Mindfulness (2019) 10:1815–1827
https://doi.org/10.1007/s12671-019-01129-3

ORIGINAL PAPER

Mindfulness Training Offered In-person and in a Virtual World—Weekly Self-reports of Stress, Energy, Pain, and Sleepiness among US Military Active Duty and Veteran Personnel

Valerie J. Rice[1] · Baoxia Liu[2] · Stephen C. Allison[3] · Paul J. Schroeder[2]

Published online: 23 March 2019

Abstract

Objectives The purpose of this paper is to present research findings on the effects of mindfulness meditation training on four weekly self-report measures among three groups: those receiving training delivered in-person (M-IP) or in a virtual world (M-VW), and a waitlist control group (WLC).

Methods Participants ($n = 191$) were US military active duty service members and veterans. The M-IP and M-VW groups reported their stress, energy, pain, and sleepiness before/after each mindfulness training class, while the control group answered the same questions once a week for the 8-week duration of training.

Results The M-IP and M-VW groups showed greater reductions in stress over the 8 weeks than the control group (1.70, 0.80, and 0.30 points, respectively; $p = .028$). Meaningful improvements ($\geq$ 20%) pre- to post-training were seen for stress, pain, and sleepiness in the M-IP group, for pain only in the VW group, and for none in the WLC group. Those experiencing high levels of stress or pain before training experienced reductions in their stress or pain post mindfulness training, while those with lower initial levels did not ($p < .001$). Within class improvements were seen for both intervention groups; however, improvements were greater for those attending M-IP for energy, pain, and sleepiness ($p \leq .034$).

Conclusions In-person mindfulness training yielded statistically and meaningfully superior results; however, both IP and VW delivery methods were effective in reducing stress among healthy US military active duty and veteran participants. Mindfulness was particularly helpful for those experiencing initially high levels of stress or pain.

Keywords MBSR · Mindfulness meditation · Stress · Pain · Military personnel

About a third of US military who return from Iraq and Afghanistan suffer from depression, post-traumatic stress disorder (PTSD), and/or traumatic brain injury (Rand 2008). Such difficulties can have a negative impact on service members' work, relationships, and home life (Thomas et al. 2010). Estimates reveal over 300,000 US active duty service members and veterans experience stress of significant magnitude to warrant assistance, yet between 30 and 60% of those in need do not seek mental health services (Sharp et al. 2015; Rand 2008). The reasons for not seeking assistance include stigma attached to mental health services and wanting to project an image of independent competence (Sharp et al. 2015; Zinzow et al. 2013; Zinzow et al. 2012), beliefs or concerns about treatment, worries about leadership or confidentiality, physical barriers (e.g., provider availability or scheduling) (Zinzow et al. 2012, 2013), and residence in locations where access to care may be limited (Kirchner et al. 2011).

Mindfulness meditation, and specifically mindfulness-based stress reduction (MBSR) (Kabat-Zinn 2013), focuses on helping participants enhance their awareness of their own physical, cognitive, and emotional states, as well as with the environment and events they experience in the present moment. Participants learn to recognize their own state-of-being and their typical reactions to their own thoughts, emotions, and surroundings, without judgment. The theory is that, with practice, participants will learn to recognize their own

✉ Valerie J. Rice
valerie.j.rice.civ@mail.mil

1 U.S. Army Futures Command, Army Combat Capabilities Development Command, Army Research Laboratory, Fort Sam Houston (JBSA), 3161 McIndoe Rd., San Antonio, TX 78234, USA

2 DCS Corporation, Alexandria, VA, USA

3 Baylor University, Waco, TX, USA

response patterns and respond deliberately to events and persons, rather than 'mindlessly reacting'. As reactions become more disciplined and intentional, participants move from quick automatic reactions without thought, to responding with a sense of calm purpose, and from reacting with panic and alarm to responding with composed, planned actions. Mindfulness meditation training offered in the civilian sector reduces stress (Creswell and Lindsay 2014) and pain (Dahl and Lundgren 2006) and improves sleep (Black et al. 2015) and energy (Smith et al. 2008).

Mindfulness training has been shown to provide benefit among active duty US military and veterans. Stanley and Jha (2009) provided mindfulness training to US Marine Reservists before deployment to Iraq. Results showed that 54% of the participants used the techniques while deployed, and those who practiced mindfulness maintained their perceived level of stress and working memory capacity during pre-deployment preparations. Stanley et al. (2011) compared a mindfulness-trained group with a matched control group of Marines, finding mindfulness was increased post-training, and the mindfulness subcategories of *non-judging* and *acting with awareness* were correlated with changes in perceived stress. In a third study, mindfulness training was provided to Marines prior to exposure to stressful training (Johnson et al. 2014). Enhanced recovery in heart and breathing rates, and lower biomarkers for stress reactivity, were seen among those receiving mindfulness training, but not in the control group. More time practicing mindfulness techniques has been associated with higher levels of positive affect and lower levels of negative affect among Marines (Jha et al. 2015). Finally, Meland et al. (2015) demonstrated that mindfulness training decreased physiological stress responses and subjective ratings of mental demand among those in a military helicopter unit. These studies demonstrate positive effects on active duty service members' physiological stress response, perceived stress, mood, and cognitive fitness during stressful conditions.

Veteran service members face unique stressors, including separation from military service (Mobbs and Bonanno 2018), transitioning to civilian life (Greer 2017), and possibly recovery from injuries sustained during service (Caddick et al. 2018). Studies on mindfulness-based interventions with veteran patient samples have shown reductions in anxiety and depression and improvements in mental health functioning (Serpa et al. 2014), and decreases in pain, fatigue, cognitive problems, and depression (Kearney et al. 2016). Specific to stress and perceptions of stress among veterans, qualitative data among veteran students found mindfulness training improved emotional and physical coping, personal functioning, and stress management skills (Wisner et al. 2014). The important point is that outcomes from these studies support the beneficial effects of mindfulness training on former service members' physical and psychological health.

While these studies have demonstrated benefits of mindfulness training, none investigated remote delivery of mindfulness training, nor did they assess weekly feedback from participants; instead, most measures were taken pre- and post-training. These omissions are noteworthy for several reasons. First, training that is offered remotely, and anonymously, could circumvent attendance difficulties due to deployment, scheduling conflicts, or disability; stigma associated with behavioral health visits; and difficulties associating with others (in-person) by those experiencing symptoms associated with PTSD. Second, prior research has shown that the benefits of mindfulness training occur incrementally (Baer et al. (2012); yet, few studies have examined progressive changes.

Virtual Worlds (VW) are online computer-based communities that provide a means of communication that is highly social, interactive, occurs synchronously in real time, and is persistent (the same people and locations exist over time) (Rice et al. 2018c). Individuals in a VW use an avatar as a self-representation and can remain anonymous, while still establishing relationships with others they encounter. In addition, VW visitors can connect from any location that has Internet service and a computer. The anonymity and easy access may be attractive to military service members and veterans, especially those who may have PTSD (Rice et al. 2018b).

The primary purpose of this study was to examine weekly self-reports of stress, pain, sleepiness, and energy level from three groups: (1) those receiving in-person mindfulness training (M-IP), (2) those receiving mindfulness training offered via the virtual world of Second Life (M-VW), and (3) those wait-listed and receiving no training–control (WLC). A second goal was to examine the same self-reports taken before and after each training class. This study did not focus on individuals with a specific diagnoses, but was open to any US active duty service member or veteran who met the basic participation criteria, with an eye toward discovering whether mindfulness meditation intervention might benefit all soldiers and veterans, not only those who have suffered an injury or illness or who were experiencing significant current stress (e.g., pre-deployment). We hypothesized (1) significantly decreased weekly self-reports of stress, pain, and sleepiness and increased energy over the 8 weeks of training among both mindfulness groups, but no improvements in the WLC group; (2) greater decreases in self-reported stress and pain among those with high initial levels of stress and pain compared with those experiencing low initial levels; and (3) significant improvements in self-reports of stress, energy, pain, and sleepiness per class, as measured before and after each of the eight individual mindfulness training classes, for both the M-IP and M-VW groups.

Method

Participants

This study was approved by an Institutional Review Board. Participants completed an informed consent form prior to participation. To meet the study criteria, participants had to (1) be at least 18 years of age or older; (2) be able to understand, read, and write English; (3) not have a current diagnosis of severe traumatic brain injury (TBI); (4) not be experiencing active hallucinations or delusions; and (5) be on US military active duty status or be a US military veteran. Individuals who had previously attended meditation training were not included in the study.

Our sample size selection was based on the following information. A meta-analysis (Grossman et al. 2004) examined the outcomes from 64 studies and computed the effect size of MBSR training on mental health and physical health variables. This analysis found a medium sized effect, $d = .54$, on mental health outcomes with a controlled group design, which yielded a sample size 52 participants per experimental group (in-person, online-virtual world, and waitlist control) (total $N = 156$) to be able to detect significant differences with an 80% chance of detecting an effect and an alpha of .05 (two-tailed test) (Cohen 1992). Power analyses were conducted using G*Power (Erdfelder et al. 1996). Recruiting efforts reflected both calculations and attrition rates from previous studies.

Of the participants who were screened, 280 participants met full eligibility criteria and signed the consent form. Data from 191 participants were included in the data analysis. Of the total 191 participants, 72 were in the M-IP group, 62 were in the M-VW group, and 57 were in the WLC group (see details in Fig. 1). Participants who withdrew consent before being assigned to a group or dropped out of the study before participating stated they did so because they did not want to participate or because of schedule conflict, temporary duty, or conflicting travel arrangements. Participants were not compensated for their involvement.

Detailed descriptive statistics for demographic variables for the three groups are shown in Table 1. While military deployments are not shown, most participants ($n = 108$, 57%) had served on military deployments.

Procedure

The data reported for this study were collected as part of a larger study on resilience in the military. Participants were non-randomly assigned to the M-IP, M-VW, and WLC groups. A given group was filled before another group was formed, to decrease participants' waiting time to begin training. Thus, enrollment was dependent on training availability, as well as on military unit missions and schedules. Before attending training, the participants completed a demographic questionnaire and completed pre-training assessments.

The in-person group attended MBSR training, while the training for the VW group was based on MBSR.VW classes followed the same schedule and content as an MBSR in-person training, but they were shorter than traditional MBSR classes (see description below). Handouts and homework were the same for both groups.

The M-IP group met for approximately 2.5 h once a week for eight continuous weeks. An all-day silent retreat was conducted for 7 h, between weeks 5 and 7. Classes were conducted in-person, face-to-face with an experienced, trained MBSR instructor in a group setting. The participants filled out a paper survey with four questions before and after each training class. Nine in-person trainings were conducted from January 2013 to May 2015 with each training group consisting of a maximum of 12 participants. In addition to classroom attendance, participants had at-home practices (i.e., homework assignments). The M-IP group used a guided meditation CD or downloaded audio files made by the instructor for at-home practices. Total in-class hours were 27.

The participants in the M-VW group were issued a laptop and a wireless headset with a microphone for the online training. They selected an avatar from secondlife.com to use in the VW and were trained on how to customize and control their avatar (i.e., talking, walking, use of emoticons, etc.) in a Second Life viewer (i.e., Firestorm). Participants partook in the online training from their home, or a place of their choosing, once a week. Participants could see the avatars of their instructor, themselves, and other participants during class using a 'birds-eye' view or they could choose to see directly through their avatars' eyes. Participants either spoke through their headsets or used text to communicate during class. While participants controlled their avatars for most of the training (including walking meditations), during yoga exercises, the instructor took control of the avatars and moved them through pre-designed yoga poses (Fig. 2). The VW training included eight 1.5-h training classes and one 3.5-h extended, silent class at week 6 or week 7. The 3.5-h class served as an abbreviated form of the 7-h silent retreat in-person. Total in-class hours were 15.5. The selection of an abbreviated schedule was based on pre-study informal data collection assessing how long soldiers and veterans would be willing to spend in an on-line VW training class. Before and after each class, the M-VW group participants filled out the pre- and post-class surveys online via Survey Monkey (surveymonkey.com), accessed from within Second Life. VW training was conducted by a trained, experienced MBSR instructor. In addition to virtual classroom attendance at pre-determined times, participants had mindfulness homework assignments that included both meditation practices and occasional, short paper-based homework that was identical to homework assigned to the M-IP group. During guided homework

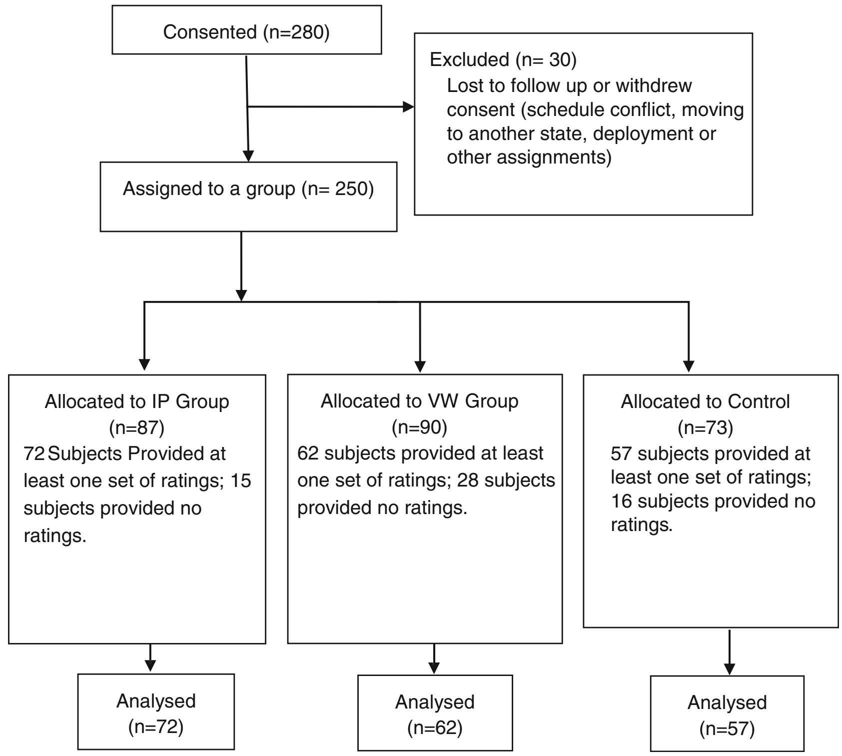

Fig. 1 Flow chart of the study participants' enrollment and assignment

meditations, the M-VW group had the option of meditating on-line in a 'homework pod' (Fig. 3) or downloading meditations. Eight groups of participants completed VW training from January 2013 to May 2015, with a maximum of 12 in each class.

The WLC group did not participate in training. They were contacted once a week for 8 weeks and were asked the same four questions as the M-IP and M-VW group participants. They were allowed to attend subsequent M-IP or M-VW training classes; however, their data were not used in subsequent analyses.

Measures

Stanford Sleepiness Scale (SSS) The SSS was developed to quantify subjective sleepiness (Hoddes et al. 1973). The scale consists of seven statements varying from very alert (1) to excessively sleepy (7). The scale is a sensitive and reliable indicator of change in sleepiness levels related to sleep deprivation (Hoddes et al. 1973) and partial sleep deprivation (Herscovitch and Broughton 1981). Test-retest reliability ($r = .88$) (American Thoracic Society 2018) and construct validity are good (Chokroverty et al. 2013).

Questions on Stress, Energy Level, and Pain Levels Participants were asked to rate their current stress, energy, and pain levels on a visual analog ten-point scale anchored by two verbal descriptors, one for each symptom extreme, from 1 (no stress/no energy/no pain) to 10 (unbearable stress/plentiful energy/unbearable pain). Similar visual analog scales (VAS), such as the Pain VAS, show high test–retest reliability ($r = 0.94$, $p < .001$) (Ferraz et al. 1990) and construct validity (Downie et al. 1978).

Data Analyses

The IBM SPSS Statistics for Windows software program (Version 23, Armonk, NY: IBM Corp 2015) was used for data analyses (www.ibm.com/SPSS/statistics). Descriptive statistics were used to analyze the demographic data and self-reports of stress, pain, energy, and sleepiness levels.

General trends across the eight classes were assessed by comparing group means for the pre-class survey scores, and comparisons with the WLC group were made using their weekly report data. Within-class change scores were computed by subtracting the pre-class score from the post-class score for the two training groups (i.e., M-IP and M-VW groups), thus using their change scores per class. As the analysis used change scores instead of raw scores, the main effect of group was of primary interest. Because most participants had some missing data, inferential analyses were performed using linear mixed-effects modeling with pre-class data and the within-class change scores as the outcome scores. Where post hoc tests were indicated, Fisher's least significant difference method was used.

Percent mean changes from baseline to end of study were computed as follows for each outcome: (week 8 mean–week 1 mean) / week 1 mean. A conservative threshold of 20% or

Table 1 Demographic features for the M-IP, M-VW and control groups[a]

	In-person		Virtual World		Control		Total	
	#/Mean	*%/SD*	*#/Mean*	*%/SD*	*#/Mean*	*%/SD*	*#/Mean*	*%/SD*
Age (years)	50.7	12.4	46.8	11.2	47.7	11.8	48.5	11.9
Time-in-service (years)	15.1	8.6	15.1	9.1	16.0	8.2	15.4	8.6
Gender								
Male	38	53	34	55	28	49	100	52
Female	34	47	28	45	29	51	91	48
Total	72		62		57		191	
Military status								
Active duty	14	19	19	32	22	39	55	29
Reserve	0	0	1	2	2	4	3	2
National guard	0	0	2	3	0	0	2	1
Veteran	58	81	38	63	32	57	128	68
Total	72		60		56		188	
Education								
GED/high school	5	7	3	5	3	5	11	6
Some college/associate's	25	35	19	31	20	35	64	34
Bachelors	18	25	16	26	12	21	46	24
Masters/doctorate	21	29	19	31	18	31	58	31
Other professional degree	3	4	4	7	4	7	11	6
Total	72		61		57		190	
Marital status								
Married	40	56	35	58	30	53	105	56
Divorced	13	18	10	17	14	25	37	20
Widowed	1	1	1	2	1	2	3	2
Single/separated	15	21	11	18	10	18	16	19
Living with significant other	3	4	3	5	2	2	8	4
Total	72		60		57		189	
Ethnicity								
African American	15	21	14	24	18	32	47	25
Native American	1	1	0	0	1	2	2	1
Caucasian	35	49	36	61	28	50	99	53
Hispanic	19	26	8	14	8	14	35	19
Asian	2	3	1	2	1	2	4	2
Total	72		59		56		187	
Military branches								
Army	39	58	31	60	24	51	94	57
Air force	19	28	9	17	16	34	44	27
Navy	6	9	8	15	5	11	19	11
Marines	3	4	4	8	1	2	8	5
Coast guard	0	0	0	0	1	2	1	1
Total	67		52		47		166	

[a] Percentages that do not add to 100 are due to rounding

greater mean improvement over the 8 weeks of training was selected to signify minimally meaningful improvement.

To further investigate whether pre-training conditions impacted the effects of the mindfulness training, participant scores were grouped based on their initial stress and pain levels. High initial stress was defined as greater than 5 (median for distribution) and high initial pain was defined as greater than 3 (median for distribution). Only the participants who reported their first week stress/pain levels were included in this analysis. To explore whether the general trends across

Fig. 2 Participants' avatars during a mindfulness meditation class

the eight regular classes were the same for the high and low initial stress or pain groups, data were analyzed with linear mixed-effects models in the same way as described above, except that the factor "group" was now defined by high vs. low initial score groups rather than by intervention group.

Results

High rates of attrition were noted (Fig. 1). Equivalence of groups at baseline was assessed using Cohen's *d* and variance ratios for age, time-in-service, and ratings of stress, energy, pain, and sleepiness. Pairwise comparisons of groups revealed Cohen's *d* values < .05 (with one exception) and variance ratios mostly near 1.0, with extreme values of 0.6 and 1.6, suggesting generally acceptable matching of groups according to thresholds suggested by Kover and Atwood (2013). The one exception was a Cohen's *d* value of 0.6 for the measure of sleepiness comparing the M-VW group to the WLC group.

Weekly Measures

Stress

The best-fitting model showed a significant ordinal group by week interaction effect, $F\,(14, 489) = 1.86$, $p = .028$, for stress, reflecting lower stress over time in both intervention groups than in the WLC group (see Fig. 4). Changes in stress ratings from week 1 to week 8 were − 1.72 points (31.6% reduction) for the M-IP group, − 0.80 points (17.0% reduction) for the M-VW group, and − 0.30 points (6.4% reduction) for the WLC group (Fig. 5). Pairwise comparisons of estimated marginal means from the statistical model comparing week 1 to week 8 were − 1.69 points, 95% CI [− 2.35, − 1.03] for the M-IP group, − 0.92 points [95% CI − 1.76, − 0.08] for the M-VW group, and − 0.06 points, 95% CI [− 0.80, 0.69] for the WLC group.

Energy

The interaction effect of group and week was not significant for energy ratings, $F\ (14, 763) = 0.40$, $p = .964$, nor was the main effect of group, $F\ (2, 186) = 0.06$, $p = .946$. There was a significant main effect of week, $F\ (7, 764) = 2.64$, $p = .011$, suggesting participants in all groups could expect a small week-to-week increase for energy level. Average changes in energy ratings from week 1 to week 8 were 0.44 points (7.8% increase) for the M-IP group, 0.58 points (9.3% increase) for the M-VW group, and 0.99 points (18.0% increase) for the WLC group (Fig. 5). Pairwise comparisons of estimated marginal means from the statistical model comparing week 1 to week 8 were 0.71 points, 95% CI [0.04, 1.38] for the M-IP group, 0.26 points, 95% CI [− 0.57, 1.09] for the M-VW group, and 0.99 points, 95% CI [0.24, 1.74] for the WLC group.

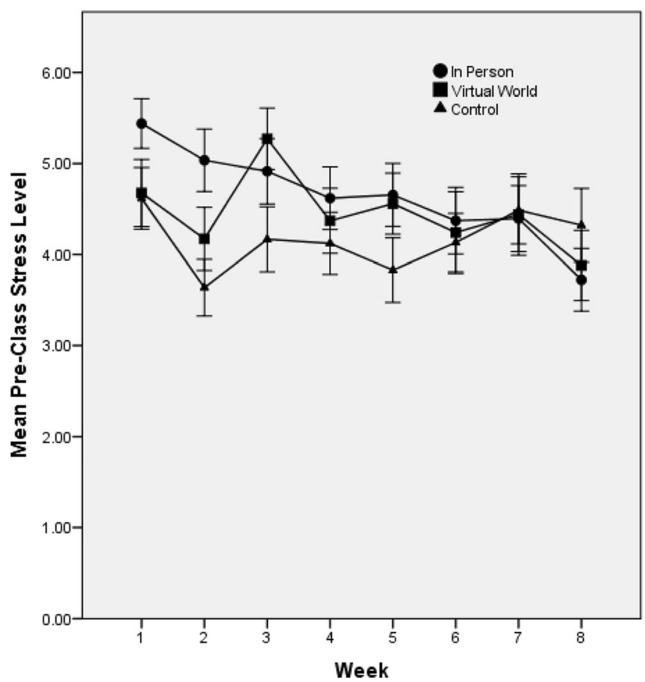

Fig. 4 Means and standard errors for the weekly reports of stress by the three groups

Fig. 3 The homework pod in Second Life for M-VW group participants

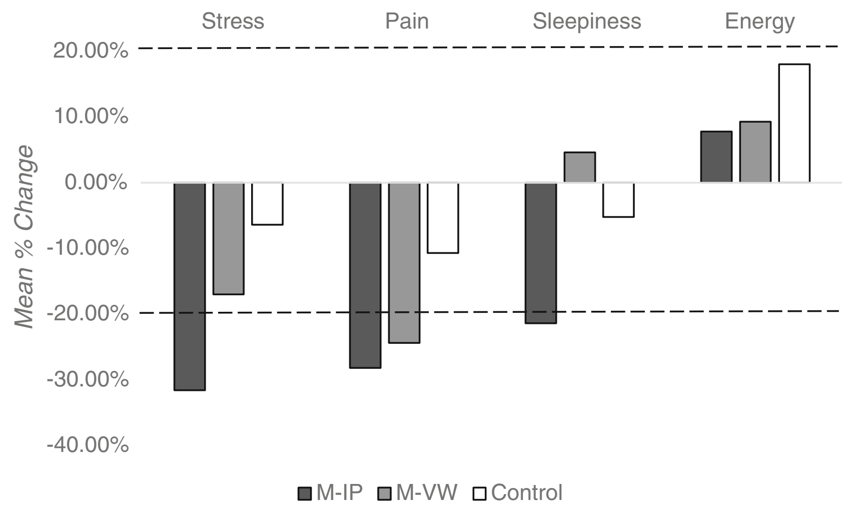

Fig. 5 Mean percent change in pre-weekly scores from week 1 to week 8 on the four measures across groups. Negative changes are improvements for stress, pain, and sleepiness; positive changes are improvements for energy. Dashed horizontal lines represent 20% thresholds for meaningful improvements

Pain

The interaction effect of group and week was not significant in the best-fitting model for the weekly pain level ratings, F (14, 504) = 1.17, p = .298. There was a significant main effect of group, F (2, 191) = 3.21, p = .043. The main effect of week was significant, F (7, 504) = 3.92, p < .001, – reflecting the overall trend of week-to-week reductions in mean pain levels for all groups. Average changes in pain scores from week 1 to week 8 were − 1.16 points (28.2% reduction) for the M-IP group, − 0.78 points (24.4% reduction) for the M-VW group, and − 0.35 points (10.7% reduction) for the WLC group (Fig. 5). Pairwise comparisons of estimated marginal means from the statistical model comparing week 1 to week 8 were − 0.98 points, 95% CI [− 1.49, − 0.47] for the M-IP group, − 0.86 points, 95% CI [− 1.50, − 0.21] for the M-VW group, and − 0.45 points, 95% CI [− 1.03, 0.12] for the WLC group.

Sleepiness

The interaction effect of group and week was not significant for the weekly sleepiness level ratings, F (14, 534) = 0.98, p = .468. There was a significant main effect of group, F (2, 187) = 3.23, p = .042. The main effect of week was not significant, F (7, 531) = 1.76, p = .093. Average changes in sleepiness from week 1 to week 8 were − 0.56 points (21.4% reduction) for the M-IP group, 0.10 points (4.6% increase) for the M-VW group, and − 0.14 points (5.2% reduction) for the WLC group (Fig. 5). Pairwise comparisons of estimated marginal means from the statistical model comparing week 1 to week 8 were − 0.50 points, 95% CI [− 0.93, − 0.07] for the M-IP group, 0.14 points, 95% CI [− 0.38, 0.66] for the M-VW group, and − 0.23 points, 95% CI [− 0.70, 0.24] for the WLC group.

High Initial Scores Vs. Low Initial Scores on Stress and Pain Scales (Pre-class Weekly Measures)

Stress

To investigate the effects of initial stress in the two training groups, two subgroups were identified based on their initial stress level at week one before training, with 46 high stress participants (stress level > 5) and 47 low stress participants (stress level ≤ 5). Results from the best-fitting model showed a significant ordinal high-low stress subgroup by week interaction effect, F (7, 277) = 5.02, p < .001, and a significant main effect of high-low stress group, F (1, 96) = 64.38, p < .001. Mean scores for subjects in the high initial stress subgroup diminished over time, while mean stress levels for those with low initial stress stayed about the same across the 8 weeks (Fig. 6a).

Pain

To investigate initial pain level, two groups of participants were identified, with 41 participants in the high pain group (pain level > 3) and 52 in low pain group (pain level ≤ 3). Results from the best-fitting model showed a significant high-low pain group by week interaction effect, F (7, 408) = 4.34, p < .001. Mean scores for subjects with higher initial pain diminished over time, while the pain levels for those with low initial pain stayed at a relatively constant level across the 8 weeks (see Fig. 6b).

Within-Class Measures

Stress

Although within-class changes in stress levels were generally greater in the M-IP group (particularly in the first few weeks),

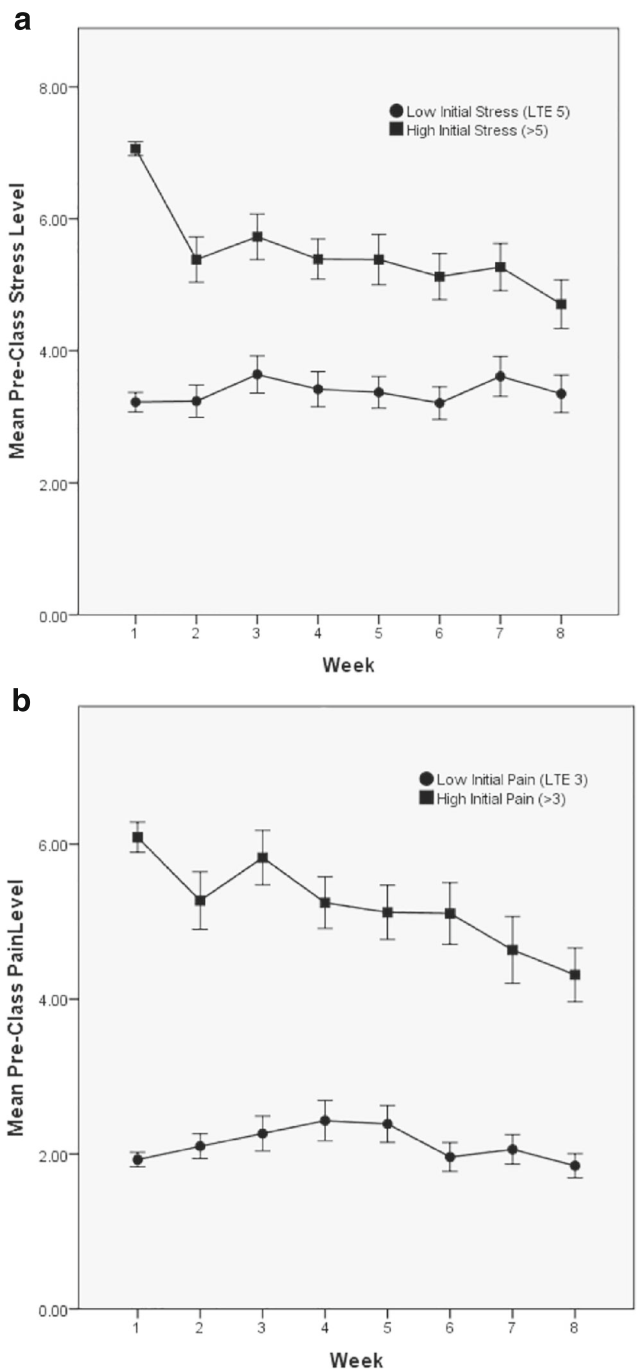

Fig. 6 Means and standard errors for the high and low initial scoring groups on stress (**a**) and pain (**b**) pre-weekly measures

the between-group differences were not quite large enough to be statistically significant (Fig. 7a). Mean within-class reductions in stress scores were greater (changes were more negative) for the M-IP group for every week except week 6 (where the M-VW group's mean change score was slightly greater [more negative] than for the M-IP group). This yielded a main effect of group that was not quite statistically significant, as seen in the best-fitting model that showed no significant effects for group, F (1, 104) = 3.42, p = .067, week, F (7, 464) = 1.77, p = .092, or for the group by week interaction, F (1, 464) = 1.34, p = .227. Thus, the rate of change for the change scores across the 8 weeks was not significantly different between the two groups.

Energy

Figure 7b shows the positive change scores were greater in the M-IP group for all 8 weeks compared to the M-VW group, where change scores were sometimes positive by relatively smaller amounts and were often negative (M-VW subjects often reported lower energy at the end of their computer sessions than at the beginning). The best-fitting model showed a significant main effect for group, F (1, 122) = 11.00, p = .001, indicating that average within-class change scores were significantly higher for the M-IP group than for the M-VW group. Effects for week, F (7, 488) = 1.45, p = .183, and for the group × week interaction, F (7, 488) = 1.72, p = .103, were not significant.

Pain

Figure 7c shows that the M-IP mean change was greater (more negative) than the M-VW group for all 8 weeks. The best-fitting model showed a significant main effect for group, F (1, 106) = 16.92, p < .001, indicating that average within-class change scores were significantly higher for the M-IP group than for the M-VW group. Effects for week, F (7, 499) = 0.90, p = .504 and for the group × week interaction, F (7, 499) = 0.42, p = .889, were not significant.

Sleepiness

Sleepiness levels increased slightly in both intervention groups during week 1, but in subsequent weeks, there was generally a within-class reduction in sleepiness, most consistently in the M-IP group (Fig. 7d). The best-fitting model showed significant main effects for week, F (7, 469) = 4.34, p < .001 and group, F (1, 109) = 4.59, p = .034. While Fig. 7d presents a slightly more complicated pattern, the M-IP group shows greater change (mean sleepiness change score is more negative, less sleepy) than the M-VW group for every week except for week 2. The group × week interaction effect, F (7, 469) = 0.91, p = .495, was not significant.

Discussion

The purpose of this study was to examine active duty and veteran US Military participants' weekly self-reports of stress, pain, sleepiness, and energy while completing an 8-week mindfulness training program delivered in-person or online in a virtual world, or while assigned to a wait-list control group.

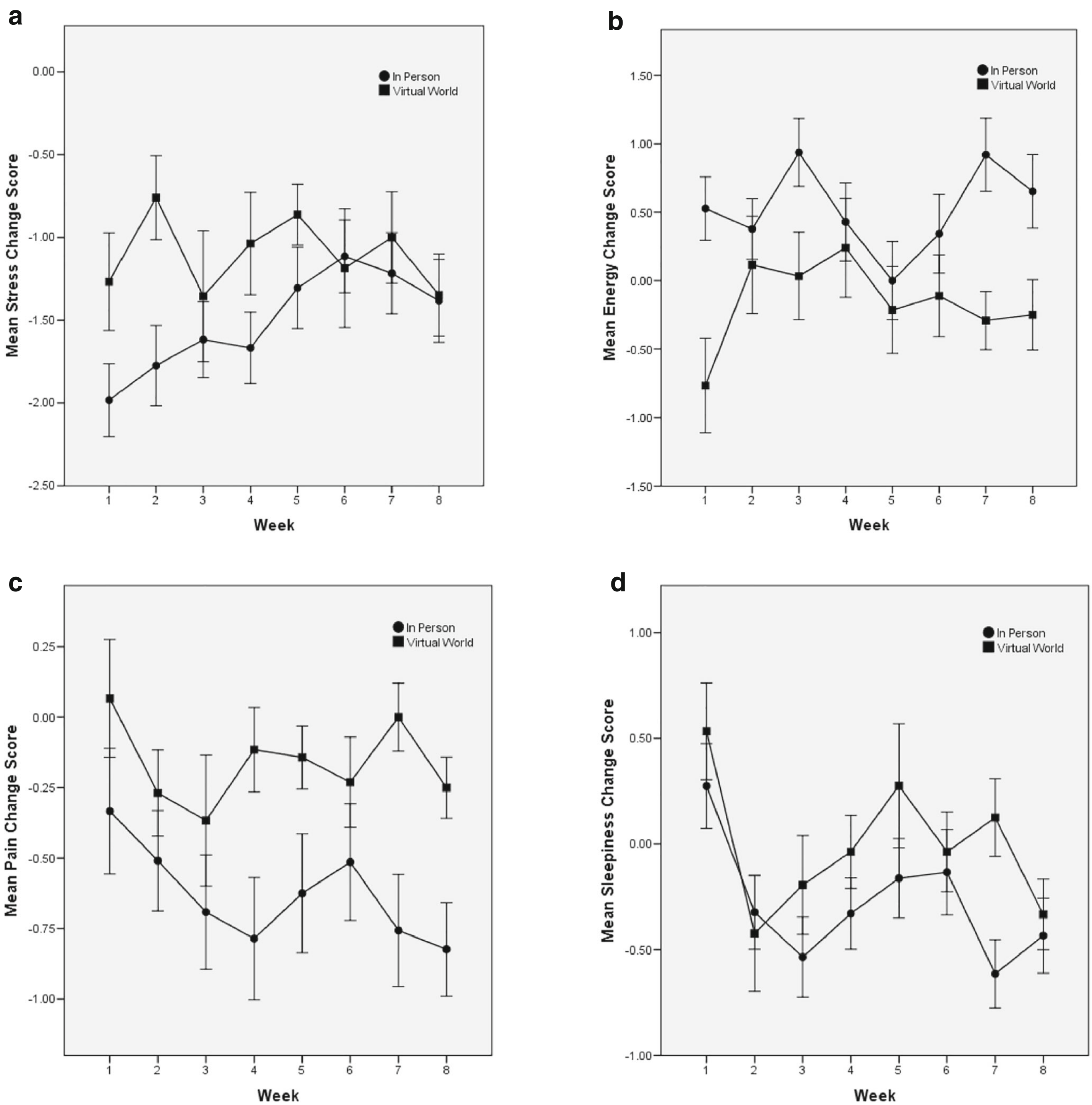

Fig. 7 Means and standard errors for the within-class changes (change scores) in Stress (a), Energy (b), Pain (c), and Sleepiness (d)

High rates of attrition were found in this study—in part due to extended wait times before enough participants were available to begin a class (classes started with a minimum of 12 participants, no classes were conducted that ran over holidays, and only one class was offered during summer when most military change-of-station moves occur). Other reasons for general attrition were unit or individual moves or deployments, inability to obtain permission to participate during a normal work/duty day, changes in duty status or responsibilities, and changing ones' mind about participating. Some participants left the study prior to attending any mindfulness training (e.g., 15% of the M-IP group and 22% of the M-VW) (for a review of the characteristics of the participants in this study who completed IP and VW mindfulness training, please see Liu and Rice 2018).

Our first hypothesis predicted significantly decreased weekly self-reports of stress, pain, and sleepiness and increased energy over the 8 weeks of training among both mindfulness groups, but no improvements in the WLC group. This hypothesis was only partially supported. Although stress was reduced over the 8 weeks for those in the M-IP and M-VW groups, when compared with a control group; energy, pain, and sleepiness did not improve. The reduction in stress for the VW was interesting as the training times were shorter than the in-person training. These findings support prior research showing in-person mindfulness training yielded reductions in personal stress as reported weekly (Baer et al. 2012), before and after training (Carlson et al. 2007; Song and Lindquist 2015), and in a meta-analysis (Sharma and Rush 2014). Also, these findings support those of Morledge et al. (2013), who reported that online mindfulness-based stress reduction training resulted in improvements in perceived stress, but not in vitality (similar to our lack of improvement in energy over time).

The first hypothesis was supported in the meaningful changes seen for stress, pain, and sleepiness for the M-IP group and for pain for the M-VW group. Stress scores improved (decreased) by 31.6% in the M-IP group by end of study and pain scores improved (decreased) by 28.2% in the M-IP group and 24.4% in the M-VW group over the 8 weeks of training. These results support outcomes from in-person studies reporting reduced chronic pain and increased pain management (Henriksson et al. 2016; Hilton et al. 2017), as well as from a web-based mindfulness program (not in a virtual world) for individuals with chronic pain (Henriksson et al. 2016). One explanation for these findings is that the greater awareness and acceptance of uncomfortable physical sensations following mindfulness training may increase tolerance to pain (Vujanovic et al. 2011). In this study, several participants voiced that, as they learned to focus their attention elsewhere, they experienced considerable pain relief. This new capacity to interrupt and refocus attention may contribute to participants' ability to more easily manage their pain.

Finally, mean sleepiness scores improved (decreased) by 21.4% in the M-IP group and 5.2% in the WLC group, but worsened (increased) by 4.6% in the M-VW group by end of study. These results support previous findings of decreased sleepiness immediately following mindfulness training among a non-patient, military sample (Rice et al. 2018a), as well as improvements in sleep in non-patient, non-military samples (Brand et al. 2012; Van der Riet et al. 2015), and research with participants who have chronic sleep issues (Frank et al. 2013; Black et al. 2015; Gross et al. 2011). Participants reported feeling sleepier following the first class. This is likely due to the training exercises and unaccustomed 'still time'. Participants often report losing their concentration as they are first learning, and some fall asleep during the first couple of classes. Sleepiness decreased in subsequent training classes. The lack of improvements in energy found this study contradicts findings from other studies in which participants reported increased vigor (Speca et al. 2000) and energy (Lengacher et al. 2009; Smith et al. 2008), but supports the on-line study findings of Morledge et al. (2013). The discrepancies may be explained by the outcome measures, times of recorded measures, and participant samples. Other studies relied on measures taken before and after 8 weeks of training (Lengacher et al. 2009; Smith et al. 2008; Speca et al. 2000), and measures of energy/vigor were different in each of the studies.

Our second hypothesis predicted greater decreases in self-reported stress and pain among those with high initial levels of stress and pain, which was supported by our results. Those with initially high stress and pain showed greater magnitudes of reduction over the 8 weeks, than those with low initial stress, whose stress and pain levels did not change substantially. For stress, these findings appear to support other mindfulness studies reporting moderate pre- to post-intervention decreases in stress and distress (Khoury et al. 2015), although others did not examine initial stress levels. While Baer et al. (2012) showed significant reductions in weekly reports of perceived stress, their study included civilian participants who suffered from stress-related illnesses or chronic health complaints, whereas the individuals in our study were (1) not selected for inclusion based on diagnosed ailments and (2) active duty and former US Military service members. Also, the study by Baer and associates (Baer et al. 2012) did not differentiate between reported levels of stress (high/low). These findings appear to reflect the idea that those experiencing higher stress benefit most from mindfulness training, perhaps because they have more to gain. The findings also suggest that studies on mindfulness meditation or compassion training might benefit from the inclusion of outcome measures that are sensitive to small, incremental changes in health variables of interest. For example, a population not currently experiencing significant stress may still gain from mindfulness training, but their gains may be smaller or different, such as improved mood, clarity of thought, improved zest for life, or changes in coping style. Similarly, in terms of pain, the findings suggest those with greater pain may have a larger margin of gain, as those who experienced greater pain benefitted more from the training than those who initially experienced less pain. Most studies that examine the impact of mindfulness meditation on pain use samples of individuals who are currently experiencing considerable or chronic pain (Dahl and Lundgren 2006; Henriksson et al. 2016; Hilton et al. 2017; Kearney et al. 2016). Thus, pain may be reduced, even among a non-specific, non-patient population.

Our third hypothesis predicted significant improvements in self-reports of stress, energy, pain, and sleepiness per class, as measured before and after each mindfulness training class, for both the M-IP and M-VW groups. This hypothesis was supported for the M-IP group only, with consistently greater improvements for the M-IP group pre- to post-class for all measures, but with significance seen only for energy, pain, and sleepiness (not stress). Stated differently, a single 2.5-h in-person class reduced pain and sleepiness, and increased energy, on a given day, and these within-class improvements continued over the 8-week MBSR training. That is, participants did not "acclimate" to the classes and cease to receive benefit during later classes. The finding of within-class improvements occurring for those in the M-IP group (and not for the VW group) may result from the face-to-face interactions, including seeing one another's facial expressions and body language, being able to give other group members a physical greeting (hand shake, hug, pat on the back), or longer in-class training times. In addition, the accountability seen during in-person participation is greater, compared to online where one can leave their computer and their avatar still appears in the group.

Having more energy and less sleepiness after a meditation class also challenges a concern voiced by military supervisors that meditating prior to work-related activity may result in service members experiencing lower energy or increased lassitude during their consequent task or mission performance. Accordingly, future research might focus on understanding changes in reported energy (and sleepiness) levels following a single meditation session (rather than a series of classes) and investigating whether increases in self-reported energy are reflected in mental or physical performance metrics.

Results from the present study suggest that (1) mindfulness training offered in-person and via a virtual world are effective for reducing self-reported stress, (2) in-person mindfulness training (MBSR) is superior to virtual world mindfulness training in achieving meaningful improvements over the 8 weeks of training for reducing stress, pain, and sleepiness, (3) those experiencing higher initial stress and pain improve more than those with initially low levels, suggesting that patient populations (who experience stress or pain as part of their diagnosis) are likely to see greater gains than non-patient populations, as are others with initially high levels of stress and pain, and (4) in-person training is superior to virtual world training for improving energy, pain, and sleepiness within each class of a mindfulness program.

Although less effective than in-person training overall, pre- to post-VW training showed improvements in self-reported stress over the 8 weeks of training, as well as meaningful reductions in pain. Thus, demonstrating this venue could increase medical outreach via telehealth. This is important as mindfulness intervention could be offered anywhere a computer and the Internet are available, reducing the impact of stigma and the lack of local credentialed mindfulness trainers.

We suggest future research investigate whether (1) commensurate changes in performance occur with daily changes (improvements) in energy and sleepiness, (2) the gains are similar if the sessions are purely meditative as opposed to a combination of meditation and group discussions, as these were, and (3) whether similar gains are obtained from non-sequential meditation sessions. Additional research using interim measurements, rather than only pre/post measurements, is also recommended.

Limitations

One limitation of the present study was that stress, pain, and energy were assessed using single-item non-standardized questions. Researchers are encouraged to include standardized and validated measures of the constructs in future studies. A second limitation was the necessity of using convenience sampling and filling one group at a time, due to a slow rate of recruitment (and to decrease the wait time for participants to enter the study). It is recognized that a randomized experimental design offers better protections against bias in assessing the effect of an intervention. While attrition might seem to be a limitation in this study, evidence indicates that attrition rates tend to fluctuate among mindfulness-based interventions from 3 to 40% (Baer 2003). For example, Kabat-Zinn and Chapman-Waldrop (1988) reported an average incompletion rate of 24%, with 9% not attending any sessions and 15% dropping out after starting an 8-week MBSR program. Likewise, Martinez et al. (2015) reported a 22% dropout rate during MBSR training. Similarities between these reports include dropouts occurring early, as was observed in this study. Differences between other reports and this study may be attributed to the inclusion of a sample of U.S. military (active duty and veterans), VW delivery of training, and the inclusion of healthy subjects. Our dropout rate in the traditional M-IP 8-week MBSR course (10%, once assigned to a group) was lower, while our M-VW dropout rate was higher (38%, once assigned to a group) than the rates reported above (Kabat-Zinn and Chapman-Waldrop 1988; Martinez et al. 2015), but still within previously reported rates (Baer 2003).

Acknowledgements We acknowledge the US active duty and veteran service members who chose to volunteer their time to participate in this study. We also thank the creators of the virtual world second life environment and programs, Jackie Morie and All These Worlds, Inc.; our virtual world instructors Dr. Steve Hickman and Allan Goldstein, and colleagues Gary Boykin, Angela Jeter, Jessica Villarreal, Cory Overby, Leah Enders, and Mariah Tree for their integral assistance with this research.

Disclaimer The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Army, Department of Defense, or the US Government.

Authors' Contribution VJR: designed and executed the study, served as the PI, and wrote the paper. BL: contributed to the initial data analysis and writing the paper. SCA: analyzed the data and wrote the results. PJS: collaborated in the writing and editing of the final manuscript.

Compliance with Ethical Standards

The study was approved by the San Antonio Military Medical Center Institutional Review Board and was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki. All of the participants provided their written informed consent before participating in the study.

Authors' Statement of Conflict of Interest The authors declare that they have no conflict of interest.

References

American Thoracic Society (2018). Retrieved June 1, 2018, from http://www.thoracic.org/members/assemblies/assemblies/srn/questionaires/sss.php.

Baer, R. A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Clinical Psychology: Science and Practice, 10*(2), 125–143. https://doi.org/10.1093/clipsy.bpg015.

Baer, R. A., Carmody, J., & Hunsinger, M. (2012). Weekly change in mindfulness and perceived stress in a mindfulness-based stress reduction program. *Journal of Clinical Psychology, 68*(7), 755–765. https://doi.org/10.1002/jclp.21865.

Black, D. S., O'Reilly, G. A., Olmstead, R., Breen, E. C., & Irwin, M. R. (2015). Mindfulness meditation and improvement in sleep quality and daytime impairment among older adults with sleep disturbances: A randomized clinical trial. *JAMA Internal Medicine, 175*(4), 494–501. https://doi.org/10.1001/jamainternmed.2014.8081.

Brand, S., Holsboer-Trachsler, E., Naranjo, J. R., & Schmidt, S. (2012). Influence of mindfulness practice on cortisol and sleep in long-term and short-term meditators. *Neuropsychobiology, 65*, 109–118. https://doi.org/10.1159/000330362.

Caddick, N., Cullen, H., Clarke, A., Fossey, M., Hill, M., McGill, G., et al. (2018). Ageing, limb-loss, and military veterans: A systematic review of the literature. *Ageing and Society*, 1–29. https://doi.org/10.1017/s0144686x18000119.

Carlson, L. E., Speca, M., Faris, P., & Patel, K. D. (2007). One year pre–post intervention follow-up of psychological, immune, endocrine and blood pressure outcomes of mindfulness-based stress reduction (MBSR) in breast and prostate cancer outpatients. *Brain, Behavior, and Immunity, 21*(8), 1038–1049. https://doi.org/10.1016/j.bbi.2007.04.002.

Chokroverty, S., Allen, R. P., Walters, A. S., & Montagna, P. (Eds.). (2013). *Sleep and movement disorders*. Oxford: Oxford University Press. https://doi.org/10.1093/med/9780199682003.001.0001.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155–159. https://doi.org/10.20982/tqmp.03.2.p079.

Creswell, J. D., & Lindsay, E. K. (2014). How does mindfulness training affect health? A mindfulness stress buffering account. *Current Directions in Psychological Science, 23*(6), 401–407. https://doi.org/10.1177/0963721414547415.

Dahl, J., & Lundgren, T. (2006). Acceptance and commitment therapy (ACT) in the treatment of chronic pain. In R. A. Baer (Ed.), *Mindfulness-based treatment approaches: A clinician's guide to evidence base and applications* (pp. 285–308). New York: Elsevier. https://doi.org/10.1016/b978-0-12-088519-0.x5000-x.

Downie, W. W., Leatham, P. A., Rhind, V. M., Wright, V., Branco, J. A., & Anderson, J. A. (1978). Studies with pain rating scales. *Annals of the Rheumatic Diseases, 37*(4), 378–381. https://doi.org/10.1136/ard.37.4.378.

Erdfelder, E., Franz, F., & Buchner, A. (1996). GPOWER: A general power analysis program. *Behavior Research Methods, Instruments, and Computers, 28*(1), 1–11. https://doi.org/10.3758/bf03203630.

Ferraz, M. B., Quaresma, M. R., Aquino, L. R., Atra, E., Tugwell, P., & Goldsmith, C. H. (1990). Reliability of pain scales in the assessment of literate and illiterate patients with rheumatoid arthritis. *Journal of Rheumatology, 17*(8), 1022–1024.

Frank, J. L., Reibel, D., Broderick, P., Cantrell, T., & Metz, S. (2013). The effectiveness of mindfulness-based stress reduction on educator stress and well-being: Results from a pilot study. *Mindfulness, 6*(2), 208–216. https://doi.org/10.1007/s12671-013-0246-2.

Greer, T. W. (2017). Career development for women veterans. *Advances in Developing Human Resources, 19*, 54–65. https://doi.org/10.1177/1523422316682737.

Gross, C. R., Kreitzer, M. J., Reilly-Spong, M., Wall, M., Winbush, N. Y., Patterson, R., Mahowald, M., & Cramer-Bornemann, M. (2011). Mindfulness-based stress reduction versus pharmacotherapy for chronic primary insomniaa: A randomized controlled clinical trial. *Explore, 7*(2), 76–87. https://doi.org/10.1016/j.explore.2010.12.003.

Grossman, P., Niemann, L., Schmidt, S., & Walach, H. (2004). Mindfulness-based stress reduction and health benefits: A meta-analysis. *Journal of Psychosomatic Research, 57*, 35–43. https://doi.org/10.1016/s0022-3999(03)00573-7.

Henriksson, J., Wasara, E., & Rönnlund, M. (2016). Effects of eight-week-web-based mindfulness training on pain intensity, pain acceptance, and life satisfaction in individuals with chronic pain. *Psychological Reports, 119*(3), 586–607. https://doi.org/10.1177/0033294116675086.

Herscovitch, J., & Broughton, R. (1981). Sensitivity of the Stanford sleepiness scale to the effects of cumulative partial sleep deprivation and recovery oversleeping. *Sleep, 4*(1), 83–92. https://doi.org/10.1093/sleep/4.1.83.

Hilton, L., Hempel, S., Ewing, B. A., Apaydin, E., Xenakis, L., Newberry, S … Maglione, M. A. (2017). Mindfulness meditation for chronic pain: Systematic review and meta-analysis. *Annals of Behavioral Medicine, 51*(2), 199–213. https://doi.org/10.1007/s12160-016-9844-2.

Hoddes, E., Zarcone, V., Smythe, H., Phillips, R., & Dement, W. C. (1973). Quantification of sleepiness: A new approach. *Psychophysiology, 10*(4), 431–436. https://doi.org/10.1111/j.1469-8986.1973.tb00801.x.

Jha, A. P., Morrison, A. B., Drainer-Best, J., Parker, S., Rostrup, N., & Stanley, E. A. (2015). Minds "at attention": Mindfulness training curbs attentional lapses in military cohorts. *PLoS One, 10*(2), 1–19. https://doi.org/10.1371/journal.pone.0116889.

Johnson, D. C., Thom, N. J., Stanley, E. A., Haase, L., Simmons, A. N., Shih, P. B., . . . Paulus, M. P. (2014). Modifying resilience mechanisms in at-risk individuals: A controlled study of mindfulness training in marines preparing for deployment. The American Journal of Psychiatry, 171(8), 844–853. doi: https://doi.org/10.1176/appi.ajp.2014.13040502.

Kabat-Zinn, J. (2013). *Full Catastrophe Living, revised edition: How to Cope with Stress, Pain and Illness using Mindfulness Meditation*. Hachette: Bantam Books.

Kabat-Zinn, J., & Chapman-Waldrop, A. (1988). Compliance with an outpatient stress reduction program: Rates and predictors of program completion. *Journal of Behavioral Medicine, 11*(4), 333–352. https://doi.org/10.1007/bf00844934.

Kearney, D. J., Simpson, T. L., Malte, C. A., Felleman, B., Martinez, M. E., & Hunt, S. C. (2016). Mindfulness-based stress reduction in addition to usual care is associated with improvements in pain, fatigue and cognitive failures among veterans with gulf war illness. *The American Journal of Medicine, 129*(2), 204–214. https://doi.org/10.1016/j.amjmed.2015.09.015.

Khoury, B., Sharma, M., Rush, S. E., & Fournier, C. (2015). Mindfulness-based stress reduction for healthy individuals: A meta-analysis. *Journal of Psychosomatic Research, 78*, 519–528. https://doi.org/10.1016/j.jpsychores.2015.03.009.

Kirchner, J. E., Farmer, M. S., Shue, V. M., Blevins, D., & Sullivan, G. (2011). Partnering with communities to address the mental health needs of rural veterans. *The Journal of Rural Health, 27*(4), 416–424. https://doi.org/10.1111/j.1748-0361.2011.00362.x.

Kover, S. T., & Atwood, A. K. (2013). Establishing equivalence: Methodological progress in group-matching design and analysis. *American Journal of Intellectual Developmental Disabilities, 118*(1), 3–15. https://doi.org/10.1352/1944-7558-118.1.3.

Lengacher, C. A., Johnson-Mallard, V., Post-White, J., Moscoso, M. S., Jacobsen, P. B., Klein, T. W … Kip, K. E. (2009). Randomized controlled trial of mindfulness-based stress reduction (MBSR) for survivors of breast cancer. *Psycho-Oncology, 18*(12), 1261–1272. https://doi.org/10.1002/pon.1529.

Liu, B., & Rice, V. J. (2018). Characteristics of United States military personnel and veterans who completed mindfulness training. In V. Duffy & N. Lightner (Eds.), *Advances in human factors and ergonomics in healthcare and medical devices* (pp. 22–32). New York: Springer. https://doi.org/10.1007/978-3-319-60483-1_3.

Martinez, M. E., Kearney, D. J., Simpson, T., Felleman, B. I., Bernardi, N., & Sayre, G. (2015). Challenges to enrollment and participation in mindfulness-based stress reduction among veterans: A qualitative study. *The Journal of Alternative and Complementary Medicine, 21*(7), 1–13. https://doi.org/10.1089/acm.2014.0324.

Meland, A., Ishimatsu, K., Pensgaard, A. M., Wagstaff, A., Fonne, V., Garde, A. H., & Harris, A. (2015). Impact of mindfulness training on physiological measures of stress and objective measures of attention control in a military helicopter unit. *The International Journal of Aviation Psychology, 25*(3–4), 191–208. https://doi.org/10.1080/10508414.2015.1162639.

Mobbs, M. C., & Bonanno, G. A. (2018). Beyond war and PTSD: The crucial role of transition stress in the lives of military veterans. *Clinical Psychology Review, 59*, 137–144. https://doi.org/10.1016/j.cpr.2017.11.007.

Morledge, T. J., Allexandre, D., Fox, E., Fu, A. Z., Higashi, M. K., Kruzikas, D. T., et al. (2013). Feasibility of an online mindfulness program for stress management—A randomized, controlled trial. *Annals of Behavioral Medicine, 46*(2), 137–148. https://doi.org/10.1007/s12160-013-9490-x.

Rand Corporation. (2008). In Rand Corporation (Ed.), *Invisible wounds of war: Psychological and cognitive injuries, their consequences, and services to assist recovery.* Santa Monica.

Rice, V. J., Boykin, G. L., Overby, C. R., Jeter, A., & Villarreal, J. (2018a). A pilot study evaluating the utility, acceptability, and feasibility of an abbreviated mindfulness meditation program before and during Army warfighting training. In V. Duffy & N. Lightner (Eds.), *Advances in human factors and ergonomics in healthcare and medical devices* (pp. 53–63). New York: Springer International. https://doi.org/10.1007/978-3-319-60483-1_6.

Rice, V. J., Liu, B., & Schroeder, P. J. (2018b). Impact of in-person and virtual world mindfulness training on symptoms of posttraumatic stress disorder and attention deficit and hyperactivity disorder. *Military Medicine, 183*, 413–420. https://doi.org/10.1093/milmed/usx227.

Rice, V. J., Tree, R., Boykin, G., Alfred, P., & Schroeder, P. J. (2018c). Trust in automation among volunteers participating in a virtual world telehealth mindfulness meditation training program. In D. Cassenti (Ed.), *Advances in human factors in simulation and modeling* (pp. 151–160). New York: Springer International. https://doi.org/10.1007/978-3-319-94223-0_14.

Serpa, S. J., Taylor, S. L., & Tillisch, K. (2014). Mindfulness-based stress reduction (MBSR) reduces anxiety, depression, and suicidal ideation in veterans. *Medical Care, 52*, S19–S24. https://doi.org/10.1097/mlr.0000000000000202.

Sharma, M., & Rush, S. E. (2014). Mindfulness-based stress reduction as a stress managment intervention for healthy individuals. *Journal of Evidence-Based Complementary & Alternative Medicine, 19*(4), 271–286. https://doi.org/10.1177/2156587214543143.

Sharp, M. L., Fear, N. T., Rona, R. J., Wessely, S., Greenberg, N., Jones, N., & Goodwin, L. (2015). Stigma as a barrier to seeking health care among military personnel with mental health problems. *Epidemiologic Reviews, 37*(1), 144–162. https://doi.org/10.1093/epirev/mxu012.

Smith, B. W., Shelley, B. M., Dalen, J., Wiggins, K., Tooley, E., & Bernard, J. (2008). A pilot study comparing the effects of mindfulness-based and cognitive-behavioral based stress reduction. *Journal of Alternative and Complementary Medicine, 14*(3), 251–258. https://doi.org/10.1089/acm.2007.0641.

Song, Y., & Lindquist, R. (2015). Effects of mindfulness-based stress reduction on depression, anxiety, stress, and mindfulness in Korean nursing students. *Nurse Education Today, 35*(1), 86–90. https://doi.org/10.1016/j.nedt.2014.06.010.

Speca, M., Carlson, L. E., Goodey, E., & Angen, M. (2000). A randomized, wait-list controlled clinical trial: The effect of a mindfulness meditation-based stress reduction program on mood and symptoms of stress in cancer outpatients. *Psychosomatic Medicine, 62*(5), 613–622. https://doi.org/10.1097/00006842-200009000-00004.

Stanley, E. A., & Jha, A. P. (2009). Mind fitness and mental amor: Enhancing performance and building warrior resilience. *Joint Force Quarterly, 55*(4), 144–151.

Stanley, E. A., Schaldach, J. M., Kiyonaga, A., & Jha, A. P. (2011). Mindfulness-based mind fitness training: A case study of a high-stress predeployment military cohort. *Cognitive and Behavioral Practice, 18*(4), 566–576. https://doi.org/10.1016/j.cbpra.2010.08.002.

Thomas, J. L., Wilk, J. E., Riviere, L. A., McGurk, D., Castro, C. A., & Hoge, C. W. (2010). Prevalence of mental health problems and functional impairment among active component and National Guard soldiers 3 and 12 months following combat in Iraq. *Archives of General Psychiatry, 67*(6), 614–623. https://doi.org/10.1001/archgenpsychiatry.2010.54.

Van der Riet, P., Rossiter, R., Kirby, D., Dluzewska, T., & Harmon, C. (2015). Piloting a stress management and mindfulness program for undergraduate nursing students: Student feedback and lessons learned. *Nurse Education Today, 35*, 44–49. https://doi.org/10.1016/j.nedt.2014.05.003.

Vujanovic, A. A., Niles, B., Pietrefesa, A., Schmertz, S. K., & Potter, C. M. (2011). Mindfulness in the treatment of posttraumatic stress disorder among military veterans. *Professional Psychology: Research and Practice, 42*(1), 24–31. https://doi.org/10.1037/2326-4500.1.s.15.

Wisner, B. L., Krugh, M. E., Ausbrooks, A., Russell, A., Chavkin, N. F., & Selber, K. (2014). An exploratory study of the benefits of a mindfulness skills group for student veterans. *Social Work in Mental Health, 13*(2), 128–144. https://doi.org/10.1080/15332985.2014.972009.

Zinzow, H. M., Britt, T. W., McFadden, A. C., Burnette, C. M., & Gillispie, S. (2012). Connecting active duty and returning veterans to mental health treatment: Interventions and treatment adaptations that may reduce barriers to care. *Clinical Psychology Review, 32*(8), 741–753. https://doi.org/10.1016/j.cpr.2012.09.002.

Zinzow, H. M., Britt, T. W., Pury, C. L., Raymond, M. A., McFadden, A. C., & Burnette, C. M. (2013). Barriers and facilitators of mental health treatment seeking among active-duty army personnel. *Military Psychology, 25*(5), 514–535. https://doi.org/10.1037/mil0000015.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.