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ORIGINAL PAPER

The Body Scan and Mindful Breathing Among Veterans with PTSD: Type of Intervention Moderates the Relationship Between Changes in Mindfulness and Post-treatment Depression

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Abstract Mindfulness-based stress reduction (MBSR) is a promising intervention for veterans with post-traumatic stress disorder (PTSD) and depression; however, a more detailed examination of the different elements of MBSR and various facets of mindfulness to determine what works best for whom is warranted. One hundred and two veterans with PTSD were randomly assigned to one of four arms: (a) body scan (BS; n=27), (b) mindful breathing (MB; n=25), (c) slow breathing (SB; n=25), or (d) sitting quietly (SQ; n=25). The purpose of this study was to (a) examine two separate components of MBSR (i.e., body scan and mindful breathing) among veterans with PTSD when compared to a nonmindfulness intervention (SB) and a control group (SQ), (b) assess if changes in specific mindfulness facets were predictive of post-treatment PTSD and depression for individuals who participated in a mindfulness intervention (BS vs. MB), and (c) investigate if type of mindfulness intervention received would moderate the relationship between pre- to post-treatment changes in mindfulness facets and post-treatment outcomes in PTSD and depression. Participants in the mindfulness groups experienced significant decreases in PTSD and depression symptom severity and increases in mindfulness, whereas the nonmindfulness groups did not. Among veterans who participated in a mindfulness group, change in the five facets of mindfulness accounted for 23 % of unique variance in the prediction of post-treatment depression scores. Simple slope analyses revealed that type of mindfulness intervention moderated the relationship among changes in facets of mindfulness and post-treatment depression.

Keywords Mindfulness · Veterans · PTSD · Body scan · Mindful breathing

Introduction

Post-traumatic stress disorder (PTSD) is a serious and pervasive public health issue. The Management of Post-Traumatic Stress Working Group (2010) estimates that 3.5 % of the general population meets diagnostic criteria for PTSD, compared with estimates of 31 % of Vietnam veterans, 10 % of Gulf War veterans, 22 % of Operation Enduring Freedom (OEF) veterans, and 20 % of Operation Iraqi Freedom (OIF) veterans (Seal et al. 2009). Individuals with PTSD suffer debilitating symptoms, which often persist for decades. Clinical hallmarks include recurrent, intrusive recollections or re-experiencing of the traumatic event, avoidance of external or internal cues that can trigger re-experiencing, emotional numbing, and hyperarousal. Additional symptoms consist of distractibility, hypervigilance, irritability, or outbursts of anger, disruption of sleep patterns, and exaggerated startle response (DSM-5; American Psychiatric Association 2013). Moreover, individuals with PTSD often experience a host of related difficulties, including depression, suicide, discord in interpersonal relationships, impaired work abilities, increased risk of medical disorders, chronic pain, and substance abuse, all of which contribute to the substantial personal and societal cost of PTSD (Hoge et al. 2004; Institute of Medicine 2010; Kang and Bullman 2008; Marshall et al. 2005; McDevitt-Murphy et al. 2010; Possemato et al. 2010; Sharp 2004; Stevanovic et al. 2012).

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Some have estimated that PTSD has a greater effect on quality of life than most other mental illnesses (Davidson et al. 2004).

The Department of Veterans Administration (VA) and Department of Defense (DOD) practice guidelines endorse the use of empirically supported psychotherapeutic treatments for PTSD (Clinical Practice Guidelines for Management of Post-Traumatic Stress; Veteran Affairs and Department of Defense, 2010). These guidelines suggest that Stress Inoculation Therapy (SIT), Prolonged Exposure (PE), Cognitive Processing Therapy (CPT), and Eye Movement Desensitization and Reprocessing (EMDR) are the most effective treatments for PTSD. However, approximately half of the military personnel and veterans with a diagnosable PTSD do not seek treatment (Shiner 2011; Tanielian 2008). In a sample of nontreatment-seeking veterans diagnosed with PTSD, more than one third of participants reported that, although they were experiencing PTSD symptoms, they were not "emotionally ready" for treatment (Stecker et al. 2013). Of the veterans who do seek treatment, less than 30 % complete the intervention (Hoge et al. 2014; Seal et al. 2010), in part because many veterans have limited adaptive and coping skills and struggle to engage effectively in emotional and cognitive processing (Seal et al. 2010; Stecker et al. 2013). For those who do seek and complete empirically based treatments for PTSD, an estimated 30 to 60 % of individuals do not experience reduced symptoms (Bradley et al. 2005; Hoge et al. 2014). In response, the DOD's and VA's practice guidelines suggest that complementary and alternative medicines (CAMs) may facilitate more engagement in care and should be considered as a supplementary treatment for veterans with PTSD (Management of Post-Traumatic Stress Working Group 2010). One such modality gaining considerable attention is mindfulness.

Although there is still a lack of consensus regarding the conceptualization of mindfulness in the western scientific community, the commonly cited definition is "the awareness that emerges by way of paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment" (Kabat-Zinn 2002, p. 732). Cultivating an awareness of the present moment with an attitude of acceptance and curiosity alters the relationship and interaction with the distressing content, rather than changing the content itself. While employing nonjudgmental awareness, one is empowered to respond to the present moment experience rather than to habitually, and often unconsciously, react. This process allows for a larger behavioral repertoire and greater freedom when faced with internal and external stressors.

Mindfulness-based stress reduction (MBSR; Kabat-Zinn 1982) is a well-established mindfulness-based intervention (MBI) that is theoretically grounded in secularized Buddhist meditation practices, mind-body medicine, and the transactional model of stress, which suggests that people can be taught to manage their stress by adjusting their cognitive perspective and increasing their coping skills to build self-efficacy in handling external, stressful situations. The primary aims are to enhance attentional control and receptive awareness by focusing internally (on bodily sensations, breath, thoughts, emotions) and externally (on sights, sounds) in the present moment. To achieve these aims, MBSR includes an assortment of meditative techniques, including the body scan and mindful breathing.

The body scan meditation is a somatically oriented, attention-focusing practice designed to increase interoceptive awareness and acceptance (Dreeben et al. 2013). Practice of the body scan enhances the felt sense of being localized within one's physical body; references the lived, immediate experience of one's own body; and cultivates a subtle distinction between thinking about the body and perceiving the body (Mehling et al. 2008). During this practice, attention is directed sequentially throughout the body with the intention to cultivate nonjudgmental awareness of physical sensations, cognitions, and emotions (Kabat-Zinn et al. 1985). Sensations in each area are carefully observed with a particular consideration to simply perceive rather than think about or evaluate them. As the mind becomes distracted, attention is gently returned to the bodily sensations arising and dissolving within that moment.

In mindful breathing practice, the attention rests on the physical sensations associated with breathing. When the mind wanders to something other than the breath, the individual nonjudgmentally takes note of the thought, allows the thought to pass, and gently returns the focus to the sensations of breathing. Other practices included in MBSR are (a) mindful movements, in which individuals cultivate awareness of the body while it is moving, stretching, or holding a position; (b) open-focused sitting practice in which individuals focus attention on their breathing, sounds in the environment, bodily sensations, and their stream of thoughts and emotions; and (c) psychoeducation regarding the science of mindfulness and tools to integrate mindfulness into daily living.

Mindfulness has been theoretically linked to reductions in PTSD symptoms, as evidenced by a number of related benefits such as (a) increased willingness to tolerate distressing internal events and a subsequent reduction in experiential avoidance and thought suppression, (b) decreased physiological arousal, (c) improved emotion regulation, (d) greater ability to effectively allocate attention, (e) enhanced exposure and extinction processes, and (e) preparation for individuals to engage with the therapeutic process (Follette et al. 2006; Hölzel et al. 2011; Shapiro et al. 2006; Treanor 2011; Vujanovic et al. 2010). Additionally, several cross-sectional studies have documented an inverse relationship between facets of dispositional mindfulness and PTSD symptoms and comorbid depressive symptoms. Among college students, nonjudgmental acceptance negatively incrementally predicted PTSD avoidance symptoms, over and beyond experiential avoidance (Thompson and Waltz 2010), and nonreactivity to inner experience was associated with lower overall PTSD

symptoms and re-experiencing/hyperarousal (Sullivan-Kalill et al. 2013). Among traumatized adult samples, acting with awareness and nonjudgmental acceptance negatively predicted PTSD symptoms (Bernstein et al. 2011; Vujanovic et al. 2009). Lastly, Wahbeh et al. (2011) found that nonjudgmental acceptance was negatively correlated with re-experiencing, numbing-avoiding, and hyperarousal among military veterans with PTSD. Furthermore, a randomized controlled trial found that among the samples of 146 trauma-exposed veterans, mindful attention gains mediated treatment effects on reduced PTSD symptoms, reduced depression, and improved psychological well-being following an MBI (mantram repetition practice; Bormann et al. 2014).

Preliminary outcome studies have indicated that MBSR can assuage PTSD and depression symptoms in adults exposed to trauma (Kimbrough et al. 2010), including veterans (Kearney et al. 2013). In a randomized controlled trial, Kearney et al. (2013) compared treatment as usual (TAU) to MBSR plus TAU among 47 veterans with PTSD. Compared to individuals in the TAU group, at a 4-month follow-up, participants who completed MBSR reported improvements in mindfulness skills and significant improvements in mental health-related quality of life (HRQOL). Post hoc analysis indicated that significantly more veterans in the MBSR group had clinically meaningful change in both PTSD symptoms and HRQOL at the 4-month follow-up. Those individuals who completed at least four of the eight classes were more likely to report salutary changes in depression and functional status.

Although the evidence for using MBIs with veterans with PTSD is growing, MBIs are multifaceted and there is limited evidence to suggest which component(s) create positive clinical effects and for whom. Carmody and Baer (2008) found that time practicing the body scan was significantly related to increases in the mindfulness facets of observing and nonreactivity to inner experience, increases in psychological well-being, and decreases in interpersonal sensitivity and anxiety. Additionally, Feldman et al. (2010) reported that a mindful breathing practice was positively correlated with increased nonreactivity and decentering, which refers to the ability to view thoughts and emotions as impermanent and to tolerate aversive experience without engaging in rigid avoidance (Segal et al. 2002).

Recently, there has been increased interest in the relations among changes in facets of mindfulness and PTSD and depression outcomes among veterans receiving treatment for PTSD (Boden et al. 2012; Owens et al. 2012). Among veterans who received CPT and seven sessions of mindfulness training, Owens et al. (2012) found pre- to post-treatment increases in acting with awareness negatively predicted post-treatment self- and clinician-reported PTSD symptoms, and patients who improved in acting with awareness were less likely to have a diagnosis of major depressive disorder at post-treatment. Among military veterans receiving only cognitive behavioral treatment, Boden et al. (2012) found pre- to post-treatment increases in acting with awareness negatively predicted post-treatment PTSD severity and increases in nonjudgmental acceptance negatively predicted post-treatment depression. Additionally, Boden et al. suggested that treatment-related training in the use of specific mindfulness skills may change the functional relationship between mindfulness skills and treatment outcomes. Hence, it may be informative to explore relations among changes in facets of mindfulness and PTSD and depression outcomes among veterans receiving only a mindfulness intervention. Understanding this functional relationship may further enhance the clinical application of mindfulness for veterans with PTSD.

Therefore, the first aim of this study was to examine two separate components of MBSR (i.e., body scan and mindful breathing) among veterans with PTSD. We hypothesized that (a) body scan and mindful breathing would increase mindfulness and decrease depression and PTSD from pre- to post-intervention and (b), when compared to a nonmindfulness intervention (i.e., slow breathing) and a nonintervention control group (i.e., sitting quietly), the mindfulness interventions (i.e., body scan and mindful breathing) would significantly increase mindfulness and decrease depression and PTSD at post-intervention. The second aim was to assess the relationship between change in facets of mindfulness and treatment outcomes among veterans receiving a mindfulness intervention. We hypothesized that pre- to post-treatment change in mindfulness facets would predict post-treatment depression and PTSD outcomes for veterans who received the body scan or mindful breathing intervention. Additionally, an exploratory aim of the study was to assess if the mindfulness interventions (i.e., body scan or mindful breathing) would moderate the relationship between pre- to post-treatment change in mindfulness facets and post-treatment depression and PTSD outcomes.

Method

Participants

The sample consisted of 102 veterans (96 males and 6 females) diagnosed with chronic PTSD. The mean age for participants was 52 years (range=25–65; SD=12). Fifty-five percent of the veterans reported duty in the Vietnam War, 34 % in Operation Enduring Freedom (OEF) or Operation Iraqi Freedom (OIF), and 11 % in other conflicts. Seventy-seven percent identified as Caucasian, 2.6 % as African-American, 3.5 % as Native American, 1.8 % as Asian, 3.5 % as Hispanic, and 0.9 % identified as other. Sixty-six percent reported being married. Two percent of the participants reported fewer than 12 years of schooling, 47 % reported 12–14 years, 26 % reported 15–16 years, and 25 % reported more than 16 years of education.

Inclusion and exclusion criteria were chosen to permit generalizability without excessive heterogeneity in the study population. Participants were combat veterans (defined by a score of ≥7 on the Combat Exposure Scale; Lund et al. 1984) with a diagnosis of chronic PTSD, in good general medical health, and if prescribed medication, reported a consistent dose for stable medical conditions for the duration of the study. The Clinician-Administered PTSD Scale for DSM-IV (CAPS; Blake et al. 1995) confirmed PTSD diagnosis. The CAPS is considered the gold standard for diagnosing PTSD (McDonald and Calhoun 2010). Exclusion criteria included significant chronic medical illness, psychosis, bipolar disorder, cognitive disorder, current delirium, actively suicidal or homicidal, and substance dependence disorder within 3 months of the study. Self-reports of sexual assault as primary PTSD event(s) were considered exclusion criteria due to previous research suggesting that the type of exposure that elicits PTSD (i.e., sexual assault, combat, motor vehicle accident) can be associated with symptom variability. Plans to move from the area in the next year and prior or current meditation practice were also exclusion criteria.

Procedures

This study examined de-identified, archival data collected as part of a larger study conducted at the Department of Neurology, Oregon Health Science & University (OHSU), during May 2009 to April 2013. This parent study was approved by the OHSU IRB, and all participants signed informed consent. The purpose of the parent study was to characterize the mechanism of action of respiration versus mindfulness in people with PTSD and examine three potential physiological pathways of individual components of meditation (citation excluded to maintain anonymity). For the parent study, the researchers employed a randomized controlled trial design in which 102 veterans with chronic PTSD were assigned to one of four arms: (a) body scan (BS; n=27), (b) mindful breathing (MB; n=25), (c) slow breathing (SB; n=25), or (d) sitting quietly (SQ; n=25). The request to obtain this de-identified, archival data from the Department of Neurology of OHSU for further analyses was submitted and approved by both the OHSU's and Pacific University's institutional review boards.

Participants were randomly assigned to one of four groups: (a) BS meditation (n=27), (b) MB (n=25), (c) SB without mindfulness training (n=25), or (d) an SQ (n=25) control group. Participant allocation was determined with a covariate adaptive randomization approach (Pocock and Simon 1975) to help ensure that arms were matched on the important baseline characteristics and to reduce selection bias (Cai et al. 2006). Three baseline characteristics were used: age, gender, and depressive symptoms.

Each intervention was structured in order to maintain equipoise and reduce performance bias. Each group had equal training time and was trained by an unblinded research assistant. The groups met weekly in the laboratory (60-min sessions for six consecutive weeks). While in the laboratory, participants practiced the intervention for 20 min. Additional lab time was used to record resting respiration rates, discuss home practices, and provide psychoeducation regarding mindfulness (for mindfulness interventions only).

The BS intervention employed the body scan meditation, which is the first formal mindfulness technique introduced and practiced intensively in MBSR. A 20-min guided meditation was used to direct the participants' attention to different regions of the body, starting with the toes of the left foot and moving slowly upwards to the top of the head. Scanning was done in silence, stillness, and sitting upright. When the mind was distracted by thoughts or emotions, the participants were instructed to bring their attention back to the part of the body that was the focus of awareness. Nowhere in the script was attention directed to the breath or breathing process. To reduce any variability, recordings were used to ensure everyone in each group received exactly the same meditation each time.

The MB intervention employed another common component of MBSR, mindful breathing. Using a 20-min guided meditation, participants sat upright and attempted to focus attention on their breath as it passed through the opening of the nostrils or on the rising and falling of the abdomen or chest. Whenever attention wandered from the breath, participants were instructed to simply notice the distracting thought, let it pass, and return the attention to the breath. This process continued as a scripted meditation. Similar to the BS group, to reduce any variability, recordings were used to ensure everyone in each group received exactly the same meditation each time. Both groups received psychoeducation of mindfulness at each visit, and participants were given a tape or CD to guide them through the meditation for their daily home practice between sessions.

The SB participants were trained on a breathing device, RESPeRATE, designed to reduce respiratory rate. RESPeRATE consists of a respiration sensor, headphones, and a control box containing a microprocessor. The system registers the participant's breathing rate and pattern and personalizes a melody with two tones that corresponds to inspiration and expiration. These tones then gradually slowed down to a rate of less than 10 breaths per min. Participants practiced with RESPeRATE once a week, for 20 min, in the laboratory with the interventionist. Respiration was monitored and recorded continuously at all laboratory trainings to ensure that the participants were actually slowing their breath from their resting breath rate. The participants were given a RESPeRATE device for use at home and asked to practice daily between laboratory trainings. This group did not receive any mindfulness training.

The SQ control group sat quietly and listened to a neutral-content book on tape for 20 min to serve as a time and attention control at each laboratory session. Participants were also asked to sit quietly at home daily and read, listen to a book on tape, or watch TV. No other formal instructions were given about what to do other than to sit quietly. At the end of their participation in the study, SQ participants were given tapes of the mindfulness body scan and mindfulness breathing meditations.

Measures

The *Beck Depression Inventory-II* (BDI-II; Beck et al. 1996) is a widely used 21-item self-report instrument that measures depressive symptoms based on DSM-IV criteria. Higher scores are indicative of more frequent and intense symptoms. The BDI-II has demonstrated good internal consistency (α=0.92; present sample at baseline α=0.89) and test-retest reliability (r=0.93). It has also demonstrated evidence of content, construct, and factorial validity (Beck et al. 1996). The BDI-II was administered pre- and post-intervention. Using the Reliable Change Index (RCI; Jacobson et al. 1999; Jacobson and Traux 1991), sustainable change was indicated by a 4–6-point decrease and reliable change was indicated by a decrease of 7 points.

The *Five Facet Mindfulness Questionnaire* (FFMQ; Baer et al. 2006) is a measure of dispositional or trait mindfulness based on a factor analysis of five independently developed mindfulness questionnaires. The 39 items load onto five facets of mindfulness: observing, describing, acting with awareness, nonjudgmental acceptance, and nonreactivity to inner experience (Baer et al. 2006). Higher scores for each facet indicate more of the trait. The FFMQ demonstrated good internal consistency on all five factors (five facets' α ranging from 0.75 to 0.91; present sample's five facets at baseline α=0.80–0.90) and good responsiveness (Bohlmeijer et al. 2011). All five factors of the FFMQ were positively correlated with well-being, and four of the five factors of the FFMQ (all except observing) were negative predictors of psychological symptoms and depression (Baer et al. 2006). The FFMQ total score or facet scores can be used (Baer et al. 2006). This scale was administered pre- and post-intervention. Sustainable change was indicated by an increase of 6–11 points, and reliable change was indicated by an increase of 12 points.

The *PTSD Checklist–Civilian* (PCL-C; Weathers et al. 1993) is a self-report measure consisting of 17 items that corresponds with the DSM-IV PTSD criteria. The scale can be divided into three sub-scores corresponding to the three main syndromes of the disorder: re-experiencing, avoidance, and hyperarousal. Higher scores indicate more intensity. Studies have demonstrated strong internal consistency (α=0.94; present sample at baseline α=0.90) and test-retest reliability (r= 0.90 to 0.98; Blanchard et al. 1996). Sustainable change was indicated by an increase of 6–10 points, and reliable change was indicated by an increase of 11 points.

Data Analyses

To assess our first hypothesis, we used mixed model ANOVAs and Reliable Change Index (Jacobson et al. 1999; Jacobson and Traux 1991). Due to the a priori nature of the hypothesis, the novel population, and the small sample size, we decided to (a) conduct pairwise comparisons to explore differences among the individual interventions, even if the interaction effects of time and treatment group were not significant, and (b) keep the p value at 0.05 while investigating the pairwise comparisons. To assess our second hypothesis and our exploratory aim, we created residualized change scores by regressing each post-treatment variable (five facets of the FFMQ, BDI-II, and PCL-C) on the same measure at baseline and saved the standardized residuals (e.g., we regressed responses on the observing items at post-treatment on observing items at baseline); the residuals became a residual change score variable for each measure. Hierarchical regression analyses were then used to assess if pre- to post-treatment residualized change scores in the five facets of mindfulness were predictive of post-treatment depression and PTSD outcomes (while accounting for pre-treatment depression and PTSD, respectively) and to evaluate if the relationship among change in facets of mindfulness and post-treatment outcomes was moderated by type of mindfulness intervention (BS or MB). To reduce multi-collinearity, each predictor in the regression analyses was centered. For both PTSD and depression outcome analyses, pre-treatment scores were entered as step 1. Mindfulness group (BS vs. MB) was entered as step 2. Pre- to post-treatment changes in acting with awareness, nonjudgmental acceptance, nonreactivity, describing, and observing facets were entered as step 3. Finally, the interactions between the type of mindfulness (BS vs. MB) and pre- to post-treatment changes in acting with awareness, nonjudgmental acceptance, nonreactivity, describing, and observing facets were entered as step 4.

Prior to data analyses, all variables were examined in SPSS-22 (SPSS Inc. 2013) to evaluate data compliance with univariate and multivariate analysis assumptions. Effect sizes were assessed using the d statistic (small effect=0.20, medium effect=0.50, and large effect=0.80) and partial eta-square (small effect=0.02, medium effect=0.15, and large effect= 0.35; Cohen 1992). Cohen's guidelines were also used for interpreting the effect size of R^2 in hierarchical multiple regression with multiple independent variables (0.02 to 0.12= small, 0.13 to 0.25=medium, and greater than 0.26=large).

Results

Equivalence for age, gender, race, education, era of reported duty, FFMQ, BDI-II, and PCL-C was assessed at baseline, and

no significant differences were found between the four groups (all *p*s>0.05). Scores on the FFMQ (total and the five facets), BDI-II, and PCL-C were normally distributed and demonstrated good internal consistency. Employing a criterion of SD >3.29 from the mean, there were no univariate outliers. Prior to performing the ANOVAs, homogeneity of variance assumption was tested and confirmed using Levene's tests of equality of variance. Prior to performing the regression analyses, collinearity statistics (i.e., tolerance and VIF) revealed that all variables were within acceptable limits. The Durbin-Watson test indicated independent residuals.

The time (pre, post)×treatment group (BS, MB, SB, SQ) interaction for FFMQ was not significant (F (3, 78)=1.27, p=0.30, $n2_p$=0.05); however, as predicted, in the BS group, pre- to post-treatment total FFMQ scores increased significantly (p=0.01, d=0.44), as did the mindfulness facet acting with awareness (p=0.02, d=0.68; Table 1). In the MB group, total FFMQ scores did not significantly increase (p=0.51, d=0.18); however, change in nonjudgmental acceptance moved in the expected direction (p=0.07, d=0.42). Also as predicted, at post-treatment, the MB group (M=128.85, SD=21.35) had significantly higher FFMQ scores than the SB group (M=116.90, SD=23.40; p=0.05, d=0.55) and the SQ group (M=112.60, SD=17.94; p=0.01, d=0.83), and the BS group (M=125.48, SD=16.26) had statistically significantly higher scores than the SQ group (p=0.04, d=0.76). In the BS group, 38 % of participants experienced a reliable increase in FFMQ (RCI>1.96). Additional 12 % of participants experienced substantial change in FFMQ (1.96>RCI>1.00). In the MB intervention, 28 % of participants endorsed reliable increases in FFMQ, with additional 16 % endorsing substantial increases (Table 2).

The time (pre, post)×treatment group (BS, MB, SB, SQ) interaction for BDI-II was not significant (F (3, 86)=0.983, p=0.41, $n2_p$=0.03); however, as predicted, pre- to post-treatment BDI-II score decreased significantly in the BS (p=0.002, d=0.65) and MB (p=0.04, d=0.41) groups. Also as predicted, at post-treatment, the BS group (M=14.25, SD=10.19) had significantly lower BDI-II scores than the SB group (M=22.56, SD=12.21; p=0.02, d=0.74) and marginally lower than the SQ group (M=20.91, SD=13.62; p=0.06, d=0.56). There were no significant differences between the MB (M=17.54, SD=11.26), SB, and SQ groups. In the BS group, 41 % of participants experienced reliable decreases in BDI-II, with additional 11 % of participants reporting substantial change. In the MB group, 36 % of participants endorsed reliable decreases in BDI-II, with additional 4 % endorsing substantial decreases.

The time (pre, post)×treatment group (BS, MB, SB, SQ) interaction for PCL-C was not significant (F (3, 85)=0.84, p=0.48, $n2_p$=0.03); however, as predicted, pre- to post-treatment PCL-C score significantly decreased in the BS (p=0.02, d=0.47) and MB (p=0.01, d=0.57) groups. Unexpectedly, PCL-C scores significantly decreased in the SQ group as well (p=0.05, d=0.43). Also as predicted, at post-treatment, PCL-C scores in the MB group (M=46.91, SD=11.05) were marginally significantly lower than the SB group (M=54.18, SD=12.05; p=0.06, d=0.43). There were no significant differences between BS (M=50.71, SD=13.91), SB, and SQ (M=51.55, SD=12.06) groups. In the BS group, 30 % of participants experienced a reliable decrease and 11 % of participants experienced a substantial decrease in PCL-C score. In the MB group, 24 % of participants reported reliable decreases and additional 10 % reported sustainable decreases in PCL-C score.

Because we were interested in assessing potential differences in change in mindfulness facets predicting PTSD and depression outcomes among participants who received an element of an MBI, only data from participants in the MB and BS groups were included in these analyses (i.e., data from the SB and SQ groups were excluded). As shown in Table 3, preliminary zero-order correlation analyses revealed significant correlations between change in facets of mindfulness and change in depression and PTSD in both groups. In the BS group, change in depression and change in acting with awareness were significantly inversely correlated. In the MB group, there were significant inverse correlations among change in depression and change in nonreactivity and describing, and change in PTSD and change in nonreactivity. Furthermore, changes in PTSD and depression were positively correlated with each other in both groups.

Pre-treatment BDI-II was entered as step 1 and was a statistically significant predictor of post-treatment BDI-II (β=0.50, p=0.001). In step 2, mindfulness intervention (BS or MB) was entered and was not a statistically significant predictor (β=−0.11, p=0.42). In step 3, pre- to post-treatment changes in acting with awareness, nonjudgmental acceptance, nonreactivity, observing, and describing facets were entered. Collectively, they accounted for unique variance in the prediction of post-treatment BDI-II (ΔR^2=0.07, p=0.007), and individually, changes in nonreactivity (β=−0.39, p=0.008), nonjudgmental acceptance (β=0.33, p=0.05), and acting with awareness (β=−0.40, p=0.02) facets were statistically significant predictors. In step 4, the interactions between mindfulness intervention (BS or MB) and pre- to post-treatment changes in the five mindfulness facets were entered. Collectively, they accounted for unique variance in the prediction of post-treatment BDI-II (ΔR^2=0.09, p=0.03), and individually, the mindfulness intervention×nonreactivity (β=0.30, p=0.05) and mindfulness intervention×observing (β=−0.41, p=0.004) interactions were statistically significant predictors of post-treatment BDI-II. The BDI-II regression results are displayed in Table 4.

To further explore the interaction between the type of mindfulness intervention and pre- to post-treatment changes in nonreactivity and acting with awareness facets, simple slope analyses were conducted. After controlling for pre-treatment BDI-II scores, we regressed post-treatment BDI-II on change scores for nonreactivity and acting with awareness, in separate analyses for the BS and MB groups. Change in nonreactivity

Table 1 Means, standard deviation, *F* values, and *p* values for pre- and post-treatment outcome variables by group

Time × group interaction	*F* value, *p* value	BS[a] (*n*=27)			MB[b] (*n*=25)			SB[c] (*n*=25)			SQ[d] (*n*=25)		
		Pre-treatment mean (SD)	Post-treatment mean (SD)	*p*	Pre-treatment mean (SD)	Post-treatment mean (SD)	*p*	Pre-treatment mean (SD)	Post-treatment mean (SD)	*p*	Pre-treatment mean (SD)	Post-treatment mean (SD)	*p*
Total FFMQ	1.27, 0.30	116.87 (22.03)	125.48 (16.26)	0.01	124.95 (20.03)	128.85 (21.35)	0.51	114.37 (21.33)	116.90 (23.40)	0.47	113.10 (17.61)	112.60 (17.94)	0.89
OB	1.50, 0.22	27.00 (5.74)	28.35 (5.54)	0.13	25.90 (5.65)	26.57 (5.80)	0.49	25.63 (5.40)	24.42 (7.00)	0.36	25.30 (5.08)	23.75 (6.37)	0.21
DES	2.23, 0.09	24.22 (7.57)	25.78 (7.52)	0.15	26.90 (8.43)	27.29 (6.10)	0.74	22.89 (6.08)	24.47 (7.05)	0.16	21.65 (5.20)	22.55 (6.27)	0.42
AWA	1.13, 0.34	23.74 (6.70)	26.30 (6.03)	0.02	24.95 (4.74)	24.81 (5.11)	0.91	22.42 (5.35)	22.68 (6.37)	0.82	23.15 (5.67)	23.50 (5.28)	0.74
NJ	1.37, 0.26	23.30 (8.98)	25.13 (5.96)	0.17	26.33 (6.43)	29.14 (7.06)	0.07	23.68 (8.00)	25.47 (7.55)	0.17	24.50 (6.33)	24.15 (7.07)	0.75
NR	1.16, 0.33	18.61 (5.00)	19.91 (4.40)	0.13	20.80 (4.27)	21.45 (5.87)	0.41	19.74 (4.71)	19.84 (5.35)	0.88	18.50 (4.22)	18.65 (4.76)	0.86
BDI-II	0.98, 0.41	20.38 (8.70)	14.25 (10.19)	0.002	21.91 (10.25)	17.54 (11.26)	0.04	24.41 (9.83)	22.56 (12.21)	0.36	23.14 (11.64)	20.91 (13.62)	0.28
PCL-C	0.84, 0.48	56.25 (9.50)	50.71 (13.91)	0.02	53.39 (10.96)	46.91 (11.05)	0.01	55.55 (11.43)	54.18 (12.05)	0.57	56.32 (9.80)	51.55 (12.06)	0.05

FFMQ Five Facets Mindfulness Questionnaire, *OB* observing, *DES* Describing, *AWA* acting with awareness, *NR* nonreactivity, *NJ* nonjudgmental acceptance, *BDI-II* Beck Depression Inventory-II, *PCL-C* PTSD Checklist–Civilian

[a] Body scan intervention

[b] Mindful breathing intervention

[c] Slow breathing intervention

[d] Sitting quietly control group

Table 2 Percentage of participants who obtained reliable change or substantial change on outcome variables by group

	BS[a] (*n*=27)		MB[b] (*n*=25)		SB[c] (*n*=25)		SQ[d] (*n*=25)	
	RC[e]	SC[f]	RC[e]	SC[f]	RC[e]	SC[f]	RC[e]	SC[f]
Total FFMQ (%)	38	12	28	16	20	16	12	0
BDI-II (%)	41	11	36	4	28	4	28	8
PCL-C (%)	30	11	24	10	12	16	20	12

FFMQ Five Facets Mindfulness Questionnaire, *BDI-II* Beck Depression Inventory-II, *PCL-C* PTSD Checklist–Civilian, *RC* reliable change, *SC* substantial change

[a] Body scan intervention

[b] Mindful breathing intervention

[c] Slow breathing intervention

[d] Sitting quietly control group

[e] Percentage of participants who made reliable change (RCI>1.96). Reliable change on FFMQ=pre- to post-intervention increase equal or greater than 12 points. Reliable change on BDI-II=pre- to post-intervention decrease equal or greater than 7 points. Reliable change on PCL-C=pre- to post-intervention decrease equal or greater than 11 points

[f] Percentage of participants who made substantial change (1.96>RCI>1.00). Substantial change on FFMQ=pre- to post-intervention increase of 6–11 points. Substantial change on BDI-II=pre- to post-intervention decrease of 4–6 points. Substantial change on PCL-C=pre- to post-intervention decrease of 6–10 points

was a statistically significant predictor of post-treatment BDI-II (β=−0.52, p=0.01) in the MB group, but not the BS group (β=−0.33, p=0.10). Alternatively, change in acting with awareness was a significant predictor of post-treatment BDI-II in the BS group (β=−0.37, p=0.05) but was not a significant predictor in the MB group (β=0.19, p=0.40).

Following the same steps outlined in the first regression, PCL-C pre-treatment was entered as step 1 and was a statistically significant predictor of PCL-C post-treatment (β=0.55, p<0.001). However, neither the mindfulness intervention (BS or MB) nor the five mindfulness facets or any of the group× mindfulness facet interactions were statistically significant predictors of post-treatment PCL-C (ps>0.05).

Table 3 Correlations between residualized change scores for study variables by group

Variables	OB	DES	AWA	NJ	NR	BDI-II	PCL-C
OB	–	0.33	0.18	0.08	0.45*	−0.31	0.07
DES	0.18	–	0.49*	0.01	0.14	−0.29	0.27
AWA	−0.03	0.53*	–	0.31	−0.05	−0.53*	−0.08
NJ	0.008	0.33	0.68**	–	0.28	−0.12	−0.15
NR	0.51*	0.34	0.46*	0.37	–	−0.36	0.22
BDI-II	0.18	−0.47*	−0.39	−0.14	−0.53*	–	0.50*
PCL-C	0.06	−0.42	−0.37	−0.08	−0.45*	0.66**	–

Correlations for the body scan group are above the diagonal, and correlations for the mindful breathing group are below the diagonal

OB observing, *DES* describing, *AWA* acting with awareness, *NR* nonreactivity, *NJ* nonjudgmental acceptance, *BDI-II* Beck Depression Inventory-II, *PCL-C* PTSD Checklist–Civilian

*p<0.05; **p<0.001

Table 4 Summary of hierarchical regression analysis for variables predicting post-treatment BDI-II

Variable		β	R^2	ΔR^2	ΔF	p
Step 1			0.30	0.30	17.38	0.001
	Pre-treatment BDI-II	0.50				0.001
Step 2			0.30	0.006	0.33	0.42
	Pre-treatment BDI-II	0.50				0.001
	Group (BS vs. MB)	−0.11				0.42
Step 3			0.38	0.07	0.80	0.007
	Pre-treatment BDI-II	0.55				<0.001
	Group (BS vs. MB)	0.07				0.58
	Change in NR	−0.39				0.008
	Change in NJ	0.33				0.05
	Change in AWA	−0.40				0.02
	Change in OB	0.18				0.22
	Change in DES	−0.17				0.22
Step 4			0.46	0.09	0.97	0.03
	Pre-treatment BDI-II	0.54				<0.001
	Group (BS vs. MB)	0.15				0.36
	Change in NR	−0.54				<0.001
	Change in NJ	0.33				0.03
	Change in AWA	−0.27				0.11
	Change in OB	0.25				0.06
	Change in DES	−0.20				0.31
	BSMB×change in NR	0.30				0.05
	BSMB×change in NJ	−0.05				0.74
	BSMB×change in AWA	−0.25				0.12
	BSMB×change in OB	−0.41				0.004
	BSMB×change in DES	0.13				0.31

Cohen's guidelines were used for interpreting the effect size of R^2 with multiple independent variables (0.02 to 0.12=small, 0.13 to 0.25=medium, and greater than 0.26=large). BSMB×change indicates the interaction between grouping variable (body scan vs. mindful breathing) and change in mindfulness facet (nonreactivity, nonjudgmental acceptance, acting with awareness, observing, describing). All predictors in the regression analyses were centered

BDI-II Beck Depression Inventory-II, *PCL-C* PTSD Checklist–Civilian, *NR* nonreactivity, *NJ* nonjudgmental acceptance, *AWA* acting with awareness, *OB* observing, *DES* describing

Discussion

Understanding the clinical effects of specific components of a mindfulness intervention has the potential to optimize clinical outcomes for veterans with PTSD. Our first hypothesis, in which we predicted that the BS and MB interventions would

significantly improve depression and PTSD symptoms, was supported. Furthermore, participants in the BS group intervention evidenced statistically significant increases in total mindfulness scores and acting with awareness mindfulness facet, whereas participants in the MB group also evidenced marginally significant increases in nonjudgmental acceptance. In the SB group, there were no significant pre- to post-treatment changes in mindfulness, depression, or PTSD symptoms. Surprisingly, the SQ group evidenced a significant reduction in PTSD symptoms, suggesting that sitting quietly for 20 min a day may provide benefits for veterans with PTSD.

We also predicted that at post-intervention, the BS and MB interventions would significantly increase mindfulness and improve depression and PTSD symptoms when compared to the SB and SQ groups. This hypothesis was partially supported by the results. Mindful breathing had a greater effect on mindfulness when compared to slow breathing or sitting quietly and a greater effect on PTSD symptoms when compared to slow breathing, though not statistically significant (p=0.06). Practicing the body scan had a greater effect on depression when compared to slow breathing. While there were no significant differences noted between the two mindfulness interventions, results did suggest that the mechanism of action in mindful breathing may be different from the reduction of respiration rate (Conrad et al. 2006).

Our second hypothesis, which predicted that change in mindfulness facets would predict depression and PTSD outcomes for veterans who received the BS or MB interventions, was also partially supported by the results. Preliminary zero-order correlation analyses revealed that in the BS group, change in depression and change in acting with awareness were significantly inversely correlated, congruent with Boden et al. (2012). In the MB group, also congruent with Boden et al., change in depression and change in describing were significantly inversely correlated, as were change in depression and change in nonreactivity. Finally, change in PTSD and change in nonreactivity were inversely correlated.

Consistent with predictions and previous literature, collective pre- to post-treatment change in the five facets of mindfulness accounted for 23 % of unique variance in the prediction of post-treatment depression scores, after controlling for pre-treatment scores (Boden et al. 2012; Owens et al. 2012). When examined individually, change in acting with awareness and nonreactivity predicted post-treatment depression. The simple slope analyses revealed that for participants in the BS group, increased observing skills led to decreased depression whereas change in nonreactivity was unrelated to depression. Alternatively, for participants in the MB group, increased nonreactivity skills led to decreased depression whereas change in observing was unrelated to depression.

Inconsistent with our predictions and previous findings (Boden et al. 2012), change in nonjudgmental acceptance positively predicted higher post-treatment depression scores and collective pre- to post-treatment changes in the five facets of mindfulness did not significantly explain post-treatment PTSD symptom severity. Inconsistencies between the current findings and previous outcome studies may be partly explained by differences in the interventions. Specifically, participants in studies of Boden et al. (2012) and Owens et al. (2012) received intensive, multifaceted interventions within residential treatment facilities. Conversely, this study employed a brief and narrowly focused intervention—a single component of a mindfulness practice taught for six, 1-h sessions.

This study contributes to the scientific literature regarding effective treatment for veterans with PTSD. First, brief, individual components of a mindfulness intervention had significant effects on mindfulness, depression, and PTSD symptoms among veterans when compared to a slow breathing intervention or a sitting quietly control group. While there were no significant differences noted between the two mindfulness interventions, results did suggest that the mechanism of action in mindful breathing may be different from the reduction of respiration rate. Furthermore, the separate components of the mindfulness intervention evidenced medium effect sizes. On contrary, effect sizes found in previous studies evaluating mindfulness-based interventions in their entirety have typically been medium to large (see Carmody and Baer 2008; Carmody et al. 2009). Current findings are consistent with those of Sauer-Zavala et al. (2013) who investigated three different meditation practices commonly used in mindfulness-based interventions. Results may further support the notion that the large effects of MBIs may not be due to any one component of these interventions, but instead the synergetic power of the combined practices.

Second, these findings are congruent with the past literature and provide additional support to suggest that acting with awareness and nonreactivity—two commonly recognized core components of mindfulness (Baer et al. 2006; Bishop et al. 2004)—are consistent and strong negative predictors of depression among individuals with PTSD (Bernstein et al. 2011; Boden et al. 2012). The increased ability to focus and pay attention to one activity at a time and to create a nonreactive awareness toward internal thoughts and emotions predicts post-treatment depression among veterans. When working with veterans with PTSD, it may be beneficial for therapists to teach and cultivate these important skills.

Third, current findings provide some support for the hypothesis that treatment-specific training in the use of specific mindfulness skills may influence the functional relationship between mindfulness skills and treatment outcomes. For participants in the BS intervention, as observing skills increased, depression decreased. This relationship was not demonstrated in the MB intervention. While practicing the body scan, veterans were instructed to sustain focus on bodily sensations. Observing bodily sensations may increase the ability to recognize the transient nature of the physical, mental, and emotional sensations, which may, in turn, increase veterans' willingness to

experience present moment sensation and decrease avoidant tendencies (Carmody and Baer 2008; Thompson and Waltz 2010). Furthermore, while attempting to pay attention to bodily sensations, one may become more aware of the mind's tendency to judge simple sensation (Sayadaw 1994). Having noticed the mind's frequent tendency to judge and evaluate, an individual can become increasingly aware of the mind as intermediary or secondary interpreter (Dreeben et al. 2013). Therefore, enhanced observation of present moment bodily sensation, as practiced in the body scan, may interrupt automatic engagement in unproductive styles of cognitive processing and, ultimately, break the cycle of automatic rumination and depression (Nolen-Hoeksema et al. 2008).

As a result of a mindful breathing practice, increased skills in nonreactivity, but not observing, were correlated with decreased post-treatment depression. During the MB intervention, participants focused their attention on the sensations of breath and, when a thought or emotion arose, they were instructed to notice the passing thought or emotion without reacting to it and return the attention to the breath. Mindful breathing has been correlated with nonreactivity (Feldman et al. 2010) and decentering (Segal et al. 2002), and decentering has been associated with decreased depression (e.g., Derosiers et al. 2013), physiological arousal, stress reactivity, and emotional reactivity (Delizonna and William 2009). Creating an internal spaciousness to notice and allow the distressing thoughts and emotions to pass without reacting and then returning the attention back to the breath may serve to strengthen the allocation of attention and enhance an individual's ability to recognize the transient nature of the distressing signals or experiences. Moreover, nonreactivity increases tolerance to aversive experiences and decreases rigid cognitive and behavioral patterns of avoidance (Delizonna et al. 2009; Sullivan-Kalill et al. 2013; Thompson et al. 2011), ultimately interrupting the cycle of automatic rumination and depression.

Finally, these findings are very important when considering that approximately half of the military personnel and veterans with a PTSD diagnosis do not seek or complete treatment (Shiner 2011; Tanielian 2008). Yet, in 2010, 39 % of veterans reported using CAM (Libby et al. 2014). Consistent with previous findings and recommendations (DOD and VA's practice guidelines, Management of Post-Traumatic Stress Working Group 2010; Boden et al. 2012; Vujanovic et al. 2011), these findings suggest that mindfulness interventions may assist veterans with PTSD to cultivate the skills necessary to prepare for the therapeutic process, thereby optimizing clinical outcomes.

Limitations

The results of this study must be interpreted with caution due to several limitations. First, the small sample size reduced statistical power. Second, the sample was mostly White men who identified as combat veterans with PTSD, residing in a small city in the northwest, thus limiting the generalizability of the findings, even within the larger veteran population. Third, all of the measures in this study were self-report questionnaires. Although all of the measures have demonstrated acceptable reliability and validity, they are, nonetheless, vulnerable to possible distortions and response bias. A fourth limitation is that adherence data was not analyzed. Finally, what we thought was an inactive control group, SQ, was actually an active control for this population. Clinically, this inadvertent finding may be helpful to understand. Perhaps, simply sitting quietly for 20 min each day may be helpful in improving PTSD symptoms. Future research should replicate these findings with a larger sample size. Furthermore, adherence data is critically important to mindfulness-based interventions and should be included in future research, as to understand the frequency and intensity of practice required to contribute to sustained effects. Finally, research combining self-report measures and biomarkers of physiological changes will enhance our understanding on the effects of mindfulness-based interventions for veterans with PTSD.

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Conflict of Interest The authors declare that they have no conflicts of interest.

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