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Development and Validation of a Brief Warfare Exposure Measure Among U.S. Iraq and Afghanistan War Veterans: The Deployment Risk and Resilience Inventory-2 Warfare Exposure-Short Form (DRRI-2 WE-SF)

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Abstract

Objective: It is important to assess warfare experiences beyond direct combat exposure, as these exposures can negatively impact military veterans' health. Although two validated scales from the Deployment Risk and Resilience Inventory-2 [DRRI-2] together capture a broad range of stressful warfare experiences, the length of this combined measure (30 items) is prohibitively long for some settings. Therefore, the goal of this project was to develop and validate a short form Warfare Exposure measure (DRRI-2-WE-SF).

Method: U.S. veterans deployed for the wars in Iraq and Afghanistan completed questionnaires across two studies (Study 1, $N = 1046$; Study 2, $N = 7141$) to develop and validate the DRRI-2 WE-SF.

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Results: Study 1 involved developing the DRRI-2 WE-SF, a nine-item self-report instrument with strong internal consistency (α = .86) and large correlations with the full Warfare Exposure measure (r = .97). In Study 2, the DRRI-2 WE-SF again demonstrated high levels of reliability and validity and evidenced high levels of classification accuracy (89.7% correct classification) and significant time savings (all ts > 39; all ps < .05) in comparison to the full measure.

Conclusions: The DRRI-2 WE-SF is a psychometrically sound measure of direct exposures to warfare and its consequences. This measure of proximal warfare exposure retains the strong properties of the full measure while significantly reducing completion time. These properties make the DRRI-2 WE-SF a useful tool for efficiently evaluating proximal warfare exposure among individuals who have served in both combat and non-combat roles.

Keywords

warfare experiences; veterans; psychometric evaluation; measure development

The importance of measuring warfare experiences is well-recognized, as research indicates that exposure to highly stressful or traumatic events in the war zone can negatively impact the health and broader well-being of war veterans (e.g., Kaylor et al., 1987; King et al., 2008). Historically, many researchers have limited their assessments of warfare exposure to direct combat experiences (e.g., firing a weapon or being fired upon in the warzone; King, King, Vogt, Knight, & Samper, 2006). However, there has been increasing recognition in recent years, particularly in light of the wars in Iraq and Afghanistan, that measures that focus solely on combat exposure have limitations (Vogt et al., 2016). Specifically, these measures cannot capture other common experiences impacting individuals who are not in combat roles but who have exposure to the consequences of warfare on both combatants and civilians. Yet, research indicates that these experiences can have unique consequences for veterans' mental health (Henschel & McDevitt-Murphy, 2016; Renshaw, 2011), and thus also warrant consideration in research examining the impacts of war exposure on veterans' health and well-being.

The Deployment Risk and Resilience Inventory (DRRI) was developed by King et al. (2006) and then updated to the DRRI-2 (Vogt et al., 2013) as a comprehensive measure of the various dimensions of warfare stress exposure that may be experienced by military service members. Of its 17 scales, the DRRI-2 includes two specifically focused on warfare exposure: the Combat Experiences scale, which assesses direct exposure to combat, and the Aftermath of Battle scale, which assesses exposure to the consequences of combat. Due to interest in assessing the full range of warfare exposures, many researchers have used a combination of these two scales in their research (e.g., Smith et al., 2017; Vogt et al., 2011). The measures that compose this combined measure of warfare exposure (hereafter referred to as the full Warfare Exposure measure) were not only developed in a systematic fashion and validated with Iraq and Afghanistan veterans as part of the full DRRI and then DRRI-2 but have also demonstrated strong psychometric quality across studies when used as a stand-alone measure.

Despite the strong psychometric properties of the full Warfare Exposure measure, its 30-item length makes it prohibitive for some research and clinical contexts. Therefore, there is

a need for a short form of the full Warfare Exposure measure. While other brief measures of warfare exposure exist (e.g., the Critical Warzone Experiences [CWE] scale; Kimbrel et al., 2014), these measures tend to focus mainly on direct combat experiences rather than a range of warfare exposures that are relevant for all types of military personnel, and at least for the CWE, were designed to specifically target those experiences that are most likely to lead to PTSD (i.e., by selecting items based on their association with PTSD).

Although there is a benefit to having scales that limit their focus to combat exposures that are most likely to lead to PTSD, it is also important to assess warfare experiences that are salient for individuals who are not in combat roles, as these experiences also have deleterious effects for health and well-being (Henschel & McDevitt-Murphy, 2016; Renshaw, 2011). For example, Henschel and McDevitt-Murphy found that non-combat experiences (e.g., seeing refugees who lost their belongings because of battle; being exposed to the sight, sounds, or smell of dying men and women) were associated with both current PTSD and functional impairment and disability in veterans who served in the wars in Iraq and Afghanistan. Therefore, the goal of this project was to develop and validate a short form of the full Warfare Exposure measure that could capture proximal warfare experiences – those most likely to occur when an individual has direct exposure to warfare and its consequences – for all types of military personnel: the DRRI-2 Warfare Exposure Short Form (DRRI-2 WE-SF).

In developing and validating the DRRI-2 WE-SF, we were particularly mindful of attending to the relevant principles from Smith and colleagues' (2000) recommendations for developing short form measures. Smith et al. describe nine common "sins" committed by developers of short form measures which compromise validity (see Table 1). Not all of Smith et al.'s sins were relevant to our goal, since Smith et al. envision the development of a short form which demonstrates the same factor structure as the original measure. Because our measure was not comprised of effect indicators (Vogt et al., 2013), nor designed to capture a traditional latent construct, but rather intended to represent a composite of exposures likely to occur in proximity to warfare, retaining a factor structure was not relevant. However, to ensure a psychometrically sound short form, we attended to all the relevant sins. Specifically: (1) we focused our development of the DRRI-2 WE-SF on a previously validated measurement tool (the full Warfare Exposure measure, described above); (2) we examined whether the DRRI-2 WE-SF was a reliable instrument both overall and in comparison to the full measure; (3) we evaluated whether the DRRI-2 WE-SF had adequate overlapping variance with the full measure; (4) we tested the construct and criterion-related validity of the DRRI-2 WE-SF in comparison to the full Warfare Exposure measure; (5) we investigated whether the DRRI-2 WE-SF demonstrated strong classification rates in comparison to the full measure; and (6) we determined whether the DRRI-2 WE-SF offered meaningful time saving in comparison to the full measure. Although the second goal is more consistent with investigations of measures of effect indicators designed to capture traditional latent constructs, we retained it both because we expected the items to covary, as they represent a collection of events likely to occur during proximal warfare exposure, and because it is a convenient metric by which to compare the DRRI-2 WE-SF to other similar measures of exposure (e.g., its parent measure). To complete these tasks, we collected and

analyzed data from two independent studies. Study 1 focused on the development of the DRRI-2 WE-SF, and Study 2 examined the psychometric properties of the new measure.

Study 1

The intent of Study 1 was to create a new, condensed scale of warfare exposure that captured the breadth of content represented in the full Warfare Exposure measure while retaining approximately 25% of the original items. As suggested by Smith et al. (2000), we then conducted preliminary psychometric analyses of the DRRI-2 WE-SF, including internal consistency and initial examination of both construct (i.e., association with the full Warfare Exposure measure) and criterion-related (i.e., association with PTSD) validity. Evidence of strong internal consistency that was comparable to the full Warfare Exposure measure would demonstrate initial evidence that the second short form development sin was avoided, while evidence of strong validity would provide evidence that we did not commit the third short form sin (see Table 1).

Method

Participants and procedure.—After securing IRB approval, potential participants were selected from a Defense Manpower Data Center (DMDC) roster of all Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) veterans who had returned from deployment and separated from service between 2008 and 2010 using stratified random sampling (see Vogt et al., 2013). The eligible sample, which was recruited as part of a larger study validating the DRRI-2, was stratified on both deployment component (50.0% Active Duty, 50.0% National Guard/Reservist personnel) and gender (50.0% women, 50.0% men) and then randomly selected from within each stratum. Potential participants (n = 3,053) were mailed a survey which included a range of measures, a cover letter detailing the purpose of the research, an opt-out form and a preaddressed postage paid envelope, and a gift card as a small token of appreciation. A modified Dillman mail survey procedure (Dillman, Smyth, & Christian, 2009) was used such that following the initial survey, non-responders were sent a reminder postcard followed by a second survey and a second reminder postcard, with each mailing separated by two weeks. This procedure was repeated for a third and final mailing. Consent was implied by return of a completed survey. Of all potential participants to whom the survey was mailed, 391 could not be reached and an additional 84 potential participants declined participation. Completed surveys were received from 1,046 veterans, representing a response rate of 39.2%, which is somewhat better than many studies of post-9/11 veterans, for which response rates typically range from 20–30% (Coughlin et al., 2011; Defense Manpower Data Center, 2016; see Vogt et al., 2013 for a full description of study recruitment). More than half of the participants in the final sample were female (53.5%) and most were in their 30s (M = 35.3 years; SD = 10.5). Most participants were White (74.7%) and non-Hispanic (88.1%). During deployment, most participants were of an enlisted military rank (82.9%) compared to 17.1% officers. Most of the sample served in the Army (64.5%), followed by 15.4% in the Navy, 12.8% in the Air Force, and 7.1% in the Marines. Fifty seven percent of participants were former Active Duty, whereas 43% had served in the National Guard or Reserves.

Measures.

DRRI-2 Full Warfare Exposure Measure.: The full Warfare Exposure measure is a 30-item measure comprised of two scales from the DRRI-2 (Vogt et al., 2013): the Combat Experiences Scale (CES) and the Aftermath of Battle Scale that is completed with respect to respondents' most recent deployment.

The CES measures combat-related exposures such as firing a weapon, receiving incoming fire, being attacked, or witnessing an attack (e.g., encountering an explosive device), encountering friendly fire, and going on special missions and patrols that involve such experiences. The 17 items are scored on a Likert scale from 1 (*Never*) to 6 (*Daily or almost daily*). Cronbach's α was .91.

The Aftermath of Battle Scale measures exposure to the consequences of combat, including observing or handling human remains, interacting with detainees or prisoners of war (POWs), and observing devastated communities and homeless refugees. The 13 items are scored on a Likert scale from 1 (*Never*) to 6 (*Daily or almost daily*). Cronbach's α was .92.

Posttraumatic Stress Disorder Checklist – Military Version (PCL-M).: The PCL-M (Weathers et al., 1993) is a 17-item, *DSM-IV* correspondent measure of PTSD symptom severity. Respondents were instructed to think about the deployment event(s) that were most disturbing to them during their most recent deployment and to rate their distress regarding each symptom over the last three months on a Likert scale from 1 (*Not at all*) to 5 (*Extremely*). The PCL-M has consistently demonstrated strong psychometric properties (e.g., Forbes, Creamer, & Biddle, 2001; Weathers et al., 1993). In the current study, we examined summed severity scores, with higher scores indicative of greater symptom severity; Cronbach's α was .96.

Demographics and military service characteristics.: Participants provided information on their age, sex, race, and ethnicity as well as their military service characteristics (i.e., military branch, rank, and deployment component) via self-report.

Data analysis plan.—We used stepwise regression to identify experiences that are most central to veterans' warfare exposure. All 30 items of the full Warfare Exposure measure were entered individually as the independent variables, and the full Warfare Exposure measure total score served as the dependent variable. Because we were interested in capturing a wide range of proximal warfare exposures, we allowed item entry at the $p = .5$ level. To ensure that the breadth of proximal exposures measured in the original scale was captured in the short form, we aimed to retain at least 90% of the scale variance. Because our goal was to produce a short form that was substantially more efficient than the full scale, we sought to retain approximately 25% of the original items. Finally, we relied on expert consensus to confirm that our final scale included items most likely to occur when an individual has direct exposure to warfare and its consequences, and to ensure that we did not omit items with the strongest face validity.

To test the initial psychometric properties of the scale, we examined Cronbach's alpha for the DRRI-2 WE-SF, and correlations between the full Warfare Exposure measure, the

DRRI-2 WE-SF, and the PCL-M. We interpreted Cronbach's alpha such that values < .60 are unacceptable, values between .61 and .79 are acceptable, and values ≥ .80 are very good (Hulin, Netemeyer, & Cudeck, 2001). Correlation coefficients were evaluated by the following guidelines: values ≤ .35 are low; values between .36 and .67 are moderate; values between .68 and .89 are high; and values ≥ .90 are very high (Taylor, 1990).

Results

All analyses were conducted using IBM SPSS version 26.

Scale development.—Our regression generated four options for item sets to represent the full Warfare Exposure measure that both retained at least 90% of the variance explained by the full Warfare Exposure measure and included 25% or fewer of the original items (see Table 2). Upon expert review, the decision was made to retain a fifth option, which included nine items from the original measure. Although this item set did not increase the variance explained and represented slightly more than 25% of the original items (30%), the ninth item retained ("I was exposed to hostile incoming fire;" CES item 5) was deemed essential for face validity. The percent of variance in the total score accounted for by these nine questions was 96%, suggesting that the shortened scale corresponded very closely with the original DRRI-2 measure. This item set included six items from the CES and three items from the Aftermath of Battle Scale (see Table 2).

Initial Psychometric Properties.—We computed internal consistency and examined correlations between the newly developed Warfare Exposure Short Form (DRRI-2 WE-SF), the full Warfare Exposure measure, and the PCL-M. Cronbach's alpha for the new measure was very good ($\alpha = .86$) and comparable with that of the full Warfare Exposure measure ($\alpha = .95$). Results indicated that, as expected, the association between the DRRI-2 WE-SF and the full Warfare Exposure measure was very high ($r = .97$). Further, the association between the DRRI-2 WE-SF and the PCL-M was moderate and identical to that of the full Warfare Exposure measure and the PCL-M (both rs = .48).

Discussion

Results of this study provide initial support for the value of a 9-item abridged version of the DRRI-2 full Warfare Exposure measure (see Appendix). This nine-item self-report instrument assesses exposure to combat experiences and their associated aftermath. Initial testing indicated that the DRRI-2 WE-SF is a sound measure of warfare exposure, showing strong internal consistency and large correlations with the full Warfare Exposure measure. Furthermore, initial results suggest that, like its predecessor, the measure is associated with PTSD.

Study 2

Study 2 involved data collection from a larger sample of participants who had been deployed as part of the wars in Iraq and/or Afghanistan. Our goals for this study were to validate the new measure and determine whether we had avoided Smith et al.'s (2000) sins of short form development (as described in Table 1). Specifically, the aims of this study were to: (1)

confirm the selection of items retained in the 9-item warfare measure in a new sample; (2) examine the reliability of the DRRI-2 WE-SF (sin #2); (3) determine if the DRRI-2 WE-SF demonstrates adequate overlapping variance with the full measure (sin #3); (4) evaluate the construct and criterion-related validity of the DRRI-2 WE-SF (sin #4); (5) assess the classification accuracy of the DRRI-2 WE-SF (sin #5), and (6) examine whether the DRRI-2 WE-SF saves a meaningful amount of time in comparison to the full measure (sin #6). We hypothesized that the new measure would again explain a large amount of variance of the full Warfare Exposure measure total score, and that consistent with Study 1, the 9-item DRRI-2 WE-SF would demonstrate high internal consistency reliability. Due to the large amount of variance captured by the nine items selected for the DRRI-2 WE-SF, we expected the new measure to demonstrate high levels of overlapping variance with the full measure. Because the new measure was designed to capture warfare exposures, we expected the measure to demonstrate the strongest associations with measures of potentially traumatic events that occurred during military service and demonstrate weaker associations with both potentially traumatic events that occurred before and after military service and with other stressful events that happened before, during, or after military service. We also expected the DRRI-2 WE-SF to demonstrate strong criterion-related validity, with evidence of moderate associations with PTSD and smaller associations with other forms of psychopathology not explicitly linked to trauma exposure. In addition, we expected the DRRI-2 WE-SF to demonstrate high levels of classification accuracy, in that most participants who endorsed any item on the full measure would be captured by this shorter measure. Finally, we expected that completion of the DRRI-2 WE-SF would demonstrate a significant advantage in time conservation in comparison to the full measure.

Method

Participants and procedure.—This investigation utilized data collected for the Comparative Health Assessment Interview (CHAI) Research Study, which surveyed veterans identified from a stratified probability-based sampling frame of U.S. veterans who served in the military during OEF, OIF, and Operation New Dawn (OND). Veterans were identified from the U.S. Veterans Eligibility Trends and Statistics (USVETS) dataset, which includes information on all current and former military members. After obtaining IRB approval, data were collected in 2018 via an online survey or computer-assisted telephone interview. Study invitations were mailed to veterans, followed by two reminders. Consent was implied by return of a completed survey. The current study included all veterans who deployed to support OEF, OIF and/or OND and who were randomized to complete one of the key study measures (i.e., the full Warfare Exposure measure or the 9-item DRRI-2 WE-SF; N= 7141). Most participants in the final sample were male (65.4%) in their 40s (M = 41.5 years; SD = 10.1), White (65.7%), and non-Hispanic (89.0%). Most of the sample served in the Army (50.0%), followed by 21.7% in the Air Force, 18.6% in the Navy, 9.6% in the Marines, and 0.1% in the Coast Guard. The split between participants who had served as Active Duty (47.9%) versus National Guard or Reserves (52.1%) was approximately equal. During deployment, most participants were of an enlisted military rank (84.3%) compared to 15.7% officers.

All participants included in the current study were randomized into one of two conditions: those who received only the full Warfare Exposure measure (i.e., hereby referred to as the long form [LF]; $n = 3315$) and those who received only the 9-item DRRI-2 WE-SF [SF-standalone] ($n = 3826$). Because participants who received the LF necessarily responded to the nine items that comprise the SF (as the nine items included in the SF-standalone were drawn from the 30-item LF), we were able to compare SF-standalone scores to both scores on the LF and scores on just the nine short form items completed as part of the LF [SF-embedded]. Apart from the version of the Warfare Exposure measure received, both groups of participants completed an identical battery of self-report measures.

Measures.

Highly Stressful Events.: This measure, which was adapted for the larger study from the Life Stressors Checklist – Revised (LSC-R; Wolfe, Kimerling, Brown, Chrestman, & Levin 1997), included 11 items reflecting stressful, but non-traumatic, events (e.g., "Did you ever go to jail?"). For each item, participants indicated if they had experienced the event (0 = no; 1 = yes). If so, they were asked when the event had occurred: before military service, during military service, and/or after military service. Data from this measure were collapsed into three separate total scale scores: stressful events prior to the military; stressful events during the military; and stressful events after the military, with higher scores on each scale indicating more exposure to stressful events.

Potentially Traumatic Events.: This measure, which was adapted from the Life Events Checklist for *DSM-5* (LEC-5) – Extended (Weathers et al., 2018), included 22 items designed to capture potentially traumatic events (PTEs; e.g., "Was kidnapped, abducted, held hostage, or prisoner of war"). Like the Highly Stressful Events measure, all participants were first asked "Which of these have you ever experienced?" and responded on a dichotomous scale (0 = no; 1 = yes). If they endorsed exposure, they were asked whether the event occurred before, during, and/or after military service. Data from this measure were collapsed into three separate total scale scores: PTEs prior to the military; PTEs during the military; and PTEs after the military, with higher scores on each indicating more exposure to PTEs.

PCL for *DSM-5* (PCL-5).: The PCL-5 (Weathers et al., 2013) —the *DSM–5* revision of the PCL-M— is a 20-item, *DSM–5* correspondent self-report measure of PTSD. Participants rate how much they have been bothered by each symptom over the past month using a 5-point Likert scale ranging from 0 (*not at all*) to 4 (*extremely*). PCL-5 scores have demonstrated excellent psychometric properties across samples (e.g., Blevins, Weathers, Davis, Witte, & Domino, 2015; Bovin et al., 2016; Wortmann et al., 2016). For the present study, items were summed to a total score, with higher scores indicating greater PTSD symptom severity. Cronbach's alpha was .98.

Patient Health Questionnaire (PHQ-9).: The PHQ-9 (Kroenke, Spitzer, & Williams, 2001) is a nine-item, *DSM-IV*-correspondent self-report measure of current depression. Participants report how frequently each symptom has occurred within the past two weeks on a Likert scale from 0 (*not at all*) to 3 (*nearly every day*). The scale has demonstrated strong

psychometric properties (Kroenke et al., 2001). In the current study, items were summed to a total score; higher scores indicate greater depression severity. Cronbach's α was .92.

Generalized Anxiety Disorder Questionnaire (GAD-7).: The GAD-7 (Spitzer, Kroenke, Williams, & Löwe, 2006) is a seven-item, self-report measure of current GAD severity. Participants report how frequently each symptom has occurred within the past two weeks on a Likert scale from 0 (*not at all*) to 3 (*nearly every day*). The scale has demonstrated strong psychometric properties (Spitzer et al., 2006). In the current study, items were summed to a total score; higher scores indicate greater GAD severity. Cronbach's α was .94.

Alcohol Use Disorders Identification Test-Concise (AUDIT-C).: The AUDIT-C (Bush et al., 1998) – a modified version of the 10-item Alcohol Use Disorders Identification Test developed by the World Health Organization (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001) – is a brief (3-item), reliable, and valid measure (Bradley et al., 2003; Bradley et al., 2004) that performs well in detecting alcohol misuse disorders defined according the *DSM-5* criteria (Hagman, 2014). Each AUDIT-C question has five answer choices ranging from 0–4 points, such that the higher the score, the more likely it is that a person's drinking is affecting his or her safety. In the current study, we looked at severity of hazardous drinking in the past year, calculated by summing the three AUDIT-C items. Cronbach's α was .74.

Demographics and military service characteristics.: Participants self-reported information on their age, sex, ethnicity, and race as well as their military service characteristics (i.e., military branch, rank, and deployment component) via self-report.

Data analysis plan.—All analyses were conducted using IBM SPSS version 26. We began by testing whether the nine items retained in the DRRI-2 WE-SF in Study 1 were again responsible for explaining a large amount of variance from the full measure. We used the same approach taken in Study 1 with data from participants who were randomized to the LF condition (n = 3315). Specifically, we used stepwise regression, allowing item entry at the .5 level, with all 30-items of the full Warfare Exposure measure entered individually as the independent variables, and the full Warfare Exposure measure total score serving as the dependent variable.

Next, we calculated Cronbach's alpha for the LF, the SF-standalone, and the SF-embedded to examine if internal consistency was high across the measures, with scores evaluated using the same guidelines as reported in Study 1.

Consistent with Smith et al. (2000)'s guidance, we then examined whether the SF-standalone had adequate overlapping variance with the LF. Although a measure of overlap can be estimated by generating a simple correlation between the long and short forms (as we did in Study 1), this approach risks overestimating the association between the two forms. Smith et al. recommend this approach only for pilot testing. For a more robust estimate of correlation, Smith et al. recommend first calculating the short form and long form correlation using the following formula for each:

$$r(kk) = \frac{n(r[ij])}{1 + (n-1)r(ij)}$$

where n refers to the number of scale items, respectively, $r(ij)$is the average interitem correlation, and $r(kk)$ is the scale reliability. Once $r(kk)$ is calculated for each form, the two estimates can be multiplied to reflect a more accurate estimate of the correlation between the measures. While Smith et al. recommend using this approach with two independent administrations to the same sample, the current study utilized a more rigorous approach; we used independent samples (i.e., different participants completed the SF-standalone - from which we calculated our SF correlation, and the LF - from which we calculated our LF correlation). Correlation coefficients were evaluated using the same criteria we applied in Study 1.

We next examined the convergent and discriminant validity of the SF-standalone, SF-embedded, and LF by calculating correlations between these three scores, respectively, and the sum scores of highly stressful events and PTEs before, during, and after military service. Criterion-related validity was examined by calculating severity scores for the PCL-5, PHQ-9, GAD-7, and AUDIT-C by summing the associated scale items, and then calculating correlations between these and the SF-standalone, SF-embedded, and LF total scores. Correlation coefficients were evaluated using the same criteria described above.

In line with Smith et al. (2000)'s guidance that a short form measure should classify respondents as accurately as the original scale, we next examined the classification accuracy of the SF in comparison to the LF. Because this analysis required knowledge of which items on the SF and LF the same participants did/did not endorse, this analysis included only participants who received the LF; this allowed us to compare the SF-embedded to the LF. Participants who endorsed at least one item on the LF (score of > 1) were operationalized as those identified by the LF and participants who endorsed at least one item on the SF-embedded (score of > 1) were operationalized as those identified by the SF-embedded. Participants were then classified into one of four categories: (1) those who endorsed at least one of the nine items that make up the SF-embedded and at least one of the 21 items in the LF but not the SF-embedded; (2) those who endorsed just SF-embedded item(s); (3) those who endorsed just LF item(s) (i.e., did not endorse any of the SF-embedded items); and (4) those who did not endorse any items on the LF (neither the SF-embedded nor LF only items). Classification accuracy of the DRRI-2 WE-SF would be demonstrated if the percent of the sample classified into category 3 was small, as these participants represent those that are captured by the LF but not by the SF-embedded.

Finally, we tested whether the DRRI-2 WE-SF represented a lower time burden for participants when compared to the full measure. To do so, we examined the time taken by participants randomized to the SF-standalone to complete the 9-item measure to the time taken by participants randomized to LF to complete the full measure. Data for these analyses came from numerous time stamps programmed into the survey which enabled us to compute the mean average, median, minimum, maximum, and total time to complete per section. These data were available for both the online survey and the computer-assisted

telephone interview. Because the items included in the DRRI-2 WE-SF are not administered consecutively within the full measure, we could not examine the time taken to complete the SF-embedded. We calculated independent *t*-tests to compare the mean (in seconds) completion time of the SF-standalone to the LF.

Results

Before proceeding with our planned analyses, we conducted sensitivity analyses to determine if participants randomized to receive the LF differed significantly from those randomized to receive the SF-standalone. Participants assigned to the two groups did not differ in terms of reported exposure to highly stressful events before or after military service, reported exposure to PTEs before or after military service, PTSD severity scores, depression severity scores, GAD severity scores, or hazardous alcohol use severity scores (all *t*s < 1.77; all *p*s > .05). However, groups did differ on mean number of reported exposures to both highly stressful events (M = 1.70, SD = 1.47 versus M = 1.79, SD = 1.72) and PTEs (M = 3.68, SD = 2.90 versus M = 4.03, SD = 3.07) during the military, with the SF-standalone group reporting more exposure in both cases (both *t*s > 2.62; *p*s < .05).

Validating the DRRI-2 WE-SF items.—To determine whether the items chosen for the DRRI-2 WE-SF captured similar amounts of full Warfare Exposure measure variance demonstrated in Study 1 in a different sample, we re-ran the stepwise regression described in Study 1 with the participants who were randomized to receive the LF (n = 3315). Results indicated that the same nine items identified in Study 1, including the item retained for face validity, again explained 96% of the variance associated with the full measure.

Internal consistency.—Next, we examined the internal consistency of both the SF-standalone and SF-embedded in comparison to the LF. Results indicated that internal consistency for the SF-standalone (α = .91) was very good, and comparable to that of the LF (α = .95). The internal consistency of the SF-embedded (α = .88) was also very good.

Overlapping variance with the LF.—To evaluate the overlapping variance of the DRRI-2 WE-SF with the full measure, we first calculated the correlations of the SF-standalone and LF as described above, and then examined their correlation. Results indicated that the scale reliability of the SF-standalone and LF were both very high ($r(kk)$ = .92 and $r(kk)$ = .95, respectively), and the correlation of the two was high (r = .87), suggesting a high level of overlapping variance between the two measures.

Associations with other measures of stressful and traumatic events.—Associations between scores on the SF-standalone, the SF-embedded, and the LF are reported in Table 3. Consistent with expectations, scores on both the SF-standalone and SF-embedded demonstrated moderate associations with the scores on the measure of PTEs that occurred during the military (*r*s > .38), and low associations with both scores on measures of PTEs that occurred before and after military service (*r*s < .19) and scores on measures of stressful experiences that occurred before, during, and after military service (*r*s < .14). Scores on the LF were both comparably sized and demonstrated the same pattern of associations to both forms of the DRRI-2 WE-SF.

Associations with relevant mental health conditions.—As predicted, scores on both the SF-standalone and SF-embedded demonstrated the strongest associations with PTSD symptom severity scores (*r*s > .31), weaker associations with scores of depression and GAD severity (*r*s > .24), and the weakest associations with the scores of hazardous alcohol use (*r*s > .09). Scores on the LF were again comparably associated and followed the same pattern as those of the SF-standalone and SF-embedded (see Table 3).

Classification accuracy of the DRRI-2 WE-SF.—Classification analyses indicated that the 9-item measure correctly classified nearly 90% of the sample, including: participants who didn't endorse any items (16.3% of participants; *n* = 539); participants who only endorsed items on the 9-item SF-embedded (i.e., they did not endorse any of the other 21 LF items; 4.8%; *n* = 159); and participants who endorsed at least one of the SF-embedded items and at least one of the 21 items in the LF but not the SF (68.7%; *n* = 2276). Only 10.3% (*n* = 341) of participants were misclassified; these participants endorsed one or more of the 21 items on the LF but none of the SF-embedded items.

To further understand the 341 participants were missed by the 9-item measure, we examined which items these participants did endorse (see Table 4). Results indicated that these participants tended to endorse more distal (e.g., Aftermath of Battle Scale item 1 "saw people beg for food"; *n* = 162; 47.5% of missed participants) as opposed to proximal (e.g., CES item 11 "injured in combat"; *n* = 0; 0.0% of missed participants) warfare exposures.

Time saved by using the 9-item DRRI-2 WE-SF.—Completion time for the SF-standalone was approximately 1.7 minutes, on average (*M* = 101.8 seconds; SD = 69.7 seconds; range 17.0–886.0 seconds) and was significantly shorter than the average 3.8-minute completion time for the LF (*M* =227.8 seconds; SD = 127.1 seconds; range 43.0–892.0 seconds; *t* = 50.5; *p* < .05). Of note, the SF-standalone was significantly shorter than the LF regardless of whether participation was via the online survey or the computer-assisted telephone interview (both *t*s > 39; both *p*s < .05).

Discussion

Study 2 served to further validate the 9-item Deployment Risk and Resilience Inventory-2 Warfare Exposure-Short Form (DRRI-2 WE-SF), by demonstrating that the composition of the measure continued to capture the same high percentage of variance of the full Warfare Exposure measure; that the reliability, validity, and classification accuracy of the new measure remained high and comparable to the full measure; and that the short form represents a significant reduction of time for completion in comparison to the full measure. Our results therefore indicate that the DRRI-2 WE-SF can be used as a robust short form measure of warfare exposure.

General Discussion

Our findings indicate that the DRRI-2 WE-SF is a reliable and valid short form of the full Warfare Exposures measure. Across both studies, the measure captured 96% of the variance associated with the full measure and demonstrated high levels of reliability, validity, and classification accuracy which were consistent with those of the full measure. Further, the

DRRI-2 WE-SF demonstrates a substantial decrease in completion time in comparison to the full measure.

The development of the DRRI-2 WE-SF represents an important addition to the literature because it is suited to settings where use of the full Warfare Exposure measure is not feasible due to time constraints. Specifically, the DRRI-2 WE-SF is ideal for use in settings where time is limited and/or the researcher or clinician is mainly interested in proximal warfare exposures. This would include both large-scale, population-based studies and busy clinical settings when assessment of this construct is needed but time is limited. In contrast, the full Warfare Exposure measure would be the best choice in situations where more time can be allotted to this assessment and capturing the full breadth of warfare exposures (i.e., both proximal and distal) is essential. For example, full clinical assessments, and studies aiming to tease apart how different types of warfare exposures may influence outcomes, would benefit most from using the longer version of the measure.

The DRRI-2 WE-SF, and our studies developing and testing the measure, are not without limitations. First, the DRRI-2 WE-SF is not intended to provide comprehensive coverage of the full continuum of warfare exposures an individual may encounter; by design, it is limited to those exposures that are most central to this concept. Our analyses suggest that the DRRI-2 WE-SF captures exposures that reflect more proximal warfare experiences that may be experienced by individuals in both combat arms and combat support roles, such as firing a weapon and seeing people who have died. Although this represents an expansion of other measures that primarily or only focus on combat exposure, the DRRI-2 WE-SF does not provide coverage of more distal warfare exposures that may also be troubling for some service members, such as observing civilians who have been displaced from their homes.

Second, in Study 2, the participants assigned to the SF-standalone condition reported significantly more exposure to both military-related PTEs and stressful experiences than those assigned to the LF condition, which may have impacted psychometric findings. However, these concerns are mitigated because the SF-embedded, completed by the participants randomized to the LF condition, demonstrated the same strong psychometric properties as the SF-standalone.

Third, although the DRRI-2 WE-SF captured a greater amount of variance in the full measure than many of the other potential short forms examined and provides coverage of aspects of combat and its associated aftermath that were judged to be central to the concept of warfare exposure, it is not the only combination of items that could be derived from the full measure for use as a short form. Other, even shorter variations could potentially be useful. Indeed, our stepwise regressions indicated that as few as three items captured 86% of the variance of the full measure and demonstrated similar associations with measures of post-military outcomes. Yet, there is a substantial literature on the challenges that can be introduced using very brief measures (e.g., Credé, Harms, Niehorster, & Gaye-Valentine, 2012), which influenced our decision to choose a 9-item short form rather than a much briefer version. This decision was also informed by a consideration of researchers' potential willingness to use a measure that they might perceive as failing to include key aspects of the targeted construct (e.g., "I was exposed to hostile incoming fire"), a non-psychometric

but very real consideration in developing new measures. Despite this, the field would benefit from future work exploring whether briefer versions of the measure could be useful in other settings or with additional populations (e.g., other veteran samples); and, if so, whether these briefer versions demonstrate the same strong psychometric properties as the 9-item short form tested here.

Fourth, both Study 1 and 2 included participants that were mostly White and non-Hispanic. Although this was fairly consistent with the larger U.S. military population at the time of data collection, it is possible that findings may not fully generalize to veterans who identify as racial and ethnic minorities. Current U.S. military trends suggest that members who identify as racial and ethnic minorities will continue to increase (e.g., National Center for Veterans Analysis and Statistics, 2018). Therefore, future work that validates the measure with a more diverse sample would be beneficial.

Finally, although we took several steps to ensure that the association between the DRRI-2 WE-SF and the full Warfare Exposure measure was not statistically inflated, confidence in the validity of our measure would be bolstered if we had the opportunity to compare it to another measure designed to capture proximal warfare experiences. To date, no measure of this kind exists, precluding this type of comparison. However, if such a measure were to be developed, we would encourage comparison of the DRRI-2 WE-SF to this measure to increase understanding of its validity.

In summary, our results support the strong psychometric properties of a 9-item short form measure designed to capture direct warfare exposures: the DRRI-2 WE-SF. Our findings suggest that this measure represents an important addition to the field, in that it maintains the high levels of reliability, validity, and classification accuracy of the larger measure while reducing completion time by more than half. These properties make the DRRI-2 WE-SF a useful tool for efficiently evaluating proximal warfare exposure in research and clinical practice among both individuals who have served in combat and non-combat roles.

Appendix

The Deployment Risk and Resilience Inventory-2 Warfare Exposure-Short Form (DRRI-2 WE-SF)

During deployment…	Never	Once or twice	Several times over entire deployment	A few times each month	A few times each week	Daily or almost daily
1. …I saw the bodies of dead enemy combatants.	1	2	3	4	5	6
2. …I encountered land or water mines, booby traps, or roadside bombs (for example, IEOs).	1	2	3	4	5	6
3. …I saw refugees who had lost their homes or belongings.	1	2	3	4	5	6
4. …I fired my weapon at enemy combatants.	1	2	3	4	5	6

During deployment…	Never	Once or twice	Several times over entire deployment	A few times each month	A few times each week	Daily or almost daily
5. …I saw civilians after they had been severely wounded or disfigured.	1	2	3	4	5	6
6. …I was involved in searching and/or disarming potential enemy combatants.	1	2	3	4	5	6
7. …I went on combat patrols or missions	1	2	3	4	5	6
8. …I personally witnessed someone from my unit or an ally unit being seriously wounded or killed.	1	2	3	4	5	6
9. …I was exposed to hostile incoming fire.	1	2	3	4	5	6

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Clinical Impact Statement:

The importance of measuring warfare experiences is well-recognized, as exposure to highly stressful warfare events can negatively impact veterans' health. Although two validated scales from the Deployment Risk and Resilience Inventory-2 [DRRI-2] together capture a broad swath of stressful warfare experiences, the length of this combined warfare exposure measure (30 items) is prohibitively long for many settings. The DRRI-2 Warfare Exposure Short Form (DRRI-2 WE-SF) is a nine-item measure that retains the strong properties of the full measure while significantly reducing completion time, making it efficient for assessing warfare exposures across all types of military personnel.

Table 1.

Application of Recommendations by Smith, McCarthy, & Anderson, 2000 to Avoid Common Sins of Short Form Development

Sin to Avoid	Was Sin Avoided?
1. Develop a Short Form of an Insufficiently Validated Measure	Yes – The Full Warfare Exposure measure has demonstrated strong psychometric properties
2. Fail to Show that the Short Form Measures Each Factor Scale Reliably	Yes – although we are not trying to preserve the factor structure, the scale demonstrates strong internal consistency reliability
3. Fail to Show that the Short Form Has Adequate Overlapping Variance with the Full Form, Using Independent Administrations	Yes – good reliability demonstrated and likely an underestimate of the actual reliability due to the use of two independent samples
4. Fail to Show that Each Factor in the Short Form has Validity on an Independent Sample	Yes – although we are not trying to preserve the factor structure, the scale demonstrates evidence of validity
5. Fail to Show that Classification Rates Remain High with the Short Form	Yes – correct classification of nearly 90% of the sample; those missed by the SF had more distal exposure to a warfare experience or circumstance
6. Fail to Show that the Short Form Offers Meaningful Time or Resource Saving for the Loss in Validity	Yes – the DRRI-2 WE-SF takes less than half the time to complete in comparison to the LF

Note. Only 6 of Smith et al.'s 9 sins were relevant to the current project (shown here). The remaining three were only relevant to multidimensional constructs, whereas we focused this investigation on what was common to the two scales under study.

Table 2.

Nine Short Form Scales Generated by Stepwise Regression of DRRI-2 Full Warfare Exposure Scale Items onto DRRI-2 Full Warfare Exposure Scale Total Score in Study 1

Model	Number/Names of Items in the Model in Order of Entry	Item Added to Model	R^2	Alpha	Correlation with Full Warfare Exposure Measure	Correlation with PCL-M
1	1 (AB8)	AB8: I saw the bodies of dead enemy combatants.	.62	---	.78	.36
2	2 (Model 1 + CE4)	CE4: I encountered land or water mines, booby traps, or roadside bombs (for example, IEOs).	.79	.56	.88	.44
3	3 (Model 2 + AB2)	AB2: I saw refugees who had lost their homes or belongings.	.86	.70	.91	.47
4	4 (Model 3 + CE12)	CE12: I fired my weapon at enemy combatants.	.89	.76	.93	.46
5	5 (Model 4 + AB5)	AB5: I saw civilians after they had been severely wounded or disfigured.	.92	.80	.95	.46
6	6 (Model 5 + CE17)	CE17: I was involved in searching and/or disarming potential enemy combatants.	.94	.82	.96	.46
7	7 (Model 6 + CE1)	CE1: I went on combat patrols or missions.	.95	.84	.96	.46
8	8 (Model 7 + CE3)	CE3: I personally witnessed someone from my unit or an ally unit being seriously wounded or killed.	.96	.86	.97	.47
9	**9 (Model 8 + CE5)**	**CE5: I was exposed to hostile incoming fire.**	**.96**	**.86**	**.97**	**.48**

Note. CE = Combat Experiences Scale; AB = Aftermath of Battle Scale. PCL-M = PTSD Checklist – Military Version. Bolded row represents the nine item DRRI-2 WE-SF.

Table 3.

Construct and Criterion-Related Validity of the DRRI-2 Warfare Exposure Short Form in Study 2.

	SF-Standalone (*n* = 3826)	LF (*n* = 3315)	SF-Embedded (*n* = 3315)
PTE pre-military[a]	.10	.12	.12
PTE military[a]	.42	.41	.39
PTE post-military[a]	.18	.20	.18
STR pre-military[a]	.09	.09	.09
STR military[a]	.09	.07	.05
STR post-military[a]	.13	.13	.12
PCL-5[b]	.32	.36	.34
PHQ-9[c]	.26	.28	.27
GAD-7[d]	.25	.28	.27
AUDIT-C[e]	.17	.11	.10

Note. PTE pre-military = potentially traumatic events experienced prior to entry into the military; PTE military = potentially traumatic events experienced during military service; PTE post-military = potentially traumatic events experienced after military discharge; STR pre-military = highly stressful events experienced prior to entry into the military; STR military = highly stressful events experienced during military service; STR post-military = highly stressful events experienced after military discharge; PCL-5 = PTSD Checklist for *DSM-5*; PHQ-9 = nine item Patient Health Questionnaire; GAD-7 = seven item Generalized Anxiety Disorder Questionnaire; AUDIT-C = Alcohol Use Disorders Identification Test-Concise.

All significant at $p < .01$ level.

[a] no missing data ($N = 7141$)

[b] $n = 6234$

[c] $n = 6669$

[d] $n = 6907$

[e] $n = 6642$

Table 4.

Endorsement of items by participants not captured by the DRRI-2 WE-SF in Study 2.

LF (non-SF) Warfare item	n (%) endorsed (of the 341 participants)
CE2 Took part in an assault	12 (3.5%)
CE6 Exposed to “friendly” fire	7 (2.1%)
CE7 In a vehicle that was attacked	4 (1.2%)
CE8 Part of a unit that fired on enemies	**39 (11.4%)**
CE9 Witnessed enemy wounded/killed	10 (2.9%)
CE10 Witnessed civilians wounded/killed	4 (1.2%)
CE11 Injured in combat	0 (0%)
CE13 Wounded/killed someone	5 (1.5%)
CE14 Located/disarmed explosives	5 (1.5%)
CE15 Searched/cleared homes/buildings	5 (1.5%)
CE16 Hand-to-hand combat	2 (.6%)
AB1 Saw people beg for food	**162 (47.5%)**
AB3 Saw homes destroyed	**51 (15%)**
AB4 Cared for injured/dying people	**34 (10%)**
AB6 Saw enemy after being wounded/disfigured	9 (2.6%)
AB7 Saw allies after being wounded/disfigured	**66 (19.4%)**
AB9 Saw bodies of dead allies	**36 (10.6%)**
AB10 Saw bodies of dead civilians	5 (1.5%)
AB11 Interacted with detainees/POWs	**46 (13.5%)**
AB12 Saw/smelled/heard dead/dying animals	27 (7.9%)
AB13 Handled human remains	29 (8.5%)

Note. CE = Combat Experiences Scale; AB = Aftermath of Battle Scale; LF = Full Warfare Exposure Scale; SF = Warfare Exposure-Short Form.

Bolded items represent those for which endorsement was ≥ 10%.