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Do gender, anxiety, or sleep quality predict mindfulness-based stress reduction outcomes?

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Abstract

Although mindfulness-based stress reduction (MBSR) can improve health and well-being, less is known about factors that predict outcomes. This prospective observational study examined gender and baseline anxiety and sleep quality as predictors of change in emotion regulation and stress symptoms following an 8-week MBSR program. Women and men reported similar improvement in stress symptoms and cognitive reappraisal, whereas men improved more in emotion suppression. Individuals with higher anxiety and worse sleep pre-treatment benefited most in terms of decreased stress. Evaluating pre-treatment characteristics could help determine optimal candidates for MBSR training, and could optimize outcomes for both women and men.

Keywords

anxiety; emotion regulation; mindfulness; sleep; stress

Stress-related health problems are prevalent worldwide, and can present in the forms of anxiety and sleep disturbances (Alsubaie et al., 2017). One increasingly popular approach to managing stress-related symptoms is mindfulness (Quaglia et al., 2016), often defined as non-judgmental awareness of the present moment. Mindfulness-based stress reduction (MBSR) programs are now widely available, impactful, and cost-effective (De Vibe et al., 2017). Further, meta-analyses have shown that MBSR helps alleviate stress in both clinical and non-clinical populations (Li and Bressington, 2019). Far less is known about who is

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most likely to benefit from mindfulness training and how to optimize MBSR outcomes. For example, the degree to which outcomes of mindfulness-based interventions (MBIs) generalize across diverse groups, including their effects among women versus men, remains unclear (Chin et al., 2019).

Some initial evidence reports greater perceived benefits of meditation training for women than men (Rojiani et al., 2017; Upchurch and Johnson, 2019). On the one hand, because women endorse higher rates of anxiety, depression, and stress-related health problems than men (Afifi, 2007), and because greater symptom severity is associated with larger treatment effects in MBI studies (Hofmann et al., 2010), it is conceivable that women could respond better to MBSR. On the other hand, due to known gender differences in emotion regulation strategies, including greater suppression of negative emotions in men (Gross and John, 2003), MBSR could have larger effects on emotion suppression in men, given its focus on mindful awareness and mindful emotion regulation (Chambers et al., 2009). Other emotion regulation strategies that do not have known gender differences, like cognitive reappraisal (Brockman et al., 2017; Gross and John, 2003), may not show gender differences in MBSR outcomes. At present, men are substantially underrepresented in clinical trials of MBIs, thereby limiting data to examine possible gender differences in treatment response (Bodenlos et al., 2017).

Moreover, although clinically diagnosed anxiety is associated with larger effects of mindfulness training, to our knowledge, no studies have yet examined whether baseline anxiety symptoms in a *community* population predict differential outcomes. Similarly, whereas a number of studies have investigated the impact of mindfulness training on sleep disturbance and insomnia symptoms (Shallcross et al., 2019), given prior evidence of mood and anxiety as putative effect modifiers, the same concept may extend to baseline sleep quality; that is, poorer sleepers may experience greater benefit after MBSR training, as do those with anxiety and mood disorders. Therefore, a critical next step for this research is to determine predictors of MBSR treatment response, to inform more targeted intervention and implementation (Kocovski et al., 2009).

Previous results from the present MBSR outcome study found that gender did not moderate changes in depressive symptoms (Greeson et al., 2015), and that MBSR-related changes in emotion regulation processes, such as avoidance and rumination, partly explained improvements in stress symptoms and sleep quality (Greeson et al., 2018). The purpose of this secondary analysis was to test whether pre-existing participant characteristics predict changes in physical symptoms of stress and emotion regulation following MBSR training. Based on our review of the literature, we hypothesized that women, along with participants with higher baseline anxiety and sleep quality complaints, would show greater improvements in physical symptoms of stress from pre-to post treatment, and men would show greater response on emotional suppression. We did not specifically predict a gender difference in cognitive reappraisal outcomes.

Method

Participants and procedure

The methods and participants for this study have been described in detail elsewhere (Greeson et al., 2011). The study was approved by the Duke University Medical Center institutional review board (IRB), where the original trial was conducted. Eligible participants 18 years of age or older, proficient in English, with internet access, were recruited from a community-based, self-pay MBSR program. After providing written consent, participants completed an online questionnaire before and after the eight-week course. For the present analyses, we included participants who completed both pre- and post-treatment questionnaires (n = 203; M_{Age} = 46 [12], 76% women, 95% white).

Measures

Hospital Anxiety and Depression Scale (HADS; Zigmond and Snaith, 1983). This 14-item scale evaluates anxiety and depression symptoms experienced over the past week. The 7-item anxiety subscale (α = .84) reported in this analysis included items such as, “I feel tense or wound up” rated on a four-point scale from zero (Not at all) to three (Most of the time). The anxiety subscale score ranges from 0 to 21, with 0–7= normal, 8–10 = borderline, and 11–21 = clinically significant. The mean (SD) anxiety scale score at baseline was 8.21 (3.96), indicating an average level of distress in the borderline range prior to MBSR training.

Pittsburgh Sleep Quality Index (PSQI Global Score; Buysse et al., 1989). This 19-item measure (α = .72) of sleep quality and disturbance includes seven component scores assessing subjective sleep quality, among six other items. Participants answered questions such as, “How often have you had trouble sleeping because you: have bad dreams?” on a four-point scale from zero (Not during the past month) to three (Three or more times a week). Summed global scores range between 0 and 21, with higher scores indicating greater sleep quality complaints, and a score over five indicating poorer sleep. The mean (SD) PSQI global score was 6.43 (3.77), which fell in the “poor sleep” range before MBSR training.

Cohen-Hoberman Inventory of Physical Symptoms (CHIPS; Cohen and Hoberman, 1983). Participants were asked to rate on a 33-item scale (α = .89) how much stress-related symptoms (e.g. headaches, back pain, etc.) bothered them within the past 2 weeks, using a five-point scale from zero (Not at all) to four (Extremely). The total score ranges between 0 and 132, with higher scores indicating more bothersome physical symptoms of stress.

Emotion Regulation Questionnaire (ERQ; Gross and John, 2003). This 10-item measure determines an individual’s self-reported ability to regulate their emotions, with subscales for cognitive reappraisal (six items, α = .86; “When I’m faced with a stressful situation, I make myself think about it in a way that helps me stay calm”) and expressive suppression of emotion (4 items, α = .76; “I keep my emotions to myself”). Statements are rated on a seven-point scale from one (Strongly disagree) to seven (Strongly agree). The mean item-level score ranges from 1 to 7; higher scores suggest more frequent use of emotion regulation skills.

Data analysis

Gender, anxiety, and sleep quality were analyzed as predictors, and stress-related physical symptoms and emotion regulation (e.g. suppression and reappraisal) as outcomes. First, independent *t*-tests were used to determine whether baseline anxiety, sleep quality, physical symptoms of stress, or emotion suppression and cognitive reappraisal differed by gender. Next, paired *t*-tests were used to examine change in physical symptoms and emotion regulation from pre- to post-intervention (full sample and within each gender). All tests of gender differences corrected for unequal group sizes, and effect sizes are reported as Cohen's *d*. Hypotheses were then tested using separate linear regressions to determine whether gender, baseline anxiety, or baseline sleep quality predicted changes in physical symptoms of stress and emotion regulation from pre- to post-intervention. We also examined the potential moderating effect of gender on any main effects of baseline anxiety and sleep quality complaints. Data for *t*-tests are reported as mean (SD) and effect sizes for regression models are reported as η_p^2.

Results

Gender was treated as a categorical variable, and was coded 0 (men), 1 (women). At baseline, anxiety, sleep quality, and cognitive reappraisal did not differ by gender (*p*s > .80). However, as anticipated, women reported more physical symptoms of stress than men at baseline (women = 21.53 [14.96], men = 16.54 [13.26], t [91.04] = 2.25, d = 0.38), and men reported greater emotion suppression than women (men = 3.75 [1.35], women = 2.92 [1.16], t [73.36] = 3.80, d = 0.69, *p*s < .05). Physical symptoms of stress (pre-MBSR = 20.59 [14.97], post-MBSR = 14.13 [11.21], t [198] = 8.06, d = 0.57), emotion suppression (pre-MBSR = 3.32 [1.26], post-MBSR = 2.83 [1.03], t [202] = 4.02, d = 0.28), and cognitive reappraisal (pre-MBSR = 4.45 [1.17], post-MBSR = 5.16 [0.84], t [203] = −8.78, d = 0.64) all showed significant change from pre- to post-intervention in the full sample (*p*s < .0001). In addition, when examined as separate groups, women and men showed significant improvement in physical symptoms of stress (women: pre-MBSR = 21.91 [15.20], post-MBSR = 15.28 [11.79], d = 0.56; men: pre-MBSR = 16.32 [13.46], post-MBSR = 10.38 [8.11], d = 0.63), emotion suppression (women: pre-MBSR = 2.92 [1.16], post-MBSR = 2.73 (1.00), d = 0.19; men: pre-MBSR = 3.75 [1.35], post-MBSR = 3.14 [1.09], d = 0.65), and cognitive reappraisal (women: pre-MBSR = 4.47 [1.08], post-MBSR = 5.11 (0.82), d = 0.62; men: pre-MBSR = 4.37 [1.43], post-MBSR = 5.30 [0.88], d = 0.74, *p*s < .05).

As expected, baseline anxiety and subjective sleep quality significantly predicted change in physical symptoms of stress, such that participants with more severe anxiety (F[1,197] = 28.11, η_p^2 = 0.12) and greater sleep quality complaints (F[1,184] = 14.30, η_p^2 = 0.07) at baseline had greater decreases in physical symptoms of stress from pre- to post-treatment (*p*s < .001). Baseline anxiety also predicted change in cognitive reappraisal; participants who began with higher anxiety showed greater improvements in cognitive reappraisal than those who began with lower anxiety (F[1,200] = 4.77, p = .001, η_p^2 = 0.10). Neither baseline anxiety nor baseline sleep quality predicted change in emotion suppression, and gender did not moderate any of these effects (*p*s > .15; see Table 1). Consistent with hypotheses, men showed a greater decrease in emotion suppression from pre- to post-intervention (t [86.44]

= 2.59, $p = .01$, $d = 0.40$). However, changes in physical symptoms of stress and cognitive appraisal showed no gender differences (ps > .30).

Discussion

The objective of the present study was to determine whether baseline characteristics predict treatment outcomes in an MBSR program, specifically for pre- to post-treatment change in physical symptoms of stress and emotion regulation. Findings showed that physical symptoms of stress and emotion regulation improved from pre- to post-treatment in both men and women, with men demonstrating significantly greater improvement in emotion suppression. In addition, individuals who reported higher baseline anxiety and greater sleep quality complaints experienced greater decreases in stress-related physical symptoms, and individuals reporting higher baseline anxiety had greater improvements in cognitive reappraisal; these benefits did not differ by gender. Previous literature that looked at gender differences during MBSR treatment found similar results, where the populations were predominantly women, but both men and women reported significant improvements in health outcomes post-treatment (Chin et al., 2019). Together with existing data, the present study demonstrates the effectiveness of MBSR and other MBI's for populations with elevated symptoms of anxiety and sleep disturbance.

Gender differences in MBSR response

Mindfulness meditation has been shown to improve emotion regulation and stress symptoms, by encouraging individuals to mindfully observe and accept distressing experiences, rather than avoid or automatically react to them (Chambers et al., 2009). In the present study, men began with higher emotion suppression scores and showed greater improvements in this outcome. Past research has suggested that men neglect opportunities for social support, and default to inhibiting their emotions (Day and Livingstone, 2003). As noted, MBSR is a group-based program that works to enhance acknowledgment, awareness, and acceptance of emotions (Vøllestad, 2016); therefore, the skills obtained during the program could explain why men displayed a significantly larger drop in emotion suppression after mindfulness training. While both men and women showed improvements in physical symptoms of stress and cognitive reappraisal from pre-to-post treatment, there were no significant gender differences in these outcomes. Thus, anticipated gender differences in outcomes, based on differential symptom severity at baseline, may or may not occur depending on the outcome assessed. Given that both baseline symptom severity and gender can predict some MBSR outcomes in work conducted to date, further research is needed to determine what predictions can be replicated across studies, across different populations, and across outcomes.

Baseline anxiety and sleep quality as predictors of MBSR outcomes

Findings also revealed that individuals with higher anxiety and worse sleep quality showed the greatest improvement in physical symptoms of stress. While both greater anxiety and sleep quality complaints can cause or exacerbate stress-related physical symptoms (Kim et al., 2016), the acceptance and awareness skills taught in MBSR may improve how one responds to physical symptoms and result in greater improvements post-treatment. Additionally, individuals higher in baseline anxiety displayed a greater improvement in

cognitive reappraisal post-treatment, consistent with the theory that mindfulness training improves emotional well-being, in part, through cognitive reappraisal (Garland et al., 2015). However, poorer baseline sleep quality did not predict change in reappraisal. Since only a small number of studies have evaluated the direct relationship between sleep and cognitive reappraisal (Palmer and Alfano, 2017), future research could benefit from looking closer at this pair in the context of mindfulness training. Further, baseline anxiety and sleep quality did not predict change in emotion suppression, suggesting that gender, rather than baseline psychological symptom severity, may best predict change in emotion suppression.

Strengths, limitations, and future directions

Strengths of this study were its considerable sample size, use of validated psychometric scales to assess outcomes, and implementation of a well-established, manualized MBSR program (Kabat-Zinn, 1990), taught by highly experienced instructors (Greeson et al., 2018). Limitations included reliance on self-report measures, lack of a control group, possible expectancy effects associated with paying to take the MBSR program, and a primarily female, Caucasian, high socioeconomic status sample. Nevertheless, the current findings are among the first to directly compare MBSR outcomes for women and men in the same program, while also examining the interaction between gender and baseline distress levels in predicting MBSR outcomes, thereby advancing a nascent field trying to better address diversity issues in mindfulness research (Chin et al., 2019).

Conclusion

To our knowledge, this study is one of the first in a healthy community sample that tested anxiety and sleep quality complaints as predictors for MBSR response, measured by emotional and physical health outcomes. Our findings underscore the importance of evaluating baseline characteristics, like gender and psychological symptom severity, so clinicians can more efficiently refer those who could benefit most from mindfulness training. Future work should focus on helping to implement MBSR and other MBIs for targeted stressed populations, thereby reducing the worldwide health burden of stress-related symptoms and illness.

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Table 1.

Regression models testing gender, anxiety, and sleep quality complaints as predictors of the MBSR treatment effect on physical symptoms of stress, emotion suppression, and cognitive reappraisal.

Predictor variables	Change in physical symptoms of stress	Change in emotion suppression	Change in cognitive reappraisal
Gender	$B = -0.69$, $SE = 1.89$, $F[1,197] = 0.13$	$B = -0.41$, $SE = 0.17$, $F[1,201] = 5.98^{*}$	$B = 1.21$, $SE = 1.10$, $F[1,201] = 0.27$
Baseline anxiety	$B = -1.01$, $SE = 0.19$, $F[1,184] = 28.11^{***}$	$B = 0.01$, $SE = 0.02$, $F[1,200] = 0.59$	$B = 0.54$, $SE = 0.11$, $F[1,200] = 4.77^{***}$
Baseline sleep complaints	$B = -0.78$, $SE = 0.21$, $F[1,184] = 14.30^{**}$	$B = 0.03$, $SE = 0.02$, $F[1,186] = 2.00$	$B = 0.24$, $SE = 0.13$, $F[1,186] = 0.07$
Gender * anxiety	$B = 0.13$, $SE = 0.43$, $F[3,195] = 0.09$	$B = -0.07$, $SE = 0.04$, $F[3,198] = 3.06$	$B = 0.30$, $SE = 0.25$, $F[3,198] = 1.2$
Gender * sleep complaints	$B = 0.42$, $SE = 0.47$, $F[3,182] = 0.81$	$B = -0.03$, $SE = 0.04$, $F[3,184] = 0.40$	$B = -0.36$, $SE = 0.29$, $F[3,184] = 0.21$

MBSR: mindfulness-based stress reduction.

$^{*}p < .05$;

$^{**}p < .01$;

$^{***}p < .0001$.