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Subjective Cognitive and Psychiatric Well-Being in U.S. Military Veterans Screened for Deployment-Related Traumatic Brain Injury: A Million Veteran Program Study

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Abstract

The purpose of this study was to examine subjective cognitive and psychiatric functioning in post-deployed military Veterans who underwent the Veterans Health Administration's Traumatic Brain Injury (TBI) Screening and Evaluation Program and enrolled in the VA's Million Veteran Program (MVP). Veterans (N=7,483) were classified into three groups based on outcomes from the TBI Screening and Evaluation Program: (1) negative TBI screen ('Screen−'), (2) positive TBI screen but no TBI diagnosis ('Screen+/TBI−'), or (3) positive TBI screen and TBI diagnosis ('Screen+/TBI+'). Chi-square analyses revealed significant group differences across all self-reported cognitive and psychiatric health conditions (e.g., memory loss, depression), and ANCOVAs similarly showed a significant association between group and subjective symptom reporting. Specifically, the relationship between TBI group and clinical outcome (i.e., health conditions and symptoms) was such that the Screen+/TBI+ group fared the worst, followed by the Screen+/TBI− group, and finally the Screen− group. However, evaluation of effect sizes suggested that Veterans in the two Screen+ groups (Screen+/TBI+ and Screen+/TBI−) are faring similarly to one another on subjective cognitive and psychiatric functioning, but that both Screen+

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Authorship Confirmation Statement

The authors confirm contribution to the paper as follows: VCM developed the study concept and design. Data curation was performed by CCC with assistance from VCM. VCM performed the data analysis and interpretation in consultation with SJF, DKD, MSS, and CCC. SJF, DDD, and MSS drafted the paper, and CCC, ALC, LDW, and VCM provided edits, feedback, and revisions. All authors approved the final version of the paper for submission.

Conflict of Interest Statement

The authors have no conflicts of interest to report.

groups are faring significantly worse than the Screen− group. Our results have meaningful clinical implications and suggest that Veterans who screen positive for TBI, regardless of ultimate TBI diagnosis, be eligible for similar clinical services so that both groups can benefit from valuable treatments and therapeutics. Finally, this research sets the stage for follow-up work to be conducted within MVP that will address the neurobiological underpinnings of cognitive and psychiatric distress in this population.

Keywords

Veterans Health Administration; MVP; TBI screen; CTBIE; subjective distress; mental health

Introduction

Many studies have explored the complex cognitive, affective, and somatic-related sequelae associated with traumatic brain injury (TBI) in Veterans serving in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) (Caplan et al., 2015; MacGregor et al., 2013; O'Neil et al., 2014). While clinical and functional outcomes tend to differ between Veterans with a history of mild TBI (mTBI) versus moderate/severe TBI (Dillahunt-Aspillaga et al., 2017; Swan et al., 2018), cognitive symptoms following any severity of TBI are particularly concerning to Veterans. Within the context of mTBI specifically, there is often a discrepancy between Veterans' ratings of their *subjective* cognitive functioning and their *objective* performance on neuropsychological testing (Drag et al., 2012; French et al., 2014; Karr et al., 2019; Spencer et al., 2010). Rather than being tightly associated with objective measures of cognitive functioning, subjective cognitive complaints have instead been linked with a wide range of mental health symptoms, reduced physical health, and decreased psychosocial functioning (Donnelly et al., 2018; French et al., 2014; Karr et al., 2019; Seal et al., 2016; Verfaellie et al., 2013). Additionally, there is ample evidence to suggest that mTBI is often comorbid with mental health diagnoses, including posttraumatic stress disorder (PTSD) and depression (Carlson et al., 2010; Seal et al., 2016), and that these mental health comorbidities may further exacerbate subjective symptoms of cognitive dysfunction (Donnelly et al., 2018; Drag et al., 2012; Karr et al., 2019). It is also important to appreciate that these symptoms are not pathognomonic for mTBI and frequently occur in other patient populations including orthopedic samples as well as healthy controls (Iverson & Lange, 2003; Smith-Seemiller et al., 2003).

In response to the increased prevalence of mTBI sustained by military personnel throughout OEF/OIF, the Veterans Health Administration (VHA) expanded its screening and assessment of TBI by implementing the TBI Screening and Evaluation Program (Department of Veterans Affairs, 2007; 2010). Beginning in 2007, any Veteran deployed to OEF/OIF who later undergoes care at the VA is screened for possible TBI, and those with a positive screen are subsequently referred to a TBI specialist who completes the Comprehensive Traumatic Brain Injury Evaluation (CTBIE; see VHA Directive 2007-013 and VHA Directive 2010-012). The VHA's TBI Screening and Evaluation Program results in three possible outcomes: (1) negative TBI screen, (2) positive TBI screen but negative CTBIE (TBI−; i.e., *not* diagnosed with TBI), or (3) positive TBI screen and positive CTBIE (TBI+;

i.e., diagnosed with TBI). Importantly, the TBI Screen was designed to be overly inclusive to capture anyone with a possible history of TBI *and* ongoing symptoms whereas the CTBIE is a more detailed assessment that captures key information about TBI injury details and characteristics (e.g., loss or alteration of consciousness, posttraumatic amnesia) that allows for increased confidence in a final TBI diagnosis (Belanger et al., 2016; VHA Directive 2007-013; VHA Directive 2010-012).

While several studies have evaluated the results of the TBI Screening and Evaluation Program (Belanger et al., 2012; Carlson et al., 2010; Scholten et al., 2012; Seal et al., 2016), few studies have explored clinical outcomes within the context of the three-group model of the TBI screen/CTBIE outlined above. Certainly, Veterans who screen positive on the TBI screen and are ultimately diagnosed with TBI on the CTBIE are an important cohort to study; however, it is vital to understand the clinical outcomes of *all three groups* to provide adequate care and assessment as well as to predict prognosis. Moreover, given the widespread reliance on self-reported symptoms in the context of TBI assessment and evaluation—as well as in medicine more broadly—there is inherent value in examining Veterans' perceptions of their cognitive and psychiatric functioning (French et al., 2014). There is also data to suggest that patients' perceptions of functioning are strongly tied to their medical outcomes (Løvvik et al., 2014; Merritt et al., 2020; Petrie et al., 2007). Therefore, the purpose of this study was to examine (1) self-reported cognitive and psychiatric health conditions and (2) subjective ratings of cognitive and psychiatric symptoms in post-deployed military Veterans who underwent the VHA's TBI Screening and Evaluation Program. We hypothesized that there would be group differences across cognitive and psychiatric well-being, such that Veterans in the Screen+/TBI+ group would have the poorest outcomes, followed by the Screen+/TBI− and Screen− groups, respectively.

Materials and Methods

Participants and Procedures

The present retrospective observational study was performed using data from the Million Veteran Program (MVP), a national research initiative intended to investigate how Veteran health is impacted by genetic characteristics, health behaviors, and environmental factors. Details on the design of MVP have been previously described (Gaziano et al., 2016). For the present study, only electronic health record (EHR) data captured from the VA's Corporate Data Warehouse (CDW) (Fihn et al., 2014) and MVP questionnaire data were examined (data collection period: October 2007-October 2019). Veteran participants provided informed consent prior to MVP enrollment and IRB approval for the current study (project "MVP026") was obtained in 2019.

MVP-enrolled Veterans were included in the present study if they: (1) completed the VHA's TBI Screening and Evaluation Program during routine clinical care; (2) had sufficient data to be classified into one of the following three diagnostic groups: (a) negative TBI screen (Screen−), (b) positive TBI screen but no TBI diagnosis (Screen+/TBI−), or (c) positive TBI screen and confirmed TBI diagnosis (Screen+/TBI+); and (3) completed the MVP Baseline and Lifestyle Surveys (i.e., had complete data for the outcome variables of interest [cognitive and psychiatric health conditions and subjective ratings of cognitive

and psychiatric symptoms]; described below). Of the 7,804 Veterans potentially eligible for inclusion (i.e., among Veterans enrolled in MVP who completed the TBI Screening and Evaluation Program and MVP Baseline and Lifestyle Surveys), 321 Veterans were excluded due to missing or incomplete TBI Clinical Reminder Screen or CTBIE TBI diagnostic data; thus, the final sample included 7,483 Veterans.

Data Sources & Measures

VA Electronic Health Record.—As part of MVP enrollment, Veteran participants consent to allow investigators access to clinical data derived from their VA EHR. All EHR data is stored within the Corporate Data Warehouse (CDW) (Fihn et al., 2014). Sociodemographic information (e.g., age, sex, race/ethnicity, military service branch) and results of the VA Clinical Reminder Screen and CTBIE were extracted from the CDW for each participant.

TBI Clinical Reminder Screen & CTBIE.—The TBI Clinical Reminder Screen is administered to OEF/OIF-era Veterans who were deployed and *not previously diagnosed* with a TBI (Belanger et al., 2012). Veterans are administered the screening, typically by a primary care provider, upon enrollment within the VHA. Thus, the screen is designed to assess for historical, or remote, injuries that occurred during deployment. The TBI Clinical Reminder Screen consists of four sections: (1) identification of injury events(s) (e.g., blast or explosion, bullet); (2) immediate neurological signs/symptoms of TBI (e.g., losing consciousness); (3) acute symptoms (e.g., memory problems, headache); and (4) current symptoms (e.g., memory problems, headache). Notably, the symptoms identified in Sections 3 and 4 of the screener are commonly reported following TBI, but frequently present within the context of other medical conditions as well as healthy samples (Iverson & Lange, 2003; Smith-Seemiller et al., 2003). Veterans must endorse all four sections for a positive TBI screen, which results in a referral to a TBI specialist who then completes the CTBIE (Belanger et al., 2012; Scholten et al., 2012).

The CTBIE is a structured interview conducted by trained clinicians with TBI expertise who collect sociodemographic data and inquire about OEF/OIF deployment-related injuries. Detailed information is gathered about mechanisms(s) of injury (i.e., bullet, vehicular, fall, blast) and TBI injury characteristics including loss of consciousness (LOC), alteration of consciousness (AOC), and post-traumatic amnesia (PTA). As part of the CTBIE, the clinician is required to determine whether a Veteran's history is consistent with TBI (i.e., TBI+ or TBI−), relying on VA/DoD guidelines (The Management of Concussion/mTBI Working Group, 2016) to determine diagnostic status.

There is robust literature examining the sensitivity and specificity associated with the TBI Clinical Reminder Screen and CTBIE (Belanger et al., 2012; Donnelly et al., 2011; Fortier et al., 2015; Radigan et al., 2018). These studies have generally shown that the tools have moderate to good sensitivity but variable specificity, ranging from low to good depending on the study. Regardless, these measures have been routinely utilized across the VHA since 2007 and there is value in determining whether these measures are associated with future functioning.

MVP Baseline and Lifestyle Surveys.—The MVP Baseline and Lifestyle Surveys are intended to provide additional context and supplement data that are contained in each Veteran's EHR (Gaziano et al., 2016).

Self-reported cognitive and psychiatric health conditions: As part of the MVP Baseline Survey, Veterans are asked whether they have been diagnosed with a wide range of health conditions; for this study, the following health conditions were evaluated: "memory loss or impairment," "anxiety reaction/panic disorder, "depression," and "posttraumatic stress disorder" (PTSD).

Cognitive and psychiatric symptom ratings: As part of the MVP Lifestyle Survey, Veterans complete several self-report questionnaires, some of which assess subjective cognitive and psychiatric functioning. Cognitive functioning was evaluated using the Medical Outcomes Study Cognitive Functioning-Revised Scale (MOS-Cog-R), a 6-item measure that assesses difficulties with cognitive functioning over the past month (Yarlas et al., 2013). For the purpose of this study, the MOS-Cog-R total score (range=6-36) and individual items (range=1-6) were evaluated. Higher scores reflect worse cognitive functioning. Additionally, psychiatric functioning was assessed using the 4-item Patient Health Questionnaire-4 (PHQ-4) (Kroenke et al., 2009) and 17-item PTSD Checklist (PCL) (Weathers et al., 1993). The PHQ-4 assesses anxiety and depression symptoms over the past two weeks; the total score (range=0-12) as well as anxiety and depression subscale scores (range=0-6) were evaluated. Finally, the PCL assesses PTSD symptoms over the past month; the PCL total score (range=17-85) and PCL symptom clusters (Cluster B: range=5-25; Cluster C: range=7-35; Cluster D: range=5-25) were evaluated. Higher scores on the PHQ-4 and PCL reflect more severe symptoms. These measures have established psychometric properties and have been frequently used in research and clinical settings (Kroenke et al., 2009; Weathers et al., 1993; Yarlas et al., 2013).

Data Analysis

Descriptive statistics were conducted on the overall sample and analyses of variance (ANOVAs) were used to evaluate participant sociodemographic characteristics by diagnostic group. Primary analyses included (1) chi-square tests to compare the three diagnostic groups across self-reported cognitive and psychiatric health conditions (all categorial variables) and (2) analyses of covariance (ANCOVAs) to compare the three diagnostic groups on subjective ratings of cognitive and psychiatric symptoms (all continuous variables). Covariates included age, sex, and race/ethnicity (evaluated as categorical variables). Effect sizes are reported as Cramer's V and phi (φ) values for the chi-square tests and as partial eta-squared (η_p^2) values for the ANCOVAs. Significant omnibus tests were followed-up with pairwise comparisons (chi-square analyses for categorical variables and ANCOVAs for continuous variables). Effect size interpretations were as follows: phi (φ) values – small = .10; medium = .30; large = .50 and partial eta-squared (η_p^2) values – small = .01; medium = .06; large = .14. All statistical analyses were conducted using Stata (Stata/MP 15.1 for Windows).

Results

Participant Characteristics

Among the enrolled Veterans (N=7,483), 68.7% (n=5,141) screened negative for TBI (Screen−); 12.7% (n=951) screened positive but did not receive a TBI diagnosis on the CTBIE (Screen+/TBI−); and 18.6% (n=1,391) screened positive and received a TBI diagnosis on the CTBIE (Screen+/TBI+). The majority of participants were male (77.3%; n=5,787) and roughly two-thirds of the sample self-identified as non-Hispanic White (68.8%; n=5,150). Participant sociodemographic characteristics, by group, are presented in Table 1.

Self-Reported Cognitive & Psychiatric Health Conditions

Chi-square analyses revealed significant group differences across all self-reported cognitive and psychiatric health conditions (all *p's*<.001; *V*=0.32-0.56). Results of group comparisons evaluating health conditions are reported in Table 2, as are the results of the pairwise comparisons. The Screen+/TBI+ group endorsed significantly higher rates of cognitive and psychiatric health conditions than the Screen+/TBI− group, who in turn endorsed significantly higher rates of cognitive and psychiatric health conditions than the Screen− group. The only exception was depression, where the Screen+/TBI+ and Screen+/TBI− groups endorsed comparable rates of depression diagnoses. Notably, effect sizes were small when comparing the two Screen+ groups for all cognitive and psychiatric health conditions (φ = 0.02-0.12). In contrast, effect sizes were generally medium to large (φ = 0.24-0.55) for all other comparisons (i.e., comparing the two Screen+ groups to the Screen− group).

Subjective Ratings of Cognitive & Psychiatric Symptoms

ANCOVAs adjusting for age, sex, and race/ethnicity showed a significant effect of group across all variables examined (i.e., MOS-Cog-R, PHQ-4, and PCL symptoms; all *p*'s<.001; η_p^2=0.16-0.32). Adjusted means and standard errors for the cognitive and psychiatric symptom variables are reported in Table 2, as are the results of the pairwise comparisons. The Screen+/TBI+ group generally endorsed significantly greater symptoms than the Screen+/TBI− group, who in turn endorsed significantly greater symptoms than the Screen− group. The exceptions were the PHQ-4 Total Score and the PHQ-4 Depression and PCL Cluster C subscale scores, where the Screen+/TBI+ and Screen+/TBI− groups did not significantly differ from each other. As before, effect sizes were small when comparing the two Screen+ groups across all symptoms (η_p^2 = ≤0.01). In contrast, effect sizes were generally large (η_p^2 = 0.10-0.29) for all other comparisons (i.e., comparing the two Screen+ groups to the Screen− group).

Discussion

The results of the present study revealed a significant relationship between diagnostic group and clinical outcome (i.e., self-reported cognitive and psychiatric health conditions and subjective ratings of cognitive and psychiatric symptoms), such that the Screen+/TBI+ group fared the worst, followed by the Screen+/TBI− group, and finally the Screen− group. However, when evaluating effect sizes, results suggest that Veterans in the two

Screen+ groups (Screen+/TBI+ and Screen+/TBI−) displayed comparable rates and levels of cognitive and psychiatric functioning, but that both Screen+ groups fared significantly worse than the Screen− group on these outcomes. No prior studies have explored subjective cognitive and psychiatric well-being in the context of the three-group model of the TBI screen/CTBIE within a large-scale and nationally representative Veteran sample, and our findings highlight the importance of examining clinical outcomes in all three groups so that appropriate clinical care and referrals can be offered.

Prior outcomes research on Veterans with a history of TBI has largely utilized a two-group paradigm—that is, comparing Veterans with and without a history of TBI on important clinical outcomes. Among the existing studies that have specifically used CTBIE samples, the Neurobehavioral Symptom Inventory (NSI) has been the focus, with Veterans in the Screen+/TBI+ group experiencing greater subjective distress than Veterans in the Screen+/TBI− group (Mortera et al., 2018; Scholten et al., 2012; Seal et al., 2016). In the present study, we evaluated a broader array of cognitive and psychiatric outcomes and, consistent with prior research, showed that Veterans in the Screen+/TBI+ group endorsed higher rates of cognitive and psychiatric health conditions (i.e., memory loss, anxiety/panic, and PTSD) as well as greater symptom distress (i.e., MOS-Cog-R symptoms, PHQ-4 Anxiety symptoms, and PTSD Cluster B and D symptoms) than Veterans in the Screen+/TBI− group. However, a major caveat to our findings is the small effects sizes observed when comparing the two Screen+ groups. For example, 74% of Veterans in the Screen+/TBI+ group endorsed having a PTSD diagnosis compared to 65% of Veterans in the Screen+/TBI− group; although clearly a greater proportion of Screen+/TBI+ Veterans are reporting a PTSD diagnosis, it is still notable that over two-thirds of the Screen+/TBI− Veterans also reported a PTSD diagnosis. Additionally, the (adjusted) mean PCL Total Score for Veterans in the Screen+/TBI+ group was only two points higher than the Screen+/TBI− group; although this was a statistically significant difference, this difference is unlikely to be clinically meaningful. The same relationships were generally observed for the other cognitive and psychiatric health conditions and self-reported symptoms. In contrast, when comparing the Screen+ groups (i.e., Screen+/TBI+ and Screen+/TBI−) to the Screen− group, effect sizes were large, signifying that Veterans screening positive on the TBI screen are at much higher risk of experiencing cognitive and psychiatric health conditions and reporting subjective distress. Importantly, these findings suggest that while the TBI Clinical Reminder Screen appears to be a valuable tool for identifying Veterans who later go on to experience subjectively poor cognitive and psychiatric functioning, the TBI diagnosis rendered as part of the CTBIE has limited clinical utility in this context. In other words, what appears to be most salient is that Veterans who screen positive for TBI—meaning that they experienced (1) an injury event, (2) immediate symptoms following the event, (3) new or worsening symptoms following the event, and (4) current symptoms—are at greater risk of reporting poorer cognitive and psychiatric functioning compared to Veterans who screen negative (i.e., who do not endorse all four sections of the TBI screen).

Taken together, our findings establish the importance of examining subjective clinical outcomes in all three groups and emphasize the need for further developing and refining evidenced-based practices for Veterans with multi-morbidities. Existing military TBI studies have demonstrated the need for clinical services such as cognitive rehabilitation and

psychotherapy to manage the cognitive and psychiatric distress experienced by Veterans with a history of mTBI, and the recently updated VA/DoD Clinical Practice Guidelines for mTBI recommend that patients who present with behavioral health conditions, regardless of whether they have a confirmed history of TBI, be evaluated and managed *in the same way* (The Management of Concussion/mTBI Working Group, 2021). Our results further underscore the need for similar care to be offered to Veterans who initially screen positive for TBI but who may or may not ultimately receive a TBI diagnosis on the CTBIE. For example, both Screen+ groups would likely benefit from a thorough evaluation of symptoms so that appropriate treatments can be delivered. Moreover, given the high levels of subjective distress reported by both Screen+ groups, other resources and interventions may be needed to prevent symptom exacerbation and/or chronic negative health trajectories in these vulnerable groups. In particular, the Screen+/TBI− and Screen+/TBI+ groups may benefit from additional follow up care and referrals, especially those aimed at addressing subjective cognitive and psychiatric distress, with a particular emphasis on psychoeducation (Cooper et al., 2015; Snell et al., 2009; Venkatesan & Ramanathan-Elion, 2021) and integrated psychotherapy treatments (Jak et al., 2019). Consideration of potentially modifiable factors such as self-efficacy and coping style may also be important treatment targets in this population (Sakamoto et al., 2021), as well as awareness of patients' illness perception and symptom attribution to TBI (Merritt et al., 2020). Recently, Venkatesan and Ramanathan-Elion (Venkatesan & Ramanathan-Elion, 2021) thoughtfully described the implementation of "personalized psychoeducation" in the context of military TBI; incorporating this approach into clinical care could greatly enhance treatment offerings for a large number of Veterans who experience ongoing subjective distress. Finally, our results support the recommendations of Vanderploeg and Belanger (2013) who advocated for post-deployment evaluations and treatments based on symptom presentation(s) rather than diagnostic conditions (i.e., TBI).

While our results are clinically informative, there are several limitations that warrant further discussion. First, our findings were based on clinical data obtained from the EHR; use of such data has inherent limitations (i.e., retrospective data, charting inaccuracies, missing data, etc.). Additionally, the primary outcomes of interest were all based on self-report data, and it is unclear whether DSM diagnostic criteria for the psychiatric conditions were met. While the study was purposefully designed to evaluate *subjective* cognitive and psychiatric distress, there is value in also examining objective data, especially given that discrepancies between these assessment types have been observed in previous research (Donnelly et al., 2018; French et al., 2014; Karr et al., 2019; Spencer et al., 2010). Future studies should examine objective measures of cognitive functioning, as well as referral patterns, service utilization, and treatment outcomes for these three groups. It is also important to note that the use of EHR data precluded our evaluation of symptom validity in this study.

Additional study limitations include the cross-sectional design, which limits our abilities to make causal statements, and issues related to generalizability. Specifically, our sample included post-deployed Iraq and Afghanistan-era Veterans who completed the TBI Screening and Evaluation Program. As highlighted previously, only Veterans who have never been diagnosed with a deployment-related TBI undergo the TBI screen and CTBIE; thus, the cohort under study does not capture Veterans who were *acutely* diagnosed with

TBI. We also do not know if our results would generalize to Veterans who did not experience deployment-related TBI(s). Furthermore, it is possible that the 'Screen−' group includes Veterans with undiagnosed historical TBIs who experienced natural recovery prior to completing the TBI Screening and Evaluation Program. As such, the 'Screen−' group should not be interpreted as a "no TBI control group." Relatedly, it is important to appreciate that many of the symptoms that are included in the TBI screen (i.e., in Sections 3 and 4) are non-specific to TBI and commonly occur in other clinical populations as well as healthy samples (Iverson & Lange, 2003; Smith-Seemiller et al., 2003).

Other caveats to be mindful of when interpreting our results is that we do not have date of injury or time since injury data; however, given the VHA's systematic method for screening and evaluating TBI in Veterans, we can be confident that any events associated with a possible TBI as documented on the TBI Screen or CTBIE all occurred remotely. This is important because historic mTBI events would not be expected to be related to ongoing sequelae (Lange et al., 2020; McCrea et al., 2009), which raises the possibility that our findings may be confounded by iatrogenesis and highlights the limitations of population-based screens (Vanderploeg & Belanger, 2013).

Despite these limitations, this research yields important information on the subjective cognitive and psychiatric experiences of Veterans participating in the TBI Screening and Evaluation Program and sets the stage for follow-up work to be conducted within MVP that will address the neurobiological underpinnings of cognitive and psychiatric distress in this population. Our results have meaningful clinical implications and suggest that Veterans who screen positive for TBI, regardless of ultimate TBI diagnosis, be eligible for similar clinical services so that both groups can benefit from valuable treatments and therapeutics. Findings also emphasize the clinical utility of using TBI Screening and Evaluation Program data—data that has been routinely collected throughout the VHA since 2007—to guide treatment and rehabilitation efforts for Iraq/Afghanistan-era Veterans.

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Table 1.

Participant sociodemographic characteristics by group.

Variables	1. Screen−		2. Screen+/TBI−		3. Screen+/TBI+		
	N	%	N	%	N	%	*p*
Age at CTBIE							
18-29	888	17.29	163	17.18	283	20.35	
30-39	1,026	19.97	225	23.71	396	28.47	<.001
40-49	1,658	32.28	328	34.56	420	30.19	
50+	1,565	30.47	233	24.55	292	20.99	
Sex							
Male	3,745	72.85	826	86.86	1,216	87.42	<.001
Female	1,396	27.15	125	13.14	175	12.58	
Race/Ethnicity							
White, Non-Hispanic	3,669	71.73	575	60.59	906	65.70	
Black, Non-Hispanic	598	11.69	156	16.44	128	9.28	
Hispanic	288	5.63	59	6.22	126	9.14	<.001
Asian	161	3.15	21	2.21	33	2.39	
Multiracial	244	4.77	71	7.48	89	6.45	
Another Race	155	3.03	67	7.06	97	7.03	
Branch of Service: Air Force [a]							
Yes	1,314	25.62	104	10.96	112	8.08	<.001
No	3,815	74.38	845	89.04	1,274	91.92	
Branch of Service: Army [a]							
Yes	2,332	45.47	669	70.50	999	72.08	<.001
No	2,797	54.53	280	29.50	387	27.92	
Branch of Service: Marine Corps [a]							
Yes	430	8.38	140	14.75	221	15.95	<.001

Variables	1. Screen−		2. Screen+/TBI−		3. Screen+/TBI+		
	N	%	N	%	N	%	*p*
No	4,699	91.62	809	85.25	1,165	84.05	
Branch of Service: Navy [a]							<.001
Yes	1,319	25.72	112	11.80	143	10.32	
No	3,810	74.28	837	88.20	1,243	89.68	

Abbreviations: TBI = traumatic brain injury; CTBIE = Comprehensive Traumatic Brain Injury Evaluation.

Notes: N=7,483 (n=5,141 Screen−; n=951 Screen+/TBI−; n=1,391 Screen+/TBI+; however, actual n for each outcome of interest may be less due to missing data).

[a]Not mutually exclusive categories; thus, it is possible for a participant to endorse more than one branch of service.

Table 2.

Self-reported cognitive and psychiatric health conditions and subjective ratings of cognitive and psychiatric symptoms: Results of group comparisons.

Variables	1. Screen−		2. Screen+/TBI−		3. Screen+/TBI+		Omnibus Test Result		Pairwise Comparisons			
Self-Reported Health Conditions	**N**	**%**	**N**	**%**	**N**	**%**	***p***	**ES (*V*)**	**Summary**	**φ1-2**	**φ1-3**	**φ2-3**
Memory Loss	119	2.31	249	26.18	530	38.10	<.001	.45	3 > 2 > 1	.36	.49	.12
Anxiety/Panic	863	16.79	414	43.53	692	49.75	<.001	.32	3 > 2 > 1	.24	.32	.06
Depression	1,226	23.85	530	55.73	798	57.37	<.001	.32	3 & 2 > 1	.26	.30	.02
PTSD	721	14.02	608	63.93	1,030	74.05	<.001	.56	3 > 2 > 1	.44	.55	.11
Subjective Symptom Ratings	**M**	**SE**	**M**	**SE**	**M**	**SE**	***p***	**ES (η_p^2)**	**Summary**	**η_p^2 1-2**	**η_p^2 1-3**	**η_p^2 2-3**
MOS-Cog-R												
Total Score	10.84	0.10	18.55	0.22	19.60	0.18	<.001	.23	3 > 2 > 1	.15	.22	<.01
Reasoning	1.68	0.02	2.84	0.04	2.99	0.03	<.001	.17	3 > 2 > 1	.11	.15	<.01
Concentration	1.82	0.02	3.11	0.04	3.24	0.03	<.001	.19	3 > 2 > 1	.12	.17	<.01
Confusion	1.63	0.02	2.86	0.04	3.07	0.04	<.001	.18	3 > 2 > 1	.11	.17	.01
Forgetfulness	2.06	0.02	3.53	0.04	3.75	0.04	<.001	.22	3 > 2 > 1	.14	.21	.01
Inattention	1.98	0.02	3.39	0.04	3.53	0.04	<.001	.19	3 > 2 > 1	.12	.17	<.01
Reacting Slowly	1.67	0.02	2.82	0.04	3.01	0.03	<.001	.17	3 > 2 > 1	.10	.16	<.01
PHQ-4												
Total Score	2.27	0.04	5.54	0.10	5.84	0.09	<.001	.19	3 & 2 > 1	.13	.17	<.01
Anxiety	1.21	0.02	2.87	0.06	3.05	0.05	<.001	.17	3 > 2 > 1	.11	.16	<.01
Depression	1.07	0.02	2.68	0.05	2.79	0.05	<.001	.16	3 & 2 > 1	.11	.15	<.01
PCL												
Total Score	29.75	0.21	51.48	0.48	53.05	0.40	<.001	.32	3 > 2 > 1	.22	.29	<.01
Cluster B	8.00	0.06	14.20	0.15	14.77	0.12	<.001	.29	3 > 2 > 1	.20	.27	<.01
Cluster C	12.05	0.09	20.84	0.21	21.26	0.18	<.001	.27	3 & 2 > 1	.19	.24	<.01
Cluster D	9.70	0.07	16.43	0.16	17.02	0.13	<.001	.30	3 > 2 > 1	.20	.27	<.01

Abbreviations: TBI = traumatic brain injury; ES = effect size; *V* = Cramer's *V* effect size; φ = Phi effect size; η_p^2 = Partial eta-squared effect size; MOS-Cog-R = Medical Outcomes Study Cognitive Functioning-Revised Scale; PHQ-4 = Patient Health Questionnaire-4; PCL = PTSD Checklist.

Notes: N=7,483 (n=5,141 Screen−; n=951 Screen+/TBI−; n=1,391 Screen+/TBI+; however, actual n for each outcome of interest may be less due to missing data). Pairwise comparisons effect size interpretations: Phi (φ) values: small = .10; medium = .30; large = .50; Partial eta-squared (η_p^2) values: small = .01; medium = .06; large = .14.