Research

The Effects of Mindfulness-Based Movement on Parameters of Stress

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Abstract

The Mindfulness-Based Stress Reduction program (MBSR) of Kabat-Zinn includes a combination of sitting meditation, yoga, and walking; thus, movement is not emphasized primarily to induce a state of awareness. The purpose of this study was to investigate the effects of a Mindfulness-Based Movement Program (MBM) in women on parameters of stress and coping; that is, in contrast to MBSR, MBM primarily emphasized yoga to cultivate awareness. This study investigated: (a) an objective measure of stress (the cortisol response to a laboratory stressor) following an 8-week MBM in year 1 participants only (n = 17; MBM group = 9; Control group = 8); (b) subjective measures of stress following an 8-week MBM in years 1 and 2 (n = 32; MBM = 16; C = 16); and (c) changes in coping style following an 8-week MBM in years 1 and 2 (n = 32; MBM = 16; C = 16). A mixed plot 2 (Group: TC or MBM) by 5 (Trial: Baseline, Stressor, Recovery 1, Recovery 2, and Recovery 3) repeated measures ANOVA was run for cortisol. Preliminary results indicated a strong trend towards a lowered cortisol response for the MBM group compared to the control group. A mixed plot 2 (Group: TC or MBM) by 2 (Time: Pretest, Post-test) repeated measures ANOVA was run for Spielberg's State Anxiety, the Perceived Stress Scale, and the Problem Focused Style of Coping Scale for the Suppressive, Reflective, and the Reactive Coping Style. There were significant main effects for time, group, and an interaction of time and group for Spielberg's State Anxiety and the Perceived Stress Scale. Significant differences were also found for time and the interaction of time and group for the Problem Focused Style of Coping for the Reflective Coping Style ($p < 0.05$). In conclusion, results indicate positive effects of the MBM program on perceived measures of stress and coping style in women.

Stress is a universal phenomenon that has become a global public health issue due to the documented detrimental effects of stress on mental, physical, and psychological health (Chong, Tsunaka, Tsang, Chan, & Cheung, 2011). Uncontrolled stress, frequently accompanied by anxiety, has a negative impact on quality of life and is associated with increased suffering and number of doctor visits (Sharma, 2013). Stress can increase an individual's vulnerability to chronic disease by decreasing immune function; additionally, stress is a risk factor for cardiovascular disease and hypertension, cancer, diabetes mellitus, chronic pain, and other conditions (Chong et al., 2011; Sharma, 2013). Mind-body interventions, a category of complementary and integrated therapies that has been investigated increasingly over the past three decades, include yoga and meditation as a means to enhance awareness and the self-regulation of stress (Riley & Park, 2015; Pascoe & Bauer, 2015). One internationally known intervention is Kabat-Zinn's Mindfulness-Based Stress Reduction Program (MBSR), which includes mindfulness meditation, hatha yoga (meditation in motion), and walking meditation to achieve awareness of the present moment (Kabat-Zinn, 1990).

Accumulating data on the effectiveness of yoga and mindfulness has led to integrated interventions to treat clinical disorders like hypertension, cancer, eating disorders, and chronic pain (Chong et al., 2011). Consequently, the growing popularity of yoga has pervaded public health contexts to where yoga is increasingly being practiced by healthy adults for health maintenance and disease prevention. A national survey estimates that 20 million Americans will use yoga at least once during their lifetime for wellness and to target health issues (Clarke, Black, Stussman, Barnes, & Nahin, 2015). Accordingly, investigation as to evidence-

based effects of yoga and mindfulness in healthy populations is needed.

In our study, we investigated the effects of a Mindfulness-Based Movement Program (MBM) on parameters of stress and coping in women; that is, MBM emphasized movement to cultivate awareness. Even though MBM is derived from Kabat-Zinn's original MBSR intervention, the primary medium to cultivate awareness of the present moment differs. Specifically, in contrast to previous research using MBSR (e.g., Tacón, Caldera, & Ronaghan, 2004; Tacón, McComb, Caldera, & Randolph, 2003), MBM emphasizes movement primarily in the form of yoga to cultivate mindfulness. Yoga is derived from the Sanskrit term Yuj, which means "to unite" or "to yoke" the mind, body, and spirit. When practicing yoga, movement is combined breath control and meditation (Parchad, 2004; Riley, 2004; Smith et al., 2011).

The format for the MBM program was similar to a schedule seen in a fitness and wellness center; group sessions were held 2 days a week for 1.5 hours each session for 8 weeks. In the MBSR program, there is 1 meeting a week for a 3-hour session for 8 weeks. Therefore, even though the total number of session contact hours between the two 8-week programs was the same (i.e., 24 hours), the format for the MBM program lends itself more easily to some type of structured movement for at least one hour two days a week. Note, however, that the MBM program did not have the 8-hour culminating retreat day as in the MBSR program. Another important difference is that sitting with the breath is emphasized in the MBSR program. In the MBM program, beginning on week 2, active breathing techniques as taught by Andrew Weil (1999) from the Self Healing Series were taught in the group sessions for the remainder of the program. Compact Discs (CDs) were given for home practice with eight different breathing techniques from this series. In the MSBR program, Hatha Yoga is introduced during weeks 3 and 4 for homework, alternating with the body scan, but not formally practiced while in the group sessions on a regular basis. In the MBM program, beginning week 3, Hatha Yoga was practiced in a group setting two days a week. Yoga was formally instructed at some point during each session for the reminder of the program (weeks 3–8). Yoga may not be the primary group activity but it was used as a tool to prepare the body for walking or to prepare the body to sit quietly for meditation. The MSM program is explained in more detail in the Methods section. In summary, the MBM is different from the MSBR program in that movement is the primary tool used to cultivate awareness.

Given the timeliness of yoga and funded research on mindfulness, the purpose of this study was to examine the effects of MBM on the cortisol response to a laboratory stressor, perceived stress, and coping style in an experimental group of healthy women compared to a control group. It was hypothesized that: (a) the post-MBM cortisol response to a standard laboratory psychological stressor would be lower in the MBM group compared to the control groups; (b) post-MBM subjective measures of stress would decrease in the intervention group compared to the control group; and (c) that there would be changes in coping style in the intervention group compared to the control group post-MBM. Funding for this two-year investigation was granted from the Laura W. Bush Institute for Women's Health (Amarillo, TX).

Method

Experimental Design

The study was approved by the Texas Tech University Health Science Center (TTUHSC) and the Texas Tech University (TTU) Institutional Review Board (IRB) before the study was formally initiated. Two years were needed to complete the study due to the rigourous demands of the study design and the difficulty of obtaining an adequate sample size in the 16-week semester that a college campus imposes (recruiting participants, screening, pretesting including blood sampling, 8-week intervention, post-testing including the collection of cortisol, and retention). The experimental design was a matched pretest-post-test randomized control group design. The control group was a no-treatment wait-list control condition. See Figure 1 for the experimental design.

Year 1 and year 2 participants were matched for resting plasma levels of cortisol and randomly assigned to an experimental or control group following the pretest blood collection trial. However, only year 1 participants participated in the post-test blood sampling of cortisol during a laboratory stressor due to limited funding. There were two different categories of post-tests: (1) objective measures of stress (blood serum cortisol levels); and (2) subjective measurements of stress (questionnaire data). Participants from both years participated in all subjective measurements of stress (questionnaire data) pretest and post-test. We investigated

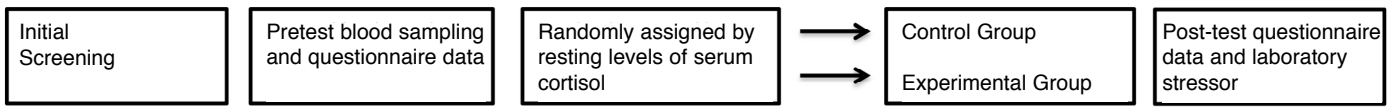

Figure 1. Experimental Study Design.

changes in these parameters following 8 weeks of MBM: (a) cortisol response to a laboratory stressor (an objective measure of stress) year 1; (b) subjective measures of stress years 1 and 2; and (c) changes in coping style years 1 and 2.

Selection and Payment of Participants

Female participants were recruited from university class announcements, flyers, and web announcements. Only females were recruited in order to maximize the homogeneity of the sample. All participants signed a consent form that was approved by the TTUHSC and TTU IRB. The consent form was signed before filling out the questionnaires required for study eligibly or testing for hematocrit level. In order to partake in the MBM program, participants must: (a) have an anxiety tendency as indicated by a score of > 35 on Spielberger's Trait Anxiety Scale (Spielberger, 1983); (b) not participate regularly in programmed recreation, sport, or physical activity; (c) be between the ages of 18 and 45 years of age; (d) answer "no" to all of the questions on the PAR-Q Screening Questionaire (Shephard, 1988); (e) not practice mind-body exercises or meditation (Yoga, Pilates, Tai Chi, etc.) during the study duration (unless the participant is in the experimental group); (f) not be taking medications that would affect heart rate, i.e., beta blockers, calcium channel blockers, etc.; (g) not have low hematocrit levels (<38%); and, (h) weigh at least 110 pounds.

In year 1, 26 women signed the consent form, but 8 of the 26 women did not qualify for study eligibility or failed to meet the number of days required to attend the 8-week MBM program. Blood samples could not be collected in the post-test blood sampling of cortisol during the laboratory stressor for 1 of the 18 women in year 1. Therefore, 18 women (n = 18; MBM = 10; C = 8) participated in the pretest blood collection trial for random assignment and all subjective measures of stress in year 1, but only 17 women (n = 17; MBM = 9; C = 8) completed the post-test blood sampling of cortisol during a laboratory stressor in year 1. There was an inability to obtain continuous blood samples during the stress protocol in only one woman year 1.

In year 2, 30 women signed the consent form; however, 16 did not qualify for study eligibility or failed to meet the number of days required to attend the 8-week MBM program due to scheduling conflicts. Therefore, the total number of women who completed the pretest blood collection trial for random assignment and all subjective measures of stress pretest post-test in year 2 was 14 (MBM = 6; C = 8).

Participants were paid for being in the study. The payment for specific tasks of the study were as follows: (a) pretest laboratory assessment protocol for random assignment ($30.00); and the (b) Trier Social Stress Test post-test protocol ($50.00). Payment occurred after completion of each testing period. There was not an obligation to complete all phases of the study to be paid. Additionally, the control group was given the option to attend and participate in the MBM program offered the following semester after the conclusion of their participation in the study.

In summary, over the two-year period, 56 women signed the consent form. Of these, 32 women (MBM = 16; C = 16) completed the pretest blood collection trial for random assignment and all subjective measures of stress pretest post-test (57%). Of these 32 women, 18 women participated in the post-test blood sampling of cortisol during the laboratory stressor in year 1 (due to limited funding) but only 17 women (MBM = 9; C = 8) completed all of the blood sampling trials required for analysis (94%). This was due to the collapse of their veins or difficulty inserting the catheter during sampling. Because the MBM program included daily practice outside of the structured class, participants could miss up to five classes as long as they were keeping up with their weekly practice and documenting their practice in their log book (MBM Manual). The average number of missed classes was 1.2 ± 1.5 (range, 0-5).

Testing Protocol

Each participant made three visits to the research laboratories located in the Exercise Sciences Center (ESC) at TTU. All laboratories were in compliance with the Occupational Safety and Health Administration (OSHA) standards for blood collection procedures.

Visit One: Screening. During the first visit, individuals completed the following screening assessment tools to determine study eligibility: (a) the Par-Q (Shephard, 1988); (b) Women's Health History Questionnaire (Robert-McComb & Mitchell, 2014); (c) Physical Activity Rating Scale (Jackson et al., 1990); (d) Spielberger's State Anxiety Inventory (Spielberger, 1983) (e) weight assessment; and (f) hematocrit levels.

Visit Two: Pretest questionnaire data and random assignment protocol. After determining eligibility, all testing was conducted between 0900 and 0100 h Monday through Friday on the TTU campus. Participants were asked to refrain from all food, alcohol, caffeine, gum chewing, or the use of tobacco products for three hours before their scheduled appointment. A short questionnaire was used to assess participant's intake of caffeine or other dietary stimulants that might affect cortisol. Subjective measures of stress were quantified through questionaires, specifically: (a) Spielberger's State Anxiety Scale (Spielberger, 1983); (b) the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) and coping style as measured by the Problem-Focused Style of Coping Inventory (Heppner, Cook, Wright, & Johnson, 1995). Spielberger's State Anxiety Scale

consist of 20 statements with answers in a Likert format ranging from 1 (*not at all*) to 5 (*very much so*). An example of one of the statements is "I feel worried." Participants would then rate how they felt at that time from 1 to 5. The Perceived Stress Scale had a similar Likert format with answers ranging from 1 (*never*) to 5 (*very often*). An example statement is "In the past month, how often have you felt that you could not cope with all that you have to do?" The Problem-Focused Style of Coping Inventory consists of statements about how people think, feel, and behave as they attempt to resolve personal difficulties and problems in their day-to-day lives. An example of a question is "I avoid even thinking about my problems." Responses were in a Likert format with answers ranging from 1 (*almost never*) to 5 (*almost all of the time*). Participants' answers were scored using total points for answers to questions that fit into each category: *Reflective* (pause and think before action); *Suppresive* (feelings are repressed); or *Reactive* (impulsive backlash). Following the completion of questionaire data, we began the process of collecting resting levels of cortisol. Resting levels of cortisol were used to match the participants and randomize them to a control group or an experimental group.

An indwelling IV catheter was inserted by a certified phlebotomist and flushed. Three blood samples (5cc's) were taken at 10-min intervals while the participants assumed a seated position.

Blood samples were preferred rather than saliva to measure cortisol levels. Saliva can become contaminated with mucus, exogenous and topical hormones, and make-up on lips/hands (Veining & McKinley, 1987; Lac, 2001). Plasma levels of cortisol (25µL plasma aliquots) were measured in duplicate in all samples by solid phase radioimmunoassay (Diagnostic Products Corporation; Los Angeles, CA). The average of three blood samples was used to obtain the mean for resting baseline cortisol measurements in µg/dl. Resting baseline cortisol measurements (µg/dl) were matched as closely as the measurements allowed. Table 1 visually demonstrates the procedure used to match participants.

		5 cc's of Blood		
Procedure	Insert IV	Sample 1	Sample 2	Sample 3
Timeline	-30	-20	-10	0
Event	Flush	Baseline Average		

Figure 2. Blood sampling for random assignment.

The matched samples were randomly divided between the MBM and C group. There were no significant differences initially between groups for resting levels of cortisol. However, the values that need to be reported in order to interpret our study results are the pretest differences in resting levels of cortisol for the women who completed the study since this was the condition for random assignment. There were no pretest differences in cortisol for the women who completed the post-test laboratory stressor in year 1 $t(15) = .87$, $p = 0.39$ [$n = 17$; MBM ($n = 9$); C ($n = 8$)], nor were there any pretest differences in cortisol for the number of women who completed the questionnaire data $t\,(30)$ 0.2, $p = 0.8$ [$n = 32$; MBM ($n = 16$); C ($n = 16$)]. Values are reported in the Results section.

Visit Three: Laboratory stressor and post-test questionnaire data. The Trier Social Stress Test (TSST) was replicated exactly as described by Kirschbaum, Pirke, and Helljammer (1993) and used for the post-test laboratory stressor for year 1 participants only. The TSST consists of a 10-min anticipation period and a 10-min test period that uses a simulated free speech and the performance of mental arithmetic problems in front of an audience. A tape recorder and video camera were used as tools to increase anxiety during the 10-min test period in front of an audience. The audience was composed of three panelists (two male and one female or two females and one male—always mixed) dressed in white lab coats sitting behind a table with clipboards taking notes. Anticipatory anxiety was expected in the period immediately preceding the TSST (McComb, Norman, Qian, Veldhuis, & McGlone, 2006). Therefore, the measurement of cortisol at the beginning of the stressor was used for the 20-min average for this time segment (Behnke & Beatty, 1981; Kirschbaum et al., 1993). Three collection periods were averaged for baseline and two collection periods were averaged for each additional time interval. Table 2 depicts the collection of cortisol and the time intervals analyzed for changes across trials and between groups for the post-test.

Post-test questionnaire data were collected from all study participants (both year 1 and year 2). Subjective measures of stress were quantified through questionaires as in the pretest, specifically: (a) Spielberger's State Anxiety Scale (Spielberger, 1983); (b) the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) and coping style measured by the Problem-Focused Style of Coping Inventory (Heppner, Cook, Wright, & Johnson, 1995).

	Insert IV Saline Flush	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11
Amount	3 cc's	5 cc's	5 cc's	5 cc's	5 cc's	5 cc's	5 cc's	5 cc's	5 cc's	5 cc's	5 cc's	5 cc's
Time	–10 min	0 min	10 min	20 min	30 min	40 min	50 min	60 min	70 min	80 min	90 min	100 min
Samples Used for Average		Baseline		Stressor			Recovery 1		Recovery 2		Recovery 3	

Figure 3. Blood sampling during the laboratory stressor.

Intervention: Mindfulness-Based Movement Program

A weekly manual was created for the intervention by one of the study researchers who was certified in MBSR from the University of Massachusetts Medical School. The manual, *Mindfulness-Based Movement*, outlined the 8-week program. The basic format, principles, and techniques of Kabat-Zinn's MBSR program remained the foundation for the MBM program (Kabat-Zinn, 1990). In our experiment, however, movement was the primary behavior used to cultivate mindfulness or awareness of the present moment. The structured intervention occurred two times a week for 90 minutes per session on the TTU campus in a quiet room. The first 15–30 min of the intervention was used to discuss the concepts of the traditional MBSR program. The lecture consisted of didactic, inductive, and experiential modes of learning regarding stress responses and mindfulness skill development training. During the last 60–90 minutes of class, the participants received training in several basic core mindfulness techniques: the body scan, breathing techniques such as diaphragmatic breathing, mindful walking, hatha yoga, and sitting meditation. The last six weeks of the sessions included yoga for the majority of the class sessions or at least some part of the class format. For example, if sitting meditation was the teaching, yoga was used to prepare the body to sit quietly. The Body Scan was only practiced week 1 and then CDs were given for homework practice. The body scan involved a gradual and thorough sweeping of attention through the entire body from feet to head, focusing non-critically on any sensations or feelings in body regions with periodic suggestions of breath awareness and relaxation. Diaphragmatic or "belly breathing" is a basic parasympathetic nervous system activity that normally induces the relaxation response; it is in contrast to shallow breathing, which is associated with sympathetic nervous system activation during stress. Some type of breathing technique was practiced every week following week 2. Hatha yoga involved simple stretches and postures designed to strengthen and relax the musculoskeletal system and develop mindful movement of the body. Yoga was practiced beginning week 3 and continued to be a part of the class for the remainder of the sessions. Mindful walking involved paying attention to and being mindful of the body and the physical sensations that occur during the everyday activity of simply walking. Sitting meditation involved mindful attention of the breath and a heightened state of observational yet non-judging awareness of cognition and the stream of thoughts and distractions that constantly flow through the mind. Both mindful walking and sitting meditation were preceded by yoga to prepare the body for either walking or sitting meditation.

Activities for the MBM group varied. The primary structured movement for the participants was to practice yoga twice weekly in class. There were two certified yoga instructors who led the sessions consistently through the program. During the yoga sessions, calories expended and total movements were measured with Actical (Bio-Lynx; Montreal, Quebec) monitoring straps placed around the wrists, hips, and ankles. Ultimately, homework consisted of both mental and physical (mind and body) strategies to induce mindfulness. Home practice included instructions for the body scan, hatha yoga, breathing exercises, and sitting meditation and was guided by the CD. The breathing exercises were from many sources including Andrew Weil, as mentioned above. The exercises included basic breathing techniques taught in yoga such as the stimulating breath, *kapalabhati,* and single and alternate nostril breathing, among others.

Although mindful walking was introduced for home practice, participants could choose the activity that brought about the greatest relief from stress that had been presented in class during the eight weeks. The participants were given pedometers (Omron Healthcare Inc.) to measure the total number of steps and calories expended per day. Additionally, participants turned in log sheets each week that listed the number of minutes the participants spent each day in breathing exercises, awareness exercises, sitting meditation, hatha yoga, walking, and the body scan. Tables 3 and 4 list the average weekly activities for the study participants.

Actical Wrists		Actical Hips		Actical Ankles		Pedometers		
Calories	Movements	Calories	Movements	Calories	Movements	Calories	Steps	
57.4	35551.6	40.2	18164.1	36.1	11998.4	724.8	18191.7	
(5.8)	(11267.8)	(18.1)	(11360.4)	(5.5)	(6225)	(406)	(3561.4)	
Note: MBM is Mindfulness-Based Movement								

Table 1. MBM weekly movements (M +/- SD).

Body Scan	Breathing Techniques	Sitting Meditation	Hatha Yoga	Walking	
80.42 min	60.7 min	20.26 min	30.49	56.22 min	
(100.22)	(58.5)	(24.29)	(39.83)	(48.12)	
Note: MBM is Mindfulness-Based Movement					

Table 2. MBM weekly activities outside of the structured class (M +/- SD).

Debriefing of the Participants

Debriefing of the participants occurred after all testing had been completed. In the debriefing, the researchers told the participants that the reviewers in lab coats during the Trier Social Stress Test were not really trained to observe non-verbal behavior nor were they critically judging the participants' behavior. They were also told that they were not videotaped and voice recorded and that their name or their data would not be disclosed.

Statistical Analysis

SPSS and Excel software was used to analyze the data. Probability of acceptance of the hypothesis was set at $p < 0.05$. Descriptive statistics were used to define the participant population. Independent t-tests between groups were run on the pretest dependent variables in order to be able to state that the differences that were found at the completion of the study were due to the treatment and not existing pretest differences. If pretest differences were found, a statistic that controlled for pretest differences was employed.

A mixed plot 2 (Group: TC or MBM) by 5 (Trial: Baseline, Stressor, Recovery 1, Recovery 2 and Recovery 3) repeated measures ANOVA was run for cortisol. Figure 3 depicts the five trials (along with the samples used for each trial) that were analyzed for changes in blood serum level of cortisol across trials. Because of the large variability in the data, each set of an individual's observations was normalized by her baseline value. All changes are expressed as percentage change from each individual baseline value.

A mixed plot 2 (Group: TC or MBM) by 2 (Time: Pretest Post-test) repeated measures ANOVA was run for Spielberg's State Anxiety, the Perceived Stress Scale, and the Problem Focused Style of Coping Scale for the Suppressive, Reflective, and the Reactive Coping Style. If pretest differences were found, an independent t-test on the delta score (difference between pretest and post-test) was employed to control for pretest differences.

Results

Descriptive statistics for all study participants ($n = 32$) were as follows: (a) age (years) = 22.7 ± 3.9; (b) height (cm) = 162.3 ± 7.8; (c) weight (kg) = 63.2 ± 10.8; (d) body mass index = 23.9 ± 3.7 (e) physical activity rating scale = 1.2 ± 1.1; and (f) estimated V02 max = 32.7 ± 4.5 (Jackson et al., 1990). Pretest differences for questionnaire data are reported in Table 5 along with the means (*M*) and standard deviations (*SD*) for the resting level of cortisol (µg/dl) used for random assignment.

Variable	C M & SD	MBM M & SD	t-statistic (two-tailed)	Probability
Resting Level of Cortisol (µg/dl)				
Year 1 Participants	13.5(8.6)	16.6(5.8)	0.87	0.4
Year 2 Participants	17.2(12.2)	16.2(7.9)	0.28	0.78
Spielberger State Anxiety	43.3(8.7)	49.2(10)	2.04	0.08
Perceived Stress Scale	34.1(5.4)	34(5.8)	0.78	0.43
Problem Focused Style of Coping				
Suppressive	15.9 (4.5)	17 (3.8)	0.76	0.45
Reflective	19.9 (6.3)	20.8 (5.4)	0.42	0.68
Reactive	14.8 (3.5)	17.8 (3.9)	2.3	0.03*
Note: *statistically significant				

Table 3. Pretest differences between Mindfulness-Based Movement (MBM) and control (C) group.

	Baseline	*Stressor*	*Recovery 1*	*Recovery 2*	*Recovery 3*
MBEP	15.56 ± 6.38 (6.45 – 24.67)	17.22 ± 6.13 (6.75 – 25.85)	16.20 ± 4.10 (8.15 – 24.16)	14.36 ± 4.36 (3.94 – 24.16)	14.36 ± 4.36 (8.87 – 20.73)
CTRL	13.49 ± 8.63 (4.61 – 26.50)	14.43 ± 7.91 (4.57 – 26.66)	17.88 ± 9.90 (6.94 – 32.66)	15.17 ± 7.94 (5.93 – 29.31)	15.44 ± 9.76 (3.64 – 33.04)

Table 4. Cortisol µg/dl (M +/- SD and range) for each group during the Trier Social Stress Test.

Cortisol

No significant effects were found for trial [$F(4,60) = 1.5$, $p = 0.22$, power = 0.430]; group [$F(1,15) = 3.04$, $p = 0.1$, power = 0.37]; or the interaction between trial and group [$F(4,60) = 1.2$, $p = 0.3$, power = 0.36]. Table 6 depicts M and SD for each trial for both groups. Figure 1 graphically depicts the normalized data adjusted to baseline.

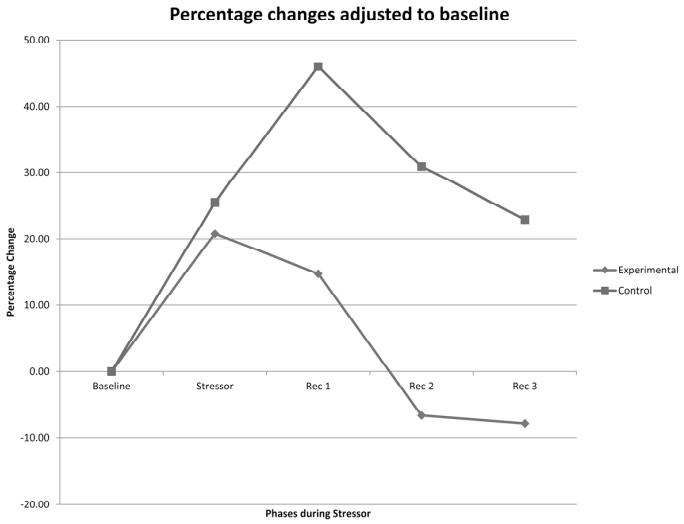

Figure 4. Normalized cortisol data.

State Anxiety

There was a significant main effect for time [$F(1,30) = 12.86$, $p = 0.001$, power = 0.934]; group [$F(1,30) = 14.78$, $p = 0.001$, power = 0.960]; and the interaction of time and group [$F(1,30) = 10.86$, $p = 0.001$, power = 0.934]. See Table 7 for *M* and *SD*.

Perceived Stress

There was a significant main effect for time [$F(1,30) = 14.2$, $p = 0.001$, power = 0.954]; [group, $F(1,30) = 7.6$, $p = 0.010$, power = 0.960]; and the interaction of time and group [$F(1,30) = 10.86$, $p = 0.001$, power = 0.762]. See Table 7 for *M* and *SD*.

Problem Focused Style of Coping

Reflective. There was a significant main effect for time [$F(1,30) = 5.9$, $p = 0.021$, power = 0.651]; and the interaction of time and group [$F(1,30) = 6.9$, $p = 0.013$, power = 0.720]. There was not a significant effect for group [$p = 0.420$]. See Table 7 for *M* and *SD*.

Reactive. Because there was a significant pretest difference, an independent t test was run between groups on the delta score or the difference score from pretest to post-test to account for pretest differences. There were no significant differences between groups [$p = 0.5$]. See Table 7 for *M* and *SD*.

Suppressive. There was a significant main effect for time [$F(1,30) = 23.84$, $p = 0.000$, power = 0.954]; group [$F(1,30) = 7.6$, $p = 0.010$, power = 0.997]; but there was not a significant effect for group [$p = 0.179$] and no interaction of time and group [$p = 0.240$]. See Table 7 for *M* and *SD*.

Variable	C (*n*=16)		MBM (*n*=16)	
	Pretest	Post-test	Pretest	Post-test
State Anxiety	49.25 (10.03)	48.69 (14.54)	43.31 (8.75)	30.06 (7.5)
Perceived Stress	34.12 (5.43)	31.69 (8.59)	32.56 (5.84)	22.31 (6.53)
Coping Style				
Suppressive	17 (3.83)	14.5 (5.45)	15.88 (4.49)	11.75 (3.67)
Reflective	20.8 (5.4)	20.56 (6.6)	19.9 (6.3)	24.56 (6.6)
Reactive	17.81 (3.95)	15.69 (4.08)	14.7 (3.49)	11.69 (2.52)

Table 5. Mindfulness-Based Movement (MBM) and control (C) group inventories (M +/- SD).

Discussion

Limitations of the study include the low power of the test statistic in some instances, lack of generalization of the results to other populations that would benefit from the study (e.g., males, children, elderly), as well as payment to the study participants. Therefore, the study results can only be generalized to young college age women. For the physiological stress response (cortisol) to the laboratory stressor (Trier Social Stress Test), the power of the test statistic was low: 0.36-0.43. Optimal power is 0.8 (Cohen, 1988). The power of the test statistic for the Perceived Stress and Trait Anxiety data was good, however: 0.76-0.96. For coping style, power ranged from 0.12-0.99. Another weakness, which we controlled for as much as possible by normalizing the data, was that there was no documentation of habitual sleep-wake schedule or wake time. Therefore, the variability in baseline cortisol values between participants could be the actual time of sample collection and sleep-wake schedule.

The strength of the study is the expertise of the author of the manual and the creative design of the intervention. The intervention incorporated insights and strengths from many renowned sources: the Arizona Center for Integrative Medicine, Andrew Weil; the Stress Reduction Clinic and the Center for Mindfulness, Jon Kabat-Zinn; *The Power of Now: A Guide to Spiritual Enlightenment* by Eckhart Tolle (Tolle, 2004). One yoga teacher was also certified through YogaFit, the American Council of Exercise, and the American College of Sports Medicine in Clinical Exercise Physiology. The second yoga teacher was certified in Restorative Yoga. Another strength of the study was the rigor of the study design. Most studies in stress management utilize questionnaire data, which is valuable but subjective. In this study, the researchers examined questionnaire data in addition to the physiological stress response by analyzing cortisol.

Cortisol is a steroid hormone—a glucocorticoid that is released in response to stress and low blood glucose. Diurnal cycles of cortisol levels are found in humans, with higher levels peaking early in the morning and the lowest level occurring after midnight. Its activation or secretion to a stressor is not immediate; in fact, cortisol is known to peak during recovery following a stressor (McComb et al., 2006). Because of the characteristics of cortisol, certain conditions exist when validating the measurement of cortisol. It is important that the participant not eat at least 3-4 hours prior to measurement. In research studies when comparing groups, all participants must be measured within the same time frame. The blood collection time frame was wide, 0900 and 0100 h, due to scheduling difficulties and the time conflicts for participants for early morning testing.

Learning how to manage the stress response and control cortisol release is a positive coping tool. Elevated levels of stress resulting in high cortisol secretion can have negative effects on long-term health outcomes (Yehuda & McEwen, 2004). Cortisol blocks glucose entry into the cell, which impairs glucose regulation, especially in the diabetic population (Powers & Howley, 2012). High levels of cortisol weaken the immune system, making individuals more susceptible to disorders of the immune system and more susceptible to disease (Khansari, Murgo, Faith, 1990). Cortisol also decreases bone formation, favoring long-term development of osteoporosis (Chyun, Kream, Raisz, 1984).

While we saw a strong trend in lowered cortisol release during a stressor (see Figure 4), we did not see a significant difference statistically between the C group and the MBM group. However, the power of the test statistic was very low. We hope to replicate this study in the future using a larger sample size to increase the power of the test statistic. The present results are promising, however. A healthy neuroendocrine system responds with a heightened physiological response to a stressor—in this case, cortisol—yet a healthy system is able to return to homeostasis sooner than a system that has exceeded its allostatic load (Robert-McComb, Chyu, Tacon, & Norman, 2015). Allostatic load represents the physiological consequences of chronic exposure to fluctuating or heightened neural or neuroendocrine response to a stressor. As can be seen in Figure 2, cortisol secretion for the experimental group (quicker return to baseline) compared to the control group was complemented by a significant difference in both state anxiety and perceived stress between the MBM group and the C group following the 8-week intervention. There was a 1% decrease in state anxiety in the C group and a 31% decrease in the MBM group. For perceived stress, there was 7% decrease in the C group and a 31% decrease in the MBM group. A reduction in perceived stress following integrated yoga in women during pregnancy has been found (Satyapriya, Nagendra, Nagarathna, & Padmalatha, 2009). Yoga has also been shown to have a positive effect on emotional outcomes and fatigue in women with disease (Danhauer et al., 2009).

There was also a significant increase in the reflective style of coping in the MBM group, but not in the C group. There was almost a 1% increase in the C group and a 28% increase in the MBM group. This pattern is not surprising since the body scan, siting meditation, yoga, and breathing exercises could be practiced with the use of an audio CD that was given to the participants for home practice. All of these exercises involve a heightened sense of awareness. The body scan seemed to be the most popular activity practiced outside of class, followed by breathing exercises (see Table 4). For the reflective style of coping, one would think that sitting meditation would be the most beneficial. Even though sitting meditation was practiced in the structured

class setting, participants found it difficult to practice at home based on the reported minutes that were spent in the practice and class discussions (see Table 4).

A higher association between the time spent in mindful yoga and improved wellbeing has been found relative to positive health outcomes and other forms of mindfulness, such as the body scan or sitting meditation (Carmody & Baer, 2008). As stated, the outside homework chosen by the participants in our study most often to cultivate awareness was the body scan. The fact that yoga was already practiced twice a week in the formal class setting may have affected their choice of awareness mediums. Another possibility for choosing the body scan most often was that they had been active all day walking from class to class and, at night, they chose the body scan as a form of relaxation. Results from a similar study that examined 27 first- and second-year medical students found that self-regulation and self-compassion increased significantly following an elective course entitled Embodied Health (Bond et al., 2008). The course combined yoga and meditation with neuroscience didactics. Even though the medical students' perceived stress levels fell, the changes did not reach significance. However, another study examining a workplace yoga intervention found that the yoga group (n = 37) compared to the control group (n = 37) had scores that were significantly lower for perceived stress, back pain, sadness, and hostility, and were substantially higher for feeling self-assured, attentive, and serene (Hartfiel et al., 2014). All of these results support our finding in the present study, that mindfulness-based movement increases wellbeing.

According to the Anxiety and Depression Association of America (2015), anxiety disorders affect 40 million adults in the United States age 18 and older. Women are twice as likely to be affected by a generalized anxiety disorder as men. Anxiety disorders are highly treatable, yet only about one-third of those suffering receive treatment.

Given the research about the benefits of yoga and mindfulness for health and wellness in the literature (Hartfiel et al., 2014; Carmody & Baer, 2008; Bond et al., 2008) and the promising results from our study, a MBM program for managing stress is warranted, especially for women. A MBM program could easily be organized in communities at churches, schools, and social gathering places. There would probably be someone within the group that would have a background in teaching who could lead the program. If a yoga teacher was not among the group members, there are many sources to purchase yoga videos that could be shown in a group setting.

Walking together as a group could also be a tool to cultivate calmness. Research has shown that regular physical activity can have a positive effect on health outcomes (De Moor, Beem, Stubbe, Boomsma, & De Geus, 2006; Demark-Wahnefried, 2006; Stubbe, De Moor, Boomsma, & De Geus, 2006). Social support alone could be beneficial. Social support has been shown to decrease resting blood pressure in women (Hughes & Howard, 2009).

However, caution must be used when stating that one type of program would be beneficial for all. There are many factors that contribute to increased health outcomes following an intervention; some studies have even found that social support may not be a factor in health promotion (Paukert et al., 2010). Therefore, for the intervention to be health promoting, it must meet the individual's personal needs (Luszczynska & Cieslak, 2005). An advantage of the MBM program is that it allows flexibility to cultivate a climate for coping with stressors in each individual's life.

Conclusion

The MBM program, as structured in this study, decreased state anxiety and perceived stress significantly following eight weeks of practice. Even though the cortisol response for the experimental group returned to baseline following the stressor much sooner than the control group (see Figure 2), the results were not significantly different between groups. We recommend that future studies have a larger sample size if examining hormonal response. The MBM manual is available for future research by contacting the study authors. We also believe that this study should be replicated with a larger sample size in women and also in males and in the elderly population.

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