A Randomized Controlled Trial of Mindfulness Meditation Versus Relaxation Training: Effects on Distress, Positive States of Mind, Rumination, and Distraction

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ABSTRACT

Background: *Although mindfulness meditation interventions have recently shown benefits for reducing stress in various populations, little is known about their relative efficacy compared with relaxation interventions.* ***Purpose:*** *This randomized controlled trial examines the effects of a 1-month mindfulness meditation versus somatic relaxation training as compared to a control group in 83 students (M age = 25; 16 men and 67 women) reporting distress.* ***Method:*** *Psychological distress, positive states of mind, distractive and ruminative thoughts and behaviors, and spiritual experience were measured, while controlling for social desirability.* ***Results:*** *Hierarchical linear modeling reveals that both meditation and relaxation groups experienced significant decreases in distress as well as increases in positive mood states over time, compared with the control group ($p < .05$ in all cases). There were no significant differences between meditation and relaxation on distress and positive mood states over time. Effect sizes for distress were large for both meditation and relaxation (Cohen's d = 1.36 and .91, respectively), whereas the meditation group showed a larger effect size for positive states of mind than relaxation (Cohen's d =.71 and .25, respectively). The meditation group also demonstrated significant pre–post decreases in both distractive and ruminative thoughts/behaviors compared with the control group ($p < .04$ in all cases; Cohen's d = .57 for rumination and .25 for distraction for the meditation group), with mediation models suggesting that mindfulness meditation's effects on reducing distress were partially mediated by reducing rumination. No significant effects were found for spiritual experience.* ***Conclusions:*** *The data suggest that compared with a no-treatment control, brief training in mindfulness meditation or somatic relaxation reduces distress and improves positive mood states. However, mindfulness meditation may be specific in its ability to reduce distractive and ruminative thoughts and behaviors, and this ability may provide a unique mechanism by which mindfulness meditation reduces distress.*

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INTRODUCTION

In recent years, there has been a resurgence of interest in more integrative stress-reduction techniques that attempt to address not only a person's mental and physical ailments, but also his or her interpersonal, emotional, and spiritual needs (1). Integrative stress reduction techniques, such as mindfulness meditation (MM), have been increasingly reported to be effective interventions for reducing stress symptoms in various patient populations (2–5). The practice of MM, rooted in Buddhist *vipassana* (translated as *insight*) meditation, encourages the cultivation of nonjudgmental, moment-to-moment awareness both during the formal mediation practice and in everyday life (6). The theoretical premise of the practice is the belief that cultivation of present-moment, nonjudgmental awareness focuses the mind to notice better, understand, and integrate one's perceptions of self and environment. Such practice is said to bring forth insight into one's cognitions or mental formations (*samojana*) that may be positive or negative in nature while at the same time providing an avenue to observe rather than react to one's thoughts and emotions, ultimately providing peace of mind (7). Inherent in the practice of nonjudgmental awareness is observing one's experience without trying to change it (e.g., just noticing the tension of a muscle as opposed to trying to relax a tense muscle, or just noticing a thought as it arises as opposed to trying actively to change the thought).

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MM has been reported to decrease mood disturbance in medical students (8) and reduce psychological distress and enhance empathy and spiritual experience in medical and premedical students (9,10). However, the previous studies did not address whether these benefits specifically were a direct result of mindfulness training. One hypothesis that has been presented is that the benefits that come with meditation practice are a result of the relaxation response (11). Therefore, it seems important to address this question by directly comparing MM with a relaxation intervention.

Traditional relaxation methods vary in their approaches, but all differ from MM in that there is an intentional focus to relax during the practice, either through specific exercises or through imagery techniques. Through relaxation, bodily tension is released, leading to a psychophysiological state of decreased arousal that opposes that of the stress response and is experienced as a calming state (11). Given that relaxation techniques are empirically supported for alleviating distress, anxiety, and depression in students as well as various other populations (12–14), it is important to compare MM with relaxation to determine its potential efficacy and specificity in reducing distress.

This study incorporates comprehensive interventions that addresses several components of stress reduction. However, we hypothesize that the two interventions might show different effects on the outcome measures chosen, due to different mechanisms of action. Given that both MM and relaxation interventions have shown positive effects in terms of reducing overall symptoms (5,8,10,13,15–17), we predicted that both interventions would be beneficial in reducing overall distress. However, we hypothesize that the mindfulness intervention, due to its focus on cultivating moment-to-moment awareness as well as its inclusion of loving-kindness meditations, would be unique in its capacity to reduce distractive and ruminative thoughts and behaviors, increase reports of spiritual experience, and increase positive mood states as compared with the control and relaxation groups.

We further hypothesized that the differences in psychological distress found for the meditation group would be related to changes in rumination. Recently there has been much discussion and research surrounding the coping styles of rumination and distraction as they are related to negative affect (18–20). Generally, rumination has been found to be associated with greater levels of depression, as well as predict depressive disorders and anxiety symptoms (19,20). Current research also suggests that rumination relates to anxiety as well as other forms of negative affect (21). A recent study reported that MM practice may reduce rumination in persons with prior depression, independent of changes in affect (22); however, this study did not incorporate a comparison intervention, and, thus, it is unknown whether reductions in rumination may have been more due to nonspecific effects such as relaxation. Given that rumination has been found to be especially prevalent in student populations (23), we hypothesized that a mindfulness-based intervention might reduce rumination in distressed students due to the increased practice of moment-to-moment awareness and that this potential reduction in rumination might predict reductions in distress.

METHOD

Participants

Full-time medical students, graduate nursing students, and undergraduate students majoring in premedical or prehealth studies were eligible for participation in the study. Participants were recruited and enrolled for approximately 1 month's duration and 2 months prior to the commencement of the intervention study. Recruiting methods included brief presentations to the premedical honors society, the Fostering and Achieving Cultural Equity and Sensitivity premedical student group, and the 1st- and 2nd-year medical student class. Students were also recruited via flyers and e-mails to their respective list serves.

Power analyses based on normative standard deviations for a primary outcome measure (the Global Severity Index [GSI]), at a significance level of .05, a desired power of .8, and a small to medium effect size (i.e., Cohen's $d \approx .4$) indicated that 25 persons per group would be required to detect a significant difference for the intervention versus control groups. One hundred and four students volunteered and met criteria for the study. Eligible students had to (a) be a currently active and full-time student studying health and medicine, whether graduate (nursing or medical) and undergraduate (premedical students and prehealth majors); (b) self-identify as currently experiencing a significant amount of stress, with a desire to participate in a stress reduction program; (c) agree to complete pre-, post-, and weekly questionnaires; (d) agree to be randomized to a meditation, relaxation, or control group; and (e) be able to attend the weekly classes and 1-day retreat if subsequently randomized to the meditation or relaxation group. Based on meeting these eligibility criteria, participants were enrolled in the study by the principal investigator and a trained research assistant. Students were randomly assigned to the meditation, relaxation, or control group via matched randomization for sex and medical, nursing, premedical, or prehealth status; this was accomplished by using a computerized random number generator software program and stratifying participants per group based on sex and student status.

Eighty-one students completed the entire study (27 meditation, 24 relaxation, and 30 control; 15 men and 66 women). Participants' mean age was 25, with an age range of 18 to 61. The sample was 63% White, 16% Hispanic, 4.9% Native American, 7.4% Asian/Pacific Islander, and 2.5% mixed race. Five participants (6.2%) did not report their ethnicity. There were 17 medical students, 5 nursing students, 28 premedical students, and 31 prehealth students.

Interventions

MM

The MM intervention utilized in this study is modeled on the Mindfulness-Based Stress Reduction (MBSR) program developed at the University of Massachusetts Medical Center (24). The MM course differed from the original MBSR program in length. Our intervention consisted of four 1.5-hr sessions, compared with the eight 2.5-hr sessions specified in MBSR. The duration of the intervention was shortened from the original MBSR length due to students' time constrictions because of fi-

nal exams and subsequent holiday break. The length of each session was shortened from the original MBSR program due to student feedback that 2.5 hr would be too long of a time block to fit into their current class schedules.

MM incorporates formal techniques utilized in MBSR, such as body scan meditation, in which the practitioner focuses attention on each part of the body to notice sensations that arise; sitting meditation, where the practices focusing non-judgmental awareness on whatever arises moment by moment; Hatha yoga, where one practices gentle stretching while maintaining attention on subtle movements in the body; walking meditation, where one practices walking slowly, with awareness; and loving-kindness meditation, where one focuses attention on feelings of caring and love for one's self and others to cultivate compassionate awareness and action in everyday life. The MM intervention, thus, integrates cognitive components (such as selective attention skills to focus on one's thoughts and emotions, as well as bodily sensations and environmental sounds), somatic components (such as Hatha yoga techniques), and empathic/spiritual components (such as loving-kindness meditations) to provide a participant with techniques to focus interpersonally as well as intrapersonally and transpersonally (25). Participants were also given tapes and manuals, homework assignments, and didactic material on mindfulness to facilitate practice and reflection at home.

Somatic Relaxation (SR)

SR intervention utilized in this study is a primarily body awareness-based relaxation intervention. Designed to be a comprehensive, somatic-focused intervention, SR integrates techniques of autogenic relaxation using the six autogenic phrases used by Schultz (26), progressive muscle relaxation (using tension and release of muscles throughout the body to relax), simple breathing techniques (such as simple diaphragmatic breathing and breathing with counting), and guided imagery to give a comprehensive course on stress reduction via a focus on bodily relaxation. All these techniques were incorporated in the intervention to allow the participant to experience multiple approaches focused on relaxing the body, thus allowing for variety while simultaneously keeping the intention on bodily relaxation as a means for reducing stress. Participants in SR were also given tapes and manuals with homework (such as instructions for progressive muscle relaxation) as well as didactic information on relaxation and coping with stress to facilitate practice and reflection at home.

Design and Procedure

This randomized controlled trial compared two active intervention groups (MM and SR) with each other as well as with a control group. The control group was a waitlist control group who had no contact with the instructors or intervention materials until after postintervention data collection, when they received manuals and tapes of their choice of either MM or SR, plus one class on stress reduction by an MM or SR instructor.

Participants completed questionnaires 10 days before the commencement of the intervention and within 2 weeks after the conclusion of the intervention. All data were collected in a research laboratory at the University of Arizona. To assess slopes of change during the actual intervention, weekly questionnaires were also given to all participants.

There were four different class groups (two MM class groups and two SR class groups), each with a different instructor (thus two mindfulness instructors and two relaxation instructors total). Both interventions lasted 4 weeks with one 1.5-hr class per week, for a total of four class sessions. Classes for both intervention groups were held in conference rooms at the University of Arizona Medical Center. In addition, the meditation and relaxation groups each participated in a 6-hr Saturday retreat between Session 3 and Session 4 at Miraval Resort and Spa in Tucson, Arizona. The interventions were designed to parallel each other in ways that might affect outcomes. For instance, both interventions utilized manuals and 30-min tapes that were designed to parallel each other in terms of material given for particular activities (i.e., breath meditation vs. diaphragmatic breathing). In addition, both interventions utilized similar amounts of time allotted for lecture and practice of specific activities related to the intervention type (e.g., Hatha yoga for the meditation group or stretching exercises for the relaxation group). The amount of teaching experience of the instructors (all women) ranged from 4 to 10 years. Both MM instructors were trained in the Jon Kabat-Zinn MBSR course, and both SR instructors were trained in the Schultz method of autogenic relaxation.

To determine whether warmth or affability of the instructor or surroundings could contribute to intervention efficacy, students were asked to rate the pleasantness of the room and the affability, knowledge, and caring of the instructor after the third class session. These responses were subsequently examined for potential differences in groups due to instructors or setting characteristics.

Measures

Preinvention Measures

The following measures were administered preintervention, every week during the 4-week intervention, and postintervention:

Brief Symptom Inventory (BSI). The BSI (27) is a 53-item Likert scale (1–5) self-report symptom checklist that was designed to be a brief form of the SCL–90–R. The BSI measures psychological symptoms of distress over nine primary symptom dimensions: somatization, obsessive–compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. The average of all 53 items provides an overall measure of psychological distress, termed the GSI. Higher scores on the GSI reflect higher overall distress. The BSI has been found to have high reliability (Cronbach's α coefficients between .71 and .80 for all subscales), as well as high validity and sensitivity (28). This instrument was used in this study to track possible changes in overall psychological distress as a result of being in the MM or SR intervention group, using the GSI as a global index of psychological symptom severity.

Positive States of Mind Scale (PSOM). The PSOM is a brief self-report tool designed to assess various aspects of positive psychological states (29). The scale consists of a 4-point rating of seven items probing the dimensions of focused attention, productivity, responsible caretaking, restful repose, sharing, sensuous nonsexual pleasure, and sensuous sexual pleasure. Higher scores on the PSOM indicate higher positive mood states. The PSOM has been reported to have high internal consistency, with a Cronbach's $\alpha = .77$ reported for college students (30). This PSOM scale has been consistently found to correlate inversely with measures of anxiety, as well as with response to stressful events (29). This scale was used to assess possible differential changes in positive states of mind before, during, and after the intervention for all groups.

Practice log. All participants (intervention and control) completed weekly questionnaires describing the amount of time and types of activities they participated in (e.g., exercising, socializing) to reduce their stress during the week. In addition, participants in the MM and SR group were asked to keep a log of the amount of time, in number of hr and days per week, they spent practicing the techniques taught to them.

Pre- and Postinvention Measures

The following measures were administered before and after the intervention:

Daily Emotion Report (DER). The DER (31) is a self-report questionnaire designed to assess distractive and ruminative thoughts and behaviors associated with depression. The DER consists of two subscales: one that measures ruminative thoughts and behaviors in response to depressed mood, and one that measures distractive thoughts and behaviors in response to depressed mood. Higher scores on these subscales indicate higher reports of ruminative or distractive responding to depressed mood. Examples of items measuring ruminative behaviors include "go to my room alone and think about my feelings" and "isolate myself and think about the reasons I'm feeling this way." Examples of ruminative thoughts include "I need to understand these feelings" and "If I don't snap out of this mood, I won't be able to get anything done." Examples of items measuring distractive behavior include "do something active to get my mind off my feelings" and "do something I enjoy." Examples of distractive thoughts include "I'm only going to think about good things "and "I've got to get up and do something to make myself feel better."

Cluster analysis has indicated that the items used in this scale fall into two significant item groupings, with items measuring distraction falling in one cluster, and items measuring rumination falling in a separate cluster. Further analysis for reliability has indicated that over a 1-month period, 83% of participants showed consistent responses (31), making this scale appropriate for use over a 1-month intervention period. Higher scores on this rumination subscale have been linked to longer duration of depressed mood, even when controlling for depression severity (31). This questionnaire is used to test the hypothesis that meditation participants would experience less overall distractive and ruminative behaviors and thoughts in response to depressed mood postintervention as compared with the relaxation and control group.

Index of Core Spiritual Experiences (INSPIRIT–R). The INSPIRIT–R is a seven-item self-report unidimensional questionnaire designed to assess both relational and experiential aspects of spirituality (32). Reliability for the INSPIRIT–R has been reported to be acceptable, with Cronbach's $\alpha = .81$ (33). Higher scores on this measure indicate higher ratings of perceived spirituality and spiritual experiences. This questionnaire is used to test the hypothesis that meditation participants would experience increases in spiritual perception and experience postintervention as compared with the relaxation and control group.

Marlowe-Crowne (M-C) Short Form. This questionnaire is a 13-item short form of the original M-C scale, which is used to assess socially desirable responding (34). It has been reported to have adequate reliability and validity for undergraduate populations (34,35). Higher scores on this measure indicate a greater tendency to respond in a socially desirable manner. This questionnaire is used as a covariate in subsequent analyses to determine whether any significant self-reported positive effects might be due to social desirability.

Statistical Analyses Strategy

Preliminary and Pre–Post Data Analysis

Chi-square and analysis of variance were conducted to assess success of randomization and examine possible pretest differences between groups. Correlations of M-C scores with outcome variables were also examined to assess for the need to control for social desirability in subsequent analyses. To account for possible baseline differences between groups, pre- and postintervention data for the INSPIRIT–R and DER rumination and distraction subscales were analyzed via analysis of covariance (ANCOVA), with preintervention scores entered as a covariate (as well as M-C scores when appropriate). To more conservatively protect against Type I error, post hoc Tukey tests were run for all comparisons of postintervention group means.

Weekly Data Analysis

Hierarchical linear modeling (HLM) is employed to evaluate potential changes over time as a function of condition (control, relaxation, and meditation) for the weekly data obtained for distress (GSI) and positive states of mind (PSOM). HLM is more accurate than analysis of variance and ANCOVA measures in estimating growths rates of change for different levels of variables, including assessing covariates without assuming homogeneity of slopes among groups (36).

In HLM, individual change is initially modeled using growth trajectories for each participant. In this study GSI and PSOM scores are modeled at the individual participant level. Subsequently, the initial status (i.e., intercept) and slope of the average growth trajectories are aggregated across individuals. The slope was of primary interest in that this parameter reflects the increase, decrease, or stable pattern of GSI and PSOM scores across time.

In this study, three primary models were tested. GSI and PSOM, respectively, were the level-1 (or lower-level) outcomes in each model. In Model 1 (referred to as the unconditional linear growth model), time (repeated-measures variable for visits coded 0, 1, 2, 3, 4) was considered a lower level predictor variable. In Model 2 (referred to as the conditional linear growth model), dummy-coded variables representing the comparison between the (a) control condition and the relaxation condition and the (b) control condition and the meditation condition were entered as higher order predictor variables (i.e., between-person variables). An additional HLM analysis was run using an alternative dummy-coding scheme to get the final comparison between the relaxation and meditation conditions. In Model 3, the relation between practice and both the GSI and PSOM scores, respectively, were assessed using HLM. Practice was specified as a level-1 predictor variable and a dummy-coded variable representing experimental condition (i.e., relaxation vs. meditation) was specified as a level-2 predictor. The regression coefficients presented in the sections to follow are unstandardized (*b*).

Distraction and Rumination Findings: Tests for Meditation

We performed analyses with pre–post data to determine whether potential reductions in psychological distress (as measured by the GSI of the BSI) were mediated by potential reductions in distractive and ruminative thoughts and behaviors. Mediation analyses were conducted via linear regression using previously recommended procedures (37,38). Change scores (posttest minus pretest scores) were calculated for the GSI, rumination, and distraction scales and entered into subsequent analyses. We examined mediation effects separately for rumination and distraction, to determine whether reductions found for one or both of these constructs might partially or fully mediate reductions in psychological distress. Because pretest M-C scores were significantly correlated with pretest GSI and rumination scores and were marginally related to post-GSI scores, we entered the M-C scores as a covariate in mediation analyses.

Effect Size Estimates

Effect size estimates were obtained comparing pre- and postintervention means (with respective pre- and postintervention standard deviations) for the GSI, PSOM, and rumination and distraction measures for each group. Cohen's *d* was calculated using gain scores and pooled standard deviations as previously described (39), using the standard formula: $d = M_{pre} - M_{post} / \sigma_{pooled}$; $\sigma_{pooled} = \sqrt{((\sigma_{pre}^2 + \sigma_{post}^2)/2)}$. In line with current conventions (40), effect sizes for improvements (i.e., reductions in distress, rumination, and distraction, and increases in positive mood states) are reported as positive in sign.

RESULTS

Compliance and Attrition

There were 104 participants enrolled in the study. Twenty-three participants (6 MM, 11 SR, and 6 controls) dropped out before completion of the study, citing schedules, family emergency, or health issues that kept them from participating. No adverse events were reported by any participant as a result of participating in the study. Although there was greater attrition from the relaxation group than the other groups, reported reasons for dropping from the study did not differ among the groups. Attrition analyses were conducted with one-tailed *t* tests to compare dropouts with nondropouts on all measures in the study. There were no significant baseline differences on any measure. However, there was a trend ($p = .09$) for dropouts to have higher rumination scores. Given that those participants who were randomized to the relaxation group tended to have higher baseline rumination scores (as noted in the following discussion), this might explain why more participants in the relaxation group dropped from the study. To estimate statistical effects more conservatively, maximize internal validity, and prevent possible bias from data imputation methods that are appropriate only for data missing completely at random, we elected to report a completer analysis as our primary analysis. Data was thus analyzed for the remaining 81 participants (30 controls, 27 MM, and 24 SR) who completed pre- and postintervention data. However, for the reader's interest, we also report findings based on intent to treat (ITT) analyses (using the "last observation carried forward" approach).

Preliminary Analyses

Table 1 shows the unadjusted group pre- and postintervention means and standard deviations on all measures for participants who completed the study. Chi-square analysis revealed that the matched randomization across gender, ethnicity, and student status was successful. There were no significant gender differences on pretest scores for any measure. Initial scores on the GSI indicated that students were indeed experiencing a considerable amount of distress (mean GSI = .66). This score is considerably higher than adult nonpatient norms as reported by Derogatis and Spencer (27). One-tailed *t* tests revealed no significant differences among the group means at baseline for the GSI, PSOM, and INSPIRIT–R. However, there were trends and significant differences found among the preintervention means for the MM, SR, and control groups for the DER subscales, with the students assigned to the SR group showing more distractive and ruminative thoughts and behaviors preintervention, $F(2,77) = 5.5$, $p = .006$ for rumination; $F(2,77) = 2.7$, $p = .07$ for distraction. The elevations in distraction and rumination for the SR group did not reflect the presence of outliers. The bivariate (Pearson product–moment) correlation of preintervention scores of distraction and rumination was significant ($r = .281$, $p = .048$).

The mean amount of total hours reported for outside-class practice for the meditation and relaxation groups was 5.27, with a standard deviation of 5 hr and a range of reported total practice time of 0.5 to 15 hr. SR and MM participants did not differ significantly in total amount of hr spent practicing class techniques. One-way ANCOVAs (with each preintervention score entered as a covariate, each postintervention score entered as the dependent variable, and class day and type entered as levels of the independent variable) reveal no significant differences between

TABLE 1
Unadjusted Pre- and Postintervention Means and Standard Deviations for Control, Meditation, and Relaxation Groups

	Control Preintervention[a]		*Control Postintervention*[a]		*Meditation Preintervention*[b]		*Meditation Postintervention*[b]		*Relaxation Preintervention*[c]		*Relaxation Postintervention*[c]	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Brief Symptom Inventory GSI scores	.59	.43	.46	.52	.64	.40	.22	.17	.74	.52	.35	.31
Daily Emotion Report Rumination scores	3.5	2.4	4.4	3.1	3.9	2.9	2.5	1.9	6.0	3.2	5.0	3.4
Daily Emotion Report Distraction scores	6.7	2.7	7.9	3.1	6.0	3.4	5.2	2.9	8.0	3.4	8.6	3.3
Positive States of Mind Scale scores	16.2	3.5	16.3	3.8	15.0	2.9	17.1	3.0	15.9	3.1	16.8	4.0
Index of Core Spiritual Experiences scores	27.7	7.6	27.5	7.2	28.4	8.0	28.9	7.0	26.8	8.4	27.4	7.8

Note. GSI = Global Severity Index.
[a]$n = 30$. [b]$n = 27$. [c]$n = 24$.

the two meditation classes or the two relaxation classes on the psychological variables, suggesting that the differences in teachers, room, or day/time did not predict outcomes within intervention type. In addition, there were no significant differences between the four classes in student ratings of room warmth and comfort, or teacher knowledge, warmth, or affability.

Preintervention M-C scores were examined for significant correlations with pre- and postintervention scores for our outcomes variables (GSI, PSOM, DER, and INSPIRIT–R). The M-C was significantly correlated with the pretest GSI ($r = -.297, p = .007$), as well as with pretest scores of rumination ($r = -.259$, $p = .02$). The M-C was marginally correlated with posttest GSI ($r = -.208, p = .065$) but not with posttest rumination ($r = .141, p = .213$). There were no significant associations between the M-C and PSOM, INSPIRIT–R, or DER distraction scales. Thus, M-C scores were entered as covariates in subsequent analyses with the GSI and DER rumination.

Pre–Post Questionnaire Analyses

Analyses were first conducted with measures that were assessed only at pre- and postintervention (DER subscales and INSPIRIT–R). ANCOVA analyses were conducted with postintervention scores of the INSPIRIT–R and DER questionnaires, using preintervention scores as covariates (as well as the M-C as a covariate for rumination analyses). There were no significant group differences on the INSPIRIT–R at postintervention. There were significant postintervention group differences for both the Distraction and Rumination subscales ($p < .004$ in both cases. Post hoc Tukey tests for distraction demonstrated that the meditation postintervention group mean was significantly lower than both the control ($p < .003$) and relaxation ($p < .004$) group means. For rumination, post hoc Tukey tests demonstrated that the meditation group postintervention mean was significantly lower than the control group mean ($p = .003$), with a trend for the comparison with relaxation group mean ($p = .06$). Thus, the meditation group showed significantly less ruminative thoughts and behaviors than the control group and significantly less distractive thoughts and behaviors than the control and relaxation group at postintervention. The relaxation group did not significantly differ from the control group for ruminative or distractive thoughts and behaviors at postintervention. These ANCOVA analyses are shown in Table 2. ANCOVA analyses conducted using an ITT approach yielded similar results. There were no group effects for the INSPIRIT–R, and there were significant omnibus effects for DER Rumination and Distraction ($p < .025$ in both cases), with the meditation group significantly differing from the control group and the relaxation group for both distraction and rumination ($p < .016$ in all cases). The relaxation group did not significantly differ from the control group on either distraction or rumination ($p > .20$ in both cases).

Weekly Data Analyses

Unconditional Linear Growth Model

Separate unconditional linear growth models were tested for the GSI and the PSOM, which were assessed weekly. Time was significantly related to both the GSI ($b = -.067, p < .001$) and the PSOM ($b = .334, p < .001$). Thus, GSI scores significantly decreased across time, whereas PSOM scores significantly increased across time. However, significant variation around the GSI-time slope, $\chi^2(80) = 195.42, p < .001$, and the PSOM-slope, $\chi^2(80) = 140.76, p < .001$, was evident, indicating the need to add group status as a higher order predictor in the model.

Conditional Linear Growth Model With Type of Condition Higher Order Predictors

The next HLM model for the GSI included group status as a higher order predictor as well as pretest M-C scores as a covariate. In the model predicting the GSI-time slope, signifi-

TABLE 2
Adjusted Postintervention Group Means and CIs Based on ANCOVA Analyses

	Control Postintervention[a]	*Meditation Postintervention*[b]	*Relaxation Postintervention*[c]	*F test for ANCOVA Analysis*
Daily Emotion Report Rumination scores[d]	4.84 (.47) CI 95% [3.9; 5.8]	2.73 (.51)* CI 95% [1.7; 3.7]	4.19 (.55) CI 95% [3.1; 5.3]	$F(2, 75) = 4.71$, $p = .012$
Daily Emotion Report Distraction scores[e]	7.97 (.51) CI 95% [7.0; 9.0]	5.64 (.56)** CI 95% [4.5; 6.7]	8.10 (.59) CI 95% [6.9; 9.2]	$F(2, 76) = 6.02$, $p = .004$
Index of Core Spiritual Experiences scores[e]	27.5 (.59) CI 95% [26.3; 28.7]	28.3 (.62) CI 95% [27.1; 29.6]	28.1 (.66) CI 95% [26.8; 29.5]	$F(2, 77) = .540$, $p = .586$

Note. Standard errors are in parentheses. ANCOVA = analysis of covariance; CI = confidence interval.
[a]$n = 30$. [b]$n = 27$. [c]$n = 24$. [d]Adjusted for preintervention and Marlowe-Crowne scores. [e]Adjusted for preintervention scores.
*Significant difference from control group postintervention mean, $p < .05$. **Significant difference from control and relaxation group postintervention means, $p < .05$.

cant differences were found between the control and the relaxation groups ($b = -.061$, $p = .01$) and the control and the meditation groups ($b = -.07$, $p = .002$), but not between the relaxation and meditation groups ($b = .00$, $p = .93$). Post hoc probing of this interaction revealed a significant decline in GSI scores across time for the participants in the relaxation group ($b = -.136$, $p = .002$), the meditation group ($b = -.140$, $p = .002$), and in the control group ($b = -.022$, $p = .036$). As the regression coefficients for this analysis suggest, however, the decline in GSI scores was significantly steeper (i.e., the GSI-time slope was more negative) for those participants in both the relaxation and meditation groups relative to those participants in the control group. ITT analyses yielded slightly different results: Only the meditation group significantly differed from the control group ($b = -.064$, $p = .002$), while there was a trend for the relaxation group to differ from the control group ($b = -.046$, $p = .08$).

A similar model was run for PSOM with group entered as a higher order predictor. In the model predicting the PSOM-time slope, significant differences were found between the control and the relaxation groups ($b = .334$, $p = .046$) and the control and the meditation groups ($b = .449$, $p = .012$), but not between the meditation and relaxation groups ($b = .185$, $p = .400$). Post hoc probing of this interaction revealed a significant increase in PSOM scores across time for the participants in the relaxation group ($b = .859$, $p = .006$) and the meditation group ($b = 1.060$, $p < .001$), but not for participants in the control group ($b = .103$, $p = .403$). ITT analyses suggested a trend for significant differences between the meditation and control group ($b = .318$, $p = .079$), but no difference between the relaxation and control groups ($b = .183$, $p = .80$).

Predicting Practice Effects

In the HLM model predicting the GSI-practice slope with the level-2 predictor type of experimental condition (relaxation vs. meditation), no significant differences were found between the two groups ($b = .051$, $p = .14$). Moreover, regardless of experimental condition, there was not a significant relation between GSI scores and practice as measured by total number of hours practiced ($b = -.018$, $p = .30$).

Similarly, in the model predicting the PSOM-practice slope with the level-2 predictor type of experimental condition (relaxation vs. meditation), no significant differences were found between the two groups ($b = .075$, $p = .745$). However, overall there was a marginally significant and positive relationship between PSOM scores and practice ($b = .295$, $p = .074$). Those individuals who practiced more, regardless of intervention group, also had higher PSOM scores.

Potential practice effects were also examined for the DER rumination and distraction subscales for the mediation and relaxation groups. Linear regression analyses with change scores entered as the dependent variable, and total practice time entered as the predictor variable indicated that practice did not predict changes in rumination or distraction for either the meditation or relaxation groups ($p > .5$ in all cases).

Mediation Analyses

Rumination Analysis

We first determined whether conditions were sufficient to test for rumination as a possible mediator of group status (meditation vs. control) on distress scores. In Step 1, change scores for GSI were entered as the dependent variable, with group status as the predictor variable and pretest M-C scores entered as covariates. Group status significantly predicted changes in GSI (standardized $\beta = -.337$, $p = .011$), accounting for 17.9% of the variance ($R^2 = .179$). In Step 2, we examine whether changes in rumination were related to changes in GSI scores, using pretest M-C scores as a covariates. Change scores for the GSI were significantly predicted by change scores of rumination (standardized $\beta = .363$, $p = .005$, $R^2 = .20$). Next, in Step 3, we examine whether group status predicted changes in rumination using pretest M-C scores as a covariate. Rumination change scores were significantly predicted by group status (standardized $\beta = -.396$, $p = .004$, $R^2 = .16$).

Results of these three steps suggest that sufficient conditions were met to test for mediation. Thus, in step 4, we examine whether changes in GSI for group were potentially mediated by changes in rumination. GSI change scores were entered as the dependent variable. Rumination change scores and group status

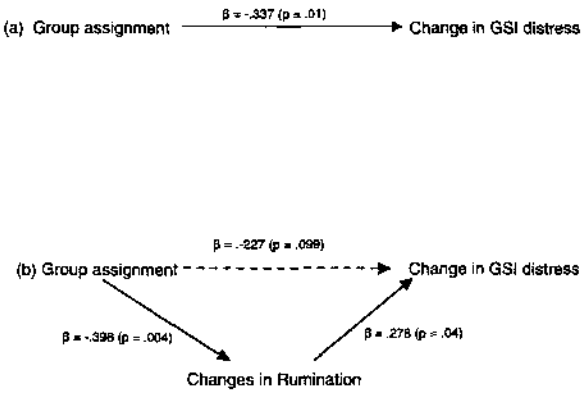

FIGURE 1 Depictions of (a) the direct relation between group status (meditation vs. control) and changes in GSI distress scores, and (b) the mediation model for changes in rumination on the relation between group status (meditation vs. control) and changes in GSI distress scores. Standardized beta estimates are depicted, with p values in parentheses. Although group status initially predicted differences in GSI change scores, this relation was no longer significant when changes in rumination are entered into the model. Regression analyses are adjusted for social desirability (M-C) scores.

were entered as predictor variables, and pretest M-C scores were entered as a covariate. Results indicate that changes in GSI distress scores were partially mediated by changes in rumination: Group status was no longer a significant predictor of GSI change scores (standardized $\beta = -.227$, $p = .099$), whereas changes in rumination remained significant (standardized $\beta = .278$, $p = .04$). The entire mediation model accounted for 24.4% of the variance in GSI change scores ($R^2 = .244$). This model is depicted in Figure 1.

Distraction Analysis

We performed similar analyses to determine whether sufficient conditions existed to test distraction as a mediator of group status on GSI scores. Step 1 was identical to the step reported previously for the rumination mediation analysis, with group status significantly predicting GSI scores (standardized $\beta = -.337$, $p = .011$). Step 2 reveals that changes in GSI scores are significantly predicted by changes in distraction scores (standardized $\beta = .295$, $p = .023$, $R^2 = .16$). Step 3 reveals significant differences between the meditation and control group means on distraction change scores (standardized $\beta = -.315$, $p = .023$, $R^2 = .09$). Finally, in Step 4 we determine whether changes in GSI might be mediated by changes in distraction. Change scores for the GSI are entered as the dependent variable, group status and change scores for distraction are entered as predictor variables, and pretest M-C scores are entered as a covariate. Results reveal that group status remained a significant predictor of GSI change scores (standardized $\beta = -.269$, $p = .048$), whereas distraction change scores did not predict GSI change scores (standardized $\beta = .215$, $p = .115$, $R^2 = .22$). Thus, our data suggest that reductions in distress for the meditation group are partially mediated by reductions in rumination but not distraction.

Effect Sizes

Using Cohen's (39) guidelines for interpreting effect sizes, reductions in distress (GSI scores) were large for the relaxation group ($d = .91$) and for the MM group ($d = 1.36$). The GSI effect size for the control group was small ($d = .27$). Thus, effect sizes for distress were comparable for both intervention groups, with the MM effect size being somewhat larger. Effect sizes for positive states of mind (PSOM) were above medium for the MM group ($d = .71$) and small for the relaxation group ($d = .25$), whereas the effect size for the control group was virtually zero ($d = -.03$). Thus, the mindfulness group showed considerably larger effects in increasing positive states of mind as compared to the relaxation group.

Although significant differences for reductions in rumination and distraction were only found for the MM versus control groups, effect sizes were also calculated for relaxation and control group means. Effect sizes for rumination were small to medium for the relaxation group ($d = .30$) and medium for the mediation group ($d = .57$). The control group, by contrast, showed a small to medium effect size ($d = -.33$) for rumination in the opposite direction (rumination increased over time). Effect sizes for distraction were small for the meditation group ($d = .25$), who showed decreases in distraction over time. Interestingly, scores in distraction increased for both the relaxation ($d = -.19$) and control ($d = -.41$) groups. Thus the MM group was unique in reducing as opposed to increasing distraction during the intervention period. Finally, effect sizes for INSPIRIT–R outcomes were negligible for each group ($d = .02$, $-.06$, and $-.07$ for the control, meditation, and relaxation groups, respectively).

DISCUSSION

This study directly compared two brief (1-month) stress-reduction interventions, each with considerably different approaches, for the reduction of stress in a student population studying health and medicine. Results of this matched randomized study indicated that, compared with a control group, participants in the MM and SR groups were successful in alleviating overall psychological distress as indexed by the GSI scores of the BSI and in increasing positive states of mind as measured by the PSOM. Effect sizes on distress were large and comparable for the meditation and relaxation groups (respective Cohen's ds were 1.36 and .91), whereas the meditation group's effect size for positive states of mind was considerably larger than that of relaxation (respective Cohen's ds were .71 and .25).

Normative GSI scores for healthy men are reported as .25, and for women as .35 (27). Comparison of these normative scores with our data indicates that all students were experiencing significant amounts of psychological distress preintervention (mean preintervention GSI = .66) but that only the meditation group fell to below-norm levels of distress (postintervention GSI means for the control, relaxation, and meditation were .46, .35, and .22, respectively). The result of lowered psychological distress for students who underwent the interventions, thus, appears to have clinical as well as statistical significance, especially for students participating in the mindfulness intervention.

Effects of MM on improving positive states of mind have been reported previously (17) and are replicated here. Although one may speculate that the relatively larger increase in PSOM for the meditation group versus the relaxation group may be related to the greater practice of cultivating present-moment awareness (and thus being more aware of positive states as they occur), the significant increase in PSOM for the relaxation group also indicates that increases in positive states of mind are not necessarily specific to mindfulness practice but may also be due to more general relaxation effects. Importantly, positive affect measures such as the PSOM have been shown to be inversely related to stress and anxiety (41), and there is mounting evidence that positive affect independently serves as a buffer against deleterious physiological consequences of stress (41,42). Future research would benefit from examining whether mindfulness interventions may reduce physiological consequences of stress by enhancing positive affect and well-being. This research could be conducted, for example, via paradigms that examine potential immune and affect changes in a chronically stressed population (such as Alzheimer caregivers) in response to mindfulness training or through examining response to specific laboratory stressor settings (e.g., examining immune or cardiovascular responses to an emotionally salient laboratory stressor) before and after mindfulness training. Finally, results of this study also suggested a trend for practice effects on positive states of mind for both the relaxation and meditation groups, such that increased practice of either relaxation or meditation techniques were associated with increases in positive states of mind. It will be important for future research to elucidate which elements of the practices lend themselves to improvements in positive states of mind, as well as optimal dose–response in terms of practice and outcomes.

MM was unique from relaxation in its ability to reduce rumination and distraction as compared with the control group. Further, results from this study suggest that the reductions in distress for the meditation group may be mediated by reductions in rumination. Findings support previous research that MM and relaxation interventions can alleviate psychological distress in clinical and nonclinical populations (5,9,10,14,16,43) and lend support to the theory that MM interventions may prevent depressive relapse by reducing tendencies to "lock in" to a ruminative cognitive cycle (44,45). However, because we did not have weekly data on the rumination measures, we were only able to assess mediation using pre–post data, and, thus, the directionality of our meditation model requires further validation with longitudinal designs. Further, our assessment of rumination was based on the DER, which assesses rumination specifically in response to depressed mood. Thus, further studies examining MM's potential effects on rumination as a more global response style or in response to anxiety, anger, or other negative emotional states are warranted.

It is also worth noting that postintervention data were collected 1 to 2 weeks after completion of the last intervention class and just before the final exam period. This indicates that the decreases in psychological distress for both groups, and decreases in distracting and ruminating thoughts and behaviors for the MM group were present even in times of high stress and considerably after commencement of the intervention itself.

No significant differences were found between the three groups in spiritual awareness as indexed by the INSPIRIT–R, a finding that is in contrast to previous studies (9). This lack of replication was not expected and may be due to brevity of the intervention (Shapiro, Schwartz & Bonner's [9] intervention consisted of 7 weeks as opposed to the 4 weeks in this intervention). The necessitated short duration of the intervention may be seen as a limitation of the study. Other potential limitations include the possibilities of bias due to a self-selected sample and inability to separate potential nonspecific effects of both interventions (e.g., social support effects due to group format for both interventions).

The reductions in rumination and distraction found for the meditation group might be explained by the changes in attention processes that are hypothesized to occur as a result of mindfulness practice. MM attempts to cultivate nonjudgmental, moment-to-moment awareness to inner as well as outer stimuli. The development of this skill would result in the ability to shift and redirect attention to the present moment rather than thinking about past or future experience or otherwise distracting oneself from the present moment. Our findings thus suggest that a potential unique mechanism of action for mindfulness training may be its ability to decrease both rumination and distraction, perhaps thereby decreasing psychological distress. MM's ability to decrease ruminative thoughts and thus decrease psychological distress has been suggested previously (44,45), with at least one other study with previously depressed patients supporting such a contention (22).

Further, results from this comparative study indicate that reductions in rumination may be unique to mindfulness training and not simply a consequence of relaxation effects and that these reductions in rumination may provide a pathway in reducing distress. Our findings have considerable implications, providing an initial step toward understanding possible mechanisms by which MM may decrease anxiety and depression. However, given that our findings may have limited generalizability, future research should confirm whether these results are consistent for populations with clinical levels of depression or anxiety, as well as examine potential mediating effects of decreased rumination in preventing onset of depressive episodes and anxiety disorders in other distressed populations.

Interestingly, this study also indicates that participation in the MM intervention reduced distractive thoughts and behaviors. Although this finding is understandable given the present-moment attention practice encouraged in MM, it is yet unclear what the clinical implications would be should these decreases in both rumination and distraction persist in the MM practitioner over time. Some researchers and theorists assert that distraction is a positive coping skill for depressive disorders (19,31). Others suggest that distraction's effects on reducing depression may depend on a person's belief and concentrative ability to distract oneself from a negative mood state (46) or on severity of depression (47,48). If our results are replicated in subsequent mindfulness intervention studies, future studies

might compare the effects of mindfulness training with techniques that promote distractive coping in distressed populations to determine whether reduced or increased distractive coping is more beneficial in relation to reducing distress.

In summary, results from this study indicate that both MM and SR are effective in reducing negative psychological states and enhancing positive states of mind for students experiencing significant distress, although MM appears unique in reducing rumination and distraction compared with relaxation. Comparisons of effect sizes indicate that mindfulness and relaxation are similar with respect to reducing distress; however, mindfulness appears more effective in enhancing positive states of mind. In addition, this study suggests that MM may be unique in its ability to reduce ruminative and distractive responses to depressed mood and that the reductions in rumination during mindfulness training may mediate reductions in distress. Future research should confirm and extend these preliminary results.

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