

Effects of Brief and Sham Mindfulness Meditation on Mood and Cardiovascular Variables

Fadel Zeidan, PhD,¹ Susan K. Johnson, PhD,² Nakia S. Gordon, PhD,² and Paula Goolkasian, PhD²

Abstract

Objectives: Although long-term meditation has been found to reduce negative mood and cardiovascular variables, the effects of a brief mindfulness meditation intervention when compared to a sham mindfulness meditation intervention are relatively unknown. This experiment examined whether a 3-day (1-hour total) mindfulness or sham mindfulness meditation intervention would improve mood and cardiovascular variables when compared to a control group.

Methods: Eighty-two (82) undergraduate students (34 males, 48 females), with no prior meditation experience, participated in three sessions that involved training in either mindfulness meditation, sham mindfulness meditation, or a control group. Heart rate, blood pressure, and psychologic variables (Profile of Mood States, State Anxiety Inventory) were assessed before and after the intervention.

Results: The meditation intervention was more effective at reducing negative mood, depression, fatigue, confusion, and heart rate, when compared to the sham and control groups.

Conclusions: These results indicate that brief meditation training has beneficial effects on mood and cardiovascular variables that go beyond the demand characteristics of a sham meditation intervention.

Introduction

MEDITATION TRAINING HAS been associated with positive effects on health and cognition.^{1–12} Mindfulness meditation, specifically, is based on focusing on the flow of the breath, while allowing discursive thoughts to “simply pass.”¹³ Mindfulness meditation teaches the individual to appraise everyday life events in a manner that does not initiate negative stress responses.¹⁴

The majority of meditation research examines individuals with extensive training or participants in Mindfulness Based Stress Reduction (MBSR) programs.⁵ MBSR requires considerable expense, a trained facilitator, a day of silent retreat, and takes approximately 8 weeks to complete. Researchers have also examined adept meditators.^{1,2,4} Studying adept meditators has contributed immensely to understanding changes in attention, emotion regulation, and the concomitant neural activity in the brain. However, the current literature does not speak directly to those who do not have the time or ability for such commitments. If brief training could promote well-being, then the benefits of meditation may reach a wider audience.

The few studies that have examined brief meditation training report positive results on a variety of outcomes.^{15–17}

Lane and colleagues¹⁵ utilized a mantra-based meditation in four 1-hour sessions, and found reductions on negative mood and stress. Research in our laboratory has found that 3 days of mindfulness meditation training significantly reduced pain ratings and sensitivity when compared to other cognitive manipulations.¹⁷ Tang and colleagues¹⁶ found that five training sessions on integrative body-mind training was effective in improving cognitive functioning, and in decreasing negative mood and stress-related cortisol levels.

Research suggests that mindfulness meditation's benefits may be associated with stress reduction,^{18,19} enhanced cognitive control,¹ and/or emotion regulation.⁴ However, meditation's positive effects may also be associated with time spent with the facilitator, and/or with demand characteristics. By including an intervention that resembles meditation and labeling such training as a mindfulness meditation intervention, we attempted to distinguish the effects of anxiety ratings, facilitator attention, and expectations from the cognitive focus of mindfulness.

It is well established that elevated blood pressure (BP) is associated with cardiovascular disease.^{19,20} Interestingly, long-term meditation practice has been shown to reduce heart rate (HR) and BP.^{18–23} The hypothesized mechanism by which meditation has this effect is by inducing a feeling of relaxation,

¹Department of Neurobiology and Anatomy, Wake Forest University School of Medicine, Winston-Salem, NC.

²Department of Psychology, The University of North Carolina, Charlotte, NC.

which decreases physiological arousal.^{18–23} To this extent, we examined whether 3 days of mindfulness meditation training would improve cardiovascular variables. We were also interested in whether this brief mindfulness training would improve mood, since meditation training is associated with decreased negative mood.^{24,25} We did not expect that 3 days of mindfulness training would decrease reports of depression, fatigue, or vigor. We expected that improvements in depression would require longer meditative practice.²⁶ We hypothesized that both the mindfulness and sham meditation group would exhibit decreases in state anxiety, because breathing exercises have been found to reduce anxiety.^{5,27}

Methods

Participants

Participants were student volunteers recruited through the Psychology Department subject pool. The students responded to a study that requested volunteers who were interested in learning how to meditate and who did not have any prior experience with meditation. Eighty-eight (88) students volunteered for the study, and 82 (sham = 27; meditation = 29; control = 26) completed all three sessions of their respective interventions. Data from the 6 students who did not complete all three sessions were not included. The median age for the participants was 19 years. Forty-eight (48) women and 34 men (white = 60%, African American = 23%, Hispanic = 4%, other = 3%, Asian = 3%, Native American = 3%) completed the study. The protocol was approved by the University institutional review board. Table 1 compares the participants in each of the three groups on demographic variables and all of the baseline measures collected in the study.

Interventions

The three groups underwent 3 consecutive days of training for 20 minutes a day. All of the groups included 5–8 participants and met in the same room at approximately the same time of day.

Mindfulness meditation. Mindfulness training was modeled on basic Vipassana meditation skills.¹³ Training was conducted by a facilitator with 8 years of training in mind-

fulness meditation interventions. Meditators were not asked to complete meditation homework, or practice outside of the intervention setting, contrary to the standard practice in MBSR. Participants were told that the mindfulness intervention had no religious teachings associated with it.

In session 1, small groups of 5–8 participants sat in chairs, and were instructed to close their eyes and relax. They were then instructed to focus on the flow of their breath.¹³ If a random thought arose, they were told to passively notice and acknowledge the thought and to simply let “it” go, by bringing the attention back to the sensations of the breath. The last 7 minutes of session 1 were held in silence, so that the participants could effectively practice mindfulness meditation. In session 2, the facilitator instructed participants to focus on the “full breath,” (sensations in the nostrils and abdomen); the last 7 minutes of session 2 were held in silence. Session 3 was an extension of sessions 1 and 2. As a manipulation check, each subject was asked, individually, “if they felt that they were truly meditating” after each meditation session. Every subject responded with a “yes” to this question across all sessions.

Sham mindfulness meditation. The main purpose of the sham mindfulness meditation group was to examine whether breathing exercises and believing that one is meditating would affect outcome variables. The same facilitator conducted both the sham and the mindfulness meditation intervention. The sham group was introduced to mindfulness meditation in the same manner as the meditation group. Sham meditation instruction was based on breathing exercises and reiterating the notion that they were meditating. In each session, the participants were told, approximately every 2–3 minutes, to “take deep breaths as we sit in meditation.” We matched time spent giving instructions in the sham meditation intervention to the mindfulness intervention. The last 7 minutes of each session were held in silence to replicate the meditation group’s sessions. This intervention differed notably from the mindfulness training because participants were not given the guided instructions (e.g., focusing on the flow of the breath) imperative for mindfulness meditation. As a manipulation check, after each session, participants were asked, individually, if they felt that they were truly meditating. Every subject in this group answered “yes” to this question.

TABLE 1. GROUP COMPARISON ON BASELINE SCORES FOR EACH OF THE MEASURED VARIABLES

	<i>Sham</i>	<i>Meditation</i>	<i>Controls</i>	F/χ^2 *	<i>p</i>
<i>Baseline mean (SD)</i>					
Age	20 (2.54)	21 (5.64)	21 (3.71)	0.25*	0.78
White	67%	72%	39%	18.18*	0.11
Female	56%	72%	56%	4.04*	0.13
SBP	119.04 (16.33) ^a	134.14 (22.44) ^b	127.81 (22.74) ^b	3.73	0.03
DBP	62.93 (9.27) ^a	67.89 (11.49) ^b	71.81 (12.74) ^b	4.16	0.02
HR	77.44 (12.25)	73.90 (15.52)	68.96 (10.94)	2.78	0.07
SAI	40.19 (10.80)	40.93 (8.42)	35.19 (10.46)	2.65	0.08
POMS	32.56 (28.22)	35.55 (29.46)	23.69 (32.71)	1.13	0.33

*Chi-square.

^{a,b}Means having the same superscript are not significantly different at $p < 0.05$.

df, 2,64.

SD, standard deviation; SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate; SAI, State Anxiety Inventory; POMS, Profile of Mood States (total).

Control group. The purpose of the control group was to compare the mindfulness and sham meditation groups to a nonmanipulated group that met for the same time period. Control group participants also believed that they were registering for a mindfulness intervention. However, the participants met for 3 consecutive days and were told to sit in a chair for 20 minutes each session. They were allowed to speak to each other, but not permitted to do homework or fall asleep.

Materials

The Profile of Mood States (POMS)

The POMS²⁸ is a 65-item inventory that measures psychologic distress by rating adjective like statements (e.g., I feel calm) on a Likert scale (0–4). The POMS consists of six subscales: tension, depression, confusion, fatigue, anger, and vigor. The POMS was used to compare group differences from baseline.

The State/Trait Anxiety Inventory (STAI)

The State Anxiety Inventory (SAI)²⁹ is a 20-item subscale of the STAI. The SAI has been reported to exhibit high internal consistency (Cronbach α of 0.73). We administered the SAI because previous research found that both meditation practice and relaxation training decrease state anxiety.^{8,14}

Cardiovascular ratings

The Dinamap 5000 was used to measure changes in HR and BP. An arm cuff was placed around each participant's nondominant arm. Cardiovascular variables were assessed before and immediately after sessions 1 and 3. Arm cuffs were left on during each session's respective intervention, in order to reduce disruption.

Procedure

The experiment was run in 12 weeks across two college semesters. Students were assigned to groups based on the week that they signed up for the study, but each student expected to be engaged in meditation. Each week a different intervention was run and interventions were randomly assigned to weeks. Each of the interventions met on the same days of the week at the same time of day. In session 1, the participants completed the SAI, POMS, and cardiovascular assessments, followed by a 20-minute intervention. After the intervention, participants completed the SAI and cardiovascular assessments to conclude session 1. In session 2, participants completed the SAI prior to and following the intervention. In session 3, the participants completed the SAI, cardiovascular assessments before the intervention, and all of the measures after the intervention. Sham and control group participants were also invited to participate in a meditation training following the completion of the experiment, but they all declined.

Statistical Analyses

Statistical Package for Social Sciences was used to conduct all statistical analyses. Scores from each of the participants on the POMS, SAI, and cardiovascular measures were analyzed

with separate mixed analysis of variances (ANOVA) to test for the between-group effect of intervention training and the within-group effect of baseline/postintervention training. Because of the unequal group sizes, type III sums of squares were used to calculate the F values. Significant interaction terms were examined with simple effects tests to determine the source of the interaction. A significance level of 0.05 was used for all statistical tests.

Results

Demographic information and baseline scores for all measured variables are presented for each group in Table 1. Significant group differences were not apparent on any of the demographic (age, gender, ethnicity), or baseline measures except for systolic and diastolic BP. The sham mindfulness meditation group exhibited lower systolic and diastolic BP at baseline, when compared to the other groups.

POMS

The total POMS scores for each of the groups are presented in Figure 1. To assess hypothesized differences between groups on total negative mood, total POMS scores were analyzed with a mixed ANOVA. There was a significant decline in total POMS scores across session, $F(1,79) = 35.19$, $p < 0.01$, $\eta^2 = 0.31$, and the session effect varied by group, $F(2,79) = 5.62$, $p < 0.01$, $\eta^2 = 0.13$. In order to examine which intervention was more effective in improving overall mood, a simple effects test measured pre/post differences in each group. The tests showed a significant decline in total negative mood for all of the groups. However, examination of the effect sizes revealed that the meditation intervention, $F(1, 28) = 29.81$, $p < 0.01$, $\eta^2 = 0.52$, had the strongest effect on reducing negative mood when compared to the sham, $F(1, 26) = 5.06$, $p = 0.03$, $\eta^2 = 0.16$, and control groups, $F(1, 25) = 5.21$, $p = 0.03$, $\eta^2 = 0.17$.

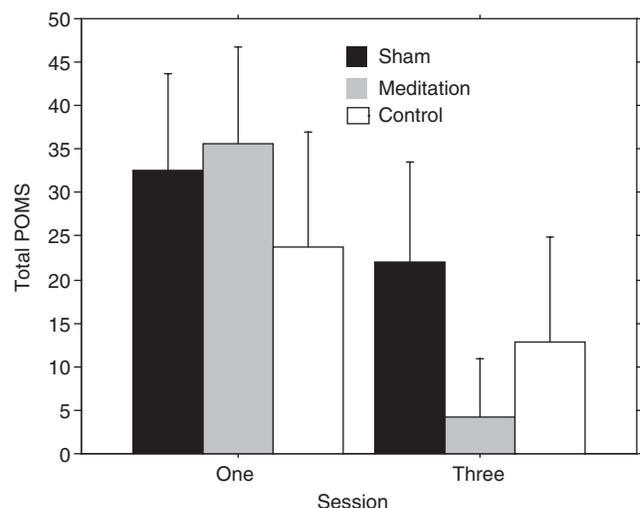


FIG. 1. Mean scores on the total Profile of Mood States (POMS) with 95% confidence scales for the meditation ($n = 29$), sham meditation ($n = 27$), and control ($n = 26$) groups on baseline and postintervention measurements.

An ANOVA was also conducted to assess differences across groups on each subscale of the POMS from before and after the interventions. The ANOVA included the POMS subscale scores as an additional repeated-measures variable. The subscale scores showed a significant decline after intervention training when compared to baseline scores, $F(1, 79)=48.03$, $p < 0.01$, $\eta^2 = 0.38$; and the baseline/post-intervention differences interacted with group, $F(2, 79)=7.61$, $p < 0.01$, $\eta^2 = 0.16$; and with the subscale scores, $F(5, 395)=7.13$, $p < 0.01$, $\eta^2 = 0.08$. There was also a main effect of the subscale scores, $F(5, 395)=43.81$, $p < 0.01$, $\eta^2 = 0.38$. There was not a significant subscale by session by group interaction, $F(10,395)=1.28$, $p = 0.24$. To understand the interaction effects and to answer the primary questions for this experiment, follow-up analyses were conducted separately on each of the POMS subscales. For these analyses, we were interested in whether the group with meditation training would show a greater change in mood state in comparison to the other two groups.

For four of the subscales (tension, depression, fatigue, and confusion), the analyses showed significant intervention group by baseline/postintervention interactions: tension, $F(2,79)=3.07$, $p = 0.05$, $\eta^2 = 0.07$, depression, $F(2, 79) = 4.35$, $p = 0.02$, $\eta^2 = 0.10$, fatigue, $F(2, 79) = 6.82$, $p < 0.01$, $\eta^2 = 0.15$, and confusion, $F(2, 79) = 4.93$, $p < 0.01$, $\eta^2 = 0.11$. Figure 2 plots these interactions together with 95% confidence intervals. It is clear from this figure that the meditation group, in comparison to the other two groups, showed the largest drop in scores on each of these negative mood subscales. It is also evident from Figure 2 that sham group performance on each of these POMS subscales was similar to the control group rather than the meditation group. For the remaining two

subscales, the intervention group by testing interaction was not significant: anger $F(2, 79) = 2.91$, $p = 0.06$, $\eta^2 = 0.07$, and vigor, $F < 1$.

SAI

Group SAI scores were taken before and after the intervention training, in each session, to measure changes in state anxiety for the meditation and sham meditation groups (Table 2). Four (4) cases are missing due to procedural errors (1 from the meditation group, and 3 from the controls). An ANOVA revealed that each session's pre- and post-SAI scores significantly decreased, $F(1,75)=113.97$, $p < 0.01$, $\eta^2 = 0.60$, and the pre/post effect interacted with group, $F(2, 75)=18.44$, $p < 0.01$, $\eta^2 = 0.33$. The meditation and sham meditation SAI scores significantly decreased for each session. The control group did not show any pre/post change. There was no main effect of group, $F < 1$, or session, $F < 1$, but group interacted with session, $F(4,150)=4.79$, $p < 0.01$, $\eta^2 = 0.11$ and in a three-way effect with pre/post intervention, $F(4,150)=2.98$, $p = 0.02$, $\eta^2 = 0.07$. This finding was due to no change in the control group on state anxiety on any of the sessions.

HR and BP

During sessions 1 and 3, HR and BP scores were taken at the beginning and the end of the session. Those data are summarized in Figure 3 (HR) and Tables 3 (systolic BP) and 4 (diastolic BP) (data from 2 of the control participants are missing because of procedural errors). HR was found to decrease significantly at the end of each session, $F(1,77) = 42.08$, $p < 0.01$, $\eta^2 = 0.35$, and the before/after dif-

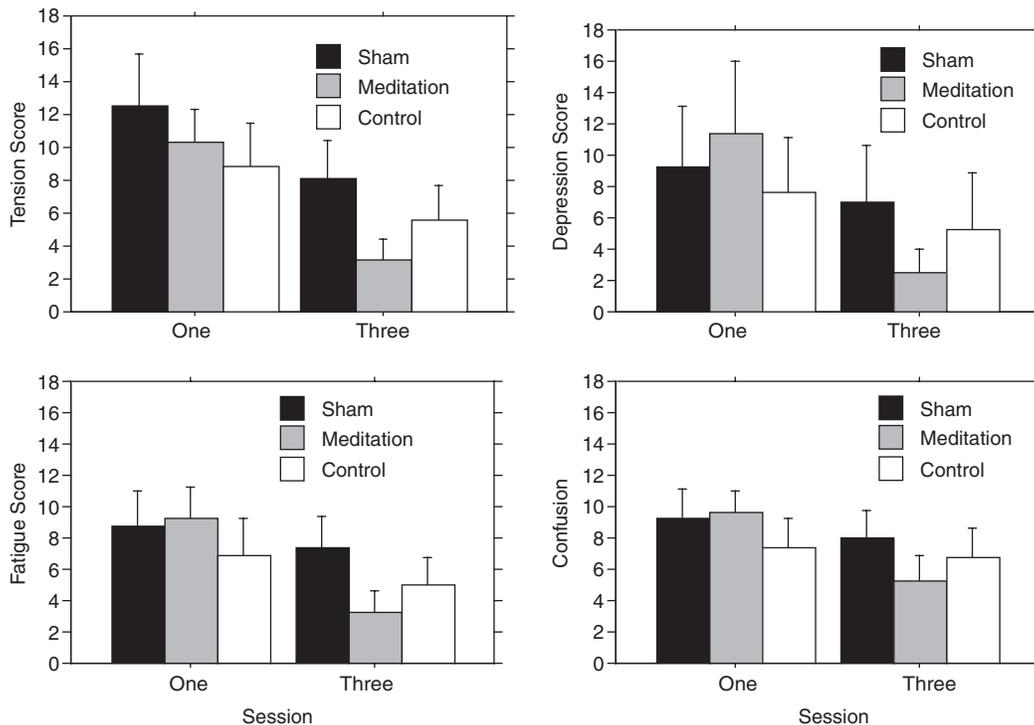


FIG. 2. Mean scores on the subscales of the Profile of Mood States with 95% confidence intervals for the meditation ($n = 29$), sham meditation ($n = 27$), and control ($n = 26$) groups on baseline and postintervention measurements.

TABLE 2. MEANS AND STANDARD DEVIATIONS FOR CONTROL, MINDFULNESS, AND SHAM MEDITATION GROUPS ON STATE ANXIETY INVENTORY

	Control				Meditation				Sham			
	Pre ^a		Post ^a		Pre ^b		Post ^b		Pre ^c		Post ^c	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Session 1	35.19	10.47	36.0	12.41	40.93	8.47	31.66	7.25	40.19	10.80	29.41	6.34
Session 2	35.88	10.37	33.48	10.49	40.34	8.71	28.89	7.45	38.41	7.49	31.04	6.13
Session 3	33.15	8.52	32.32	9.27	37.14	9.00	29.28	6.72	42.81	9.58	35.85	9.17

Session 1, State Anxiety Inventory session 1; Session 2, State Anxiety Inventory session 2; Session 3, State Anxiety Inventory session 3.

^a $n = 26$.

^b $n = 29$.

^c $n = 27$.

M, mean; SD, standard deviation.

ference in HR varied by group, $F(2, 77) = 3.57$, $p = 0.03$, $\eta^2 = 0.09$. Follow-up simple effect tests found that the mindfulness meditation group showed the strongest effect size in assessing the before/after difference, $F(1, 28) = 29.87$, $p < 0.01$, $\eta^2 = 0.52$, when compared to sham mindfulness, $F(1, 26) = 14.87$, $p < 0.01$, $\eta^2 = 0.36$, and controls, $F(1, 25) = 7.64$, $p = 0.01$, $\eta^2 = 0.23$. Before/after difference also varied by session, $F(1, 77) = 7.29$, $p < 0.01$, $\eta^2 = 0.09$, because of an unexpected increase in HR when participants were tested before session 3. This effect was also demonstrated by an increase in average HR for session 3 when compared to session 1, $F(1, 77) = 16.53$, $p < 0.01$, $\eta^2 = 0.18$.

Systolic BP (Table 3) was also found to decrease from the beginning to the end of the session, $F(1, 77) = 40.58$, $p < 0.01$, $\eta^2 = 0.35$; and across sessions, $F(1, 77) = 6.64$, $p = 0.01$, $\eta^2 = 0.08$. There was also a significant main effect of group, $F(2, 77) = 4.86$, $p = 0.01$, $\eta^2 = 0.11$. *Post hoc* (least significant difference [LSD]) tests ($p < 0.05$) show that systolic BP is higher in the meditation group than in the other 2 groups. Means for the sham, meditation, and control groups are as follows; 113, 126, and 119. The initial group differences in systolic BP were maintained throughout the sessions. There

was no session by group interaction, or a pre/post by session effect, $F_s < 1$. There was also no pre/post by session by group interaction, $F(2, 77) = 1.77$, $p = 0.18$.

The analysis on diastolic BP (Table 4) also found a main effect for group, $F(2, 77) = 4.85$, $p = 0.01$, $\eta^2 = 0.11$. *Post hoc* (LSD) tests ($p < 0.05$) show that diastolic BP was lower for the sham group in comparison to the controls and the meditators. Means for the sham, meditation, and control groups are as follows; 63, 68, and 73. However, the group difference was not found to interact with any of the other variables and there were no other main effects found in the analysis on diastolic BP.

Discussion

This study compared the efficacy of a brief mindfulness meditation intervention to a sham meditation intervention and control group on mood and cardiovascular variables. Greater changes were found in distressed mood and HR for the brief meditation intervention when compared to the sham meditation and control interventions. This study suggests that brief mindfulness meditation training is effective in promoting self-regulation and improving heart rate, results consistently found in long-term practitioners.³⁻⁵

The meditation group showed an 88% drop in negative mood compared to the 32% drop shown by the sham group and 34% by the control group. Additionally, both meditation and sham meditation reduced tension, although mindfulness meditation was more effective. In an unexpected finding, mindfulness meditation training alone reduced depression ratings; a finding consistent with studies involving extensive meditation training.¹⁹ Mindfulness meditation also decreased fatigue ratings, suggesting that the immediate effects of mindfulness meditation promote feelings of rest. The meditation group was also the only condition to reliably reduce reports on the confusion subscale. Other studies have reported enhanced attention and information processing in meditators,¹⁶ but not after such a brief intervention. These improvements on the POMS may be associated with the ability to objectively appraise negative feelings. Overall, the results provide evidence that brief mental training is effective at promoting changes in acute mood states.

The reduction in HR from before to after the intervention for the mindfulness meditation group suggests that brief meditation practice may also promote cardiovascular

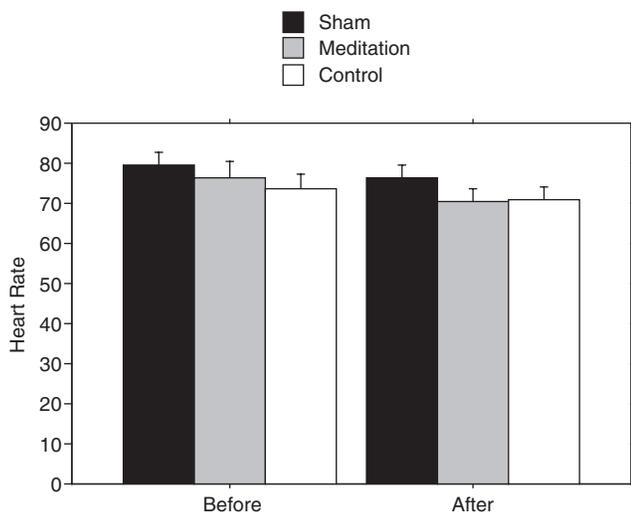


FIG. 3. Mean heart rate scores with 95% confidence intervals for the interaction of group by before/after the intervention.

TABLE 3. MEANS AND STANDARD DEVIATIONS FOR CONTROL, MINDFULNESS, AND SHAM MEDITATION GROUPS ON SYSTOLIC BLOOD PRESSURE

	<i>Control</i>		<i>Meditation</i>		<i>Sham</i>	
	<i>Pre</i> ^a M (SD)	<i>Post</i> ^a M (SD)	<i>Pre</i> ^b M (SD)	<i>Post</i> ^b M (SD)	<i>Pre</i> ^c M (SD)	<i>Post</i> ^c M (SD)
Session1	127.81 (22.74)	119.04(24.35)	134.14(22.44)	125.59(18.56)	119.04(16.33)	110.59(12.39)
Session 3	121.44 (18.5)	114.33(21.86)	128.90(12.97)	115.86(24.96)	113.11(13.32)	110.33(13.23)

^a*n* = 26.^b*n* = 29.^c*n* = 27.

M, mean; SD, standard deviation.

improvement. Although there were group differences in BP, there was no evidence they were a result of the interventions that were under study. Researchers have found improvements in cardiovascular variables for long-term mindfulness practice.⁵ Our findings suggest that the effects on BP are not realized after brief training, or perhaps the effects of brief training are evidenced only when participants are placed under stress in an experimental paradigm.

These findings also demonstrated the necessity of comparing meditation training to a sham meditation intervention. Such a comparison allowed us to tease apart the components of meditation, including the belief in meditation's palliative effects. For example, tension and state anxiety levels improved for both the sham and meditation groups. However, greater improvements in overall mood and HR demonstrate the effects of brief mindfulness training beyond the effects of a sham mindfulness intervention. Therefore, the inclusion of a sham mindfulness meditation group helps distinguish between the effects of relaxed breathing and the belief that one is meditating with the cognitive practice of mindfulness. We suggest that incorporating sham meditation interventions provides a reliable comparison to meditation training.

Our results with respect to changes in cardiovascular variables were modest and limited to changes in HR. A possible reason for that may be because there was not a stress manipulation in the experiment. It is possible that brief training effects require high levels of stress in order to show benefits. The interpretation of these findings also needs to be tempered because of the group differences on ethnicity. Although not statistically significant, there were fewer whites in the control group, when compared to the other groups. Another limitation of these findings is that they are only generalizable to a healthy undergraduate population inter-

ested in meditation, which may also have contributed to the lack of changes in BP for the meditation group. However, all groups were exposed to the same instructions upon registering for the experiment, and groups were randomly assigned to interventions. Moreover, the fact that the same facilitator ran both sham and mindfulness meditation groups raises possibility of experimenter bias. However, the goal of the sham meditation group was to promote the feeling that they were actually meditating, without teaching mindfulness skills. The reductions in anxiety ratings for the meditation and sham meditation group, but not the controls, as well as our manipulation check suggest that we met this goal. Baseline group differences in BP are a limiting factor. Although not significant, there were fewer whites in the control group, and higher HR and anxiety in the mindfulness group, when compared to the other groups. These differences are puzzling and will be a subject for future research projects.

Conclusions

A brief meditation intervention was effective in reducing overall negative mood including depression, tension, fatigue, confusion, anxiety, and lowering HR when compared to the sham meditation and control groups. Sham meditation was effective in significantly reducing state anxiety and tension. Comparisons with a sham meditation group are an effective way of controlling for the demand characteristics associated with meditation practice in experimental trials. This study demonstrated the efficacy of brief mindful training above and beyond the demand characteristics of a sham meditation condition. Moreover, our findings suggest that the benefits of the mindfulness meditation technique can be realized immediately after a brief training regimen. However, it is still unclear whether brief mindfulness meditation intervention

TABLE 4. MEANS AND STANDARD DEVIATIONS FOR CONTROL, MINDFULNESS, AND SHAM MEDITATION GROUPS ON DIASTOLIC BLOOD PRESSURE

	<i>Control</i>		<i>Meditation</i>		<i>Sham</i>	
	<i>Pre</i> ^a M (SD)	<i>Post</i> ^a M (SD)	<i>Pre</i> ^b M (SD)	<i>Post</i> ^b M (SD)	<i>Pre</i> ^c M (SD)	<i>Post</i> ^c M (SD)
Session 1	67.50 (11.67)	67.78 (11.47)	67.90 (11.49)	68.24 (9.06)	62.93 (9.27)	62.52 (8.36)
Session 3	69.64 (15.13)	67.11 (10.15)	69.07 (11.20)	67.10 (9.93)	64.63 (8.11)	63.26 (8.70)

^a*n* = 26.^b*n* = 29.^c*n* = 27.

M, mean; SD, standard deviation.

training can benefit clinical patient populations. Clinical research is required to explore the effects of brief mindfulness meditation training on health.

Acknowledgments

The authors would like to acknowledge Susan Helfrich-Avett and Adam Burch for their assistance on this project.

Disclosure Statement

No competing financial interests exist.

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Address correspondence to:

Fadel Zeidan, PhD
 Department of Neurobiology and Anatomy
 Wake Forest University School of Medicine
 Medical Center Boulevard
 Winston-Salem, NC 27157

E-mail: fzeidan@wfubmc.edu

