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Diagnostic accuracy of three scoring methods for the Davidson Trauma Scale among U.S. military Veterans

Scott D. McDonald[a,b,c,*], NiVonne L. Thompson[a,b], Kelcey J. Stratton[a,b,d], Patrick S. Calhoun[e,f,g], the VA Mid-Atlantic Mental Illness Research, Education, Clinical Center (MIRECC) Workgroup[e]

[a] Hunter Holmes McGuire, Richmond VA Medical Center (116-B), 1201 Broad Rock Boulevard, Richmond, VA 23249, USA
[b] Department of Psychology, Virginia Commonwealth University, 806 West Franklin Street, PO Box 842018, Richmond, VA 23284, USA
[c] Department of Physical Medicine and Rehabilitation, Virginia Commonwealth University, 122 E. Marshall Street, 4th Floor, Box 980677, Richmond, VA 23298, USA
[d] Virginia Institute for Psychiatric and Behavioral Genetics, Virginia Commonwealth University, 800 East Leigh Street, Suite 101, Richmond, VA 23219, USA
[e] VA Mid-Atlantic Region Mental Illness Research, Education and Clinical Center (MIRECC), 508 Fulton Street, Durham, NC 27705, USA
[f] VA Center for Health Services Research in Primary Care, Durham NC 508 Fulton Street, Durham, NC 27705, USA
[g] Department of Psychiatry and Behavioral Sciences, Duke University Medical Center, 2301 Erwin Road, Durham, NC 27710, USA

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ABSTRACT

Self-report questionnaires are frequently used to identify PTSD among U.S. military personnel and Veterans. Two common scoring methods used to classify PTSD include: (1) a cut score threshold and (2) endorsement of PTSD symptoms meeting DSM-IV-TR symptom cluster criteria (SCM). A third method requiring a cut score in addition to SCM has been proposed, but has received little study. The current study examined the diagnostic accuracy of three scoring methods for the Davidson Trauma Scale (DTS) among 804 Afghanistan and Iraq war-era military Service Members and Veterans. Data were weighted to approximate the prevalence of PTSD and other Axis I disorders in VA primary care. As expected, adding a cut score criterion to SCM improved specificity and positive predictive power. However, a cut score of 68–72 provided optimal diagnostic accuracy. The utility of the DTS, the role of baseline prevalence, and recommendations for future research are discussed.

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1. Introduction

It has become commonplace to use self-report questionnaires to identify probable Posttraumatic Stress Disorder (PTSD) in psychiatric and epidemiologic research (e.g., Brackbill et al., 2009; Milliken, Auchterlonie, & Hoge, 2007; Wolf, Miller, & McKinney, 2009). Although standardized interviews are considered the reference or "gold" standard for diagnosis in clinical research, questionnaires are often preferred for their brevity, reduced demands for administrator training, and the ability to simultaneously test many respondents. Notwithstanding these strengths, PTSD symptom questionnaires lack the diagnostic accuracy of standardized interviews, resulting in false negatives and false positives. In trauma research, misclassification can result in inaccurate conclusions about PTSD clinical features, inappropriate recommendations for policy or resource allocation, and contamination of the PTSD research database. In clinical applications, misclassification of PTSD may have several negative consequences. In the case of false negatives, patients in need of treatment may be overlooked; whereas false positives may result in stigma, iatrogenic effects, and depletion of clinical resources better dispensed for other clinical purposes.

When a self-report symptom questionnaire is used to identify probable PTSD, the researcher or clinician is tasked with applying scoring rules that maximize the number of true positive and true negative cases while concurrently minimizing false positive and false negative cases. Three scoring methods have been devised to classify PTSD "caseness" based on PTSD symptom questionnaires: (1) a cut score threshold, (2) endorsement of PTSD symptoms that meet DSM-IV-TR (American Psychiatric Association, 2000) symptom cluster criteria, and (3) a combination of both cut score threshold and symptom cluster methods. The *cut score method* simply classifies any cases at or above a particular score threshold as PTSD positive. For example, Davidson et al. (1997) found a cut score of 40 on the *Davidson Trauma Scale* (DTS) provided an optimal hit rate of .83 ([true positive + true negative]/all cases) for detecting

* Corresponding author at: Richmond VA Medical Center (116-B), 1201 Broad Rock Boulevard, Richmond, VA 23249, USA. Tel.: +1 804 675 5000; fax: +1 804 675 6627.
E-mail address: Scott.McDonald@va.gov (S.D. McDonald).

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DSM-III-R-criteria PTSD among participants of four clinical research studies. The cut score method is the most commonly reported scoring method for PTSD screening tools (Brewin, 2005; McDonald & Calhoun, 2010).

The *symptom cluster method* (SCM) requires the endorsement of one re-experiencing, three numbing/avoidance, and two hyperarousal symptoms following DSM-IV-TR diagnostic criteria. In a study involving trauma-exposed adults, Foa, Cashman, Jaycox, and Perry (1997) found a hit rate of .89 for the *Posttraumatic Diagnostic Scale* when PTSD Criteria B, C, and D (the aforementioned symptom clusters) were met in addition to Criterion A (traumatic stressor and reaction involving intense fear, helplessness, and horror) and Criterion F (impairment). Although the SCM is intuitive, it is limited in that individuals may endorse each of the minimum six symptoms at a low symptom severity and still meet the scoring criteria for PTSD. Additionally, it is unclear whether symptoms rated mild or minimally distressing would meet the DSM-IV-TR clinical significance criterion for PTSD (Hoge et al., 2004).

To counter these limitations, two modifications to the SCM have been proposed. The first involves the requirement of at least "moderate" severity or distress for the item to count toward DSM-IV-TR symptom criteria (Weathers, Ruscio, & Keane, 1999). The second modified SCM takes severity into account by adding a cut score threshold in addition to the SCM criteria (Hoge et al., 2004). This added step, which will be referred to as the SCM+ method, has been suggested to improve specificity and positive predictive power (PPP) over non-modified SCM scoring by limiting the number of false positive cases and is thought to provide a "strict definition" of PTSD (Hoge et al., 2004). In recent years, this method has become a common practice when using PTSD symptom measures to detect probable PTSD (Grieger et al., 2006; Hoge et al., 2004; Hoge, Terhakopian, Castro, Messer, & Engel, 2007; Hoge et al., 2008; Kolkow, Spira, Morse, & Grieger, 2007; Wolf et al., 2009). However, the one study that examined this scoring method found that it had little advantage over the optimal cut score alone (Sheeran & Zimmerman, 2002).

The purpose of this study was to examine the relative diagnostic accuracy of the DTS, a 17-item PTSD symptom questionnaire, across three scoring methods. Reviews of PTSD screening instruments found study-level differences in diagnostic accuracy between the cut score method and the SCM, although the heterogeneity of findings across studies seems to have limited potential inferences (Brewin, 2005; McDonald & Calhoun, 2010). A recent study of the psychometric properties of the DTS compared the cut score method to the SCM in classifying PTSD vs. no diagnosis and PTSD vs. other Axis I diagnoses among U.S. military Veterans (McDonald, Beckham, Morey, & Calhoun, 2009). Results indicated that although SCM performed reasonably well, the cut score method (at a cut score of 32 determined post-hoc) was more efficient. The SCM method was more efficient and had higher sensitivity when an item-level severity threshold of "minimally distressing" was used vs. "moderately distressing." Conversely, specificity was reduced when an item-level severity threshold of "minimally distressing" was used, particularly when classifying PTSD vs. other Axis I diagnoses. However, this study used a relatively small sample ($N = 158$) and did not examine the utility of the SCM+ scoring method.

In the current study, three scoring procedures were applied to the DTS to examine the diagnostic accuracy for this measure among a sample of U.S. military personnel and Veterans with military service since September 11, 2001. It was hypothesized that applying a cut score threshold to the SCM method (i.e., SCM+) would provide the greatest specificity and positive predictive power (the proportion of those testing positive who actually have PTSD) in comparison to the SCM method alone. A secondary aim was to establish the diagnostic accuracy of the DTS among VA primary care patients who are Afghanistan and Iraq war-era Veterans.

2. Method

2.1. Participants

Participants were 804 U.S. military personnel and Veterans who participated in the Mid-Atlantic Mental Illness Research, Education and Clinical Center (MIRECC) Recruitment Database for the Study of Post-Deployment Mental Health (the "Registry"). The Registry provides a recruitment database for other studies of post-deployment mental health and provided a convenience sample of military personnel and Veterans for this study. Eligible participants were individuals who served in the U.S. military subsequent to September 11, 2001 and were recruited though mailings, advertisements, and clinician referrals. Informed consent and the data collection were completed at one of four VA Mid-Atlantic Health Care Network Veterans Affairs medical centers. The current report utilizes data collected between July 2006 and February 2012 from Registry participants who completed the *Structured Clinical Interview for DSM-IV-TR Axis I Disorders: Patient Edition* (SCID I/P, Version 2.0) (First, Spitzer, Gibbon, & Williams, 2002) on the same day and subsequent to the administration of the DTS ($N = 835$). Seven participants with a current psychotic disorder diagnosis and two with unknown psychotic disorder status were excluded ($N = 826$). Finally, 22 participants who did not report a trauma history that met criteria for PTSD Criterion A1 on the *Traumatic Life Events Questionnaire* (TLEQ) (Kubany et al., 2000) were not administered the DTS and thus excluded, bringing the total number of cases to be analyzed to 804.

The majority of participants were male (79.1%) and had more than 12 years of education (70.2%; 28.6% had bachelor's degrees). The sample was diverse, with a majority of participants reporting non-white race and/or ethnicity (52.7% Black/African-American, 9.0% other or unspecified), and had a median age of 37 years. The majority of participants were former or current active duty troops (65.4%) vs. Reserve and National Guard. Of participants who were active duty Service Members at the time of the research study (12.2% of the sample), the majority were with the Army (65.6%). The Army Reserves (12.5%), Army National Guard (13.5%), Navy (5.2%), and several other branches (Navy Reserve, Marines, and Marine Reserve; one participant each) were also represented. Sixty-two percent had been stationed in the region of conflict during either Operation Iraqi Freedom or Operation Enduring Freedom (i.e., Afghanistan) and 79.3% reported that they had served in a war-zone, which included deployments for Operation Desert Storm and the Kosovo War, among others. A comparison of demographic and clinical variables by PTSD diagnosis is presented in Table 1.

2.2. Materials and procedure

The Veterans were administered a battery of questionnaires related to post-deployment experiences including psychiatric symptoms, mental-health service utilization, health, and health-related behaviors. These included a demographics and military history questionnaire, the DTS (Connor & Davidson, 2003; Davidson et al., 1997), the TLEQ (Kubany et al., 2000), the *Symptom Checklist-90-R* (SCL-90-R) (Derogatis, 1994), the *Combat Exposure Scale* (CES) (Keane et al., 1989), and several other questionnaires that were not the focus of this study.

The DTS is a 17-item self-report questionnaire of posttraumatic stress symptoms (Connor & Davidson, 2003; Davidson et al., 1997). For this study, the original Davidson et al. (1997) version was used. The TLEQ was administered just before the DTS to establish that a lifetime traumatic stressor was experienced. Participants were encouraged by research staff to keep the most distressing stressor identified on the TLEQ in mind while completing the DTS. Next, 17 symptoms corresponding to the DSM-IV-TR symptoms of PTSD