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Overcoming Adversity and Stress Injury Support (OASIS): Evaluation of Residential Treatment Outcomes for U.S. Service Members with Posttraumatic Stress Disorder

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Research on residential posttraumatic stress disorder (PTSD) treatment has predominantly focused on the U.S. veteran population, whereas limited research exists regarding active duty service members. The present study evaluated outcomes among service members who received treatment in the Department of Defense's only residential PTSD program, Overcoming Adversity and Stress Injury Support (OASIS). Over a 5-year period, 289 male service members with combat-related PTSD received treatment in the program. Service members completed an initial assessment and weekly PTSD and depression self-report measures during the 10-week program. Multilevel modeling results demonstrated statistically significant reductions in PTSD. On average, participants reported a 0.76-point reduction on the PTSD Checklist, $B = -0.76$, $p < .001$, for each additional week of treatment. Pretreatment symptom scores and fitness-for-duty status predicted PTSD symptoms across time. Weekly changes in depression symptoms were not statistically significant; however, a significant Time × Pretreatment Depression Severity interaction emerged. Service members with higher baseline levels of depression severity showed larger reductions in depression symptom severity than those with lower levels, $B = -0.02$, $p = .020$, although a sizeable minority continued to retain symptoms at diagnostic levels. Depression symptom change was not related to any other treatment- or service-related variables. Differing trajectories were found between service members whose symptoms improved over the course of residential treatment and those who did not. The results indicate that there were larger improvements in PTSD than depression symptoms and highlight the need to optimize care provision for service members with severe PTSD or comorbid symptoms.

The U.S. Department of Defense (DoD) has a great interest in preserving the psychological well-being of military service members, as mental health concerns not only affect service members and their families but also impact unit cohesion and operational readiness (Department of the Navy U.S. Marine Corps, 2010). As such, significant time and resources have been

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invested in psychological resilience initiatives; the mitigation of stigma; the prevention and early identification of maladaptive stress responses, such as posttraumatic stress disorder (PTSD; Institute of Medicine, 2014); and the treatment of combat-related problems. Despite these efforts, estimated rates of PTSD in active duty personnel range from 5.8% to 41.3% (Fulton et al., 2015), with increased prevalence among those who have been exposed to combat (Hoge et al., 2008; Vasterling et al., 2010) and deployed more than twice (Ramchand et al., 2015). The consequences of PTSD include an increased risk of suicidal ideation and mortality, poor physical health (Ramchand et al. 2015), impaired interpersonal and occupational functioning, reduced quality of life (Schnurr et al., 2009), and impaired work productivity and time-management (Adler et al., 2011).

Treatment for PTSD can occur on a care continuum that includes both outpatient and residential treatment. Specialized outpatient treatment is intended for veterans and service members with new-onset or severe PTSD, whereas residential treatment offers a more structured environment that allows veterans and service members with PTSD to address co-occurring psychological or substance use disorders and enhance coping skills while providing a higher level of care for those who did not respond to outpatient treatment (U.S. Department of Veterans Affairs [VA], 2017). Research has supported the notion that treatment needs may differ between individuals who need residential or outpatient treatment. Specifically, in a sample of veterans who received cognitive processing therapy (CPT; Resick et al., 2014) at a VA PTSD specialty clinic, those who received CPT in a residential treatment setting differed from those who received the treatment in an outpatient setting with regard to all demographic and pretreatment symptom variables, with veterans who received residential treatment reporting more severe symptoms on all assessment measures (Walter et al., 2014). Furthermore, the treatment outcome results indicated that PTSD and depression symptom scores significantly improved for veterans who received CPT in either a residential or outpatient treatment setting; however, veterans who received outpatient treatment consistently reported less symptom severity at both pre- and posttreatment.

Research investigating residential PTSD treatment outcomes has primarily focused on the U.S. veteran population. Meta-analytic findings of military or veteran inpatient and residential treatment have shown significantly reduced PTSD symptoms at posttreatment (i.e., $d = -0.73$), with PTSD symptoms assessed using the Clinician-Administered PTSD Scale (Blake et al., 1995) yielding the largest reduction (i.e., $d = 1.60$; Campbell et al., 2016). In addition, larger effects on PTSD symptom reduction have been noted in samples with a larger percentage of female participants as well as in more recently published studies. Studies have also demonstrated the effects of residential treatment on healthcare utilization. For example, Banducci and colleagues (2017) found that among 740 veterans in residential treatment, those with lower PTSD symptom scores at posttreatment sought fewer outpatient mental health visits. Furthermore, reductions in PTSD symptoms over the course of residential treatment were predictive of improved health-related outcomes 4 months following treatment (Sofko et al., 2016). Collectively, research has supported the need for different treatment settings for veterans and service members with PTSD, shown that PTSD symptom improvement often results following residential treatment, and highlighted that these symptom improvements, in turn, can lead to lower outpatient care utilization. However, it should also be recognized that significant symptoms may remain even after an individual receives residential PTSD treatment (e.g., Alvarez et al., 2011; Walter et al., 2014).

Limited PTSD residential treatment outcome data exist for active duty service members. In fact, the only published treatment outcome study conducted among active duty service members used data from an intensive outpatient program at the Warrior Combat Stress Reset Program (i.e., Reset) in Fort Hood, Texas. A retrospective review of patient outcomes from the Reset program found significant pre- to posttreatment symptom reductions in PTSD, anxiety, depression, and pain. Patients generally reported a high level of satisfaction with the program as well as high satisfaction with the complementary medicine components, including massage and reflexology (Libretto et al., 2015). However, the Reset program was discontinued in 2015 in favor of a new Army-wide treatment model. Thus, the Overcoming Adversity and Stress Injury Support (OASIS) program remains the only residential PTSD treatment program for active duty service members within the DoD.

The present study aimed to determine whether PTSD and related symptoms improved in active duty service members who received residential treatment in the OASIS program during the first 5 years of the program's operation (i.e., 2010–2015). More specifically, we examined pre- and posttreatment symptoms and functional impairment related to anxiety, sleep, disability, and response to stressful experiences along with symptoms of PTSD and depression, assessed weekly, among treatment participants. Determining the effects of the only DoD residential PTSD treatment program on psychological symptoms and functioning is critical for informing current treatment delivery and developing effective treatment programs for active duty service members with PTSD.

Method

Participants

The sample consisted of 304 male, active duty service members with a combat-related PTSD diagnosis who were referred and admitted to the OASIS Program at Naval Base Point Loma (San Diego, CA) between October 2010 and December 2015. During this time frame, there were 15 female active duty service members who were admitted to the OASIS program; however, these participants were removed from the study analyses due to concerns regarding power and representativeness. To be eligible for admission to the program, service members must have (a) PTSD diagnosed by a mental health provider;

(b) PTSD related to a traumatic event associated with combat or deployed operations that involved death or serious injury; (c) active duty status or be on active duty orders during treatment; (d) medical stability, including not being actively suicidal, homicidal, manic, or psychotic, or have an untreated substance use disorder; (e) independence in daily living, and (f) a military service termination date of at least 9 weeks after the OASIS admission date to ensure the patient remained on active duty through the full course of treatment before possible discharge from the military. Applicants who met the eligibility for the OASIS program were subjected to a final administrative review by program staff prior to admission to evaluate the compatibility between the applicant's treatment goals and the program. The OASIS program was developed and funded by U.S. Navy Medicine to treat Marines and sailors who served in combat operations in Iraq and/or Afghanistan; hence, the preponderance of the sample served in the Marine Corps and Navy. As the rate of referrals from these two branches decreased and awareness of the unique residential nature of OASIS increased within the Defense Health System, referrals from other services were admitted on a space-available basis.

Fifteen service members with missing data on weekly symptom measures were removed from the study, resulting in a final study sample of 289. On average, service members were between 20 and 56 years old ($M = 31.2$ years, $SD = 6.8$), married (67.0%), had completed high school (43.6%) or some college (43.9%), and identified as being non-Hispanic White (53.0%), followed by Hispanic/Latino (27.6%) and Black or African American (6.9%). Most service members served in the Marine Corps (66.4%) or Navy (21.7%) and were enlisted (94.7%). Approximately 30% of service members were classified as fit for duty at intake, whereas 52.0% were on light or limited duty (i.e., with duty restrictions), 14.8% were pending a physical evaluation, and 3.4% were not fit for duty.

Procedure

The OASIS program is in San Diego, CA and was founded in October 2010 as a residential treatment program for U.S. sailors and Marines with PTSD and expanded over time to include service members from all U.S. military branches. The program was 10 weeks in duration, with a new cohort of 10 service members admitted every 5 weeks (Sargeant et al., 2013) the size of which was intended to maintain a 5:1 patient-to-therapist ratio. The OASIS program utilized an integrative treatment approach that included evidence-based PTSD treatments, such as cognitive processing therapy (CPT), eye movement desensitization and reprocessing (EMDR; Shapiro, 1999), and prolonged exposure (PE; Foa et al., 2007), provided alongside evidence-supported complementary practices of acupuncture, nutritional supplementation, meditation, yoga, spiritual discussions, physical exercise, and art/music therapy (Sargeant et al., 2013). The first 2 weeks of the program were intended for assessment and rapport building, with trauma-focused treatment designed to start in Week 3. Evidence-based, trauma-focused individual psychotherapies (i.e., CPT, PE, EMDR) were standardly delivered during weekly, 1-hr sessions in Weeks 3–8; however, service members could request additional sessions. Service members received individual psychotherapy sessions from the same clinical psychologist for the duration of the program. All service members in the program, regardless of primary trauma-focused treatment modality, were expected to attend a weekly, 2–4 hr in vivo exposure group wherein patient cohorts were escorted by support staff to public spaces for desensitization.

In addition to evidence-based, trauma-focused psychotherapies, the OASIS program included weekly recreational therapy outings that were typically 2–4 hr in duration. Other program modalities, such as specialty treatment groups (e.g., moral injury, art therapy, yoga, pet-assisted therapy) and the complementary modalities mentioned previously, tended to be incorporated into the schedule in 1-hr increments. Participation in program activities was mandatory, with the potential for early discharge given repeated absences from prescribed and scheduled activities.

The OASIS treatment team consisted of a registered nurse or licensed clinical social worker who provided case management support (e.g., admission, pre- and posttreatment coordination with providers at primary duty stations); a clinical psychologist who delivered CPT, EMDR, PE (contingent upon the clinician's training) or tailored psychotherapy; a registered nurse who monitored and implemented pharmacological treatment; a psychiatrist who directed pharmacological treatment; and psychiatric technicians who supervised day-to-day participation in scheduled activities. A recreational therapist was also assigned to support group trips into the community and engagement in recreational activities, such as canine-assisted therapy, surf therapy (for further information, see Walter et al., 2019), and art. Study procedures related to analyzing OASIS clinic data were approved by the Naval Medical Center San Diego Institutional Review Board.

Measures

Descriptive Measures

As part of the OASIS program admission process, service members provided their demographic data, including age, race/ethnicity, education, and relationship and marital status. Service members also provided military data, including service branch, rank and pay grade, deployment history, and fitness-for-duty status (i.e., fit for duty, limited duty, not fit for duty, duty status pending decision following physical evaluation board). Treatment completion status (i.e., program completion vs. early discharge) was also examined. In general, early discharge was considered as a negative treatment outcome of the program. For example, early discharge could be that the service member, therapist, or both were in mutual agreement that treatment progress was improbable. Early discharges were also made for violation(s) of program rules, including missing curfew and substance use. The potential career impact of an early

discharge for noncompliance or violation of OASIS program rules could vary widely depending on the seriousness of the reason for discharge and the discretion of the service member's commanding officer. On the other hand, early discharges could be for nontreatment issues (e.g., family or relationship problems), emergent medical conditions, or other psychiatric comorbidities. Unfortunately, available study data do not provide a clear indication of the reasons for early discharges.

Combat Exposure

Combat experiences were assessed using the Combat Experiences and Aftermath of Battle subscales from the Deployment Risk and Resilience Inventory (DRRI; Vogt et al., 2005). The Combat Experiences measure consists of 15 items that assess exposure to combat experiences (e.g., firing a weapon; witnessing injury and death). The Aftermath of Battle measure contains 15 items used to evaluate exposure to postcombat experiences (e.g., interaction with prisoners of war, observing or handling remains). Responses to each item on both measures use a dichotomous (i.e., "yes" or "no") format, with affirmative responses summed to create a summary score for each measure and higher scores indicating a higher degree of exposure.

Weekly Symptom Measures

PTSD Symptoms. Participants' PTSD symptom severity was measured using the PTSD Checklist (PCL-M; Weathers et al., 1993). The PCL-M is an extensively used, 17-item self-report measure of PTSD symptomatology that corresponds to the diagnostic criteria in the fourth edition (text revision) of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–IV–TR*). Each item is rated on a 5-point scale ranging from 1 (*not at all*) to 5 (*extremely*). Item scores can be added to produce a total severity score or scored diagnostically; herein, a total severity score reflecting the sum of the 17 items was used. Scores can range from 17 to 85, with higher scores indicating a higher level of symptom severity. In the present study, Cronbach's alpha for the PCL-M was .85 at pretreatment and .93 at posttreatment.

Depressive Symptoms. Depression symptom severity was evaluated using the eight-item version of the Patient Health Questionnaire (PHQ-8; Kroenke et al., 2009). Participants were asked to rate the frequency with which they experienced each symptom during the past week, scoring responses on a 4-point scale ranging from 0 (*not at all*) to 3 (*nearly every day*). The PHQ-8 can be scored diagnostically, or responses can be summed to yield a total severity score; the PHQ-8 severity score was used in the current study. When using the PHQ-9 as a comparison, the PHQ-8 has been found to have high sensitivity (93.7%) and specificity (100%) in detecting depression (Wells et al., 2013). In the present study, Cronbach's alpha for the PHQ-8 was .79 at pretreatment and .82 at posttreatment.

Pre- and Posttreatment Outcome Measures

Service members completed the following assessments prior to initiating treatment and again immediately prior to being discharged from the OASIS program.

Anxiety. The presence and severity of self-reported anxiety symptoms in the past 2 weeks were determined using the seven-item General Anxiety Disorder scale (GAD-7; Spitzer et al., 2006). Respondents are asked to rate the frequency of their symptoms during the past 2 weeks, scoring items on a scale of 0 (*not at all*) to 3 (*nearly every day*), with higher scores reflecting more severe anxiety symptoms. In the present study, Cronbach's alpha for the GAD-7 was .79 at pretreatment and .90 at posttreatment.

Sleep Problems. Past-month sleep problems were assessed with the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989), a widely used self-report assessment of sleep. The PSQI consists of 19 questions used to evaluate sleep-related symptoms. The present study assessed three domains of sleep: subjective sleep quality, sleep duration, and insomnia symptoms. Sleep quality was assessed using a single item, "How would you rate your sleep quality overall?," with responses rated on a scale of 0 (*very good*) to 3 (*very bad*). Items were reverse-scored, with higher scores representing better subjective sleep quality. Sleep duration was measured using a single item, "How many hours of actual sleep do you get at night?" Finally, insomnia symptoms were calculated from two items, "How often have you had trouble sleeping because you [could not] get to sleep within 30 minutes?" and "How often have you had trouble sleeping because you wake up in the middle of the night or early morning?," with responses rated on a scale of 0 (*not during the past month*) to 3 (*three or more times/week*). Items were averaged, with higher scores representing a higher degree of insomnia symptoms.

Somatic Symptoms. Somatic symptoms were evaluated using the Patient Health Questionnaire–15 (PHQ-15; Kroenke et al., 2002). The 15-item scale asks respondents to rate the severity of each symptom on a scale of 0 (*not bothered at all*) to 2 (*bothered a lot*), with total scores ranging from 0 to 30 and higher scores suggesting more physical complaints. In the present study, Cronbach's alpha was .78 at pretreatment and .83 at posttreatment.

Disability and Functional Impairment. Disability and impairment were evaluated with the Sheehan Disability Scale (SDS; Sheehan, 2000), a 10-point visual analog scale consisting of work/school, social, and family life domains. Individuals are asked to rate disability and/or impairment in each of the three domains, scoring responses on a scale of 0 (*not at all*) to 10 (*extremely*). Scores can be summed into a single measure of global functional impairment, with higher scores indicating a higher level of impairment. Domain scores of 5 or more have been associated with significant functional impairment

(Sheehan, 2000). In the present study, Cronbach's alpha for the SDS was .74 at pretreatment and .86 at posttreatment.

Resilience. Resilience was measured using the Response to Stressful Experience Scale (RSES; Johnson et al., 2011), a 22-item assessment designed to measure how individuals respond to stress, adversity, and traumatic events. The RSES evaluates six factors, including positive appraisal, spirituality, active coping, self-efficacy, learning/meaning-making, and acceptance of limits. Items are scored on a 5-point Likert scale ranging from 0 (*not at all like me*) to 4 (*exactly like me*) and summed to a total score, with higher scores signifying greater levels of protective responses to stressful experiences. In the present study, Cronbach's alpha for the RSES was .91 at both pre- and posttreatment.

Data Analysis

We used IBM SPSS Statistics (Version 25.0) to generate descriptive statistics and determine the proportion of service members whose symptoms improved, worsened, or remained consistent over the course of treatment. In addition, in accordance with recommendations adapted from Wise (2004), we calculated the reliable change index (RCI) in concert with established thresholds to determine whether observed changes in PTSD and depression symptoms over time were due to chance. An RCI value of plus/minus 1.96 or higher combined with a PTSD symptom score change of 10 or more points on the PCL-M were considered indicative of both reliable and clinically significant change in PTSD symptoms (National Center for PTSD, n.d.), whereas a change of 5 points or more on the PHQ-8 met this threshold for depression symptoms (Kroenke, 2012).

Primary Outcomes

Multilevel modeling (MLM) using *Mplus* (Version 8.3; Muthén & Muthén, 2017) was used to explore weekly changes in PTSD and depression symptoms. Multilevel modeling account for nonindependence in service member outcomes when assessment weeks are nested within service members and allows for the simultaneous modeling of between- (Level 2) and within-person (Level 1) processes (Raudenbush & Bryk, 2002). Maximum likelihood estimation with robust standard errors was used to model outcomes with unbalanced or missing data. Treatment week was entered as the solitary Level 1 predictor and modeled as a random effect (Week 1 served as the intercept, coded as 0). All Level 2 variables were treated as fixed effects.

Consistent with recommendations (see Raudenbush & Bryk, 2002, pp. 256–278), we ran a preliminary, unconditional (null) model with no Level 1 or 2 predictors. The intraclass correlation coefficient (ICC) was .69 for PTSD symptoms and .63 for depression symptoms, indicating that 31% and 37% of the variability in symptoms was due to within-person factors. Next, we explored a main-effects model wherein treatment week was entered into the model with a random slope at Level 1 to examine the association between time of assessment and mental health symptoms. At Level 2, grand-mean centered age and pretreatment mental health symptoms (BASE), as well as dummy-coded treatment discharge (CMPLT) and medical board fitness for duty status (FIT), were entered simultaneously to examine person-level effects.

Finally, a conditional-effects model was run where continuous Level 2 moderators (i.e., age, pretreatment mental health symptoms) were grand-mean centered, and dummy-coded fitness-for-duty status was entered uncentered. Simple slopes were tested to probe interactions for significant moderation effects (Aiken & West, 1991). Equivalent models were evaluated at each step for PTSD and depression symptoms as outcomes.

Secondary Outcomes

Bivariate analyses in the form of paired-samples *t* tests assessed pre- to posttreatment differences in secondary health outcomes, specifically (a) generalized anxiety, (b) subjective sleep quality, (c) sleep duration, (d) insomnia symptoms, (e) somatic symptoms, (f) level of functional impairment, and (g) resilience. Next, a series of repeated-measures analyses of covariance (ANCOVAs) were run to adjust for age, dummy-coded treatment discharge, and fitness-for-duty status.

Results

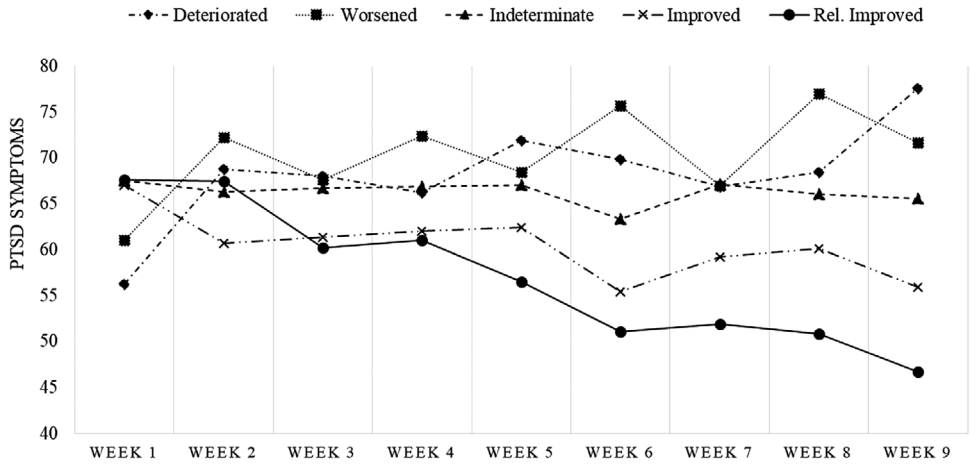
Descriptive Statistics

Service members reported high levels of combat exposure, endorsing more than 10 of the 15 items on the combat experiences scale ($M = 10.7$, $SD = 3.4$). The mean pretreatment PCL-M and PHQ-8 scores were 68.4 ($SD = 9.5$) and 17.6 ($SD = 4.5$), respectively. On average, service members completed between six and seven weekly assessments for PTSD and approximately six weekly assessments for depression. Overall, 83.7% of participants graduated from the OASIS program, whereas an additional 16.3% were discharged early. There were no significant differences between those who graduated and those who did not with regard to any of the pre- to posttreatment outcomes, *p*s = .157-.897.

Primary Outcomes

Figures 1 and 2 display the average weekly changes in PTSD and depression symptoms. Of participants who completed at least two weekly assessments, 186 (65.9%) reported decreased PTSD symptoms ($M_{\text{decrease}} = 11.8$, $SD = 9.1$) and 146 (51.8%) reported reduced depression symptoms ($M_{\text{decrease}} = 4.3$, $SD = 2.9$) across the treatment period, regardless of RCI or clinical significance. Within-group tests revealed that symptom improvements observed from pre- to posttreatment were medium for PTSD, $d = 0.50$, and small for depression, $d = 0.14$.

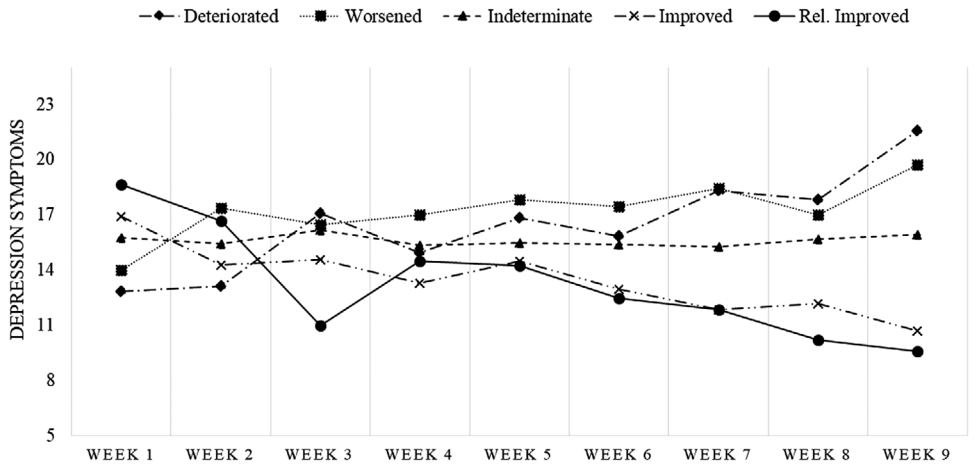
Figure 1
Average Weekly Changes in Posttraumatic Stress Disorder Symptoms



Note. "Reliably (rel.) improved" indicates having met the criteria for both the Reliable Change Index (RCI) and clinical significance (CS). "Improved" indicates having met the criteria for either the RCI or CS. "Indeterminate" indicates having met the criteria for neither the RCI nor the CS. "Worsened" indicates having met the criteria for the RCI or CS in a negative direction (i.e., increased symptoms). "Deteriorated" indicates having met the criteria for both the RCI and CS in a negative direction.

Based on the classification system adapted from Wise (2004), 23.8% of participants could be classified as "reliably improved," meaning they met the criteria for clinical significance and demonstrated an RCI score of 1.96 or higher with regard to PTSD symptom change. An additional 8.2% were classified as "improved", meaning they met one of these criteria, and 60.6% were classified as "indeterminate," meaning they met neither the RCI nor the clinical significance criteria. Moreover, 4.3% of the sample was categorized as having "worsened" over the course of the study, meaning they met the criteria for either the RCI or clinical significance in a negative direction (i.e., increased symptoms), and 3.2% were categorized as having "deteriorated," meaning they met the clinical significance criteria in a negative direction and demonstrated an RCI of -1.96 or lower at posttreatment. At the end of the treatment period, 87.6% of the sample still screened positive for PTSD, with 82.1% of those who reported reduced symptoms still screening positive (PCL-M score: $M = 55.94$, $SD = 13.19$). For depression symptoms, 9.6% of the participants who reported reduced symptoms were categorized as reliably improved and 10.3% as improved, whereas 67.4% were classified as indeterminate, 4.3% as worsened, and 8.5% as deteriorated.

Figure 2
Average Weekly Changes in Depression Symptoms



Note. "Reliably (rel.) improved" indicates having met the criteria for both the Reliable Change Index (RCI) and clinical significance (CS). "Improved" indicates having met the criteria for either the RCI or CS. "Indeterminate" indicates having met the criteria for neither the RCI nor the CS. "Worsened" indicates having met the criteria for the RCI or CS in a negative direction (i.e., increased symptoms). "Deteriorated" indicates having met the criteria for both the RCI and CS in a negative direction.

Table 1
Multilevel Model of Posttraumatic Stress Disorder (PTSD) and Depression Symptoms on Treatment Week

Variable	PTSD		Depression	
	B	*SE*	*B*	*SE*
Within-person effects				
Treatment week	−0.76*	0.35	−0.08	0.13
Between-person effects				
Full term[a]	0.29	1.44	0.26	0.63
Age	−0.01	0.07	−0.02	0.03
Fitness for duty[b]				
Full duty	−4.94*	2.16	−0.71	0.55
Limited duty	−4.86*	2.06	−0.15	0.54
Pending physical evaluation	−6.41**	2.22	−0.84	0.65
Baseline symptoms[c]	0.70***	0.06	0.51	0.05
Cross−level effects				
Full Term × Week[a]	−0.04	0.37	−0.05	0.13
Age × Week	−0.00	0.01	−0.00	0.01
Baseline × Week	0.00	0.01	−0.02*	0.01

Note.[a]Early discharge was the reference group. [b]Not fit for full duty was the reference group. [c]Baseline symptoms were continuous scores on the PTSD Checklist–Military Version and Patient Health Questionnaire–8 for PTSD and depression, respectively.
*p < .05. **p < .01. ***p < .001.

Multilevel Models

PTSD Symptoms. First, we tested a main-effects model to examine the linear effects of time (i.e., treatment week). There was a significant and negative effect of time for PTSD, $B = -0.80$, $p < .001$, suggesting that on average, for each additional week of treatment, service members reported a 0.80-point reduction in PCL scores. At the between-person level, on average, lower levels of pretreatment PTSD symptoms were associated with significantly lower levels of PTSD symptoms across the treatment period, $B = 0.70$, $p < .001$. In addition, relative to participants who were unfit for duty at pretreatment, service members who were either fit for duty, $B = -4.94$, $p = .022$; on limited duty, $B = -4.86$, $p = .018$; or whose duty status was pending a physical evaluation board, $B = -6.41$, $p = .004$, had significantly lower levels of PTSD symptoms across the treatment period. Treatment discharge status and age were not significantly associated with average PTSD symptom levels, *p*s = .820−.849.

When testing the conditional-effects model, the within-person slope for PTSD symptoms on treatment week remained statistically significant, $B = -0.76$, $p < .001$, suggesting that as the course of treatment progressed, service members reported significantly lower levels of PTSD symptoms (see Table 1). In addition, the main effects for pretreatment PTSD symptoms and dummy-coded fitness status remained statistically significant, *p*s < .001 – $p = .022$; however, no significant cross-level interactions were observed. Thus, changes in PTSD symptoms across the treatment period were not conditional with regard to age, level of pretreatment symptoms, or treatment discharge status.

Depression Symptoms. There was a significant and negative effect of time for depression symptoms, $B = -0.12$, $p = .001$, suggesting that on average, for each additional week of treatment, service members reported a 0.12-point reduction in PHQ-8 scores. At the between-person level, only pretreatment depression symptoms were associated with significantly lower depression symptoms across the treatment period. Unlike the main effect model, the within-person slope for major depression symptoms on treatment week was not statistically significant in the conditional effects model, $B = -0.08$, $p = .542$ (see Table 1). However, this association was qualified by a significant cross-level interaction with pretreatment symptoms, $B = -0.02$, $p = .020$. Simple slopes revealed that negative associations between depression symptoms and treatment week were stronger as pretreatment symptoms increased and were significantly different from 0 at low (i.e., minus 1 standard deviation), $B = -0.29$, $p = .005$; average, $B = -0.36$, $p = .006$; and high levels (i.e., plus 1 standard deviation) of pretreatment symptoms, $B = -0.43$, $p = .007$. Stated differently, participants with more severe pretreatment depression symptoms showed higher levels of improvement in their reported weekly depression symptoms. Treatment discharge status, age, and fitness-for-duty status were not significantly associated with the average level of depression symptoms, and no other cross-level interactions were observed, *p*s = .195−.776 .05.

Secondary Outcomes

The results of paired-samples *t* tests revealed several significant bivariate differences between pre- and posttreatment

Table 2
Descriptive Statistics and Bivariate Comparisons for Secondary Outcomes

	Pretreatment		Posttreatment			
Variable	*M*	*SD*	*M*	*SD*	t^a	*df*
Generalized anxiety	16.43	3.52	14.97	4.93	4.26^{***}	132
Sleep quality	0.75	0.92	0.99	0.95	-2.88^{**}	232
Sleep duration (hr)	4.40	1.34	5.24	1.33	-8.08^{***}	219
Insomnia symptoms	2.66	0.59	2.50	0.65	3.39^{**}	232
Functional Impairment	21.33	6.17	18.87	6.80	4.69^{***}	200
Somatic symptoms	14.04	4.91	14.80	4.90	−1.65	133
Resilience	42.02	16.36	44.07	17.08	-2.04^{*}	223

Note. [a]Paired samples t tests with pairwise deletion.
$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

secondary outcomes (see Table 2). Service members reported poor sleep quality at pretreatment, with approximately 82% of participants rating their sleep quality as "fairly bad" (31.1%) or "very bad" (50.5%). Sleep quality ratings were significantly higher at posttreatment relative to pretreatment, $p = .004$. Moreover, service members reported a significantly higher number of sleep hours ($M_{\text{pretreatment}} = 4.40$, $M_{\text{posttreatment}} = 5.24$), $p < .001$, and significantly fewer insomnia symptoms, $M_{\text{pretreatment}} = 2.66$, $M_{\text{posttreatment}} = 2.50$), $p = .001$, at posttreatment relative to pretreatment. Service members also reported significant improvements in general anxiety symptoms, as shown by GAD-7 scores ($M_{\text{pretreatment}} = 16.43$, $M_{\text{posttreatment}} = 14.97$), $p < .001$; resilience, as demonstrated by RSES scores ($M_{\text{pretreatment}} = 42.02$, $M_{\text{posttreatment}} = 44.07$), $p = .043$x; and functional impairment, as shown by SDS scores ($M_{\text{pretreatment}} = 21.33$, $M_{\text{posttreatment}} = 18.87$), $p < .001$. Bivariate comparisons did not reveal any significant differences in somatic symptoms, $p = .101$. When adjusting for age, treatment discharge status, and fitness-for-duty status, service members did not significantly differ from pre- to posttreatment on any secondary health outcomes.

Discussion

In the current study, we examined treatment outcomes for active duty service members receiving care in OASIS, the DoD's only residential PTSD treatment program for active duty service members. Overall, 32.0% of active duty service members in the OASIS program reported significant reductions in PTSD symptoms over the course of treatment, a finding similar to the 35.5% response rate for PTSD treatment demonstrated in a recent meta-analysis (Dewar et al., 2020). Each week of residential treatment was associated with an additional 0.76-point reduction on the PCL-M, and changes in PTSD symptoms during the OASIS program did not differ across demographic factors. Service members with higher pretreatment PTSD symptom levels and those deemed unfit for duty reported higher average PTSD symptom levels across treatment. Treatment discharge status and age were not associated with the average level of PTSD symptoms during treatment.

In addition, approximately 20% of service members in the OASIS program also reported significant decreases in depression symptoms over the course of treatment. However, this effect was conditional upon a service member's level of pretreatment depression symptoms such that service members with higher baseline depressive symptom severity demonstrated the largest reductions in PHQ-8 severity scores across treatment weeks. Treatment discharge status, age, and fitness-for-duty status were not associated with average levels of depressive symptom severity across time. Finally, bivariate analyses revealed significant improvements from pre- to posttreatment with regard to secondary outcomes (i.e., sleep, anxiety, and resilience). Although this finding suggests that targeted PTSD treatment may impact these variables, these changes were no longer significant once we accounted for demographic and service characteristics in the analyses or corrected for multiple comparisons.

Most service members in the OASIS program (60.6% and 67.4% for PTSD and depression outcomes, respectively) were in the indeterminate trajectory of treatment response, having neither reliable nor significant symptom improvement. However, when viewed from the aggregate, the average PCL-M score reduced by about 12 points across treatment, which is considered clinically significant and consistent with findings of active duty service members receiving group outpatient trauma-focused treatment (Resick et al., 2015). Although the effect sizes for PTSD symptom improvements were slightly smaller than those reported for individual outpatient PTSD treatment in samples of active duty service members (Cigrang et al., 2011; Resick et al., 2017), the overall findings are similar to those reported in studies of outpatient group trauma-focused treatment (Resick et al., 2015) and PTSD residential programs (Campbell et al., 2016), including a DoD residential program for active duty military (Libretto et al., 2015). In addition, approximately 20% of the service members in the OASIS program reported decreased symptoms of depression, with an average PHQ-8 score

reduction of 4 points, which is just below a level of clinical significance. These results add to the body of literature evaluating the effectiveness of psychological treatments for PTSD among service members (e.g., Monson et al., 2006; Powers et al., 2010; Resick et al., 2017).

Prior research has shown that elevated symptoms can remain after residential PTSD treatment (Alvarez et al., 2011; Walter et al., 2014), and in the present study, most service members in the OASIS program continued to have significant PTSD and depression symptoms following treatment, whereas others experienced a clinically significant worsening of symptoms (i.e., 7.5% and 12.8% for PTSD and depression symptoms, respectively). Evidence-based psychotherapies for PTSD are well established and the first line of care recommended; however, deficits in the effects of these approaches still exist. One of the most frequently encountered problems in PTSD treatment is retention (Schottenbauer et al., 2008), which was largely addressed in the current program given its residential nature. The low drop-out rate of the OASIS program is notable, and this high retention may be due to the association between military career or separation and treatment completion but is important given that it may have allowed for more robust treatment effects, as the analyses demonstrated that each additional week of treatment was related to added reductions in PTSD symptoms.

Moreover, the integrative nature of the OASIS program is intended to address PTSD from a more holistic standpoint rather than focusing on PTSD symptoms alone. In addition to CPT, EMDR, and PE, service members in the program have access to physical activities, yoga, acupuncture, and meditation as well as spiritual, family, and occupational therapies. This type of approach is important given extant literature that suggests that although PTSD symptoms may be reduced, other problems, such as those related to sleep, may persist following treatment (Gutner et al., 2013). Furthermore, these types of complementary interventions may be well-received and result in increased patient satisfaction (e.g., Libretto et al., 2015; Walter et al., 2019). Residential treatment programs could be well served to incorporate these types of complementary interventions in the hopes of improving satisfaction and possibly retention, which may, in turn, result in improvements to primary and secondary outcomes. However, it is also possible that the integration of other approaches could serve to detract from the potential impact of evidence-based PTSD treatments or reduce the time available for a sufficient dose to be delivered. Additional research is needed to determine not only whether complementary interventions augment or hinder the effects of evidence-based PTSD treatments but also whether they bolster effects; such research would allow clinicians to establish the optimal dose and identify which types of these interventions lead to the greatest benefit.

Furthermore, it may be important to consider additional evidence-based therapies for related problems. For example, sleep is often a significant problem for individuals with PTSD, which was shown for service members in the OASIS program as well. Behavioral sleep treatments, such as cognitive behavioral therapy for insomnia (CBT-I), have demonstrated efficacy for treating insomnia (Taylor & Pruiksma, 2014), and given that sleep problems may persist following PTSD treatment (Gutner et al., 2013), integrating treatments that directly target this problem may improve sleep and other associated problems, such as somatic symptoms. It should be noted that the OASIS program has incorporated CBT-I, but it was not commonly used during the time from which these study data were derived.

A finding warranting further attention is the evaluation of trajectories between service members whose symptoms improved following residential treatment and those whose symptoms remained consistent or worsened. A deviation in symptom scores appeared to emerge at Week 3, which is the beginning of the trauma-focused treatment phase. In Session 2, PTSD and depression severity scores were comparable between participants whose symptoms improved and those whose symptoms worsened over the course of residential treatment; however, the scores diverged at the third week. Specifically, at Week 3, individuals who worsened over time showed increased PTSD and depression severity scores, whereas those who improved over time demonstrated decreased scores. As residential treatment is costly and time-intensive, identifying responders and nonresponders earlier in treatment could be valuable for individuals who receive residential PTSD treatment and the staff who support these programs.

The present results should be viewed considering several limitations. As the OASIS program was designed for clinical care and not as a research study, the study involves a single-group design, and there are no patient-reported data available on clinical variables of interest following treatment completion. Thus, it is difficult to know whether improvements were maintained when service members returned to their daily lives. Posttreatment outcomes, such as promotions, legal infractions, and dishonorable discharges would provide important data but were not available for the current study. Some common comorbidities with PTSD, such as hazardous alcohol use and history of traumatic brain injury, were not uniformly assessed throughout the program, resulting in an inability to sufficiently explore their potential association with PTSD treatment response. In addition, study data did not provide the capacity to discern which trauma-focused treatment each patient received, the dose of treatments received and whether it was a sufficient dose, the fidelity with which the treatment adhered to the protocol, and the level of patient progress within a given treatment modality. Outcome data were also based solely on self-report measures, which are subject to inherent limitations and have been shown to yield smaller effect size changes in PTSD than clinician-administered measures following residential treatment among military samples (Campbell et al., 2016). The OASIS program used an integrative treatment approach; thus, the relative contribution of each treatment component to the study outcomes

cannot be ascertained. Although the focus of the current study was on active duty service members, it is possible that these results may not generalize to the civilian community. Similarly, the sample consisted of all men, who were primarily non-Hispanic, White, and had experienced combat trauma; thus, the results may not generalize to more ethnically diverse populations or those with other types of traumatic experiences, and treatment response may be attenuated compared to women receiving residential PTSD treatment (Campbell et al., 2016; Walter et al., 2014).

Despite these limitations, the study also had significant strengths. Many residential PTSD treatment outcome studies focus on veterans, whereas the current study contributes to the existing literature by providing outcomes among active duty service members. Data collected were obtained from a large sample of service members over a period of approximately five years. Furthermore, the data were longitudinal, with a potential of nine time points per participant. We utilized MLM for data analysis, which is optimally suited for longitudinal designs. The study also provides some support for the external validity and real-world utility of CPT, EMDR, and PE, as these treatments have well-established efficacy in the treatment of PTSD, but how they—and associated interventions—function in clinical and in military settings is less clear. Data from the OASIS program are from a real-world treatment setting and not from a clinical trial, so they provide preliminary evidence pertaining to the clinical utility of integrative residential treatment programs. Finally, the inclusion of secondary outcomes of interest adds to the current literature on residential PTSD treatment and offer a more comprehensive view of treatment outcomes instead of focusing solely on PTSD symptoms.

The results of the current study demonstrate that the OASIS program, the DoD's only residential PTSD treatment program for active duty service members, had high retention rates and effectively reduced PTSD and depression symptom severity for approximately 32% and 20% of service members in the program, respectively. Additionally, service members with higher levels of pretreatment depression demonstrated the largest reduction in depression symptoms over the course of the OASIS program. However, depression symptoms were less affected by residential treatment than PTSD symptoms. Although there were improvements in some secondary outcomes, after we controlled for other variables, these changes were not statistically significant. It is important to note that differing trajectories were found between service members whose symptoms improved and those whose symptoms worsened, providing an avenue toward identifying individuals who may be best suited to benefit from residential treatment. Collectively, these findings provide areas for improvement, such as the consideration for and assessment of relevant residential treatment outcomes, as well as through the incorporation and sufficient dosing of additional evidence-based therapies or complementary approaches, to evaluate and optimize improvements in severe PTSD symptoms and co-occurring conditions.

Open Practices Statement

Neither of the studies reported in this article was formally preregistered. Neither the data nor the materials have been made available on a permanent third-party archive; requests for the data or materials should be sent via email to the lead author at Kristen.h.walter.civ@mail.mil .

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