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Hyperarousal Symptoms Linger After Successful PTSD Treatment in Active Duty Military

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Objective: Evidence-based psychotherapies are efficacious at reducing posttraumatic stress disorder (PTSD) symptoms, but military and veteran samples improve less than civilians. The objective of this secondary analysis of two clinical trials of cognitive processing therapy (CPT) was to determine if hyperarousal symptoms were more resistant to change compared with other PTSD symptom clusters in active duty service members. ***Method:*** Service members completed the PTSD Checklist for the *DSM–5* (PCL-5) pre- and post-CPT. Symptoms were coded present if rated 2 (*moderate*) or higher on a 0–4 scale. Cutoffs for reliable and clinically significant change classified 21%, 18%, and 61% of participants as recovered, improved, and suboptimal responders, respectively. Data analyses focused on the post-treatment status of symptoms that were present at baseline to determine their persistence as a function of treatment outcome. Generalized linear mixed effects models with items treated as a repeated measure estimated the proportions who continued to endorse each symptom and compared hyperarousal

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The data reported in this article are from two randomized clinical trials (RCTs; Resick et al., 2015; Resick, Wachen, et al., 2017) and have been used in whole or part in 27 other manuscripts. Six manuscripts used Study 1 (Resick et al., 2015) baseline and posttreatment data: MS1 was the RCTs main outcomes. MS2 examined changes in suicidal ideation. MS3 examined changes in cognition over treatment. MS4 examines sleep disturbances. MS5 examines hazardous drinking. MS6 was a brain imaging study. Two articles used Study 1 (Resick et al., 2015) baseline data only: MS7 was a glucose metabolism brain imaging study. MS8 was a resting state neuroimaging study. Eight articles examine Study 2 (Resick, Monson, et al., 2017) baseline and posttreatment data: MS9 was the main outcomes paper. MS10 examined depression. MS11 examined predictors of treatment outcomes. MS12 examined timing of CPT sessions. MS13 examined hazardous drinking and CPT format. MS14 examined CPT in in those with

continued

symptoms with symptoms in other clusters. ***Results:*** Among improved participants, the average hyperarousal symptom was present in 69% compared with 49% for symptoms in other clusters ($p < .0001$). Among recovered patients, hyperarousal symptoms were present for 26%, while symptoms in the reexperiencing (2%), avoidance (3%), and negative alterations (4%) clusters were almost nonexistent ($p < .0001$). ***Conclusions:*** Even among service members who recovered from PTSD after CPT, a significant minority continue to report hyperarousal symptoms while other symptoms remit. Hyperarousal symptoms may require additional treatment.

Clinical Impact Statement

There are evidence-based psychotherapies (EBP) to help those with posttraumatic stress disorder (PTSD). Active duty service members respond differently to EBP than civilians. We examined if there were specific PTSD symptom clusters that were more likely to linger after cognitive processing therapy (CPT) in active duty service members who had served at least one combat deployment. Hyperarousal symptoms were more likely to persist than the other symptom clusters even in service members who responded optimally to CPT. Providers should be aware that hyperarousal symptoms may need treatment before or after CPT.

Keywords: posttraumatic stress disorder, service members, hyperarousal symptoms, cognitive processing therapy, evidence-based psychotherapies

Cognitive processing therapy (CPT; Resick, Monson, et al., 2017) is a first-line psychotherapy for posttraumatic stress disorder (PTSD; Institute of Medicine, 2008; U.S. Department of Veterans Affairs and U.S. Department of Defense, 2017). CPT putatively targets symptoms of PTSD by asking individuals to identify and challenge unrealistic cognitions that theoretically maintain symptoms. Efficacy trials of CPT have shown large pretreatment to posttreatment decreases in PTSD symptoms (d = 1.0–1.1; Resick, Wachen, et al., 2017; Resick et al., 2015). However, some have argued that service members and veterans are less responsive to evidence-based psychotherapies (EBP) for PTSD, such as CPT, compared with civilians (Dillon et al., 2019; Steenkamp & Litz, 2013; Steenkamp et al., 2020). Service members may not respond as well to EBP due to types and frequency of traumas experienced in combat resulting in more entrenched hyperarousal symptoms (e.g., exaggerated startle). Additionally, service members may also fail to distinguish between behaviors that were trained and adaptive in combat (e.g., vigilance) and behaviors that have become maladaptive in civilian environments (e.g., hypervigilance). Unfortunately, the majority of the literature that has examined how PTSD symptom clusters respond to EBP has studied civilians who experienced interpersonal traumas (Belleville et al., 2011; Galovski et al., 2009; Larsen et al., 2019). The goal of this secondary analysis of clinical trials data was to extend the previous literature and examine if hyperarousal symptoms were less responsive to CPT relative to symptoms from other clusters in active duty service members who had deployed for combat operations. Understanding which symptom clusters are more resistant to CPT can aid in expectation management for service members and assist providers in treatment planning.

The hyperarousal PTSD cluster includes irritability/aggression, impulsive behavior, hypervigilance, exaggerated startle, difficulties concentrating, and difficulties falling and/or staying asleep. Women who survived rape continued to report significant hyperarousal symptoms after completion of prolonged exposure (PE; Foa et al., 2007) and CPT with trauma account, that is, CPT+A (Larsen et al., 2019). For female service members and veterans who primarily experienced interpersonal trauma (sexual and physical assault) and completed PE, the magnitude of pretreatment to posttreatment

child abuse histories. MS15 examined sexual functioning. MS16 measured treatment fidelity. Four articles combined some or part of the samples from Study 1 (Resick et al., 2015) and Study 2 (Resick, Monson, et al., 2017). MS17 examined anger and aggression. MS18 examined blame. MS19 examined how support related to treatment outcomes. MS20 examined depression and treatment response. Seven articles combined Study 1 and Study 2 samples with other RCT samples, including psychometric analyses: MS21 examined psychometrics of PCL-5. MS22 identified trauma types in service members. MS23 examined psychometrics of Peritraumatic and Posttraumatic Emotions Questionnaires. MS24 examined dropout across three RCTs. MS25 examined predictors of change across multiple RCTs. MS26 examined changes in aggression across multiple RCTs. MS27 examined the Scale for Suicide Ideation.

Shannon R. Miles served as lead for conceptualization, methodology, writing – original draft, and writing – review & editing. Willie J. Hale served in a supporting role for conceptualization, formal analysis, and writing – original draft. Jim Mintz served as lead for formal analysis, contributed equally to conceptualization, and served in a supporting role for writing – original draft. Jennifer Schuster Wachen served in a supporting role for project administration and writing – original draft. Brett T. Litz served in a supporting role for formal analysis, investigation, methodology, supervision, and writing – review & editing. Katherine A. Dondanville served in a supporting role for investigation, project administration, and writing – review & editing. Jeffrey S. Yarvis served in a supporting role for investigation, project administration, and writing – review & editing. Elizabeth A. Hembree served in a supporting role for project administration and writing – review & editing. Stacey Young-McCaughan served in a supporting role for supervision and writing – review & editing. Alan L. Peterson served in a supporting role for resources, supervision, and writing – review & editing. Patricia A. Resick served as lead for funding acquisition, project administration, resources, and supervision and served in a supporting role for writing – review & editing.

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changes in hyperarousal (Cohen's $d = .62$) and reexperiencing ($d = .59$) were less than that of the avoidance ($d = .77$) and numbing ($d = .70$) symptom clusters (Schnurr & Lunney, 2015).

Studies that examined individual symptoms of PTSD, rather than symptom clusters, have produced similar results. Residual sleep difficulties (Belleville et al., 2011; Galovski et al., 2009; Pruiksma et al., 2016; Taylor et al., 2020) and aggression (Miles, Dillon, et al., 2020) often remain problematic for the majority of patients after successful completion of EBP for PTSD in civilian as well as military samples. In a group of female survivors of rape who completed CPT+A or PE, both EBP led to large decreases in symptoms (Larsen et al., 2019). However, at long-term follow-up, three of the five most common residual symptoms were from the hyperarousal cluster: hypervigilance (30% of the sample endorsed), exaggerated startle (31%), insomnia (34%), distress related to trauma reminders (34%), and inability to recall details of the trauma (40%; Larsen et al., 2019). Residual symptom was defined as having the symptom once or twice per week causing at least moderate distress (Weathers et al., 1999) as measured by the Clinician-Administered PTSD Scale (Blake et al., 1995).

By contrast, CPT+A equally reduced hyperarousal and the other clusters in civilian women who experienced interpersonal violence (Griffin et al., 2012) and rape (Nishith et al., 2002). Women who experienced rape and/or physical assault, completed CPT, and no longer met PTSD criteria had statistically significant reductions in startle reactions (eyeblink, heart rate, and skin conductance) in the laboratory. Participants who continued to meet criteria for PTSD after CPT did not have reduced startle (Griffin et al., 2012). The extant and sometimes inconsistent literature is still unclear if hyperarousal symptoms as an entire cluster remain elevated after CPT or if only select symptoms, such as sleep difficulties and irritability/aggression, account for this cluster remaining elevated.

Service members and veterans are a unique group and respond differently from civilians to EBP for PTSD (Dillon et al., 2019). One factor that may contribute to different treatment outcomes is the types and frequencies of traumas experienced by service members. Service members can experience trauma as civilians in addition to combat trauma involving death and/or injury of enemy combatants, civilians, comrades, or oneself (Tanielian & Jaycox, 2008). Moral injury from events that violate one's ethical beliefs can also occur during war (Griffin et al., 2019). The frequency and types of traumas experienced by service members may translate to more severe and entrenched hyperarousal symptoms that reflect unconditioned changes in biology, as can be seen with the exaggerated startle reflex (Maeng & Milad, 2017; Sherin & Nemeroff, 2011).

Another potential reason that service members and veterans respond differently to EBP for PTSD than civilians is that service members may be reluctant to reduce symptoms that are viewed as promoting survival. Military ethos and combat environments require vigilance and quick physical reaction to potential threats (Adler et al., 2017; Adler & Castro, 2013; Hall-Clark et al., 2019). Training emphasizes targeted aggression to threats and often disrupts normal sleep rhythms due to training and missions being conducted at night. These adaptive behaviors can become maladaptive in civilian environments or when they become too extreme and cross over into hypervigilance, impulsive aggression, or insomnia.

While CPT does not directly target hyperarousal symptoms, it does teach patients how to examine unrealistic and/or unhelpful thoughts that may be contributing to their hyperarousal symptoms. For example, challenging unrealistic safety beliefs can lead to reductions in avoidance that allow for the opportunity to learn that the situation is not dangerous and does not require hypervigilance. However, those who believe their safety cognition is helpful will continue to avoid the feared situation which maintains the symptoms. A similar situation can arise with irritability/aggression. If this behavior is viewed as promoting survival, then service members may be reluctant to test beliefs about it, resulting in stagnant unrealistic cognitions and less behavior change. Reductions in trauma-related cognitions often precede reductions in overall PTSD symptoms (Brown et al., 2019).

In order to extend the previous literature, we examined if the hyperarousal cluster is more resistant than other clusters to change after CPT in active-duty military personnel with PTSD. We hypothesized that the hyperarousal cluster would change the least. Additionally, it was possible that any changes in hyperarousal symptoms would depend on if the participants responded to CPT and reduced their overall PTSD symptoms, as seen in the civilian women who completed CPT (Griffin et al., 2012). Thus, we examined symptom changes for participants who did not respond to CPT (symptoms changed less than the reliable change index [RCI; Jacobson & Truax, 1991]), those who had a reliable change in symptoms (met RCI), and those who recovered from PTSD (exceed both the RCI and clinically significant change score [CSC]).

Method

Sample Participants

This study is a secondary analysis of two clinical trials of active duty military personnel who received either individual or group CPT ($N = 324$; Resick, Wachen, et al., 2017; Resick et al., 2015). Trial 1 compared group CPT with group present-centered therapy (Resick et al., 2015). Only the group CPT arm was examined in this study. Trial 2 compared group CPT with individual CPT (Resick, Wachen, et al., 2017); both groups were examined in this study. Details regarding these trials conducted by the South Texas Research Organizational Network Guiding Studies on Trauma and Resilience (STRONG STAR Consortium; http://www.STRONGSTAR.org) are described in detail elsewhere (Resick, Wachen, et al., 2017; Resick et al., 2015). As a brief overview, inclusion criteria for the trials were as follows: (a) experience of a Criterion A traumatic event during deployment (treatment could have focused on another Criterion A event); (b) PTSD diagnosis measured by the PTSD Symptom Scale—Interview (PSS-I: Foa et al., 1993); (c) taking psychotropic medications, on a stable dose for 6 weeks prior to study entry, and agreeing not to change medications during treatment; (d) support from unit commanders to engage in treatment; and (e) no engagement in other PTSD treatments during the study. Exclusion criteria were as follows: (a) current suicide or homicide risk meriting crisis intervention, (b) active psychosis, and (c) moderate to severe traumatic brain injury. Because our primary analyses involved examining posttreatment data, only those who provided posttreatment assessment data were included in the current study ($n = 204$; see Table 1).

Table 1
Demographic Characteristics

Characteristic	Mean (*SD*) or *N* (%)
Age	33.8 (7.2)
Male	187 (91.7%)
Married	147 (72.1%)
Ethnicity	
Black	50 (24.5%)
Hispanic	40 (19.6%)
White	93 (45.6%)
Other	21 (10.3%)
Education	
High school or less	56 (27.5%)
Some college/associate degree	133 (65.2%)
College/graduate degree	15 (7.4%)
Army	200 (98%)
Enlisted rank	197 (96.6%)
Months in military	134.0 (75.3)
Typical duty	
Combat arms	70 (34.3%)
Combat support	45 (22.1%)
Combat service support	89 (43.6%)
Number of deployments	
1	52 (25.5%)
2	73 (35.8%)
3	47 (23.0%)
4+	32 (15.7%)

Procedure

Trials were approved by institutional review boards at Brooke Army Medical Center, the University of Texas Health Science Center at San Antonio, VA Boston Health care System, and Duke University. Participants signed informed consent documents and completed diagnostic assessments and self-report measures. All measures were common data elements (Barnes et al., 2019) administered in clinical trials conducted as part of the STRONG STAR Consortium. Participants who met inclusion/exclusion criteria were randomized into the trials. CPT consisted of 12 sessions, delivered twice weekly for 6 weeks. Individual CPT sessions were 50–60 min, and group CPT sessions were 90 min. In order to reduce the risk of losing service members who were redeployed, discharged, or relocated, the posttreatment assessment was conducted 2 weeks after the final treatment session.

Instruments for Current Study

PTSD Symptoms

To determine study eligibility, PTSD symptoms were evaluated with the PSS-I (Foa et al., 1993). The PSS-I is a 17-item clinical interview that evaluates PTSD symptoms as defined in the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–IV*; American Psychiatric Association, 1994) on a frequency/severity scale of 0 to 3 (0 = *not at all*; 1 = *once per week or less/a little*; 2 = 2–4 *times per week/somewhat*; 3 = *5 or more times per week/very much*). One item was added that assessed if the symptom had been present for the past month in order to establish the time frame necessary for PTSD diagnosis.

When the trials were being conducted, the PTSD diagnostic criteria were being revised for the *DSM–5* (American Psychiatric Association, 2013). Thus, while eligibility diagnosis was made with the PSS-I, changes in PTSD symptoms were evaluated with a draft version of the PTSD Checklist for the *DSM–5* (PCL-5; Weathers et al., 2013). The draft version of the 20-item PCL-5 had nominal wording differences from the final PCL-5 and was validated in a military sample (Wortmann et al., 2016). There is a strong association between *DSM–IV* and *DSM–5* diagnostic criteria for PTSD, particularly when PTSD measures use minimum total severity scores (see Weathers et al., 2018 for scoring details). PCL-5 scoring is based on how much the individual is bothered by the symptoms during the past month on a scale from 0–4 (0 = *not at all*; 1 = *a little bit*; 2 = *moderately*; 3 = *quite a bit*; 4 = *extremely*).

Data Analysis

In order to examine subgroups of treatment responders, we used the two-step method (Jacobson & Truax, 1991) to determine whether individuals experienced reliable change (reliable change index [RCI]) and/or clinically significant change (CSC) in PCL-5 scores over the course of treatment. The RCI was calculated as (RCI = [posttreatment − pretreatment]/standard error of measurement of the outcome). The standard error was calculated using the baseline internal consistency of the PCL-5 as suggested by Martinovich et al. (1996). An RCI value that is a z score >1.96 (corresponding to a change score of 13 points in this study) reflects change that is statistically unlikely to be due to measurement error. For CSC, participants had to have posttreatment scores that were at least two standard deviations below the pretreatment mean of all randomized individuals (a score less than 20 in this sample), consistent with Jacobson and Truax (1991) empirical recommendation. CSC represents a low score that was unlikely to occur in a person seeking treatment. Together, the CSC and RCI values allow researchers to classify individuals into one of three treatment response categories: recovered (surpassed both CSC and RCI cutoffs in the positive direction), improved (passed the RCI but not the CSC, cutoff in the positive direction), or suboptimal (passed neither criterion).

Symptoms were designated as present if participants indicated that they were bothered by the symptom "moderately" or higher (PCL-5 scores $\geq$ 2 on a 0–4 scale). We used data from all 204 patients, but because our interest was in the persistence of existing symptoms and responsiveness to treatment, the final posttreatment analyses for each symptom were based only on participants who had the individual symptom at baseline (i.e., each symptom had a different number of people endorse it at baseline). We wanted to examine if the average proportion of endorsement for each cluster differed between clusters (reexperiencing, avoidance, negative alteration, and hyperarousal) for each treatment response group (recovered, improved, and suboptimal). We ran generalized linear mixed models for each individual PCL-5 symptom dichotomized as present or absent. The analyses were linear probability models, using an identity link function rather than logits to directly model proportions rather than log-odds. The results are typically similar to logistic models and have the advantages of permitting straightforward estimates of proportions, calculation of the differences in proportions rather than log odds, and estimation with zero cells (Von Hippel, 2015). The parent trials (Resick, Wachen, et al., 2017; Resick et al., 2015) demonstrated that while both individual and group CPT produced significant symptom reduction, individual CPT produced larger reductions. We repeated the analyses by separating those who had individual CPT from those who had group CPT. The pattern

Table 2
Pretreatment Prevalence of PCL-5 Symptoms in the Treatment Outcome Groups

	Recovered (n = 43)	Improved (n = 36)	Suboptimal (n = 125)
Intrusions	79%	92%	90%
Nightmares	56%	78%	70%
Flashbacks	33%	69%	45%
Emotional distress	81%	94%	77%
Physical reactivity	77%	89%	75%
REEXPERIENCING CLUSTER	65%	84%	71%
Avoid thoughts	81%	94%	79%
Avoid activities	79%	89%	90%
AVOIDANCE CLUSTER	80%	92%	84%
Inability to recall	30%	39%	37%
Negative cognitions	49%	69%	49%
Self/other blame	37%	58%	43%
Strong negative emotions	70%	81%	66%
Anhedonia	77%	83%	88%
Detachment	79%	86%	82%
Numbing	60%	81%	66%
NEGATIVE ALTERATIONS CLUSTER	57%	71%	62%
Irritability/aggression	84%	89%	78%
Impulsivity	12%	42%	13%
Hypervigilance	84%	97%	80%
Startled	67%	81%	78%
Difficulty concentrating	84%	92%	87%
Insomnia	93%	94%	95%
HYPERAROUSAL CLUSTER	71%	82%	72%

Note. Entries are the proportions of patients rating each PCL-5 symptom 2 (*moderate*) or higher. Figures in the highlighted rows are averages of the individual symptoms listed above in each cluster. PCL-5 = PTSD Checklist for *DSM-5*.

of lingering symptoms were not meaningfully different, thus the sample is reported together. Analyses were conducted using SAS 9.4.

Results

The combined sample with posttreatment data contained 204 mostly male (91.7%) active duty service members who were on average 34 years old. The majority (74.5%) were married or cohabiting, had attended at least some college (65.2%), and served in the Army at an enlisted rank (96.1%). Additional demographic and military characteristics can be found in Table 1.

Treatment Response Groups

The algorithm that used the RCI and CSC for classifying treatment outcomes resulted in the following groups: (a) 61.3% (n = 125) of the sample were considered suboptimal responders who did not meet the RCI criterion of improving 13 points or more; (b) 17.6% (n = 36) were classified as improved, having decreased their PCL-5 at least 13 points (RCI), but ending treatment with a posttreatment score of 20 or more (i.e., did not pass the CSC); (c) 21.1% (n = 43) were classified as recovered, having improved 13 or more points (RCI) and also with a PCL-5 total score less than 20 at posttreatment.

Table 2 presents the proportions in these three outcome categories endorsing each of the PCL-5 symptoms as "present" at baseline. The higher prevalence of symptoms at baseline in the Improved group is a result of the algorithm that rewards amount of improvement but penalizes those who fail to end treatment with a low total score (i.e., exceeding the CSC). Individuals with more baseline symptoms and thus higher baseline scores are more likely to end in the improved category even if they have considerable improvement.

Persistence of Symptoms

Table 3 presents the proportion of participants who had the symptom at baseline and continued to endorse each symptom at the end of treatment. In the suboptimal group, prevalence was high for most symptoms, and differences among the symptom clusters were not significant (F = .47, df = 3, 1715, p = .70). In contrast, the differences between clusters were significant in both the improved (F = 7.89, df = 3, 555, $p < .0001$) and recovered (F = 30.45, df = 3, 544, $p < .0001$) groups. For patients in the recovered and improved groups, hyperarousal symptoms were more likely to be present at the end of treatment than symptoms in any of the other clusters (both $p < .0001$). The omnibus tests of differences among the other three clusters were not significant in either the recovered (p = .50) or improved (p = .36) groups, meaning there were no statistical differences in the average proportion of the group that endorsed those clusters at posttreatment. Notably, only 2%–4% of the recovered group endorsed symptoms from the reexperiencing, avoidance, and negative alterations clusters.

Discussion

This study examined whether active duty service members had different reductions in symptoms across PTSD clusters after

Table 3
Posttreatment Prevalence of PCL-5 Symptoms in the Treatment Outcome Groups

	Recovered (n = 43)	Improved (n = 36)	Suboptimal (n = 125)
Intrusions	3%	42%	81%
Nightmares	0%	46%	84%
Flashbacks	0%	36%	75%
Emotional distress	3%	50%	86%
Physical reactivity	3%	53%	87%
REEXPERIENCING CLUSTER	2%	46%	83%
Avoid thoughts	3%	53%	82%
Avoid activities	3%	59%	83%
AVOIDANCE CLUSTER	3%	56%	82%
Inability to recall	0%	43%	63%
Negative cognitions	0%	40%	85%
Self/other blame	6%	33%	81%
Strong negative emotions	0%	38%	85%
Anhedonia	6%	70%	93%
Detachment	9%	55%	94%
Numbing	4%	66%	90%
NEGATIVE ALTERATIONS CLUSTER	4%	49%	85%
Irritability/aggression	25%	78%	92%
Impulsivity	0%	40%	56%
Hypervigilance	28%	74%	93%
Startled	28%	69%	86%
Difficulty concentrating	28%	76%	95%
Insomnia	45%	79%	92%
HYPERAROUSAL CLUSTER	26%	69%	86%

Note. Entries are the proportions of patients who continued to endorse each PCL-5 symptom 2 (*moderate*) or higher. Figures in the highlighted rows are averages of the individual symptoms listed above in each cluster. PCL-5 = PTSD Checklist for *DSM-5*.

completing CPT. The main outcome articles for the clinical trials demonstrated that the total samples saw reductions from pretreatment to posttreatment for all symptom clusters (Resick, Wachen, et al., 2017; Resick et al., 2015). Our study extends the previous literature by demonstrating PTSD symptoms did not uniformly decrease after CPT. Hyperarousal symptoms responded differently than the other clusters and were resistant to change even in patients who achieved optimal symptom reduction. Our findings are inconsistent with civilian samples who had roughly equal reductions across all symptom clusters (Griffin et al., 2012; Nishith et al., 2002).

The exaggerated startle response and difficulties concentrating may represent more biologically based symptoms (Maeng & Milad, 2017; Sherin & Nemeroff, 2011), which are less responsive to CPT in service members. Additionally, difficulties sleeping remained problematic for all of the treatment response groups, including the recovered group. Sleep problems that were once related to the trauma, swing shifts, or night missions as part of duty may develop into a separate disorder that needs additional treatment (Pruiksma et al., 2016; Taylor et al., 2020). Conversely, challenges with sleep may predate the trauma exposure and be a risk factor for subsequent development of PTSD (Cox et al., 2017; Koffel et al., 2013).

Importantly, service members are trained to be vigilant to threats and respond with targeted aggression (Adler et al., 2017; Adler & Castro, 2013; Hall-Clark et al., 2019). The high proportion of the sample who continued to endorse hypervigilance and irritability/aggression (even among participants who recovered) may reflect that service members believe hyperarousal is required for success in combat roles (Hall-Clark et al., 2019). This finding is consistent with a study that found nearly 50% of a sample of returning soldiers reported that anger was at least sometimes helpful in performing their occupational duties (Adler et al., 2017). Interestingly, when active duty service members transition to veteran status, they report irritability as one of the most common concerns when attempting to adjust to a civilian lifestyle (Sayer et al., 2010). The environment is an important consideration when treatment planning for those with PTSD. It may be helpful to provide education about how behaviors that were adaptive in combat (e.g., vigilance, targeted aggression) need to be adjusted when returning to a civilian environment, so that they do not become symptoms.

Our findings are important for both providers and service members. Knowing that hyperarousal symptoms may remain after a service member's successful course of CPT can provide realistic treatment expectations. The understanding that one's symptoms may decrease but not disappear after CPT may help service members feel less discouraged if they have residual symptoms. Providers can give education about treatment options that target individual symptoms that linger after CPT. For example, treatments that focus on reducing irritability/aggression or insomnia may be needed. Cognitive–behavioral therapy for anger is commonly offered to service members and veterans with aggression and produces small to moderate effect-size reductions in aggression (Morland et al., 2010). More recent research suggests that Strength at Home, a trauma-informed group treatment for veterans who have engaged in interpersonal violence based on the social information processing model (Taft et al., 2016), and emotion regulation treatments (Miles, Kent, et al., 2020) may also be useful in reducing irritability/aggression as both found moderate reductions in aggressive behaviors.

Cognitive–behavioral therapy for insomnia is the current gold standard for insomnia (Qaseem et al., 2016) and may be provided pre- or post-CPT (Taylor et al., 2021). Medications aimed at improving fragmented sleep, such as trazodone (which is often paired with prazosin for nightmares), may also be helpful for a subtype of service members with greater hyperarousal symptoms and high blood pressure (Bajor et al., 2011). Novel treatment approaches, such as meditation-based interventions, have demonstrated moderate reductions in hyperarousal symptoms as compared to supported psychotherapy (Crawford et al., 2019). Finally, recent research supports the use of variable-treatment lengths for CPT (Resick et al., 2021; Taylor et al., 2021). Varying treatment length rather than adhering to the 12-session model allowed 12% more patients to reach a good end state (i.e., PTSD Checklist for *DSM–5* $<$ 19). Reductions in each PTSD cluster were not individually examined.

Limitations of this study include the *DSM–5* being published during the conduct of the two trials. *DSM–IV* criteria were used for the diagnosis of PTSD and study eligibility. However, the PCL-5 was available and used to assess symptom change. Results may not generalize to civilian samples because previous studies have found that hyperarousal symptoms decrease as much as the other symptom clusters in female civilian rape victims who received CPT+A and responded to treatment (Nishith et al., 2002). Additionally, active duty service members may be at risk to deploy again and may want to retain high levels of hyperarousal symptoms. The possibility of deployments may impact generalizability of findings to veterans. A key difference between previous studies and the current one is how treatment responders were defined. We used the RCI and CSC while other studies defined change as no longer meeting diagnostic criteria for PTSD (Larsen et al., 2019; Nishith et al., 2002; Resick, Wachen, et al., 2017) or a PCL-5 reduction of at least 10 points (Resick et al., 2015).

Strengths of the study include the ability to combine and analyze data from two of the largest RCTs ever conducted testing CPT in active duty service members. Few exclusion criteria were used in the trials, making the sample more representative of all service members who seek treatment for PTSD. Gold-standard PTSD assessments for inclusion criteria and monitoring symptom change were used. In summary, this study demonstrates that PTSD symptoms do not uniformly decrease with CPT. There was substantial variation in how service members responded to the treatment. Creating subgroups allowed us to determine that hyperarousal symptoms are more resistant to CPT even among those who respond optimally to treatment. These symptoms may need additional treatment before or after CPT in military samples.

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