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Sustained Impact of MBSR on Stress, Well-Being, and Daily Spiritual Experiences for 1 Year in Academic Health Care Employees

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Abstract

Objectives: The objectives of the study were (1) to evaluate self-reported stress levels and daily spiritual experiences in academic health care employees before, immediately after, and 1 year after enrolling in a mindfulness-based stress reduction (MBSR) course; and (2) to evaluate the correlation between a potential measure of pulse rate variability and self-reported stress levels.
Subjects: Fifty-nine (59) participants in the MBSR course offered to employees at the University of Texas Medical Branch in Galveston (UTMB) comprised the intervention group, and 94 health care providers in the neonatal nurseries comprised the control group.
Intervention: MBSR is an 8-week course that introduces mindfulness meditation practices. No intervention was offered to the control group. All participants were employees (or relatives of employees) at UTMB.
Design: All MBSR participants completed Cohen's Perceived Stress Scale, the SCL-90, the SF-36 Measure of Health and Well-Being, the Daily Spiritual Experiences Scale, and a 5-minute measure of pulse rate coherence. This testing was done before and after the MBSR course and 1 year later. Ninety-four (94) neonatal health care providers completed the same series of questionnaires and pulse rate variability (PRV) measures, with 49 of the 94 completing the questionnaires 2 months and 1 year later.
Results: MBSR participants improved on all measures except the physical component score of the SF-36 upon completion of the MBSR course, and these results were maintained at the 1-year follow-up. The control group did not significantly change on any of the measures. PRV as measured by the Heart Math system did not correlate with any of the self-report questionnaires.
Conclusions: MBSR effectively reduces self-report measures of stress and increases daily spiritual experiences in employees in an academic health care setting, and these effects are stable for at least 1 year. Using a simple measure of PRV was not a clinically reliable biologic measure of stress.

Introduction

Stress seems to be an ever present phenomenon in our fast-paced culture. One definition of stress is the relationship between an individual and the environment that the individual appraises as potentially endangering to their well-being.[1] This definition allows one person's stressors to be different from another's and the amount of tension created by a stressor to be dependent on a balance between an individual's appraisal and their inner resources for coping. The external manifestations of stress are unique to an individual but physiologically, stress predominantly impacts the psychoneuroimmunology, particularly the hypothalamic–pituitary–adrenal axis and the autonomic nervous system.

Mindfulness-Based Stress Reduction (MBSR) is an 8-week program with a 30-year history that has been shown to decrease stress, anxiety, and hypertension; improve immune function and chronic pain management; decrease medical symptom reporting, and induce neuroplasticity,[2–10] in patients with an array of diagnoses (work-related stress, cancer, chronic pain, anxiety, hypertension, psoriasis, depression, headache, back pain, asthma, and diabetes[2,4,5,8–17]). MBSR has also been found to influence one's sense of spirituality,[18] which may have an impact on mental and physical

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health.[18,19] These mind–body practices are safe, broadly applicable, and affordable interventions.

When introduced to health care workers, MBSR enhances well-being, mindfulness, empathy, emotional stability, and spiritual experience while decreasing burnout, anxiety, and depression.[20–22] This is accomplished by focusing on paying attention moment to moment to things as they are in one's life, without judgment. Specifically, participants are taught meditation practices including yoga, body scans, sitting and walking meditation, and mindfulness in everyday activities. The common core of these activities is gaining skills for living within each moment of one's life and openly and flexibly accepting the changes that one encounters. Gaining resources to be with things as they are without judgment may ease one's wanting or needing their situation to be different than it is, which may reduce one's appraisal of their potentially endangering environment.

Despite the success of MBSR for health care workers, there are some remaining questions. First, while participants have shown dramatic reductions in psychometric measures of stress at the completion of the class, it is less clear about long-term benefits. A few follow-up studies have shown that there are continued improvements,[4,23–25] with follow-up assessments occurring from 6 months to 4 years, but these have not been in a heterogeneous, generally healthy population. In addition, the impact of MBSR on spirituality[18] has only begun to be investigated.

Second, when examining stress reduction interventions in homogeneous populations, such as hypertensive individuals, it is relatively straightforward to measure a biologic impact of reduced stress, in this case a decrease in blood pressure. To date, the authors do not have a reliable biomarker for stress for heterogeneous populations, and thus are often limited to self-report assessments. Responses to influenza vaccination,[3] salivary cortisol, and heart rate variability (HRV)[26] have all been considered but have practical limitations. However, preliminary reports suggest that utilizing a finger probe and measuring pulse rate variability (PRV) may provide a quick screen of HRV, and thus may provide a practical solution. HRV is a measure of the degree of variability between heartbeats, with increased variability reflecting a dynamic and healthy balance between the parasympathetic and sympathetic nervous system.[26–30] PRV will not provide accurate data reflecting the underlying contributions of the sympathetic and parasympathetic tone, but it may provide a quick screen of HRV without the equipment, time, and costs of HRV measures.[31–33]

Thus, this study examines the implementation of MBSR for health care workers and extends the previous literature by examining its impact over 1-year time and the potential value of PRV as a clinically simple biomarker for stress in a relatively heterogeneous population.

Materials and Methods

Participants

MBSR participants were from four MBSR courses between August 2006 and August 2007, and they completed the course and the immediate postcourse surveys. All participants were employees at University of Texas Medical Branch (UTMB), with the exception of 2 participants who were relatives of employees. Control subjects were employees from both the Newborn Nursery and the Neonatal Intensive Care Units (NICU) at UTMB. These employees were chosen because a waitlist control group could not be created, given the inability to offer this course more often than once a year. NICU employees are recognized to be stressed relative to the general population,[34] and thus made a reasonable comparison group for self-identified stressed individuals at an academic health care institute. Ninety-four (94) employees (86 nurses, 3 nurse practitioners, and 5 respiratory therapists) were recruited between August and September 2007. In October 2007, 49 of the 94 participants who worked exclusively in the NICU were enrolled in the longitudinal arm of this study, of whom 37 completed the August/September 2008 questionnaires. The 1-year follow-up arm of this study was interrupted by Hurricane Ike, which devastated both UTMB and Galveston Island. Participants whom had not completed the questionnaires prior to Hurricane Ike evacuation (September 11, 2008) were excluded from the 1-year follow-up portion of the study because their questionnaire answers would be impacted by the stress of the hurricane.

Participants for the PRV portion of this study included all the MBSR participants mentioned above and the initial 94 control subjects.

MBSR course

The MBSR course was unmodified from the course created at the University of Massachusetts at Amherst.[35] It was taught by a certified MBSR instructor (CAG). The class met for 3 hours each week and for an 8-hour retreat sometime between class 5 and class 7.

Questionnaires

For the intervention group, questionnaires and PRV measures were administered during orientation, along with a short demographic form. This was repeated at the end of the course and again 1 year later. For the control group, questionnaires and PRV measures were done in August 2007, October 2007, and August 2008 to temporally correspond with the MBSR participant time points.

Demographic data collected on all participants included gender, age, race/ethnicity, marital status, occupation, level of education, and years of employment at UTMB.

Three (3) questionnaires used in previous MBSR courses were included. The Cohen's Perceived Stress Score (PSS) examines how an individual perceives events in their life, with a higher score reflecting a higher degree of stress.[36] The Short Form–36 (SF-36) is a well-recognized scale measuring general well-being.[37,38] The SF-36 has eight subscales and two cumulative scores: the Physical Component Score (PCS) and the Mental Component Score (MCS). For convenience and space limitations, only data from the cumulative scores are reported here. The SCL-90-R Symptom Checklist (SCL-90) is a well established self-report questionnaire of psychologic distress.[39] The SCL-90 has a single Global Severity Score (GSS) created from nine subscales of mental distress, and these are the only data reported in this study. The Daily Spiritual Experiences Scale (DSES) was used because the experience of the investigator was that MBSR participants report returning to their spiritual practice during the course. This is a self-report questionnaire examining the degree of

spiritual connection on a daily basis[22,40] and provides a single summative score.

Data analysis

All questionnaires were scored according to published guidelines and then analyzed by *t* test (paired *t* test for participants over time and unpaired for comparisons between control and MBSR groups with *post-hoc* adjustment for multiple comparisons). PRV values were analyzed by paired *t* test in MBSR participants. Using linear regression, correlation between PRV and five specific questionnaire scores (PSS, DSES, MCS, PCS, and GSS) were examined as an independent evaluation of the utility of PRV as a screen for stress/mental health. Direct correlation analysis was done along with analysis after arcsine transformation of the data, to confirm the findings. There were 200 paired measurements of PRV and the questionnaire sets to provide 80% power for the correlation analysis.

Results

Class participation

Four classes were completely enrolled in 14 months. Cumulative completion of the courses over the period of the study was 89% of those registering for the course.

Demographics

Table 1 shows the comparison between the MBSR group and the 49 NICU employees in the longitudinal arm of the control group. The only difference in demographics is the percentage involved in patient care. The PRV subjects included these two groups plus the 45 Neonatal employees who participated in the baseline measures but not the longitudinal arm of the study. The demographics of these 45 employees are quite similar to the 49 in the Control Group (data not shown).

Cohen's Perceived Stress Scale

Table 2A shows the PSS score in the MBSR and control groups at 0, 2, and 12 months (with the MBSR intervention occurring from 1 to 2 months). All of the groups scored significantly lower than the pre-MBSR group. The lowered PSS score was maintained 1 year after completing MBSR, and both the post-MBSR and 12-month follow-up scores were significantly lower than scores of the control group at all time points. The PSS score was unchanged over time in the control group.

SCL-90-R questionnaire

Table 2B shows the summative GSS of the SCL-90 questionnaire in the MBSR and control groups at 0, 2, and 12 months. Data are expressed as area T-scores normalized to an adult nonpsychiatric outpatient population, with *lower* scores reflecting better mental health. All composite scales and subscales significantly improved. The global severity composite score (GSS) reflects the sum of all the subscales. All of the groups scored significantly lower than the pre-MBSR group. The lowered GSS score was maintained 1 year after completing MBSR, and both the post-MBSR and 12-month follow-up scores were significantly lower than the control group at all time points. Within the control group, the GSS score was unchanged over time.

SF-36 Health Survey Questionnaire

Scores are normalized to the general population with a mean of 50 and a standard deviation of 10, with *higher* scores indicating better well-being or health. Eight (8) subscales evaluate aspects of physical and mental functioning. Two (2) summary scales provide a physical component score (PCS) and a mental component score (MCS). Table 2C shows the MCS score in the MBSR and control groups at 0, 2, and 12 months. All of the groups scored significantly higher than the pre-MBSR group. The higher MCS score was maintained 1 year after completing MBSR, and both the post-MBSR and 12-month follow-up scores were significantly higher than the control group at 0 and 12 months, but not at 2 months. Table 2D shows the PCS score of the SF-36 in the MBSR and control groups at 0, 2, and 12 months. The post-MBSR group scored statistically but only slightly higher than the pre-MBSR group, but that was the only significant comparison among all the groups.

Daily Spiritual Experiences Scale

Table 2E shows the average DSES score in the MBSR and control groups at 0, 2, and 12 months. *Lower* scores reflect more daily spiritual experiences. The DSES score in MBSR participants significantly improved after MBSR, and this was maintained at 12 months. The control groups did not significantly change over time, and their score was in between the pre-MBSR score and post-MBSR scores.

Table 1. Demographics

Demographics	*MBSR group* (N = *59*)	*Control group* (N = *49*)
Gender	85% female	96% female
Age	48 ± 9.6	42 ± 8.7
Race/ethnicity	75% white, 18% Hispanic 2% African Am., 5% Asian	55% white, 14% Hispanic 11% African Am., 17% Asian
Marital status	43% not married, 57% married	39% not married, 61% married
Years at UTMB	10.5 ± 8.2	9.3 ± 8.0
Involved in patient care	50%	100%
Level of education	27% Doctoral, 27% Masters 20% BA/BS/RN, 27% < 4-yr college	17% Masters, 61% BA/BS/RN, 22% < 4-yr college

MBSR, Mindfulness-Based Stress Reduction; UTMB, University of Texas Medical Branch in Galveston.

Table 2. Questionnaire Scores for the PSS, SCL-90, and DSES Before the MBSR Course, Immediately Following the MBSR Course, and 1 Year After the MBSR Course with Corresponding Time Points in the Control Group

	Control group	*MBSR group*
A. Perceived Stress Score (PSS; lower scores indicative of lower stress)		
Precourse/baseline	22.94 ± 8.0* (*N* = 49)	27.12 ± 7.9 (*N* = 59)
Postcourse or 2-month follow-up	22.05 ± 6.9*,** (*N* = 49)	17.37 ± 7.3*,*** (*N* = 59)
One-year follow-up	21.41 ± 7.49*,** (*N* = 37)	17.53 ± 8.1*,*** (*N* = 54)
B. SCL-90R Symptom Checklist (SCL-90) Global Severity Score (lower scores indicative of fewer symptoms)		
Precourse	58.58 ± 9.2* (*N* = 49)	64.85 ± 9.36 (*N* = 59)
Postcourse or 2-month follow-up	55.65 ± 9.5*,*** (*N* = 49)	53.02 ± 10.9*,*** (*N* = 59)
One-year follow-up	55.97 ± 10.9* (*N* = 37)	52.54 ± 11.5*,*** (*N* = 54)
C. Short Form–36 (SF-36) Mental Component Score (lower scores indicative of worse mental health well-being)		
Precourse	48.19 ± 10.7* (*N* = 49)	40.09 ± 13.0 (*N* = 59)
Postcourse or 2-month follow-up	50.73 ± 7.8*,*** (*N* = 49)	52.29 ± 8.96*,*** (*N* = 59)
One-year follow-up	47.41 ± 12.6* (*N* = 37)	51.6 ± 9.7*,*** (*N* = 54)
D. SF-36 Physical Component Score (lower scores indicative of worse physical well-being)		
Precourse	49.89 ± 7.1 (*N* = 49)	47.3 ± 9.34 (*N* = 59)
Postcourse or 2-month follow-up	48.31 ± 7.3 (*N* = 49)	50.93 ± 8.14* (*N* = 59)
One-year follow-up	49.31 ± 9.2 (*N* = 37)	49.10 ± 8.61 (*N* = 54)
E. Daily Spiritual Experiences Scale (DSES; lower scores indicate more daily spiritual experiences)		
Precourse	49.60 ± 18 (*N* = 49)	50.48 ± 17.5 (*N* = 59)
Postcourse or 2-month follow-up	50.45 ± 19.2 (*N* = 49)	44.04 ± 19.2*,** (*N* = 59)
One-year follow-up	50.06 ± 19.0 (*N* = 37)	42.26 ± 18.7*,** (*N* = 54)

*Indicates a significant difference compared to the precourse MBSR group.
**Indicates a significant difference compared to the precourse control group.
***Indicates a significant difference compared to the postcourse MBSR group.
MBSR, Mindfulness-Based Stress Reduction.

Pulse rate variability

A total of 200 measures of self-report scores were compared to PRV coherence values, giving a power of 0.8 for detecting a significant statistical difference. These 200 measures were obtained from the 94 controls, and the 59 MBSR participants (with repeat measures in participants after completing MBSR and 1 year later). PRV was expressed either as the low, medium, or high coherence summary values after a 5-minute recording. There was no significant change in PRV coherence values before and after MBSR, or between any of the groups. For correlation analysis, the three individual coherence values and multiple combined values reflecting all three scores were used. None of the individual values or combined coherence values showed any significant correlation to any of the self-report scores on the four questionnaires (PSS, GSS, MCS, PCS, or DSES). The correlation coefficients ranged between 0.011 and 0.234. The influence of specific health information (medications and diagnosed illnesses) did not alter the lack of correlation.

Discussion

Implementing an MBSR course was feasible within a health care setting, with a completion rate similar to that reported in the literature.[2,3,7] Unlike many published studies, participants in this study were relatively heterogeneous in regard to not having any unifying diagnosis, but similar to each other in being employed full time. Education levels ranged from having completed high school to having graduate degrees. On all self-report questionnaires, the MBSR participants were more stressed than the comparison group and normative population data, suggesting appropriate self-selection of MBSR participants.

The control group provides evidence of stability in self-report scores over time, which suggests that the MBSR course is responsible for the improved scores over time in the participants. Given the difference between the participants and the control group, no other reliable inferences can be made by comparing the two groups. It is possible that the MBSR participant's improvement simply represents regression toward the mean; however, MBSR participants with scores starting at the level of control group participants or levels at population means showed improvement in their scores to lower than these averages.

MBSR participants improved an average of 1 standard deviation on the self-report questionnaires. This effect persisted for a full year after the start of the 2-month course. The course helps ease the internal tension of wanting or needing things to be different than they are by building inner resources to be with things exactly as they are in their lives. This would fit with studies of trait effects of MBSR on optimism.[41]

Daily spiritual experiences significantly increased with MBSR and were maintained for at least a year. This is not an aspect of the secular MBSR course that is often investigated or discussed. The course introduces meditation, a practice inherently associated with many spiritual traditions, as a means of reducing stress. Within the course itself, participants are asked to practice being present for life exactly as it is in this moment without judgment. This is also a message relayed in those spiritual traditions with strong foundations in meditation. Thus, it is not surprising to see this increase in daily spiritual experiences among MBSR participants. This

study is not capable of determining whether lowered stress levels led to an increase in spiritual experiences or increased spirituality lowered stress levels or whether the two occur independently within the course. As a general measure, the DSES is considered to be measuring a phenomenon separate from that measured by stress scales.[22,40]

Having a heterogeneous population of MBSR participants makes identifying a single biomarker of stress challenging. When offering MBSR to a group of hypertensive individuals, a reduction in blood pressure would be an obvious biomarker to measure a biologic impact of MBSR. In heterogeneous populations, responses to immunization and cortisol levels have been measured. This study attempted to identify a clinically simple biologic measure that could identify stressed individuals. HRV is a reasonable candidate, because low HRV suggests a lack of coherence between the sympathetic and parasympathetic nervous system and a relationship to both health and stress. A heart rate that does not vary from beat to beat is correlated with poor health. Low HRV is associated with increased age, depression, diabetic neuropathy, stress, anxiety, panic disorders, and increased mortality post-myocardial infarction. Increases in HRV are seen with meditation, regular exercise, and relaxation therapy.[21–25] Measuring HRV is not clinically simple. Pulse rate variability may provide a simpler assessment of HRV.[42] The possibility was explored that the quick and simpler reflection of pulse rate variability could be utilized as an indicator of stress. The results indicated no change over time in the MBSR participants, nor when correlated with the self-reported stress questionnaires, which did show change. This may be related to the alternative use of the Heart Math system, the length of measurement (5-minute measure after a 5-minute rest period), a relative insensitivity of PRV for capturing biologic implications for reduced stress, or a lack of change in PRV with decreased stress.

Conclusions

In conclusion, MBSR introduced within an academic health care environment was well received; it effectively reduced self-reported stress with effects lasting for at least 1 year and increased the daily spiritual experiences of participants.

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Disclosure Statement

No competing financial interests exist.

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