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Mindfulness-Based Stress Reduction to Enhance Psychological Functioning and Improve Inflammatory Biomarkers in Trauma-Exposed Women: A Pilot Study

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Abstract

This study examined the effects of a Mindfulness-Based Stress Reduction (MBSR) program on psychological functioning and inflammatory biomarkers in women with histories of interpersonal trauma. The 8-week MBSR program was conducted at a community-based health center and participants (N = 50) completed several measures of psychological functioning at study entry as well as 4 weeks, 8 weeks, and 12 weeks later. Inflammatory biomarkers were assayed from blood collected at each assessment. A series of linear mixed model analyses were conducted to measure the effect of attendance and time on the dependent variables. Time was associated with significant decreases in perceived stress, depression, trait and state anxiety, emotion dysregulation, and post-traumatic stress symptoms as well as increases in mindfulness. Session attendance was associated with significant decreases in interleukin (IL)-6 levels. This pilot study demonstrated the potential beneficial effects of MBSR on psychological functioning and the inflammatory biomarker IL-6 among trauma-exposed and primarily low-income women. Decreases in inflammation have implications for this population, as interpersonal trauma can instigate chronic physiological dysregulation, heightened morbidity, and premature death. This study's preliminary results support efforts to investigate biological remediation with behavioral interventions in vulnerable populations.

Keywords

mindfulness; trauma; inflammatory cytokines; women

Exposure to interpersonal trauma substantially contributes to mental and medical health burden among low-income women (Gillespie et al., 2009; Sachs-Ericsson, Blazer, Plant, & Arrow, 2005). Rates of interpersonal trauma are high in low-income urban areas. By one estimate, out of over 700 low-income, urban women in a primary care setting: 86.1% had experienced at least one significant lifetime trauma, 33% had suffered intimate partner violence, 16.9% experienced sexual assault between the ages of 14–17, and 23.9% had a history of sexual abuse before the age of 13 (Gillespie et al., 2009). Interpersonal trauma can instigate chronic biological, emotional, and behavioral dysregulation, and raise the risk for inflammatory-mediated disease (Wong, Fong, Lai, & Tawari, 2014). In studies among

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adults, childhood sexual and physical assault histories have been associated with heightened risk for medical problems, disease (Sachs-Ericsson et al., 2005, Dube et al., 2009; Korkeila et al., 2009), and disability (Anda et al., 2008; Chartier, Walker, & Naimark, 2007). Early trauma exposure is associated with higher levels of inflammatory cytokines, particularly interleukin (IL)-6 and tumor necrosis factor (TNF)-α, as well as C-reactive protein (CRP) (Carpenter et al., 2010; Danese & McEwen, 2011; Danese, Pariante, Caspi, Taylor, & Poulton, 2007; Gouin, Glaser, Malarkey, Beversdorf, & Kiecolt-Glaser, 2012).

Psychological distress may be amplified by the process of inflammation, as proinflammatory cytokines induce depressive symptoms and increase anxiety (Maes & Bonaccorso, 2004). The bidirectional relationship between stress and inflammation makes women with a history of trauma and high perceived stress levels vulnerable to inflammatory processes and their downstream effects on physical and mental health. Behavioral interventions designed to modify the response to high stress could mitigate changes in inflammation and emotion regulation. Numerous studies in clinical and nonclinical samples have shown beneficial effects of Mindfulness-Based Stress Reduction (MBSR) on perceived stress and psychological symptoms (Grossman, Niemann, Schmidt, & Walach, 2004; Hofmann, Sawyer, Witt, & Oh, 2010) and immune function (Carlson, Speca, Faris, & Patel, 2007; Davidson et al., 2003; Fang et al., 2010).

MBSR is an evidence-based transdiagnostic intervention that has been shown to be effective for depression, anxiety, and PTSD (Fjorback, Arendt, Ørnbøl, Fink, & Walach, 2011; Kearney, McDermott, Malte, Martinez, & Simpson, 2012). MBSR provides effective tools to enable psychologically and physiologically adaptive responses to stress. Specifically, MBSR has demonstrated salutary effects on trauma-related symptoms, including stress, anxiety, and depression, as well as improvement in health-related quality of life (Fjorback, Arendt, Ørnbøl, Fink, & Walach, 2011), and has been demonstrated to be effective in improving these symptoms in trauma-exposed and primarily low-income women (Kimbrough & Magyari, 2010; Roth & Robbins, 2004). MBSR training involves guided sitting and walking meditations and hatha yoga. Each meditation is a practice of sustaining non-judgmental attention on one's moment-to-moment experience, including body functions, feelings, and content of consciousness. The goal of mindfulness is to help practitioners develop attitudes of acceptance, kindness, compassion, openness, patience, and curiosity. Developing an attitude of acceptance and nonjudgmental experiencing of physical sensations, emotions, and thoughts are key features of MBSR instruction, and may contribute to decreased stress reactivity. We reasoned that this feature of MBSR could be specifically useful to women who had experienced interpersonal trauma and may continue to experience physiological stress reactivity, dysregulated affect, and maladaptive cognitions. Enhancing connectedness to the body leads to greater bodily and emotion regulation (Kabat-Zinn, 2005; Hölzel, 2011). Increased capacity for emotion regulation may be highly advantageous to immune regulation, particularly in a population facing high levels of perceived stress.

The major objective of this study was to examine the effects of MBSR on psychological function and immune outcomes among women with trauma exposure histories and high perceived stress who were living in low-income conditions. To date, no studies have

examined the effects of MBSR on immunological outcomes in trauma-exposed and primarily low-income women. We hypothesized that the participants would show significant decreases in stress, depression, anxiety, post-traumatic stress symptoms and emotion dysregulation after participation in the MBSR program. We further hypothesized that participation in the MBSR program would increase mindfulness. Acknowledging that trauma exposure is associated with higher levels of inflammatory cytokines and that MBSR has been shown to improve immune function, we also hypothesized that the MBSR participants would have lower levels of pro-inflammatory cytokines IL-6 and TNF-α, as well as CRP.

Methods

Participants and Procedures

The participants were recruited from local clinics and hospitals providing medical and mental health care to low-income individuals, including those who were uninsured and under-insured. Potential participants were recruited by recommendations from medical or mental health providers and flyers placed in waiting rooms at the clinics and hospitals. To be eligible for the study, participants had to be women over the age of 18 and English speaking. They also had to have a history of at least one interpersonal trauma before the age of 18, and report current high perceived stress. Interpersonal trauma was defined as physical abuse, sexual abuse, witnessing family violence, and sudden loss of a loved one, and was assessed using the Traumatic Life Events Questionnaire (TLEQ). High perceived stress was measured by a score of ≥25 on the 10-item Perceived Stress Scale (PSS). Potential subjects were excluded from the study if they had cognitive deficits defined as a score of 24 or lower on the Mini-Mental State Examination, or other observed neuropsychological deficits deemed by investigators as significant enough to interfere with study participation.

Initial assessment—A total of 50 women met inclusion criteria, provided written informed consent, and completed the initial assessment. Of those 50 women, 42 participated in the 8-week MBSR program. The eight women who did not start the program were no longer available after the initial assessment due to starting a new work schedule (n = 3), illness in the family (n = 1), moving out of the country (n = 1), and loss to follow up (n = 3). The program was implemented in a community-based setting offering comprehensive healthcare for uninsured and underinsured individuals. Data from the subjects were collected within a week before beginning the MBSR program (Time 1); midway through the MBSR program (4 weeks from baseline; Time 2); immediately following completion of the 8-week MBSR program (Time 3); and four weeks after study completion (12 weeks from baseline; Time 4). Blood was obtained at Times 1–4. To help with retention, participants received weekly phone reminders of the MBSR class session. Participants were also compensated with $20 per assessment visit and were offered bus passes and childcare if necessary.

MBSR intervention—All women participated in a group-based (8 cohorts of 5–10 members) 8-week curriculum that included weekly 120-minute sessions and one intensive 4-hour retreat. The curriculum followed the MBSR manual as developed by the University of Massachusetts Center for Mindfulness (CFM; Kabat-Zinn, 1990) and was delivered by the

same experienced MBSR teacher with advanced CFM training. MBSR emphasizes the development of four mindfulness practices: sitting meditation (mindful awareness of one's experience while sitting), walking meditation (mindful awareness of one's experience while walking), mindful movement (mindful awareness of movement and holding poses similar to hatha yoga), and a body scan (serial attention to the sensations of different regions of the body). These practices are designed to foster a calm, non-judgmental awareness of one's sensations and feelings. Sustained attention on previously abused parts of the body during the body scan had the potential to induce distress and dysregulation (Vallejo & Amaro, 2009). To enhance feelings of safety, the instruction during the body scan acknowledged the potential for difficult emotions to arise, encouraged participants to notice thoughts, feelings, and sensations associated with certain body parts, refocus their attention on the breath, and return to the meditation.

Measures

Self-report—Demographic information was obtained using the demographic form from the intervention site, which contained items regarding age, race/ethnicity, employment status, income, and disability status. Participant characteristics are reported in Table 1.

The Traumatic Life Events Questionnaire (TLEQ) is a reliable and valid measure of life events (Kubany et al., 2000). To reduce participant burden, only those items concerning interpersonal trauma were included from the TLEQ for a total of 16 items.

The Mini Mental State Examination (MMSE) is a commonly used measure of cognitive function. This 11-item measure has a maximum score of 30; lower scores are related to cognitive impairments depending on age, education level, and mental health status. The MMSE is a reliable measure of cognitive state (Folstein, Folstein, & McHugh, 1979), and was used as a screening tool.

Perceived stress was measured using the 10-item Perceived Stress Scale (PSS-10). The items pertain to perceived stress during the last month and are coded from 0 (never) to 4 (very often). Scores range from zero to 40 and higher scores relate to higher levels of stress. The 10-item, single factor PSS has satisfactory psychometric properties, with an alpha coefficient of .78. It has been shown to correlate with life-event scores, depressive and physical symptomology, accessing of health services, and social anxiety (Cohen & Williamson, 1988). The alpha coefficients for the PSS 10 were consistent, and ranged from .85–.94 over the course of the study.

The Spielberger State-Trait Anxiety Inventory (STAI) is a well-validated 40-item inventory, with 20 items defining state (relative to recent stimuli) and 20 defining trait (reflecting more chronic stimuli) anxiety (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The items are coded from 1 (not at all or almost never) to 4 (very much so or almost always); scores can range from 20–80, and higher scores reflect greater levels of anxiety. The internal consistency for state and trait anxiety among females ranges from .86-.95 and .89-.91. Internal consistency for state and trait anxiety among our participants ranged from .90 - .97 and .89 -.95, respectively.

Categorical symptoms of depression were measured using the 20-item Center for Epidemiologic Studies Depression Scale (CES-D). Each item asks about depressive symptoms over the past week and is coded from 0 ["rarely or none of the time (less than 1 day)"] to 3 ["most or all of the time (5–7 days"]; scores range from zero to 60. The CES-D is a validated measure with Cronbach's alpha of .85-.90 (Radloff, 1977). The alphas for our study were consistent, ranging from .91–.95.

The Difficulties in Emotion Regulation Scale (DERS) is a 36-item measure that assesses individuals' typical levels of emotion dysregulation across six separate domains: nonacceptance of negative emotions, inability to engage in goal-directed behaviors when experiencing negative emotions, difficulties controlling impulsive behaviors when experiencing negative emotions, limited access to emotion regulation strategies perceived as effective, lack of emotional awareness, and lack of emotional clarity. The items are coded from 1 (almost never) to 5 (almost always). Scores range from 36 to 180 and higher scores reflect more difficulty with emotion regulation. The DERS has been found to have high internal consistency (α = .93), good test-retest reliability, and adequate construct and predictive validity (Gratz & Roemer, 2004). In the current study, the alphas for non-acceptance, goal-directed behaviors, impulsive behaviors, strategies, awareness, clarity, and the overall total score ranged from .93–.95, .75–.90, .88–.90, .82–.92, .76–.85, .53–.87, and .93–.96, respectively.

Participant symptoms of posttraumatic stress disorder (PTSD) were assessed using the Modified PTSD Symptom Scale Self-Report (MPSS-SR; Falsetti, Resnick, Resick, & Kilpatrick, 1993). This modified assessment was created based on Foa's PTSD Symptom Scale (PSS; Foa, Riggs, Dancu, & Rothbaum, 1993), and consists of frequency and severity subscales. The 17-item scale asks about symptoms over the past two weeks. Items on the frequency scale are coded from 0 (not at all) to 3 (5 or more times per week/very much/almost always) and the items on the severity scale are coded from 0 (not at all distressing) to 4 (extremely distressing). The severity and frequency subscales are combined to provide an overall score for PTSD symptoms, which can range from 0 to 119. The full scale has an internal consistency of .96 and .97 for treatment and community samples (Falsetti et al., 1993). The overall score for the current study had alphas that ranged from .95–.98, respectively.

Dispositional mindfulness was assessed using the 39-item Five Facet Mindfulness Questionnaire (FFMQ). The items are coded from 1 (never or very rarely true) to 5 (very often or always true). Scores range from 39–195 and higher scores suggest higher levels of mindfulness. This instrument is based on five factors that appear to represent elements of mindfulness as it is currently conceptualized. The five facets are observing, describing, acting with awareness, non-judging of inner experience, and non-reactivity to inner experience with alpha coefficients of.83, .91, .87, .87, and .75 for each subscale (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). In the current study Cronbach's alpha coefficients for each of the five facets across administrations ranged from .78–.89, .89–.91, .72–.82, .40–.70, and .75–.82, respectively.

Participants evaluated their satisfaction with the program at Time 3. The measure asked the participants to rate their satisfaction on the overall quality of the MBSR program (poor to excellent) and their overall satisfaction with the program (quite dissatisfied to very satisfied).

Immunological data—A trained nurse at the intervention site collected approximately 30 ml of blood from the antecubital vein of each subject at the 4 assessment visits, which occurred on the day they arrived for each class, between 2 and 4 PM. Blood was kept on ice, then centrifuged, and serum stored at −80°C for 12–14 months. Circulating IL-6, TNF-α and CRP were assayed using standard high sensitivity enzyme-linked immunosorbent assay protocols and anticytokine antibody pairs (R&D Systems, Minneapolis, MN). Absorbance was measured at 405 nm using an automated Opsys MR Microplate Reader (Thermo Labsystems, Chantilly, Virginia). The minimum detectable dose (MDD) for IL-6 was 0.039 pg/mL, 0.106 pg/ml for TNF-α, and 0.010 ng/ml for CRP. The intra- and inter-assay variability for IL-6 and CRP was CV <10%, and CV ≤10.6% for TNF-α.

Due to funding limitations, we ran assays for Times 1, 3, and 4. The only data excluded from the analyses were the CRP results that were out of range, likely due to hemolysis. Hemolysis is the breakage of the red blood cell's membrane, causing the release of the hemoglobin and other internal components into the surrounding fluid. Hemolysis may compromise laboratory test results and may be due to specimen collection, processing, transport, or pathological conditions.

Attendance—Attendance was measured based on hours in each MBSR session (8 sessions x 2 hours = 16 hours) and an intensive retreat (4 hours). In total, participants were offered 20 hours of intervention.

Statistical Analyses

Linear mixed models (LMM) with repeated measures was conducted to determine the effect of the MBSR intervention on changes in psychological functioning and inflammatory biomarkers using all four time points. A LMM was fit to each outcome. Variance components was the covariance structure used for the random subject effects, and time and attendance were treated as fixed effects. An autoregressive covariance structure was determined to be the best repeated measures covariance structure on all but two outcomes. Scaled identity was the repeated measures covariance structure used for the TNF-α and CRP variables. A second model was used to determine whether different covariance structures fit this model better because the blood data was assayed for Times 1, 3 and 4. Again, variance components was the covariance structure used for the random subject effects, and time and attendance were treated as fixed effects. Scaled identity was determined to be the best repeated measures covariance structure on all but two outcomes. Specifically, an autoregressive covariance structure was used for the FFMQ Describe variable and IL-6. Each model was fit using the procedures for LMM in SPSS. All of the data that was collected was used in the analyses since SPSS linear mixed models allows the inclusion of cases with missing values.

Results

Demographics for the 50 individuals who enrolled are presented in Table 1. Over half of the participants were White (54%) and 26% were African American, with a mean age of 46 (*SD* = 10.75). Nearly 75% had an income of under $25,000/year, over half were not employed, and one-third of the participants were on disability. Out of the 42 participants who started the MBSR program, 24 (57%) completed 50% or more of total class hours, with 18 (43%) attending 75% or more of total class hours and 9 (21%) completing all class hours and the intensive retreat. Mean (SD) attendance was 11.24 (6.56) hours for all participants. The majority of attrition occurred after the second session (n = 13; 30%), for reasons including difficulties with transportation (n = 1), admittance to a partial hospitalization program (n = 2), homelessness (n = 1), and starting work or school (n = 1); 8 women were lost to follow up. Attempts were made to assess participants who had discontinued MBSR; however, no participant that was lost to follow-up returned for the assessment visits.

Self-Report Data

On the TLEQ, the participants reported interpersonal traumatic exposure before the age of 18, including witnessing family violence (75%), physical abuse (56.2%), sexual abuse before the age of 13 (43.7%), sudden loss of a loved one (37.5%), and sexual abuse between the ages of 13 and 18 (31.2%).

The self-report data for the psychological outcome variables are presented in Table 2. A significant effect of time was observed for perceived stress [$F(3, 46.11) = 10.24$, $p < .001$]. Specifically, by Time 3, perceived stress had significantly decreased from baseline and was also significantly lower from baseline to follow-up. Significant main effects for time on depression [$F(3, 42.19) = 12.75$, $p < .001$] were observed at each time point. A significant effect of time was observed for trait anxiety [$F(3, 35.13) = 10.87$, $p < .001$] as well as state anxiety [$F(3, 37.93) = 6.09$, $p = .002$], with lower scores at Times 3 and 4 in comparison to baseline. A significant main effect for time on emotion dysregulation [$F(3, 29.47) = 6.80$, $p = .001$] was observed. Over time, the scores for emotion dysregulation were significantly lower at Time 3 and 4 compared to baseline. A significant main effect for time on PTSD symptoms [$F(3, 21.49) = 4.69$, $p = .011$] was observed. The overall MPSS-SR score was significantly lower at Times 3 and 4 in comparison to baseline.

Self-report data for the mindfulness outcome variables are presented in Table 3. There was a significant main effect for time on each of the mindfulness components. The FFMQ Observe scores [$F(3, 37.46) = 3.34$, $p < .03$] at Time 3 and Time 4 were both significantly higher in comparison to baseline; FFMQ Describe scores [$F(3, 35.45) = 3.46$, $p < .03$] at Time 2, 3, and Time 4 were each significantly higher in comparison to baseline; FFMQ Act Aware scores [$F(3, 37.43) = 5.59$, $p < .003$] were significantly higher at Time 3 and Time 4 in comparison to baseline; FFMQ Non-judgment scores [$F(3, 46.41) = 10.04$, $p < .001$] at Time 3 and Time 4 were both significantly higher in comparison to baseline; and FFMQ Non-react scores [$F(3, 36.07) = 9.69$, $p < .001$] were significantly higher at Time 3 and Time 4 in comparison to baseline. All of the participants rated the overall quality of the course as good to excellent, with 75% rating excellent. On overall satisfaction, all of the

participants were satisfied with the program, with 84% indicating that they were very satisfied.

Immunological Data

The second LMM using Times 1, 3, and 4 showed a main effect for attendance on circulating IL-6 [$F(1, 20.38) = 5.36$, $p = .03$], but time did not have a significant effect. Specifically, IL-6 decreased with increased attendance (Table 4). There were no significant effects of the intervention on TNF-α or CRP.

Discussion

In this preliminary study, we examined the effects of an MBSR program on psychological functioning and inflammatory biomarkers among trauma-exposed and primarily low-income women. This is the first study to examine the effect of MBSR on inflammatory biomarkers in this population.

Our findings support the hypothesis that participation in MBSR would be associated with significant decreases in stress, depression, anxiety, post-traumatic stress symptoms and emotion dysregulation. Our findings also confirmed that MBSR participants would show an increase in mindfulness. In regard to depression and anxiety, our finding of significant symptom reduction is consistent with several MBSR studies (Carlson, Speca, Patel, & Goodey, 2003; Gross et al., 2004; Hofmann et al., 2010; Roemer et al., 2009; Sephton et al., 2007; Speca, Carlson, Goodey, & Angen, 2000). Our emotion regulation finding is in accord with other studies that have found that mindfulness is associated with lower levels of maladaptive emotion regulation strategies associated with depression and anxiety, including thought suppression, worry, rumination, and overgeneralization (Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2007). Significant improvements in psychological and mindfulness outcome variables occurred at Time 3 and were sustained at Time 4, which may indicate that time is an important element to building one's practice, and once skills are developed, they can be maintained.

The reduction in PTSD symptoms is an important finding in light of the participants' history of interpersonal violence and trauma. Conceptually, mindfulness is understood to effect attention regulation, body awareness, emotion regulation (including reappraisal and exposure, extinction, and reconsolidation), and change in perspective on the self (Hölzel et al., 2011). Each of the proposed mechanisms of change is essential to the improvement of PTSD symptoms of re-experiencing, avoidance, and hyperarousal. For women who have been physically and sexually victimized, the practice of reappraising thoughts and physiological sensations with mindful awareness may improve their ability to successfully regulate emotions and mitigate trauma symptoms. Further, experiential avoidance is a central contributor to post-traumatic symptoms. Mindfulness practice has been found to decrease avoidance by encouraging patients to approach rather than avoid distressing thoughts and feelings (Vujanovic, Youngwirth, Johnson, & Zvolensky, 2009).

For the immunological data, our findings demonstrated that greater attendance in the MBSR program was associated with lower levels of inflammatory cytokine IL-6. The linear mixed

model analyses revealed that class attendance was significantly related to the effects of the MBSR intervention on decreases in the pro-inflammatory cytokine IL-6. Similar effects on biological outcomes were found by Pace et al. (2009), who observed reduction in stress-induced plasma IL-6 among compassion meditation practitioners who reported practice times above the median. Rosenkranz et al. (2013) also found that greater time spent engaged in MBSR practice predicted a significantly lower post-stress inflammatory response. Further, Creswell, Myers, Cole and Irwin (2009) demonstrated that attendance in an MBSR program was significantly related to buffering the declines in CD4+ T lymphocyte in HIV-1 infected adults. Although these studies measured different outcomes in different samples, they demonstrate that behavioral stress management interventions, such as MBSR, are associated with changes in a variety of immune outcomes, which may be dependent on practice time. We did not, however, observe significant decreases in TNF-α or CRP levels. A similar study examined pro-inflammatory cytokines IL-6, TNF-α, and CRP among older adults who were exposed to childhood abuse (Gouin, Glaser, Malarkey, Beversdorf, & Kiecolt-Glaser, 2012). Similar to our finding, their study results indicated that childhood abuse moderated IL-6, but not TNF-α or CRP. Although inflammatory biomarkers are interrelated and simultaneously upregulated by stimuli such as in the acute phase response, we found that circulating levels of IL-6, TNF-α and CRP were not highly correlated at any of the time points. Therefore, it is not surprising that IL-6, but not TNF-α or CRP, decreased following the intervention. Decreases in inflammation have implications for our population, as interpersonal trauma can instigate chronic physiological dysregulation, heightened morbidity, and premature death. This uncontrolled measure of change supports the effort to continue investigating biological remediation with behavioral interventions in vulnerable populations.

Our study demonstrated acceptability of the intervention in this population. We had an adherence rate of 57% of participants attending five or more sessions and 21% attending all eight sessions and the intensive retreat. The rate of attendance was similar to another MBSR study with primarily low-income women (Roth & Robbins, 2004) in which 66% of the participants attended 5 or more sessions and 21% attended all eight sessions. Another community-based MBSR study with low-income women had 61% of their participants complete 6 or more sessions (Vallejo & Amaro, 2009). Similar to our study, common reasons cited for missed classes or early program termination were difficulties with transportation and conflicts with medical, social service, or legal appointments (Roth & Robbins, 2004). Given the time and practice requirements of an MBSR program, we believe the acceptability of the intervention, as reported by the participants, and the sustained psychological and mindfulness outcomes at Time 4 speak to the feasibility of this program for this population. Future studies with this population should make marked efforts to increase adherence by offering classes at multiple times throughout the week and the opportunity to attend other classes to make up for missed classes.

The findings should be considered in light of study limitations. The sample size was small, the study was uncontrolled, and, as with other MBSR studies with this population, many participants did not complete the program. Due to the small sample size and lack of a priori power analyses, this study may have a greater chance of Type II errors. Future studies should examine the effects of MBSR on inflammatory biomarkers and psychological

functioning among trauma-exposed low-income women in a randomized controlled trial. This is the first study to examine the effects of MBSR on immune outcomes among trauma-exposed and primarily low-income women. This work contributes to the growing body of literature on the effects of mind-body therapies on PTSD and begins to extend this literature to include measures of inflammation, an important contributor to many common diseases of aging.

Conclusion

This pilot study demonstrates the potential beneficial effects of MBSR on psychological functioning and the inflammatory biomarker IL-6 among trauma-exposed and primarily low-income women. We conclude that MBSR may be an effective intervention to improve emotion regulation and immune function in a community-based setting, and warrants further study.

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Table 1

Demographic Characteristics of Enrolled Participants

	Characteristic	*M (SD) or n*	*%*
Age		44.1 (11.2)	-
Race/Ethnicity	White	27	54
	Black	13	26
	Hispanic	2	4
	Native American	2	4
	Biracial/Multiracial	3	6
	Unknown	3	6
Employment Status	Unemployed	27	54
	Part-Time	8	16
	Full-Time	13	26
	Unknown	2	4
Income	Under $10,000	18	36
	$10,000–14,999	8	16
	$15,000–25,000	10	20
	Over $25,000	11	22
	Unknown	3	6
Disability Status	Yes	16	32
	No	31	62
	Unknown	3	6

Note: N = 50

Table 2

Parameter Estimates for Fixed and Random Effects: Psychological Outcome Variables

	PSS (n = 47)	CES-D (n = 48)	STAI-T (n = 46)	STAI-S (n = 42)	DERS (n = 32)	MPSS-SR (n = 23)
Fixed Effects	***β (SE)* (95% CI)**	***β (SE)* (95% CI)**	***β (SE)* (95% CI)**	***β (SE)* (95% CI)**	***β (SE)* (95% CI)**	***β (SE)* (95% CI)**
Intercept	27.9 (1.8)*** [24.4, 31.4]	35.2 (2.9)*** [29.4, 40.9]	55.0 (3.2)*** [48.5, 61.5]	53.9 (3.9)*** [45.9, 61.8]	100.4 (7.9)*** [84.4, 116.5]	58.9 (12.9)*** [32.3, 85.6]
Time 4	−7.2 (1.6)*** [−10.4, −3.9]	−14.5 (2.4)*** [−19.5, −9.5]	−13.1 (2.4)*** [−17.9, −8.2]	−14.0 (3.3)*** [−20.8, −7.3]	−25.8 (5.8)*** [−37.9, −13.8]	−23.4 (6.3)*** [−36.5, −10.2]
Time 3	−6.6 (1.4)*** [−9.3, −3.9]	−10.3 (2.2)*** [−14.6, −5.9]	−8.9 (2.2)*** [−13.3, −4.5]	−8.6 (3.1)* [−14.9, −2.3]	−15.1 (5.2)* [−25.5, −4.6]	−15.7 (6.6)* [−29.3, −2.1]
Time 2	−1.6 (1.1) [−3.8, 0.6]	−7.0 (1.7)*** [−10.3, −3.7]	−2.8 (1.8) [−6.5, 0.9]	−4.3 (2.7) [−9.8, 1.2]	−6.3 (4.1) [−14.5, 2.0]	−11.4 (6.5) [−24.7, 2.0]
Attendance	−0.1 (0.0) [−0.1, 0.0]	−0.1 (0.1) [−0.2, 0.0]	−0.0 (0.1) [−0.1, 0.1]	−0.0 (0.1) [−0.2, 0.1]	−0.0 (0.1) [−0.3, 0.2]	−0.1 (0.2) [−0.5, 0.2]

Note:

* $p < .05$

*** $p < .001$.

Table 3

Parameter Estimates for Fixed and Random Effects: Mindfulness Outcome Variables

	FFMQ Observe (n = 47)	FFMQ Describe (n = 48)	FFMQ Act Aware (n = 48)	FFMQ Non-judgment (n = 47)	FFMQ Non-react (n = 44)
Fixed Effects	***β (SE)* (95% CI)**	***β (SE)* (95% CI)**	***β (SE)* (95% CI)**	***β (SE)* (95% CI)**	***β (SE)* (95% CI)**
Intercept	24.7 (1.8)*** [21.2, 28.3]	24.5 (1.7)*** [20.9, 27.9]	20.6 (1.4)*** [17.9, 23.4]	21.9 (1.6)*** [18.7, 25.0]	18.9 (1.4)*** [16.3, 21.7]
Time 4	3.6 (1.1)* [1.2, 5.9]	3.3 (1.1)* [1.0, 5.6]	4.6 (1.2)*** [2.2, 6.9]	5.3 (1.0)*** [3.2, 7.4]	5.4 (1.0)*** [3.3, 7.6]
Time 3	2.4 (0.9)* [0.4, 4.3]	2.7 (0.9)* [0.9, 4.6]	3.0 (1.0)* [0.9, 5.0]	2.7 (0.9)* [0.7, 4.6]	2.8 (0.9)* [0.9, 4.7]
Time 2	1.2 (0.7) [−0.2, 2.7]	1.4 (0.7)* [0.1, 2.8]	0.9 (0.8) [−0.7, 2.6]	0.8 (0.9) [−0.9, 2.6]	0.8 (0.8) [−0.7, 2.3]
Attendance	0.0 (0.0) [−0.0, 0.1]	0.0 (0.0) [−0.0, 0.1]	0.0 (0.0) [−0.0, 0.1]	0.0 (0.0) [−0.0, 0.01]	−0.0 (0.0) [−0.0, 0.0]

Note:

* $p < .05$

*** $p < .001$.

Table 4

Parameter Estimates for Fixed and Random Effects: Immunological Outcome Variables

	IL-6 (n = 25)	TNFa (n = 25)	CRP (n = 20)
Fixed Effects	***β (SE)* (95% CI)**	***β (SE)* (95% CI)**	***β (SE)* (95% CI)**
Intercept	5.5 (1.4)*** [2.5, 8.5]	1.4 (1.5) [−1.6, 4.5]	135.9 (106.0) [−86.1, 357.9]
Time 4	−0.1 (0.2) [−0.4, 0.2]	−0.8 (0.6) [−2.1, 0.5]	5.2 (18.6) [−32.9, 43.2]
Time 3	0.1 (0.2) [−0.4, 0.5]	−0.9 (0.6) [−2.1, 0.4]	19.3 (17.8) [−17.1, 55.6]
Time 2	- -	- -	- -
Attendance	−0.0 (0.0)* [−0.1, −0.0]	0.0 (0.0) [−0.0, 0.0]	0.1 (1.3) [−2.5, 2.7]

Note:

* p < .05

*** p < .001.