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Effects of PTSD and MDD Comorbidity on Psychological Changes during Surf Therapy Sessions for Active Duty Service Members

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broadly implemented. Dr. Glassman also has clinical expertise in the delivery of evidence-based psychological interventions for mood, anxiety, and trauma-related conditions. *Travis N. Ray*, received a Bachelor of Arts in psychology from Point Loma Nazarene University and a Master of Science in psychology from Oakland University. Travis currently is a Doctor of Philosophy student at Oakland University, concentrating in social and health psychology. His interests fall within two primary lines of research. The first examines masculinity and how it relates to violence and aggression. The second examines the interconnectedness between individuals and the natural environment, such as the psychological benefits of being in nature and predictors of pro-environmental behavior. Travis also works as a Research Associate at the Naval Health Research Center, where he assists with research examining military sexual assault, the interpersonal experiences of lesbian, gay, and bisexual military personnel, as well as the psychological effects of surfing. *Betty Michalewicz-Kragh*, Exercise Physiologist and Program Manager of the Surf Therapy Program at Naval Medical Center San Diego. As an exercise physiologist, she believes that people are better able to cope with life's challenges if they are active and spend ample time outdoors. Betty was a founder of the Surf Therapy Program and has provided surf therapy to wounded, ill, and injured service members for over 12 years. The program offers a holistic way to manage posttraumatic stress disorder, major depressive disorder, and other psychological and physical conditions. As part of her regular outdoor self-care, Betty spends time enjoying the beach with her family and friends, surfing, swimming, running, practicing yoga, and stand up paddle boarding with her dog, Fiji. *Cynthia J. Thomsen*, Research Psychologist at the Naval Health Research Center in San Diego, CA. For over twenty years, she has studied military stressors and their effects on service members' mental and behavioral health. Dr. Thomsen's research has focused on a range of adverse outcomes, including sexual, family, and workplace violence; suicidal behavior; impaired decision-making and performance; substance abuse; mental health problems such as PTSD and depression; and health disparities. In addition to research focused on identifying risk and protective factors for psychological health issues, Dr. Thomsen and her team also develop and test interventions to prevent service members from developing health problems and to mitigate existing problems.

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Abstract

Together, posttraumatic stress disorder (PTSD) and major depressive disorder (MDD) are debilitating and commonly comorbid; however, the effects of this comorbidity on psychological outcomes during exercise programs, such as surf therapy, have not been examined. This study compared changes in depression/anxiety and positive affect during surf therapy sessions between active duty service members with comorbid PTSD and MDD and those with either disorder alone. The study applied DSM-5 criteria to baseline self-report measures to assign probable disorder status, and used a longitudinal design involving repeated measurements to assess outcomes within 6 weekly sessions. Service members completed validated self-report questionnaires using the Patient Health Questionnaire-4 and the Positive Affect Schedule before and after each session. Within surf therapy sessions, both the comorbid and single disorder groups reported significant improvements in symptoms of depression/anxiety and positive affect. However, those with comorbid PTSD and MDD experienced significantly greater reductions in depression/anxiety (β = −1.22, p = .028) and significantly greater improvements in positive affect (β = 3.94, p = .046) compared with the single disorder group. Surf therapy appears to have global effects on psychological symptom reduction and may be a useful adjunctive intervention for the treatment of comorbid PTSD and MDD in both clinical and community health settings.

Posttraumatic stress disorder (PTSD), a psychiatric disorder that can result following exposure to a traumatic event, occurs among both civilian and military populations. Although estimates vary (Creamer, Wade, Fletcher, & Forbes, 2011; Sundin, Fear, Iversen, Rona, & Wessely, 2010), meta-analytic results estimate that 23% of U.S. service members serving during the conflicts in Iraq and Afghanistan have PTSD (Fulton et al., 2015). Unfortunately, more often than not, individuals with PTSD also have one or more other psychological disorders—most commonly, major depressive disorder (MDD). Approximately 50% of U.S. service members with PTSD also have a comorbid diagnosis of MDD (Walter, Levine, Highfill-McRoy, Navarro, & Thomsen, 2018). Compared to individuals with either disorder alone, those with this comorbidity exhibit more severe psychological symptoms (Gradus et al., 2010; Ikin, Creamer, Sim, & McKenzie, 2010; Lindley, Carlson, & Hill, 2014; Nixon, Resick, & Nishith, 2004; Shalev et al., 1998; Taft, Resick, Watkins, & Panuzio, 2009; Tural, Onder, & Aker, 2012), greater functional impairment (Blanchard, Buckley, Hickling, & Taylor, 1998), and a higher risk of suicide (Jakupcak et al., 2009; Panagioti, Gooding, & Tarrier, 2012). The high prevalence of this comorbidity, along with ensuing impairments, highlight the need for interventions that alleviate symptoms of comorbid PTSD and MDD and improve functioning.

Currently, the most efficacious treatments for PTSD are manualized, trauma-based psychotherapies (Foa, Keane, Friedman, & Cohen, 2008), and these are the primary treatments recommended by the

Departments of Veterans Affairs (VA) and Defense (DoD; VA, DoD, & Management of Posttraumatic Stress Disorder Work Group, 2017). Pharmacotherapy options, such as selective serotonin reuptake inhibitors, are also supported as treatment options for PTSD, albeit with weaker evidence for effectiveness or sustained improvements (Lee et al., 2016; Watts et al., 2013). For MDD, first-line treatments include several psychotherapies and pharmacotherapies that have shown effectiveness alone or in combination, depending on depression severity (VA, DoD, & Management of Major Depressive Disorder Working Group, 2016). Although effective evidence-based treatments for both PTSD and MDD are available, these interventions present limitations, such as varied individual response to treatment (Cipriani et al., 2009; Steenkamp, Litz, Hoge, & Marmar, 2015), limited accessibility (Sayer et al., 2009), patient dropout (Cooper & Conklin, 2015; Najavits, 2015), symptom relapse (Hollon, Thase, & Markowitz, 2002), negative stigma (Dickstein, Vogt, Handa, & Litz, 2010; Sharp et al., 2015), and side effects (Papakostas, 2008). Moreover, few treatments specifically address the comorbidity of PTSD and MDD (some exceptions include Nixon & Nearmy, 2011; Strachan, Gros, Ruggiero, Lejuez, & Acierno, 2012; Walter, Glassman, Hunt, Otis, & Thomsen, 2018), despite recommendations to develop integrated treatments to do so (Najavits et al., 2008). For these reasons, there is a critical need to identify alternative and adjunctive interventions to optimally treat comorbid PTSD and MDD.

Physical activity is one type of alternative intervention that has been shown to improve symptoms among individuals with either PTSD (Fetzner & Asmundson, 2015; Greer & Vin-Raviv, 2019; Hegberg, Hayes, & Hayes, 2019; Oppizzi & Umberger, 2018; Powers et al., 2015; Rosenbaum, Sherrington, & Tiedemann, 2015; Rosenbaum, Vancampfort, et al., 2015; Rosenbaum, Stubbs, Schuch, & Vancampfort, 2017) or MDD (Babyak et al., 2000; Craft & Landers, 1998; Mota-Pereira et al., 2011; Schuch et al., 2016; Silveira et al., 2013), suggesting that it may be an effective intervention option for those with both disorders. However, research examining the effects of exercise on psychological comorbidities is limited. The present study examines the effectiveness of one specific type of exercise-based intervention—surf therapy—for alleviating mental health symptoms among service members with comorbid PTSD and MDD.

Previous Research on Surf Therapy

Emerging evidence indicates that surf therapy may improve psychological symptoms among service members and veterans with PTSD or MDD. In a study of U.S. service members participating in a 6-week surf therapy program (as a largely adjunctive intervention), Walter and colleagues (2019) found clinically and statistically significant reductions in self-reported PTSD and depression symptoms from pre- to post-program. They also found significant reductions in anxiety and negative affect, and increases in positive affect. Notably, the magnitude of symptom change was greatest for service members with probable PTSD or probable MDD (based on self-report instruments) compared with the full sample. In addition to the changes from pre- to post-program, immediate changes in psychological outcomes were found during surf therapy sessions; that is, within each session, depression/anxiety symptoms lessened and positive affect improved. Importantly, the effect size for positive affect was the largest observed for any outcome, a critical finding given that emotional numbing and sad mood are impairing symptoms of PTSD and MDD that are often recalcitrant following otherwise successful treatment (Larsen, Fleming, & Resick, 2019; McClintock et al., 2011).

Additional studies have evaluated the benefits of surf therapy for symptoms of

PTSD and MDD among veterans, with similar results. Based on qualitative data, Caddick, Smith, and Phoenix (2015) found that surfing improved both PTSD symptoms and psychological well-being in U.K. veterans. In a quantitative study with analogous results, Rogers, Mallinson, and Peppers (2014) examined outcomes following a 5-week surf program among 14 U.S. veterans with PTSD, MDD, or both; levels of PTSD and depression symptoms were significantly lower after program completion. Likewise, in an evaluation of a surf program for U.S. veterans with PTSD, Crawford (2016) found that PTSD and depression symptoms decreased significantly from pre- to post-program and remained significantly reduced 30 days later. Collectively, these findings suggest that surf therapy may be an effective intervention for service members with comorbid PTSD and MDD.

Why Surf Therapy?

Although research broadly supports the utility of physical activity for mental health symptoms (Rosenbaum, Tiedemann, Sherrington, Curtis, & Ward, 2014; Stubbs et al., 2017), evidence suggests that beneficial effects of physical activity on psychological health may be enhanced under specific conditions. For example, benefits of physical activity appear to be enhanced if the activity occurs in a natural environment (Barton & Pretty, 2010; Bowler, Buyung-Ali, Knight, & Pullin, 2010; Thompson Coon et al., 2011), especially one near water (Barton & Pretty, 2010). In military/veteran samples, exercise involving water sports (e.g., kayaking, sailing, fly-fishing) has been shown to produce improvements in several psychological outcomes, including symptoms of PTSD, depression, anxiety, and negative affect (Bennett, Piatt, & Van Puymbroeck, 2017; Gelkopf, Hasson-Ohayon, Bikman, & Kravetz, 2013; Lundberg, Bennett, & Smith, 2011; Scherer, Gade, & Yancosek, 2013). The fact that surf therapy occurs in a natural environment near water may enhance the positive impact of this type of intervention on psychological health.

Another factor that may make surf therapy particularly suited to addressing symptoms of PTSD and MDD is the fact that it can occur in a social setting involving interaction with others. Social interaction has consistently been shown to produce improvements in psychological health (Umberson & Montez, 2010). The importance of social support in surf therapy has been supported by Caddick and colleagues (2015), who found that U.K. veterans with PTSD participating in group-based surf therapy reported feeling connected to others through this experience, rather than experiencing social isolation. Other research also suggests that relationships developed around exercise, such as surf therapy, may create a sense of community based on shared experiences, and that this may increase the desire to develop social connections more generally (Carless, Peacock, McKenna, & Cooke, 2013). This sense of connection and community may be particularly beneficial for service members or veterans seeking reintegration or the restoration of a community such as that found in service (Caddick & Smith, 2017).

Another aspect of surf therapy that may contribute to alleviating symptoms of comorbid PTSD and MDD is mindfulness. Mindfulness—that is, awareness of the present moment—is a component of some existing treatments for PTSD or MDD (e.g., mindfulness-based cognitive therapy, acceptance and commitment therapy). Surf therapy may invoke mindfulness because it occurs in a unique environment that requires intense focus on one's immediate surroundings in order to navigate shifting waves. The focused attention required for surfing may provide a temporary reprieve from symptoms of comorbid PTSD and MDD. Based on qualitative interviews with U.K. veterans with PTSD, Caddick and colleagues (2015) found that the mindfulness needed for surfing provided a respite from traumatic

memories and psychological symptoms. Additionally, diversion from distressing symptoms may allow for the experience of positive emotions, which can be challenging for individuals with PTSD, MDD, or both. In sum, surf therapy offers the benefits associated with engaging in exercise in a natural, water-based setting, and can facilitate social connection and engender a state of mindfulness, thereby offering a respite from psychological symptoms. For these reasons, surf therapy may be a beneficial intervention for individuals with comorbid PTSD and MDD.

The current study extends prior surf therapy research (Walter et al., 2019) by comparing the benefits of surf therapy for improving psychological symptoms among active duty service members with probable comorbid PTSD and MDD (i.e., comorbid group) and those with either probable disorder alone (i.e., single disorder group). The effects of surf therapy are examined with respect to immediate changes in symptoms (depression/anxiety symptoms and positive affect) across each surf session attended. Previous research has demonstrated that, following surf therapy, symptoms of PTSD and MDD significantly decreased among military service members or veterans with PTSD, MDD, or both (Crawford, 2016; Rogers et al., 2014; Walter et al., 2019); however, no study to date has specifically evaluated the immediate psychological effects of surf therapy for those with both disorders, or compared their outcomes to the outcomes of individuals with either disorder alone. Given the high prevalence and detrimental consequences of comorbid PTSD and MDD, it is critical to explore and identify treatments and adjunctive interventions that might be optimally suited to address this comorbidity.

Methods

Participants

Data were drawn from a larger study (see Walter et al., 2019) that included U.S. active duty service members participating in a surf therapy program at Naval Medical Center San Diego (NMCSD). The study used broad inclusion criteria, excluding only those who had not received a medical clearance or who had previously participated in the surf therapy program. To be included in the current study, participants (N = 47) also must have met criteria for probable PTSD, probable MDD, or both (see *Measures*).

Procedure

Active duty military personnel seeking surf therapy as part of their standard medical care at NMCSD provided voluntary, written informed consent. Service members who did not wish to participate in the study received surf therapy as normal, but they did not complete study questionnaires and were not included in the sample. Consenting participants completed an initial pre-program self-report questionnaire, which included assessments of probable PTSD and probable MDD. In addition, before and after each surf therapy session, participants completed brief self-report questionnaires assessing depression/anxiety symptoms and positive affect. All study procedures were approved by the NMCSD Institutional Review Board.

Program

The surf therapy program is part of the Wounded, Ill, and Injured Wellness Program at NMCSD; it is an established program that incorporates therapeutic activities designed to rehabilitate service members suffering from physical or psychological impairments. The surf therapy program consists of 6 weekly sessions, each lasting three to four hours. Each cohort consists of roughly 20 patients, and sessions occur on a public beach in Southern California. Participants are provided with necessary equipment (e.g., wet suits, surfboards) and assigned a surf instructor, who typically works with them for

the duration of the program to achieve individually tailored goals (e.g., comfort in the water; paddling; standing up). Surf instructors are certified through the Armed Services Young Men's Christian Association and receive basic training in patient safety, mental health (e.g., behaviors/symptoms associated with PTSD and MDD), and program policies and procedures. Prior to each surf session, patients have the option of engaging in a beach yoga class. The program provided was the standard NMCSD surf therapy protocol; the only addition for purposes of the study was self-report assessments.

Measures

Pre-program survey. The pre-program survey assessed mental health symptoms (PTSD, depression, anxiety, and positive and negative affect), demographic and military characteristics, and concurrent treatment. These measures were used to characterize the sample and to categorize participants as having probable PTSD and/or probable MDD.

Probable PTSD. The PTSD Checklist for DSM-5 (PCL-5; Weathers, Litz, et al., 2013) assessed probable PTSD based on DSM-5 diagnostic criteria. This 20-item self-report measure asked respondents to indicate the extent to which they were bothered by each of the 20 symptoms over the past month (ranging from 0 [*not at all*] to 4 [*extremely*]). The PCL-5 also contains the extended version of the Life Events Checklist for DSM-5 (LEC-5; Weathers, Blake, et al., 2013), which assesses lifetime exposure to traumatic events. In accordance with DSM-5 criteria, participants were classified as having probable PTSD if they self-reported a Criterion A traumatic event on the LEC-5, and endorsed a score of 2 or higher (i.e., "moderately" to "extremely" bothersome) on at least one symptom in cluster B, one symptom in cluster C, two symptoms in cluster D, and two symptoms in cluster E. Symptom severity scores were also computed by summing responses to each symptom item. Internal consistency in the current sample was excellent ($\alpha = .92$).

Probable MDD. The 8-item Patient Health Questionnaire (PHQ-8; Kroenke, Strine, et al., 2009) was used to assess probable MDD in accordance with DSM-5 criteria. Respondents indicated how often they had been bothered by each of eight symptoms over the past 2 weeks, ranging from 0 (*not at all*) to 3 (*nearly every day*). Participants were classified as having probable MDD if they provided a rating of 2 or higher (i.e., "more than half the days" or "nearly every day") on (a) at least one item assessing loss of interest and/or feeling down or depressed, and (b) at least four of the remaining six items. Severity scores were computed by summing item responses ($\alpha = .83$).

Anxiety symptoms. Anxiety symptoms were assessed using the 7-item Generalized Anxiety Disorder scale (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006). Respondents rated the frequency with which they experienced each symptom in the past 2 weeks. Severity scores were computed by summing item responses ($\alpha = .86$).

Positive and negative affect. The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) was used to assess pre-program levels of positive and negative affect. The 20-item self-report instrument consists of 10 positive and 10 negative emotions; respondents rated how frequently they had experienced each emotion in the past several hours (ranging from 1 [*very slightly or not at all*] to 5 [*extremely*]). Responses were summed to create separate indices of positive and negative affect ($\alpha = .88$ and .85, respectively).

Within-session assessments. Before and after each surf therapy session, participants completed brief measures of depression/anxiety symptoms and positive affect. Data from these within-session

assessments were used for the main study analyses.

Depression and anxiety symptoms. The 4-item Patient Health Questionnaire (PHQ-4; Kroenke, Spitzer, Williams, & Lowe, 2009) assessed depression/anxiety symptoms. The PHQ-4 includes two depression items from the PHQ-8 and two anxiety items from the GAD-7. Participants rated how much they were currently bothered by each of the four items, ranging from 0 (*not at all*) to 3 (*extremely*). Item responses were summed to compute a total depression/anxiety score before and after each surf therapy session (α = .75 at the initial pre-session assessment).

Positive affect. The Positive Affect Schedule (PAS), a 10-item subscale of the PANAS (Watson et al., 1988), assessed positive affect at the pre- and post-session assessments. Scores were computed as described previously (α = .91 at the initial pre-session assessment).

Data Analysis

Analyses compared service members who met criteria for probable PTSD and MDD (*n* = 24) and those with a single disorder (either probable PTSD or probable MDD; *n* = 23) and were conducted using IBM SPSS Statistics 25. Initial analyses compared the individual and programmatic characteristics of service members in the comorbid and single disorder groups, using *t* tests for independent samples for continuous variables and chi-square tests of association or Fisher's exact tests (when expected cell counts were low) for categorical variables. Multilevel modeling (MLM) was used to determine whether benefits of surf therapy differed for service members with and without comorbidity. MLM is a flexible statistical approach that was selected because of its advantages over traditional repeated measures analyses, including the accommodation of nested data (e.g., repeated measurement of service members within group) and estimation approaches to address the missing data often present in outcome research. Separate two-level MLM models were run to examine changes in depression/anxiety symptoms and positive affect.

Results

Pre-Program Group Comparisons

Of the 47 service members in the study sample, 51% (*n* = 24) met criteria for both PTSD and MDD, and 49% (*n* = 23) met criteria for only one disorder (PTSD, *n* = 16; MDD, *n* = 7). Table 1 provides pre-program characteristics as well as program participation characteristics of participants in each group. The groups did not differ in demographic or military characteristics, the use of concurrent treatment, or the mean number of surf therapy sessions attended, although service members with comorbid disorders attended significantly fewer yoga sessions than those with a single disorder. Significant differences between the comorbid and single disorder groups were evident with respect to the severity of mental health symptoms at pre-program. Compared to service members with either disorder alone, those with comorbid PTSD and MDD endorsed significantly greater symptom severity of depression, PTSD, anxiety, and negative affect (see Table 1). Differences in pre-program levels of self-reported positive affect approached significance (*p* = .071).

Table 1

Pre-Program Sample Characteristics

Characteristic	Total sample (N = 47)	Comorbid PTSD and MDD (n = 24)	Either PTSD or MDD (n = 23)
	n (%)	n (%)	n (%)
Gender			
Male	26 (55.3)	12 (50.0)	14 (60.9)
Female	21 (44.7)	12 (50.0)	9 (39.1)
Service branch			
Navy	37 (78.7)	19 (79.2)	18 (78.3)
Marine Corps & Coast Guard	9 (19.1)	5 (20.8)	4 (17.4)
Rank[a]			
E1–E4	19 (40.4)	11 (45.8)	8 (34.8)
E5–E9	20 (42.5)	10 (41.7)	10 (43.4)
Officer	6 (12.8)	2 (8.3)	4 (17.4)
Concurrent treatment			
Any treatment	37 (78.7)	17 (70.8)	20 (87.0)
Psychiatry	14 (29.8)	5 (20.8)	9 (39.1)
Psychotherapy	23 (48.9)	12 (50.0)	11 (47.8)
Health and wellness	23 (48.9)	9 (37.5)	14 (60.9)
	M (SD)	M (SD)	M (SD)
Age, years	29.6 (8.4)	28.4 (6.6)	30.9 (10.0)
Sessions attended			
Surf therapy	4.4 (1.7)	4.6 (1.6)	4.3 (1.7)
Yoga	1.3 (1.7)	0.8 (1.4)*	1.9 (1.8)
Pre-program measures			
PHQ-8	15.0 (5.4)	18.4 (3.0)***	11.4 (5.0)
PCL-5	52.8 (15.3)	58.0 (12.2)*	47.3 (16.6)[b]
GAD-7	14.7 (5.0)	17.1 (2.9)**	12.3 (5.6)
PAS	23.1 (8.1)	21.0 (6.2)	25.3 (9.4)
NAS	28.3 (8.6)	31.3 (8.5)*	25.3 (7.8)

Note. PTSD = posttraumatic stress disorder; MDD = major depressive disorder; E = enlisted rank; PHQ-8 = 8-item Patient Health Questionnaire; PCL-5 = PTSD Checklist for DSM-5; DSM-5 = *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition; GAD-7 = 7-item Generalized Anxiety Disorder Scale; PAS = Positive Affect Schedule; NAS = Negative Affect Schedule. PTSD and MDD diagnoses were based on DSM-5 criteria applied to self-report measures, and are therefore probable. Marine Corps and Coast Guard categories were combined due to small cell size. Because concurrent treatment categories are not mutually exclusive, the sum across treatment categories is greater than 100%. For other columns, totals may not sum to sample numbers or percentages due to missing data. Asterisks indicate significant difference between comorbid and individual disorder groups.

[a]Rank variables could not be further combined in a meaningful way, and thus were not analyzed due to low cell count. [b]Pre-program scores of PTSD symptom severity were used to describe the entire sample, even though some service members in the single disorder group did not have PTSD, but rather MDD only (n = 7). *p < .05. **p < .01. ***p < .001.

Pre- to Post-Surf Session Analyses

In the first step of each MLM model, the intercept and random time slope were entered; time was coded as 0 (pre-session; intercept) and 1 (post-session). In the second step, between-subjects grouping variables were added to the model as fixed effects. These included comorbidity status (0 = single disorder, 1 = comorbid disorders), week of session (1–6), and number of yoga sessions attended (0–6). In the third step, two interactions were added to the model (time × comorbidity, time × week). Model specifications consisted of intercept as random, time as repeated (and linear), covariance structure as unstructured, and the estimation approach to account for missing data as restricted maximum likelihood. Continuous predictors were grand-mean centered.

Initial MLM models for both depression/anxiety and positive affect showed significant variation for time and intercept variables (*p*s < .001), allowing for additional variables to be added in ensuing steps. In the second step, the number of yoga sessions attended was not significantly associated with outcomes (*p*s = .697-.970), indicating that yoga attendance was unrelated to PHQ-4 and PAS scores. This variable was therefore dropped. The final models thus included the intercept, three main effects (time, comorbidity status, and week), and two interactions (time × comorbidity, time × week). Results from the final MLM models for both outcome variables are provided in Table 2. Mean scores on each of the outcome variables across and within sessions, separately for individuals in the comorbid and single disorder groups, are provided in Figure 1.

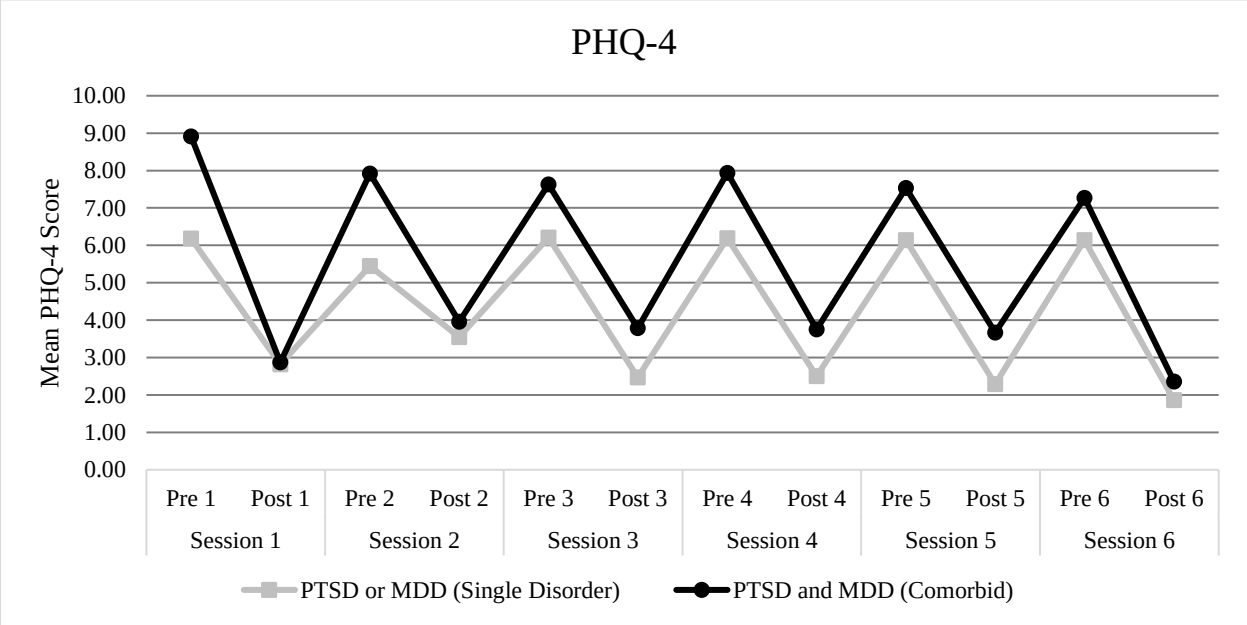
For both outcomes, a significant main effect of time indicated that across all participants, outcomes improved from pre- to post-session (*p*s < .001). That is, on average, depression/anxiety symptoms decreased from pre- to post-session, and positive affect increased. The main effect of comorbidity status was also significant for both outcomes, indicating that overall, participants with comorbid PTSD and MDD endorsed greater depression/anxiety (*p* < .001) and lower positive affect (*p* = .006) than those with a single disorder.

Table 2

Summary of Final Multilevel Analyses Examining PTSD and MDD Comorbidity Status on Pre- to Post-Session Change for Outcome Variables

Variable	PHQ-4	PAS
	β (*SE*)	
Intercept	9.21 (0.91)***	18.77 (3.10)***
Time (within session)	−3.19 (0.55)***	6.96 (1.79)***
Week of session	0.07 (0.21)	0.14 (0.63)
Comorbidity status	3.35 (0.94)***	−10.16 (3.50)**
Time × week of session	−0.06 (0.13)	0.26 (0.40)
Time × comorbidity status	−1.22 (0.54)*	3.94 (1.92)*

Note. PTSD = posttraumatic stress disorder; MDD = major depressive disorder; PHQ-4 = 4-item Patient Health Questionnaire; PAS = Positive Affect Schedule; DSM-5 = *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition. Probable PTSD and MDD diagnoses were based on DSM-5 diagnostic criteria applied to self-report measures. Comorbidity status refers to grouping variable for participants who met probable criteria for PTSD and MDD (coded as 1) and those who met criteria for either disorder alone (coded as 0).
*p < .05. **p < .01. ***p < .001.



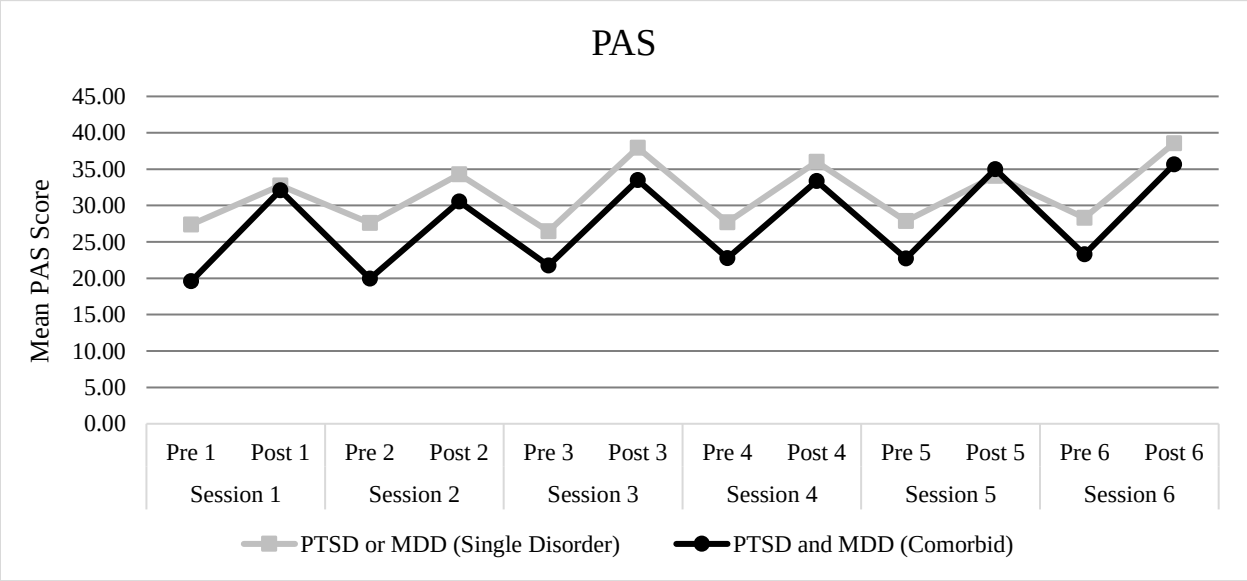


Figure 1. Means of pre- to post-session outcomes by comorbidity status. PHQ-4 = 4-item Patient Health Questionnaire; MDD = major depressive disorder; PAS = Positive Affect Schedule; PTSD = posttraumatic stress disorder.

Interactions. For both outcomes, the interaction between time and week was not significant (*p*s = .513-.665), suggesting that the degree of change within surf therapy sessions was consistent over the course of the six weekly sessions. However, the interaction between time and comorbidity status was statistically significant for both depression/anxiety and positive affect.

Depression/anxiety. For depression/anxiety, the interaction between time and comorbidity status was statistically significant (*p* = .028), reflecting the fact that participants in the comorbid group

experienced greater reductions in depression/anxiety symptoms over the course of surf therapy sessions than did those with a single disorder. Specifically, adjusting for other predictors, those with comorbid PTSD and MDD decreased by an average of 4.41 points, while those with either disorder decreased by an average of 3.19 points. Moreover, independent group *t* tests showed that the comorbid and single disorder groups had statistically different average pre-session PHQ-4 scores (M_{diff} = 2.12, $p < .001$), but the two groups did not differ on average post-session scores (M_{diff} = 1.01, p = .065). These results indicate differing average trajectories.

Positive affect. Patterns of change were similar for positive affect. A significant interaction of time by comorbidity status (p = .046) revealed that service members with comorbid conditions demonstrated greater average improvements in positive affect over surf therapy sessions than those with either disorder alone. In particular, when accounting for other predictors, service members with comorbid conditions increased their positive affect scores by an average of 10.90 points, compared with 6.96 points by those with either disorder alone. Similar to the findings for depression/anxiety, independent *t* tests revealed that the comorbid and single disorder groups had statistically different average PAS scores prior to participating in surf sessions (M_{diff} = 6.32, p = .012), but afterward they did not (M_{diff} = 1.79, p = .519), indicating differing trajectories of improvement.

Discussion

PTSD and MDD comorbidity is debilitating and highly prevalent among military, veteran, and civilian populations. Due to limitations in traditional treatment approaches, alternative and adjunctive interventions that reduce PTSD and MDD symptomology are critically needed. As an adjunctive treatment, surf therapy is an intervention that has been shown to improve the symptoms of each disorder alone. Results from this study suggest that individuals with probable PTSD or MDD experience improvements in depression/anxiety and positive affect following surf therapy sessions. However, individuals with comorbid PTSD and MDD demonstrated even greater improvements in depression/anxiety and positive affect following surf sessions when compared with individuals who had one of the two conditions.

These results echo findings reported in previous research among military/veteran populations with PTSD or MDD (Crawford, 2016; Rogers et al., 2014; Walter et al., 2019). Our findings add to the current body of literature by showing that surf therapy may be even more beneficial for individuals with both MDD and PTSD than for those with either disorder alone. Individuals with both conditions began each session, on average, with significantly higher depression and significantly lower positive affect scores compared with their single disorder counterparts, yet they improved more. Additionally, differences in average outcomes scores between groups were significant at pre-session but not at post-session. Considering little attention has been given to the relationship of psychological comorbidities and exercise therapy outcomes, there is currently no literature to contextualize these findings. Other comorbid outcomes research has investigated different treatments, measures, and time points (e.g., Green et al., 2006; Walter, Barnes, & Chard, 2012). Overall, changes in depression/anxiety and positive affect following surf therapy sessions appear to be more beneficial for those with comorbid PTSD and MDD than for those with either disorder alone, although more research is needed to confirm our findings.

There are various plausible explanations for the greater response to surf therapy sessions among individuals with comorbid PTSD and MDD. First, the effects of surf therapy may be

global in nature, and not specific to one disorder (e.g., trauma-focused treatment). By targeting multiple symptom types, surf therapy may produce greater changes among comorbid individuals by reducing symptoms of both PTSD and MDD. For example, surf therapy may be optimally suited to address comorbidities because it includes several factors that are beneficial to general psychological health, including social interaction, mindfulness, increased self-efficacy, and exercise in a natural environment (Caddick et al., 2015; Rogers et al., 2014; Thompson Coon, 2011). Second, greater improvements in depression/anxiety and positive affect among those with PTSD and MDD may be due to statistical artifacts such as regression to the mean or a floor effect. In other words, because the comorbid group began surf sessions with more extreme scores on both outcome measures, there is more room for possible improvement, and/or ensuing measurements are expected to fall closer to the population mean. However, this study used several techniques that are likely to reduce the influence of regression to the mean on results. For example, participants were not selected for the overall study based on pretreatment symptom scores, data were collected repeatedly for up to 12 time points per participant, and all measures used have strong psychometric properties, including among military samples; therefore, it may be less likely that current results are due to regression to the mean (Marsh & Hau, 2002).

Both depression/anxiety and affect results suggest that the benefits of surf therapy may be general in nature and not specific to one single disorder, which has important clinical implications for individuals with comorbid conditions. Oftentimes, psychological or psychiatric treatments are tailored for a particular disorder, rather than targeting co-occurring conditions or common non–disorder-specific symptoms (e.g., insomnia, anger). This could limit the benefit of these interventions for individuals with comorbid conditions. For those with both PTSD and MDD, surf therapy sessions appear to reduce negative symptoms associated with both disorders (like depression/anxiety), and also improve positive ones (like affect). As such, surf therapy may be particularly effective as an adjunctive treatment to address a range of symptoms that present with varying psychological disorders.

There are many benefits to using surf therapy. Surf therapy might be well suited for individuals who do not want to seek traditional treatment options for PTSD or MDD, or for those who prefer exercise-based therapies. First, interventions involving exercise may particularly appeal to military/veteran samples, as fitness is a fundamental component of military readiness (Chief of Naval Operations, 2011). Therefore, interventions that target both physical and mental health, such as surf therapy, may be especially useful for service members and veterans. Outside of military and veteran populations, this type of intervention may broadly appeal to individuals who value physical fitness and outdoor activity, as well as those in physically demanding occupations, such as firefighters or search and rescue personnel. Relatedly, interventions that address both physical and mental health, such as surf therapy, offer additional benefits in that they are likely to be less stigmatizing than traditional mental health treatments (e.g., psychotherapy; Caddick et al., 2015). This stigma can be a significant barrier to mental health care and utilization, especially among military/veteran populations (Blais & Renshaw, 2013; Greene-Shortridge, Britt, & Castro, 2007; Kulesza, Pedersen, Corrigan, & Marshall, 2015; Sayer et al., 2009; Sharp et al., 2015; Tanielian et al., 2008; Vogt, 2011). Lastly, adding surf therapy as a new therapeutic option for patients with PTSD and MDD broadens the range of treatment options available, which may enhance patient engagement and willingness to participate. Surf therapy thus offers theoretical promise for increasing use of

mental health therapies among multiple populations.

There are also a number of practical and behavioral limitations of surf therapy that must be considered. Generally, surfing is only feasible in select parts of the world with access to large bodies of water that generate waves, such as oceans, large lakes, and swift rivers. Moreover, equipment required to surf may be cost prohibitive (Wagner, Nelsen, & Walker, 2011). Thus, surfing may only be an alternative or adjunctive intervention for those with geographic or financial means to access this care. Behaviorally, avoidance and lack of motivation also present barriers to engagement in surf therapy. For example, activities like purchasing surf equipment, transportation to surfing locations, and motivation to exercise may be significant functional and behavioral challenges for individuals with PTSD and MDD. However, research suggests that if exercise is guided and progressive, it may be a viable adjunctive and well-tolerated form of treatment for those with mental illness (Cooney et al., 2013; Gourgouvelis, Yielder, Clarke, Behbahani, & Murphy, 2018; Richardson et al., 2005; Knapen, Vancampfort, Moriën, & Marchal, 2014; Stubbs et al., 2016; Vancampfort, Stubbs, Ward, Teasdale, & Rosenbaum, 2015). Therefore, where available, progressively phased and guided interventions that are integrated into care (such as the surf therapy program at NMCSD) may be the best approach for treatments utilizing surf therapy.

This study offers numerous strengths that contribute to the larger literature. More broadly, to our knowledge, this was the first outcomes study to analyze the effects of psychological comorbidity on an exercise intervention—and, importantly, an intervention that also occurred in a natural environment. This study was also unusual in its focus on the immediate effects of surf therapy—changes in symptoms from pre- to post-session—and how those varied by comorbidity status. This provides a more fine-grained view of changes within and across individual surf therapy sessions. Further, the study not only examined reductions in mental health symptoms of depression/anxiety, but also potential benefits for well-being with respect to positive affect. In addition, the study used a naturalistic design to observe standard care provided at NCMSD without manipulation of the subjects or existing program design. This allowed for broad inclusion criteria and increased generalizability of findings. Lastly, this work utilized validated psychological measures commonly used with military/veteran samples, and determined probable mental health diagnoses by applying DSM-5 criteria to self-report measures, rather than relying on patient self-reported medical diagnoses.

There are also several study limitations to consider despite promising findings. Our moderately small (N = 47) sample included active duty service members who were relatively young (mean age = 28 years); thus, generalizability may be limited, especially with respect to older individuals or nonmilitary populations. In addition, although DSM-5 criteria were used, diagnoses of PTSD and MDD were based on self-report measures, not “gold standard” clinician assessments; therefore, they should be considered “probable.” Relatedly, within-session outcomes were based on self-report measures, which have inherent limitations (e.g., social desirability, individual interpretation). The study also could not determine whether other comorbidities were present. Furthermore, the single disorder group consisted of service members with either PTSD or MDD; although it would be preferable to consider both single disorder groups separately, the small numbers of participants in these groups necessitated combining them for statistical power. Finally, symptom changes within surf sessions were examined for depression/anxiety (as well as positive affect), but not for PTSD. This was

done because of the lack of well-validated short measures of PTSD symptoms; still, it leaves a gap in our understanding of the immediate benefits of engaging in surf therapy for PTSD symptoms.

Future Directions

Research examining surf therapy is nascent but growing. To begin, future research studies should employ randomized controlled designs to increase study rigor and extend findings. They should also improve assessment techniques (including the use of multiple methods rather than exclusively relying self-report measures) to enhance validity and to confirm diagnoses. Based on the present findings, which suggest that surf therapy is more beneficial for individuals with comorbid PTSD and MDD than for those with either disorder alone, future work should examine whether surf therapy offers similar advantages to individuals with other comorbidities, including both psychological (e.g., depression/anxiety) and psychological–physical comorbidities (e.g., depression/metabolic syndrome). Additionally, research that includes sufficient numbers of participants with either disorder alone, as well as with both conditions, would yield more specific information about how treatment effects differ across these groups. Future research should also examine hypothesized mechanisms of change, such as social connectedness, mindfulness, and self-efficacy; further exploration of the factors associated with psychological benefits achieved during surf therapy would inform future intervention development and refinement. Lastly, surf therapy as a complementary intervention should be compared with surf therapy as a stand-alone treatment to determine treatment effectiveness.

Conclusions

Our results suggest that surf therapy may be an especially effective intervention to improve symptoms associated with comorbid PTSD and MDD. Participants with comorbid PTSD and MDD experienced significantly greater reductions in depression/anxiety during surf therapy sessions compared to those with either disorder alone. Comorbid participants also showed significantly greater improvements in positive affect, an often recalcitrant symptom following successful treatment of PTSD and MDD. Surf therapy appears to have global effects on symptom reduction, targeting nonspecific symptoms common to many disorders (e.g., affect). Given that symptom severity is typically worse in those with comorbid disorders, these findings suggest that surf therapy may be a useful adjunctive intervention for the treatment of comorbid PTSD and MDD in both clinical and community health settings. Considering the promising results of surf therapy for addressing psychological symptoms and affect among those with comorbid PTSD and MDD, additional research on environmentally based exercise interventions is greatly needed.

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