = Clinician-Administered PTSD Scale for *DSM-IV*; DASS = Depression, Anxiety and Stress Scale; DASS-D = DASS Depression subscale; DASS-A = DASS Anxiety subscale; mTBI = mild traumatic brain injury; WHODAS 2.0 = World Health Organization Disability Assessment Schedule II; PSQI = Pittsburgh Sleep Quality Index; LDH = Lifetime Drinking History.

[a]Clinically significant disability is defined as a WHODAS 2.0 total score of 32 or higher (Bovin et al., 2019). "Decline" indicates the percentage of participants who showed a statistically significant worsening in functional disability from baseline to follow-up based on a cutoff of 1.96 (z score) on the Reliable Change Index standardized regression model (RCI_{SRB}). "Chronic" indicates the percentage of participants whose functional disability did not significantly change from baseline to follow-up. "Improve" indicates the percentage of participants who showed a statistically significant improvement in functional disability from baseline to follow-up based on a cutoff of 1.96 (z score) on the RCI_{SRB}.

facets of functional disability. The simple scoring method was applied such that each subscale score contributed equally to the WHODAS 2.0 total score (WHO, 2010). The square roots of the total WHODAS 2.0 and subscale scores were used to normalize the positively skewed distribution (Fortenbaugh et al., 2020). After participants report their functional difficulties across the six subscales, they are asked to indicate how much their functioning interferes with their daily life, scoring their responses on a scale of 0 (*none*) to 4 (*extreme*). Total scores ranged from 0 to 75. As the present study aimed to examine changes in functional disability, individuals who reported no interference in daily life functioning (i.e., WHODAS 2.0 total score less than 32) across both time points were removed from the analyses ($n = 45$). An examination of global functioning among this subgroup (i.e., WHODAS 2.0 total score) at baseline ($M = 3.89$) and follow-up ($M = 5.31$) confirmed participants' lack of interference in daily life functioning.

Internal reliability for the WHODAS 2.0 total score was adequate, $r = .60$ for the correlation between baseline and follow-up.

Somatic and psychiatric symptoms

PTSD

The Clinician-Administered PTSD Scale for *DSM-IV* (CAPS-IV; Weathers et al., 1995), a structured interview used to assess symptoms and establish a diagnosis based on the criteria outlined in the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV*; American Psychiatric Association, 1994), was used to assess PTSD symptom severity. Respondents were asked to rate symptom severity on a scale of 0 to 4, with higher scores indicating more severe PTSD symptoms (range: 1–109). In the present sample, internal reliability for the CAPS-IV was adequate, $r = .72$.

Depression and anxiety

The self-report Depression and Anxiety subscales from the 21-item Depression, Anxiety, and Stress Scale (DASS; Lovibond & Lovibond, 1995) were used to measure depressive and anxiety-related symptoms, respectively. Respondents were asked to rate their symptoms on a scale of 0–3, with higher scores reflecting more severe symptoms. Scores ranged from 0 to 42 for the Depression subscale and from 0 to 36 for the Anxiety subscale. In the present sample, internal reliability correlations were $r = .64$ and $r = .55$, respectively, for the Depression and Anxiety subscales.

Pain

Pain was assessed using the visual analog scale of the McGill Short-Form Pain Questionnaire (Melzack, 1975). In the present sample, scores ranged from 0 to 87, and the internal reliability correlation was $r = .54$.

Sleep quality

The Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) was used to assess perceived sleep quality. In the present sample, total scores ranged from 1 to 20, and the internal reliability correlation was .57.

Alcohol use

Alcohol use was assessed using the Lifetime Drinking History Interview (Skinner & Sheu, 1982) by multiplying the average number of drinks on a drinking day by the number of drinking days in the most recent phase. In the present sample, total scores ranged from 0 to 21, and internal reliability was adequate, $r = .95$.

Symptom report validity

The Validity-10 scale of the Neurobehavioral Symptoms Inventory (NSI; Cicerone & Kalmar, 1995; Vanderploeg et al., 2014) was used to identify potential symptom exaggeration or overreporting on self-report measures. A failure on the Validity-10 Scale, indicating possible symptom overreporting, was defined based on an a priori defined cutoff score of 23 or higher (range: 0–40; Lange et al., 2015).

Cognitive performance

Participants completed a battery of validated neuropsychological measures to assess attention, memory, and executive function (Esterman et al., 2019; Riley et al., 2019). These cognitive domains were targeted given their demonstrated associations with PTSD and other deployment-related sequelae (Esterman et al., 2019; Vasterling et al., 1998). Raw scores were converted to scaled, age-corrected z scores; to compute composite scores, z scores were summed within each cognitive domain and divided by the number of scores within a domain. Measures of attention measures included the Test of Variables of Attention (TOVA; Henry, 2005; d-prime and reaction time) as a measure of sustained attention, Digit Span (Digits Forward; Wechsler, 2008) as a measure of simple auditory attention, and Trail Making Test Part A (Delis et al., 2001; total time) as a measure of visual attention and processing speed. Measures of executive function included the Trail Making Test Part B (Delis et al., 2001; total time) as a measure of task-switching, Stroop Test (Delis et al., 2001; inhibition total time) as a measure of inhibitory control, Cambridge Neuropsychological Test Automated Battery (CANTAB) Intra-Extra Dimensional Set Shift (www.cantab.com; the number of stages completed) as a measure of set-shifting, Verbal Fluency (FAS; Delis et al., 2001; total score) as a measure of phonemic fluency, and Auditory Consonant Trigrams (ACT; Stuss et al., 1985; total score) as a measure of working memory. Select scores from the California Verbal Learning Test-II (CVLT; Woods et al., 2006; i.e., short-delay free recall, long-delay free recall, and long-delay recognition hits) were included as a measure of verbal memory. Composite scores ranged from −1.5 to 1.7 for attention, −3.5 to 1.5 for memory, and −1.7 to 1.4 for executive functioning and demonstrated adequate internal reliability in the present sample, rs = .57, .49, and .66, respectively.

Premorbid intellectual functioning was estimated using the Wechsler Test of Adult Reading (WTAR; Wechsler, 2001). Additionally, consistent with previous studies from our lab, the Medical Symptom Validity Test (MSVT; Green, 2004) was used as a measure of performance

validity. Individuals who scored 85% or below on immediate recall, delayed recall, or consistency, according to manual guidelines, were removed from the analyses.

Data analysis

Change in functional disability on the WHODAS 2.0 across 1–2 years was defined using a regression-based approach to ensure against findings attributable to regression to the mean and to account for baseline functional disability levels. Specifically, we computed a continuous, regression-based reliable change metric (i.e., the RCI standardized regression model; RCI_{SRB}) introduced by McSweeny and colleagues (1993), which adjusts for regression to the mean, test–retest reliability, and inequality of variance, using the following formula: $\frac{X}{\sqrt{2*(std(T1\ CAPS)*\sqrt{1-R})^2}}$ (Hinton-Bayre, 2016; McSweeny et al., 1993). In this formula, X represents global functional disability at Time 2 (*T2 WHODAS*) adjusted for baseline global functioning ([*T1 WHODAS*]; residuals) and time since baseline, and R is the test–retest reliability of the WHODAS 2.0 (Chisolm et al., 2005). Square roots of the total WHODAS 2.0 scores at baseline and follow-up were computed prior to computing X to normalize the positively skewed distribution (Fortenbaugh et al., 2020). Although the present study took a continuous approach to characterizing associations with changes in functioning, this formula results in a standardized (i.e., z score) metric of change, which can be used to define statistically significant changes in global functional disability. For descriptive purposes, a statistically significant change at the individual level was defined at a z score cutoff of 1.96.

Pearson correlation coefficients were used to examine associations between (a) baseline psychiatric and cognitive variables and baseline global functional disability (i.e., WHODAS 2.0 total) and (b) baseline psychiatric and cognitive variables with changes in global functional disability (RCI_{SRB}). A Bonferroni correction ($p = .0002$) was applied to all analyses within domains (i.e., psychiatric/somatic vs. cognitive). Because multiple baseline psychiatric variables were correlated with baseline global functional disability (see Results), these psychiatric variables were next entered into follow-up simultaneous multiple linear regressions to examine whether particular psychological variables were independently predictive of global functional disability. These same psychiatric variables were also entered as predictors into simultaneous multiple linear regressions to examine whether discrete psychological variables were independently predictive of specific facets of functional disability (i.e., WHODAS 2.0 subscale scores) at baseline.

Pearson correlation coefficients were also used to examine the associations between changes in psychiatric and cognitive variables with changes in global functional disability (RCI_{SRB}). Similar to the baseline analyses, psychiatric variables were next entered into follow-up simultaneous multiple linear regressions to examine whether changes in particular psychiatric variables were independently predictive of changes in global functional disability. The same psychiatric variables were also entered as predictors into simultaneous multiple linear regressions to examine whether changes in particular psychiatric variables were independently predictive of changes in specific facets of functional disability.

RESULTS

Prevalence of functional disability at baseline and follow-up and changes in disability

The prevalence of clinically meaningful functional disability (i.e., a WHODAS 2.0 total score of 32 or higher) at baseline and follow-up can be found in Table 1. A similar proportion of participants endorsed clinically meaningful disability at baseline (39.4%) and follow-up (38.2%). RCIs, using a z score cutoff of 1.96, indicated that 21.2% of participants in the full sample displayed a statistically significant decline in functioning from baseline to follow-up, whereas 20.5% displayed statistically significant improvements in functioning and 59.4% did not demonstrate significant change. Descriptive information regarding continuous measures of somatic and psychiatric symptoms, cognitive performance, and functional disability at baseline and follow-up can be found in Supplementary Table S3.

Associations among baseline somatic and psychiatric symptoms, cognitive performance, and functional disability

Correlations among baseline somatic and psychiatric symptoms and global functional disability measures can be found in Supplementary Table S4. Higher levels of baseline PTSD, anxiety, depressive, pain-, and sleep dysfunction–related symptoms were correlated with higher baseline functional disability, Bonferroni-corrected $ps < .001$. In contrast, alcohol use at baseline was not significantly correlated with functional disability, $p = .277$. These associations did not vary in strength depending on history of military mTBI and/or blast exposure (see Supplementary Tables S5 and S6 , respectively). No baseline cognitive domains (i.e., attention, memory, or executive function) were significantly correlated with baseline functional disability, $ps = .053–.646$ (see Supplementary Table 7).

Somatic and psychiatric variables that were correlated with global functional disability at baseline were next entered into simultaneous multiple linear regressions to examine independent associations (see Supplementary Table S8). Regressions indicated that more severe baseline PTSD, anxiety, depressive, and pain-related symptoms were independently associated with higher global functional disability at baseline, $R^2 = .614$, $p < .001$. Regarding WHODAS 2.0 subscales, more severe PTSD symptoms were independently associated with lower scores on measures of communication, the ability to get along with others, and the ability to participate in society, βs = .20–.36, ps < .001–.009. Higher levels of depressive symptoms were independently associated with lower ratings on measures of communication, the ability to take care of oneself, the ability to get along with others, completion of life activities and work/school tasks, and participation in society, βs = .22 –.35, ps < .001–p = .005. Higher pain ratings were independently associated with lower scores on measures of the ability to get around, take care of oneself, complete life activities and work/school tasks, and participate in society, βs = .21–.35, p< .001–p = .023. Higher levels of anxiety symptoms were independently associated with lower ratings on measures of the ability to communicate with others and participate in society, βs = .16–.21, ps = .006–.041. More sleep-related symptoms were independently associated with a lower ability to take care of oneself. β = .16, p = .032.

Associations between baseline somatic and psychiatric symptoms and cognitive performance and changes in functional disability

We next examined whether baseline psychiatric or cognitive variables were correlated with changes in global functional disability and, surprisingly, found no significant associations, ps = .461–.541 This indicates that baseline psychiatric and cognitive differences among participants did not substantially determine who improved or worsened with regard to functional outcomes.

Associations among changes in somatic and psychiatric symptoms, cognitive performance, and changes in functional disability

Correlations between changes in somatic and psychiatric symptoms and global functional disability measures can be found in Supplementary Table S9, and scatter plots depicting several change correlations are found in Figure 1. Parallel to the baseline correlations noted, larger increases in PTSD, anxiety, depression, pain, and sleep dysfunction–related symptoms were correlated with larger increases in global functional disability, ps < .001. Also similar to the baseline correlations, changes in alcohol use were not correlated with changes in global functional disability, p = .821. Further, changes in cognitive domains were not associated with changes in global functional disability, ps = .436–.704 (see Supplementary Table S7).

Psychiatric change variables that were correlated with changes in global functional disability were next entered into simultaneous multiple linear regressions to examine independent associations (Table 2). The regressions indicated many similar associations to those found at baseline. Specifically, larger increases in PTSD, depressive, pain, and sleep dysfunction–related symptoms were independently associated with larger increases in global functional disability, $R^2 = .48$, βs = .15–.32, $p < .001$. In contrast, changes in anxiety symptoms did not uniquely predict changes in global functional disability, p = .347.

Regarding WHODAS 2.0 subscales, larger increases in PTSD were independently associated with difficulties communicating, getting along with others, completing life activities and work/school tasks, and participate in society, βs = .21–.31, ps < .001–p = .018. Larger increases in depressive symptoms were independently associated with increased difficulties communicating with others, taking care of oneself, getting along with others, completing life activities and work/school tasks, and participating in society, βs = .15–.33, ps < .001–p = .038 Larger increases in pain were independently associated with increased difficulties communicating with others, getting around, completing work and school tasks, and participating in society, βs = .15–.22, ps < .001–p = .022. Larger increases in anxiety were independently associated with increased difficulties communicating with others and taking care of oneself, βs = .16–.23, ps = .007–.031. Larger increases in sleep-related symptoms were independently associated with increased difficulties communicating with others and completing life activities, βs = .15–.21, ps = .002–.033.

DISCUSSION

The present study identified independent associations between overall functional disability and changes in the symptom severity of multiple somatic and psychiatric conditions common in post-9/11 veterans. Specifically, increases from baseline to 2-year follow-up in PTSD, depressive, pain, and sleep dysfunction–related symptoms were each independently associated with concurrent increases in global functional disability. Notably, whereas baseline symptoms of some conditions (i.e., PTSD,

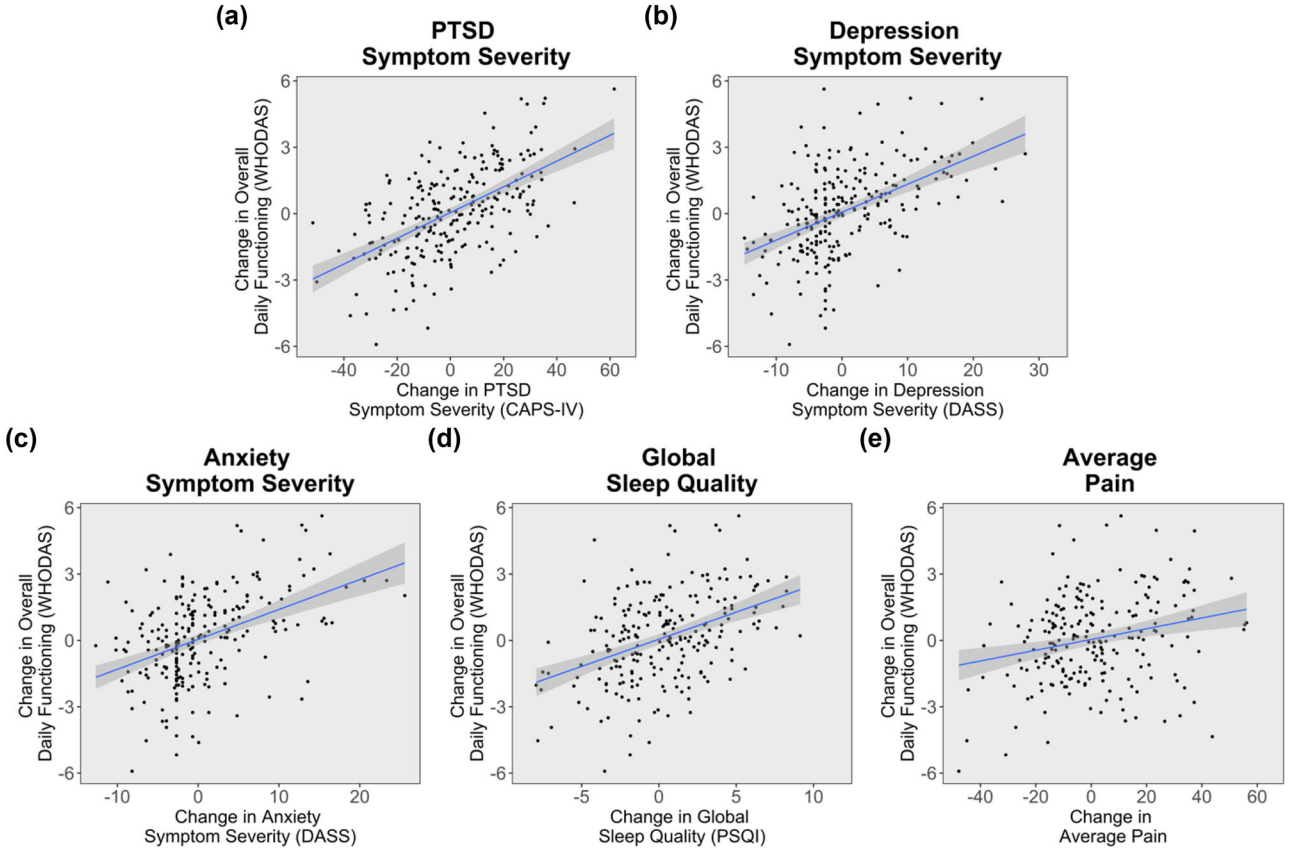

FIGURE 1 Changes in somatic and psychiatric symptoms and changes in functional disability. Note. Scatter plots displaying the associations between change in global functioning and change in (A) posttraumatic stress disorder symptom severity, (B) depressive symptom severity, (C) anxiety symptom severity, (D) global sleep quality, and (E) average pain rating

depression, and pain) were also independently predictive of baseline global disability, others (i.e., sleep) were not. Baseline somatic and psychiatric symptoms were broadly unrelated to changes in global disability. This pattern of findings suggests that relatively little information about a veteran's change in functional disability can be gleaned from past psychiatric symptom levels; rather, these symptoms must be continuously monitored to have an accurate understanding of an individual's current level of disability.

Baseline alcohol use was not correlated with baseline global disability nor were changes in alcohol use correlated with changes in global disability, following a Bonferroni adjustment. Although individuals who meet the criteria for alcohol use disorders report significant disability on the WHODAS 2.0 (Balhara et al., 2017), the present study suggests that alcohol use is less strongly tied to disability when measured continuously in a sample that includes individuals with and without alcohol use disorders. This may partially be attributable to the lack of negative effects of light-to-moderate alcohol consumption on disability and cognitive health (Rodgers et al., 2005). Participants in the present sample also endorsed a relatively large amount of drinking, which may have resulted in a limited range on the drinking self-report measure.

To date, this study represents one of the only examinations of how changes in somatic and psychiatric symptoms may be linked with changes in facets of post-9/11 veterans' functional disability. In comparison to Fortenbaugh and colleagues (2020), the present study used RCIs to show that temporal increases in symptoms of these same disorders were linked to increases in disability over this period. Such findings indicate that even over this relatively brief interval, fluctuations in somatic and psychiatric symptoms were closely associated with functional disability. Fortenbaugh et al. (2020) also used clinical diagnoses and/or clinical cutoff scores to measure the presence or absence of a particular psychiatric condition, while the present study employed continuous measures of somatic and psychiatric symptoms. As such, temporal associations between psychiatric functioning and disability appear to be continuous across the full span of psychiatric and disability severity and not limited to individuals whose symptoms reach a specific clinical threshold.

TABLE 2 Linear regression models examining changes in somatic and psychiatric symptoms and changes in functional disability

Predictor	WHODAS 2.0 subscale															
	ΔGlobal Function (RCI_{SRB})		ΔUnderstand & Communicate		ΔGet Around		ΔSelf-Care		ΔGet Along		ΔLife Activity		ΔWork/ School		ΔParticipate in Society	
	β	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*	*β*	*SE*
ΔPTSD severity (CAPS-IV)	.32***	.06	.21**	.07	.15	.08	−.10	.08	.31***	.07	.23**	.08	.22*	.08	.25***	.07
ΔDASS Depression	.31***	.06	.22**	.07	.11	.07	.20**	.08	.28***	.07	.15*	.07	.30***	.08	.33***	.06
ΔDASS Anxiety	.08	.06	.16*	.07	.08	.08	.23**	.08	.02	.07	−.01	.07	−.04	.08	.04	.07
ΔOverall sleep quality (PSQI)	.15**	.06	.15*	.07	.13	.07	.10	.08	.02	.07	.21**	.07	.11	.08	.10	.06
ΔAverage pain	.15**	.05	.09	.06	.22***	.07	.08	.07	.10	.06	.08	.06	.17*	.07	.17**	.06
Time since baseline (years)			.07**	.06	.05	.06	.14*	.07	.05	.06	.09	.06	.13	.07	.12*	.06
Adjusted R^2	.480	.321	.1882	.152	.272	.217	.276	.387								
Model *p*	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001								

Note: WHODAS 2.0 = World Health Organization Disability Assessment Schedule II; CAPS-IV = Clinician-Administered PTSD Scale for *DSM-IV*; DASS = Depression, Anxiety and Stress Scale; PSQI = Pittsburgh Sleep Quality Index.

***$p < .001$; **$p < .01$; *$p < .05$.

The present study also examined how somatic and psychiatric symptoms may be related to specific facets of disability. In general, PTSD and depression were among the strongest predictors of the most facets of disability and bore significant overlap in the facets of disability with which they were associated, including the ability to communicate with others, get along with others, complete life activities, complete work or school obligations, and participate in society. PTSD and depression are highly comorbid in this population due, in part, to their high degree of symptom overlap (Lippa et al., 2015). Thus, the independent and remarkably similar strength of associations with aspects of disability suggests that symptoms of PTSD and depression should be separately assessed when evaluating disability among post-9/11 veterans rather than considering both to represent trauma-related distress more broadly (Fortenbaugh et al., 2020). Pain was the only outcome that was uniquely associated with the ability to get around, and this was true both at baseline and when examining change variables. This is somewhat unsurprising, as the WHODAS 2.0 Get Around subscale consists of items related to one's physical capacity to mobilize in and outside their home (e.g., standing, walking).

Compared to U.S. veterans who served in previous conflicts, post-9/11 veterans are at an increased risk of experiencing both psychiatric and somatic symptoms following their military service (Fulton et al., 2015; Parker et al., 2019). These individuals are more likely to report having experienced posttraumatic stress due to their military service (37% of post-9/11 veterans vs. 16% of veterans from earlier war eras) and are more likely to say that their reintegration was difficult (44% vs. 25%; Parker et al., 2019). In the present study, the rates of psychiatric diagnoses were considerably higher than those reported in recent years for other war eras; for example, 63% of participants in the current study met the criteria for PTSD compared with approximately 6% of Vietnam veterans and 8% of Gulf War veterans (Boscarino et al., 2018). This rate is also higher than the rate found among veterans from previous war eras at a similar time point postdeployment (Wolfe et al., 1999). Several factors may explain these differences, including the use of weaponry unavailable during previous wars, less frequent engagement by post-9/11 veterans in mental health treatment, and more recognition of the effects of trauma exposure on veterans' mental health (Inoue et al., 2021; Levine et al., 2018).

Cognitive functioning was broadly unrelated to disability both at baseline and over time. The absence of significant associations at baseline seems to conflict with reports by Riley and colleagues (2019), who found that post-9/11 veterans with clinically significant cognitive dysfunction endorsed higher degrees of disability. However, Riley et al. identified these significant associations using categorical

cutoffs to denote cognitive status (i.e., cognitive dysfunction vs. none), but continuous measures of cognitive dysfunction were only weakly linked to disability (Riley et al., 2019). Thus, whereas post-9/11 veterans who demonstrate significant cognitive difficulties are at risk for more disability, cognitive testing appears to be less useful as a predictor of disability when individuals who display no or only subtle cognitive difficulties are included in the analyses. In addition to a dearth of significant cognition–disability associations at baseline, the current results showed that changes in cognitive function from baseline to follow-up were not associated with changes in disability. This may be explained by the relatively small change in cognitive performance over this brief period. Future work should examine these alterations over a more extended period during which cognitive change is more likely, such as the transition from middle to older adulthood.

The present results suggest that, regardless of baseline mental health symptoms, symptoms of PTSD, depression, and pain are particularly important clinical targets for intervention when seeking to reduce the functional disability of post-9/11 veterans. Indeed, veterans who endorse even subclinical levels of psychiatric symptom severity may stand to benefit functionally from brief, targeted treatments that address the specific psychiatric symptom areas of concern. These findings conflict somewhat with current clinical practices, as providers frequently only treat patients who meet the full diagnostic criteria for a psychiatric disorder. On the other hand, cognitive abilities should generally not be considered the sole target for improving daily functioning for most post-9/11 veterans. Although cognitive rehabilitation may be recommended for post-9/11 veterans with clinically significant cognitive dysfunction (Riley et al., 2019) and may be considered a supplement for ongoing psychotherapy in some cases (Jak et al., 2019), such interventions in isolation are not warranted for individuals who demonstrate more mild cognitive difficulties.

Although the findings of the current study are compelling, there are some limitations. The TRACTS longitudinal study only recently began assessing psychological treatments in which participants may be engaged between study visits (e.g., cognitive processing therapy for PTSD). As such, our understanding of participants' engagement in psychotherapy and its potential to reduce somatic and psychiatric symptoms and, thus, potentially impact disability is unclear. Additionally, as noted, although the regression models controlled for the time between baseline and follow-up appointments, it is possible that changes in some predictor measures, most notably domains of cognitive functioning, would have been tied more strongly to disability if a longer follow-up period (e.g., decades) was observed. Despite the longitudinal study design, the analyses were unable to establish causality, and it is possible that the associations observed were bidirectional in nature, whereby reductions in disability may have, in part, led to reductions in somatic and psychiatric symptoms. Because the TRACTS study recruits solely a post-9/11 veteran population that is predominantly male, it is unclear whether the same associations between symptoms and functional disability would be observed in samples from other war eras, samples composed exclusively of female veterans, or civilians, where the frequency and severity of somatic and psychiatric symptoms may differ. The recruitment of a convenience sample rather than a random-sampling approach further limits the generalizability to individuals who are less likely to participate in clinical research (Elfil & Negida, 2017). In particular, the recruitment of such individuals may have limited the sample to participants with milder cognitive dysfunction and/or psychiatric symptom severity, which, in turn, might limit or weaken the observed associations between these variables and disability.

This study used a well-validated set of measures to tap facets of attention, memory, and executive functioning (Esterman et al., 2019; Riley et al., 2019). Tests of these abilities were chosen based on their purported associations with deployment-related psychiatric conditions (McGlinchey et al., 2017); however, they by no means represent an exhaustive assessment of all cognitive domains that may be impacted in this population. For example, prior work suggests that inhibitory control measures that include emotional stimuli (e.g., the emotional Stroop task) are particularly sensitive to the effects of PTSD on cognitive performance (Cisler et al., 2011). Additionally, the present study's reliance on paper-and-pencil measures of timed abilities (e.g., Trails, Stroop) rather than computerized versions may have limited their sensitivity (Park & Schott, 2021). Finally, although the present study strived to capture disability via the WHODAS 2.0, the instrument is, nonetheless, a self-report measure with inherent subjective biases and possible floor effects for this population, especially for some subscales (e.g., Self-Care). Future studies using more objective assessments of functional disability (e.g., employment status, technology-based measures of mobility) would provide a fuller understanding of veterans' difficulties completing everyday activities (Amick et al., 2018; Greenhalgh et al., 2021).

In summary, changes in post-9/11 veterans' somatic and psychiatric symptoms, particularly PTSD and depression, were found to be strongly associated with changes in functional disability. In contrast, cognitive performance in isolation provided comparatively less information about a veteran's functional disability. Ongoing symptom, especially with regard to PTSD and depression, is fundamental to understanding a veteran's current level of functioning. The assessment of and treatment for these individuals should emphasize a holistic approach to more fully

comprehend how various somatic and psychiatric symptoms may directly or interactively impede veterans' quality of life.

OPEN PRACTICES STATEMENT

The study reported in this article was not formally preregistered. Neither the data nor the materials have been made available on a permanent third-party archive; requests for the data or materials should be sent via email to the lead author at jberns16@u.rochester.edu.

ORCID

John P. K. Bernstein https://orcid.org/0000-0002-4621-0666
Jennifer R. Fonda https://orcid.org/0000-0001-9482-2918

REFERENCES

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Author.

Amick, M. M., Meterko, M., Fortier, C. B., Fonda, J. R., Milberg, W. P., & McGlinchey, R. E. (2018). The deployment trauma phenotype and employment status in veterans of the wars in Iraq and Afghanistan. *Journal of head trauma rehabilitation*, *33*(2), E30–E40. https://doi.org/10.1097/HTR.0000000000000308

Aupperle, R. L., Melrose, A. J., Stein, M. B., & Paulus, M. P. (2012). Executive function and PTSD: Disengaging from trauma. *Neuropharmacology*, *62*(2), 686–694. https://doi.org/10.1016/j.neuropharm.2011.02.008

Balhara, Y. P. S., Singh, S., Modak, T., & Sarkar, S. (2017). A cross-sectional study to assess disability and its correlates among treatment-seeking individuals with alcohol use disorders. *Indian Journal of Psychological Medicine*, *39*(1), 40–45. https://doi.org/10.4103/0253-7176.198941

Boscarino, J. A., Adams, R. E., Urosevich, T. G., Hoffman, S. N., Kirchner, H. L., Boscarino, J. J., Withey, C. A., Dugan, R. J., & Figley, C. R. (2018). Mental health impact of homecoming experience among 1,730 formerly deployed veterans from the Vietnam war to current conflicts: results from the veterans' health study. *Journal of Nervous and Mental Disease*, *206*(10), 757–764. https://doi.org/10.1097/NMD.0000000000000879

Bovin, M. J., Meyer, E. C., Kimbrel, N. A., Kleiman, S. E., Green, J. D., Morissette, S. B., & Marx, B. P. (2019). Using the World Health Organization Disability Assessment Schedule 2.0 to assess disability in veterans with posttraumatic stress disorder. *PloS One*, *14*(8), e0220806. https://doi.org/10.1371/journal.pone.0220806

Brandes, D., Ben-Schachar, G., Gilboa, A., Bonne, O., Freedman, S., & Shalev, A. Y. (2002). PTSD symptoms and cognitive performance in recent trauma survivors. *Psychiatry Research*, *110*(3), 231–238. https://doi.org/10.1016/S0165-1781(02)00125-7

Brewin, C. R., Kleiner, J. S., Vasterling, J. J., & Field, A. P. (2007). Memory for emotionally neutral information in posttraumatic stress disorder: A meta-analytic investigation. *Journal of Abnormal Psychology*, *116*(3), 448–463. https://doi.org/10.1037/0021-843X.116.3.448

Buysse, D. J., Reynolds III, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research*, *28*(2), 193–213. https://doi.org/10.1016/0165-1781(89)90047-4

Chisolm, T. H., Abrams, H. B., McArdle, R., Wilson, R. H., & Doyle, P. J. (2005). The WHO-DAS II: Psychometric properties in the measurement of functional health status in adults with acquired hearing loss. *Trends in amplification*, *9*(3), 111–126. https://doi.org/10.1177/108471380500900303

Cicerone, K. D., & Kalmar, K. (1995). Persistent postconcussion syndrome: The structure of subjective complaints after mild traumatic brain injury. *Journal of Head Trauma Rehabilitation*, *10*(3), 1–17. https://doi.org/10.1097/00001199-199510030-00002

Cisler, J. M., Wolitzky-Taylor, K. B., Adams Jr T. G., Babson, K. A., Badour, C. L., & Willems, J. L. (2011). The emotional Stroop task and posttraumatic stress disorder: A meta-analysis. *Clinical Psychology Review*, *31*(5), 817–828. https://doi.org/10.1016/j.cpr.2011.03.007

DeGutis, J., Esterman, M., McCulloch, B., Rosenblatt, A., Milberg, W., & McGlinchey, R. (2015). Posttraumatic psychological symptoms are associated with reduced inhibitory control, not general executive dysfunction. *Journal of the International Neuropsychological Society*, *21*(5), 342–352. https://doi.org/10.1017/S1355617715000235

Delis, D. C., Kaplan, E., & Kramer, J. H. (2001). *Delis-Kaplan Executive Function System (D–KEFS)* [Database record]. APA PsycTests. https://doi.org/10.1037/t15082-000

Duff, K. (2012). Evidence-based indicators of neuropsychological change in the individual patient: Relevant concepts and methods. *Archives of Clinical Neuropsychology*, *27*(3), 248–261. https://doi.org/10.1093/arclin/acr120

Elfil, M., & Negida, A. (2017). Sampling methods in clinical research: An educational review. *Emergency*, *5*(1), e52.

Esterman, M., Fortenbaugh, F. C., Pierce, M. E., Fonda, J. R., DeGutis, J., Milberg, W., & McGlinchey, R. (2019). Trauma-related psychiatric and behavioral conditions are uniquely associated with sustained attention dysfunction. *Neuropsychology*, *33*(5), 711–724. https://doi.org/10.1037/neu0000525

Fonda, J. R., Fredman, L., Brogly, S. B., McGlinchey, R. E., Milberg, W. P., & Gradus, J. L. (2017). Traumatic brain injury and attempted suicide among veterans of the wars in Iraq and Afghanistan. *American Journal of Epidemiology*, *186*(2), 220–226. https://doi.org/10.1093/aje/kwx044

Fortenbaugh, F. C., Fonda, J. R., Fortier, C. B., Amick, M. M., Milberg, W. P., & McGlinchey, R. E. (2020). The impact of common psychiatric and behavioral comorbidities on functional disability across time and individuals in post-9/11 veterans. *Journal of Traumatic Stress*, *33*(5), 750–761. https://doi.org/10.1002/jts.22501

Fortier-Brochu, É., Beaulieu-Bonneau, S., Ivers, H., & Morin, C. M. (2012). Insomnia and daytime cognitive performance: A meta-analysis. *Sleep Medicine Reviews*, *16*(1), 83–94. https://doi.org/10.1016/j.smrv.2011.03.008

Frueh, B. C., Turner, S. M., Beidel, D. C., Mirabella, R. F., & Jones, W. J. (1996). Trauma management therapy: A preliminary evaluation of a multicomponent behavioral treatment for chronic combat-related PTSD. *Behaviour Research and Therapy*, *34*(7), 533–543. https://doi.org/10.1016/0005-7967(96)00020-4

Fulton, J. J., Calhoun, P. S., Wagner, H. R., Schry, A. R., Hair, L. P., Feeling, N., Elbogen, E., & Beckham, J. C. (2015). The prevalence of posttraumatic stress disorder in Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) veterans: A meta-analysis. *Journal of Anxiety Disorders*, *31*, 98–107. https://doi.org/10.1016/j.janxdis.2015.02.003

Grande, L. J., Robinson, M. E., Radigan, L. J., Levin, L. K., Fortier, C. B., Milberg, W. P., & McGlinchey, R. E. (2018). Verbal memory deficits in OEF/OIF/OND veterans exposed to blasts at close range. *Journal of the International Neuropsychological Society*, *24*(5), 466–475. https://doi.org/10.1017/S1355617717001242

Green, P. (2004). *Medical Symptom Validity Test (MSVT) for Microsoft Windows: User's manual*. Paul Green Publishers.

Greenhalgh, M., Kulich, H., Blaauw, E., Turner, R., Peterson, S., Cooper, R. A., & Songer, T. (2021). Health outcomes used to determine facets of health-related quality of life for post-9/11 veterans using assistive technology for a combat-related mobility impairment: A literature review. *Military Medicine*, *106*(11–12), 1106–1114. https://doi.org/10.1093/milmed/usab028

Harned, M. S. (2014). The combined treatment of PTSD with borderline personality disorder. *Current Treatment Options in Psychiatry*, *1*(4), 335–344. https://doi.org/10.1007/s40501-014-0025-2

Heinz, A. J., Pennington, D. L., Cohen, N., Schmeling, B., Lasher, B. A., Schrodek, E., & Batki, S. L. (2016). Relations between cognitive functioning and alcohol use, craving, and post-traumatic stress: An examination among trauma-exposed military veterans with alcohol use disorder. *Military Medicine*, *181*(7), 663–671. https://doi.org/10.7205/MILMED-D-15-00228

Henry, G. K. (2005). Probable malingering and performance on the test of variables of attention.*The Clinical Neuropsychologist*, *19*(1), 121–129. https://doi.org/10.1080/13854040490516604

Hinton-Bayre, A. D. (2016). Clarifying discrepancies in responsiveness between reliable change indices. *Archives of Clinical Neuropsychology*, *31*(7), 754–768. https://doi.org/10.1093/arclin/acw064

Inoue, C., Shawler, E., Jordan, C. H., & Jackson, C. A. (2021). *Veteran and military mental health issues*. StatPearls.

Jak, A. J., Jurick, S., Crocker, L. D., Sanderson-Cimino, M., Aupperle, R., Rodgers, C. S., Thomas, K. R., Boyd, B., Norman, S. B., & Lang, A. J. (2019). SMART-CPT for veterans with comorbid posttraumatic stress disorder and history of traumatic brain injury: A randomised controlled trial. *Journal of Neurology, Neurosurgery & Psychiatry*, *90*(3), 333–341. https://doi.org/10.1136/jnnp-2018-319315

Kessler, R. C. (2002). The categorical versus dimensional assessment controversy in the sociology of mental illness. *Journal of Health and Social Behavior*, *43*(2), 171–188. https://doi.org/10.2307/3090195

Lange, R. T., Brickell, T. A., Lippa, S. M., & French, L. M. (2015). Clinical utility of the Neurobehavioral Symptom Inventory validity scales to screen for symptom exaggeration following traumatic brain injury. *Journal of Clinical and Experimental Neuropsychology*, *37*(8), 853–862. https://doi.org/10.1080/13803395.2015.1064864

Levine, D. S., Valenstein, M., Yosef, M., Mavandadi, S., Oslin, D. W., Himle, J. A., & Zivin, K. (2018). Differences in mental health service use among unemployed veterans of different eras. *Journal of Nervous and Mental Disease*, *206*(2), 155–158. https://doi.org/10.1097/NMD.0000000000000771

Lippa, S. M., Fonda, J. R., Fortier, C. B., Amick, M. A., Kenna, A., Milberg, W. P., & McGlinchey, R. E. (2015). Deployment-related psychiatric and behavioral conditions and their association with functional disability in OEF/OIF/OND veterans. *Journal of Traumatic Stress*, *28*(1), 25–33. https://doi.org/10.1002/jts.21979

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, *33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-U

Maguen, S., Li, Y., Madden, E., Seal, K. H., Neylan, T. C., Patterson, O. V., DuVall, S. L., Lujan, C., & Shiner, B. (2019). Factors associated with completing evidence-based psychotherapy for PTSD among veterans in a national healthcare system. *Psychiatry Research*, *274*, 112–128. https://doi.org/10.1016/j.psychres.2019.02.027

McDermott, L. M., & Ebmeier, K. P. (2009). A meta-analysis of depression severity and cognitive function. *Journal of Affective Disorders*, *119*(1–3), 1–8. https://doi.org/10.1016/j.jad.2009.04.022

McGlinchey, R. E., Milberg, W. P., Fonda, J. R., & Fortier, C. B. (2017). A methodology for assessing deployment trauma and its consequences in OEF/OIF/OND veterans: The TRACTS longitudinal prospective cohort study. *International Journal of Methods in Psychiatric Research*, *26*(3), e1556. https://doi.org/10.1002/mpr.1556

McSweeny, A. J., Naugle, R. I., Chelune, G. J., & Lüders, H. (1993). "*T* scores for change": An illustration of a regression approach to depicting change in clinical neuropsychology. *The Clinical Neuropsychologist*, *7*(3), 300–312. https://doi.org/10.1080/13854049308401901

Melzack, R. (1975). The McGill Pain Questionnaire: Major properties and scoring methods. *Pain*, *1*(3), 277–299. https://doi.org/10.1016/0304-3959(75)90044-5

Metcalf, O., Stone, C., Hinton, M., O'Donnell, M., Hopwood, M., McFarlane, A., Forbes, D., Kartal, D., Watson, L., & Freijah, I. (2020). Treatment augmentation for posttraumatic stress disorder: A systematic review. *Clinical Psychology: Science and Practice*, *27*(1), e12310. https://doi.org/10.1111/cpsp.12310

Park, S. -Y., & Schott, N. (2021). The trail-making-test: Comparison between paper-and-pencil and computerized versions in young and healthy older adults. *Applied Neuropsychology: Adult*. Advance online publicaiton. https://doi.org/10.1080/23279095.2020.1864374

Parker, K., Igielnik, R., Barroso, A., & Cilluffo, A. (2019). The American veteran experience and the post-9/11 generation. *Pew Research Center*. https://www.pewsocialtrends.org/wp-content/uploads/sites/3/2019/09/PSDT.10.09.19_veteransexperiences_full.report.pdf

Riley, E., Mitko, A., Stumps, A., Robinson, M., Milberg, W., McGlinchey, R., Esterman, M., & DeGutis, J. (2019). Clinically significant cognitive dysfunction in OEF/OIF/OND veterans: Prevalence and clinical associations. *Neuropsychology*, *33*(4), 534–546. https://doi.org/10.1037/neu0000529

Rodgers, B., Windsor, T. D., Anstey, K. J., Dear, K. B., F Jorm, A., & Christensen, H. (2005).

Non-linear relationships between cognitive function and alcohol consumption in young, middle-aged and older adults: The PATH Through Life Project. *Addiction*, *100*(9), 1280–1290. https://doi.org/10.1111/j.1360-0443.2005.01158.x

Schneider, C., Fulda, S., & Schulz, H. (2004). Daytime variation in performance and tiredness/sleepiness ratings in patients with insomnia, narcolepsy, sleep apnea, and normal controls. *Journal of Sleep Research*, *13*(4), 373–383. https://doi.org/10.1111/j.1365-2869.2004.00427.x

Skinner, H. A., & Sheu, W. J. (1982). Reliability of alcohol use indices. The Lifetime Drinking History and the MAST. *Journal of studies on alcohol*, *43*(11), 1157–1170. https://doi.org/10.15288/jsa.1982.43.1157

Stika, M. M., Riordan, P., Aaronson, A., Herrold, A. A., Ellison, R. L., Kletzel, S., Drzewiecki, M., Evans, C. T., Mallinson, T., & High, W. M. (2021). Cognition and other predictors of functional disability among veterans with mild traumatic brain injury and posttraumatic stress disorder. *Journal of Head Trauma Rehabilitation*, *36*(1), 44–55. https://doi.org/10.1097/HTR.0000000000000611

Stuss, D., Ely, P., Hugenholtz, H., Richard, M., LaRochelle, S., Poirier, C., & Bell, I. (1985). Subtle neuropsychological deficits in patients with good recovery after closed head injury. *Neurosurgery*, *17*(1), 41–47. https://doi.org/10.1227/00006123-198507000-00007

Swick, D., Honzel, N., Larsen, J., Ashley, V., & Justus, T. (2012). Impaired response inhibition in veterans with post-traumatic stress disorder and mild traumatic brain injury. *Journal of the International Neuropsychological Society*, *18*(5), 917–926. https://doi.org/10.1017/S1355617712000458

Vanderploeg, R. D., Cooper, D. B., Belanger, H. G., Donnell, A. J., Kennedy, J. E., Hopewell, C. A., & Scott, S. G. (2014). Screening for postdeployment conditions: Development and cross-validation of an embedded validity scale in the neurobehavioral symptom inventory. *Journal of Head Trauma Rehabilitation*, *29*(1), 1–10. https://doi.org/10.1097/HTR.0b013e318281966e

Vasterling, J. J., Brailey, K., Constans, J. I., & Sutker, P. B. (1998). Attention and memory dysfunction in posttraumatic stress disorder. *Neuropsychology*, *12*(1), 125–133. https://doi.org/10.1037/0894-4105.12.1.125

Verfaellie, M., Lee, L. O., Lafleche, G., & Spiro, A. (2016). Self-reported sleep disturbance mediates the relationship between PTSD and cognitive outcome in blast-exposed OEF/OIF veterans. *Journal of Head Trauma Rehabilitation*, *31*(5), 309–319. https://doi.org/10.1097/HTR.0000000000000197

Blake, D. D., Weathers, F. W., Nagy, L. M., Kaloupek, D. G., Gusman, F. D., Charney, D. S., & Keane, T. M. (1995). The development of a clinician-administered PTSD scale. (PDF) *Journal of Traumatic Stress*, *8*(1), 75–90. https://doi.org/10.1002/jts.2490080106

Wechsler, D. (2001). *Wechsler Test of Adult Reading: WTAR*. Psychological Corporation.

Wechsler, D. (2008). *Wechsler Adult Intelligence Scale* (4th ed.). Pearson.

Wolfe, J., Erickson, D. J., Sharkansky, E. J., King, D. W., & King, L. A. (1999). Course and predictors of posttraumatic stress disorder among Gulf War veterans: A prospective analysis. *Journal of Consulting and Clinical Psychology*, *67*(4), 520–528. https://doi.org/10.1037/0022-006X.67.4.520

Woods, S. P., Delis, D. C., Scott, J. C., Kramer, J. H., & Holdnack, J. A. (2006). The California Verbal Learning Test–second edition: Test-retest reliability, practice effects, and reliable change indices for the standard and alternate forms. *Archives of Clinical Neuropsychology*, *21*(5), 413–420. https://doi.org/10.1016/j.acn.2006.06.002

SUPPORTING INFORMATION

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