Meditation Programs for Psychological Stress and Well-being: A Systematic Review and Meta-analysis

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**Importance** Many people meditate to reduce psychological stress and stress-related health problems. To counsel people appropriately, clinicians need to know what the evidence says about the health benefits of meditation.

**Objective** To determine the efficacy of meditation programs in improving stress-related outcomes (anxiety, depression, stress/distress, positive mood, mental health-related quality of life, attention, substance use, eating habits, sleep, pain, and weight) in diverse adult clinical populations.

**Evidence Review** We identified randomized clinical trials with active controls for placebo effects through November 2012 from MEDLINE, PsycINFO, EMBASE, PsycArticles, Scopus, CINAHL, AMED, the Cochrane Library, and hand searches. Two independent reviewers screened citations and extracted data. We graded the strength of evidence using 4 domains (risk of bias, precision, directness, and consistency) and determined the magnitude and direction of effect by calculating the relative difference between groups in change from baseline. When possible, we conducted meta-analyses using standardized mean differences to obtain aggregate estimates of effect size with 95% confidence intervals.

**Findings** After reviewing 18,753 citations, we included 47 trials with 3,515 participants. Mindfulness meditation programs had moderate evidence of improved anxiety (effect size, 0.38 [95% CI, 0.12-0.64] at 8 weeks and 0.22 [0.02-0.43] at 3-6 months), depression (0.30 [0.00-0.59] at 8 weeks and 0.23 [0.05-0.42] at 3-6 months), and low evidence of improved stress/distress and mental health-related quality of life. We found low evidence of no effect or insufficient evidence of any effect of meditation programs on positive mood, attention, substance use, eating habits, sleep, and weight. We found no evidence that meditation programs were better than any active treatment (ie, drugs, exercise, and other behavioral therapies).

**Conclusions and Relevance** Clinicians should be aware that meditation programs can result in small to moderate reductions of multiple negative dimensions of psychological stress. Thus, clinicians should be prepared to talk with their patients about the role that a meditation program could have in addressing psychological stress. Stronger study designs are needed to determine the effects of meditation programs in improving the positive dimensions of mental health and stress-related behavior.
Meditative techniques are categorized as emphasizing mindfulness, concentration, and automatic self-transcendence. Popular techniques, such as transcendental meditation, emphasize the use of a mantra in such a way that it transcends one to an effortless state where focused attention is absent. Other popular techniques, such as mindfulness-based stress reduction, emphasize training in present-focused awareness or mindfulness. Uncertainty remains about what these distinctions mean and the extent to which these distinctions actually influence psychosocial stress outcomes.

Reviews to date report a small to moderate effect of mindfulness and mantra meditation techniques in reducing emotional symptoms (eg, anxiety, depression, and stress) and improving physical symptoms (eg, pain). These reviews have largely included uncontrolled and controlled studies, and many of the controlled studies did not adequately control for placebo effects (eg, waiting list- or usual care-controlled studies). Observational studies have a high risk of bias owing to problems such as self-selection of interventions (people who believe in the benefits of meditation or who have prior experience with meditation are more likely to enrol in a meditation program and report that they benefited from one) and use of outcome measures that can be easily biased by participants’ beliefs in the benefits of meditation. Clinicians need to know whether meditation training has beneficial effects beyond self-selection biases and the nonspecific effects of time, attention, and expectations for improvement.

An informative analogy is the use of placebos in pharmaceutical trials. A placebo is typically designed to match nonspecific aspects of the “active” intervention and thereby elicit the same expectations of benefit on the part of the provider and patient in the absence of the active ingredient. Office visits and patient-provider interactions, all of which influence expectations for outcome, are particularly important to control when the evaluation of outcome relies on patient reporting. In the situation when double-blinding has not been feasible, the challenge to execute studies that are not biased by these nonspecific factors is more pressing. To develop evidence-based guidance on the use of meditation programs, we need to examine the specific effects of meditation in randomized clinical trials (RCTs) in which the nonspecific aspects of the intervention are controlled.

The objective of this systematic review is to evaluate the effects of meditation programs on negative affect (eg, anxiety, stress), positive affect (eg, well-being), the mental component of health-related quality of life, attention, health-related behaviors affected by stress (eg, substance use, sleep, eating habits), pain, and weight among persons with a clinical condition. We include only RCTs that used 1 or more control groups in which the amount of time and attention provided by the control intervention was comparable to that of the meditation program.

**Methods**

**Study Selection**

We searched the following databases for primary studies: MEDLINE, PsycINFO, EMBASE, PsycArticles, Scopus, CINAHL, AMED, and the Cochrane Library through June 2013. We developed a MEDLINE search strategy using PubMed medical subject heading terms and the text words of key articles that we identified a priori. We used a similar strategy in the other electronic sources. We reviewed the reference lists of included articles, relevant review articles, and related systematic reviews to identify articles missed in the database searches. We did not impose any limits based on language or date of publication. The protocol for this systematic review is publicly available.

Two trained investigators independently screened titles and abstracts, excluding those that both investigators agreed met at least 1 of the exclusion criteria (Table 1). For those studies included after the first review, a second dual independent review of the full-text article occurred, and differences regarding article inclusion were resolved through consensus.

We included RCTs in which the control group was matched in time and attention to the intervention group. We also required that studies include participants with a clinical condition. We defined a clinical condition broadly to include mental health/psychiatric conditions (eg, anxiety or stress) and physical conditions (eg, lower back pain, heart disease, or advanced age). In addition, because stress is of particular interest in meditation studies, we also included trials that studied stressed populations, although they may not have had a defined medical or psychiatric diagnosis.

**Data Abstraction and Data Management**

We used systematic review software (DistillerSR, 2010; Evidence Partners) to manage the screening process. For each meditation program, we extracted information on measures of intervention fidelity, including dose, training, and receipt of intervention. We recorded the duration and maximal hours of structured training in meditation, the amount of home practice recommended, description of instructor qualifications, and description of participant adherence, if any. Because numerous scales measured negative or positive affect, we chose scales that were common to the other trials and the most clinically relevant to make comparisons more meaningful.

To display outcome data, we calculated the relative difference in change scores (ie, the change from baseline in the treatment group minus the change from baseline in the control group, divided by the baseline score in the treatment group). We used the relative difference in change scores to estimate the direction and approximate magnitude of effect for all outcomes. We were unable to calculate a relative differen-
en in change score for 6 outcomes owing to incompletely reported data for statistically insignificant findings. We considered a 5% relative difference in change score to be potentially clinically significant because these studies examined short-term interventions and relatively low doses of meditation.

For the purpose of generating an aggregate quantitative estimate of the effect of an intervention and the associated 95% confidence interval, we performed random-effects meta-analyses using standardized mean differences (effect size [ES]; Cohen d). We also used these analyses to assess the precision of individual studies, which we factored into the overall strength of evidence. For each outcome, ES estimates are displayed according to the type of control group and the duration of follow-up. Trials did not give enough information to conduct a meta-analysis on 16 outcomes. We display the relative difference in change scores along with the ES estimates from the meta-analysis so that readers can see the full extent of the available data (Figure 1 and Supplement eFigures 1 to 34).

We classified the type of control group as a nonspecific active or specific active control (Table 1). The nonspecific active comparison conditions (eg, education or attention control) control for the nonspecific effects of time, attention, and expectation. Comparisons against these controls allow for assessments of the specific effectiveness of the meditation program beyond the nonspecific effects of time, attention, and expectation. This comparison is similar to a comparison against a placebo pill in a drug trial. Specific active controls are therapies (eg, exercise or progressive muscle relaxation) known or expected to change clinical outcomes. Comparisons against these controls allow for assessments of comparative effectiveness similar to those of drug trials that compare one drug against another known drug. Because these study designs are expected to yield different conclusions (efficacy vs comparative effectiveness), we separated them in our analyses.

**Table 1. Study Inclusion and Exclusion Criteria**

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population and condition of interest</strong></td>
<td>Adult populations (≥18 y); clinical (medical or psychiatric) diagnosis, defined as any condition (eg, high blood pressure, anxiety) including a stressor</td>
</tr>
<tr>
<td>Interventions</td>
<td>Structured meditation programs (any systematic or protocol meditation programs that follow predetermined curricula) consisting of, at a minimum, 24 h of training with instructions to practice outside the training session, including mindfulness-based programs (ie, MBSR, MBCT, vipassana, Zen, and other mindfulness meditation), mantra-based programs (ie, TM, other mantra meditation), and other meditation programs</td>
</tr>
<tr>
<td>Comparisons of interest</td>
<td>Active control is defined as a program that is matched in time and attention to the intervention group for the purpose of matching expectations of benefit (examples include attention control, educational control, or another therapy, such as progressive muscle relaxation, that the study compares with the intervention; nonspecific active control only matches time and attention and is not a known therapy); specific active control compares the intervention with another known therapy, such as progressive muscle relaxation</td>
</tr>
<tr>
<td>Study design</td>
<td>RCTs with an active control</td>
</tr>
<tr>
<td>Timing and setting</td>
<td>Longitudinal studies that occur in general and clinical settings</td>
</tr>
</tbody>
</table>

Abbreviations. ACT, acceptance and commitment therapy; DBT, dialectical behavioral therapy; MBCT, mindfulness-based cognitive therapy; MBSR, mindfulness-based stress reduction; RCTs, randomized clinical trials; TM, transcendental meditation. *We excluded articles with no original data (reviews, editorials, and comments), studies published in abstract form only, and dissertations.

**Strength of the Body of Evidence**

We assessed the quality of the trials independently and in duplicate based on the recommendations in the *Methods Guide for Conducting Comparative Effectiveness Reviews.* We supplemented these tools with additional assessment questions based on the Cochrane Collaboration’s risk-of-bias tool. Two reviewers graded the strength of evidence for each outcome using the grading scheme recommended by the Methods Guide for Conducting Comparative Effectiveness Reviews. This grading was followed by a discussion to review and achieve consensus on the assigned grades. In assigning evidence grades, we considered the following 4 domains: risk of bias, directness, consistency, and precision. We classified evidence into the following 4 basic categories: (1) high grade (indicating high confidence that the evidence reflects the true effect and that further research is very unlikely to change our confidence in the estimate of the effect), (2) moderate grade (indicating moderate confidence that the evidence reflects the true effect and that further research may change our confidence in the estimate of the effect and may change the estimate), (3) low grade (indicating low confidence that the evidence reflects the true effect and that further research is likely to change our confidence in the estimate of the effect and is likely to change the estimate), and (4) insufficient grade (indicating that evidence is unavailable or inadequate to draw a conclusion).

**Results**

We screened 18 753 unique citations (Figure 2) and 1651 full-text articles. Forty seven trials met our inclusion criteria. Most trials were short-term but ranged from 3 weeks to 5.4 years in duration (Table 2). Not all trials reported the amount
Summary across measurement domains of comparisons of meditation programs with nonspecific active controls (efficacy analysis) (A) and specific active controls (comparative effectiveness) (B). CAD indicates coronary artery disease; CHF, congestive heart failure; CSM, clinically standardized meditation (a mantra meditation program); MA, meta-analysis; PA, primary analysis; PO, number of trials in which this was a primary outcome for the trial; and TM, transcendental meditation (a mantra meditation program). Direction is based on the relative difference in change analysis. ↑ indicates the meditation group improved relative to the control group (with a relative difference generally >5% across trials); ↓, the meditation group worsened relative to the control group (with a relative difference generally <5% across trials); Ø, a null effect (with a relative difference generally ≤5% across trials); |, an effect (with a relative difference generally >5% but ≤10% across trials); and ↑↓, inconsistent findings (some trials reported improvement with meditation [relative to control], whereas others showed no improvement or improvement in the control group [relative to meditation]). Magnitude is based on the relative difference in the change score, a relative percent difference, using the baseline mean in the meditation group as the denominator. For example, if the meditation group improves from 10 to 19 on a mental health scale and the control group improves from 11 to 16 on the same scale, the relative difference between groups in the change score is: (19 – 10) – (16 – 11)/10 = 40%. The interpretation is a 40% relative improvement on the mental health scale in the meditation group compared with the control group. Improvement in all scales is indicated in the positive direction. A positive relative percent difference means that the score improved more in the intervention group than in the control group. The meta-analysis figure (far right) shows the Cohen d statistic with the 95% CI.

Negative affect combines the outcomes of anxiety, depression, and stress/distress and is therefore considered a composite measure of affective disturbance. Citation bias, publication bias, and small-study effects are potential sources of bias in the meta-analyses. In particular, because of the specific design of the included trials, the meta-analyses may have been subject to a publication bias that favors the reporting of positive results. For this reason, we specifically investigated the effect of publication bias on the findings of the meta-analyses, using methodological, statistical, and computational techniques. Publication bias was not found to be a significant factor in the results of the meta-analyses.

aSummary effect size is not shown owing to concern about publication bias for this outcome.

bNegative affect combines the outcomes of anxiety, depression, and stress/distress and is therefore considered a composite measure of affective disturbance. Citation bias, publication bias, and small-study effects are potential sources of bias in the meta-analyses. In particular, because of the specific design of the included trials, the meta-analyses may have been subject to a publication bias that favors the reporting of positive results. For this reason, we specifically investigated the effect of publication bias on the findings of the meta-analyses, using methodological, statistical, and computational techniques. Publication bias was not found to be a significant factor in the results of the meta-analyses.

cWe did not perform an MA on this outcome because it would duplicate the information already reported in the meta-analysis of anxiety and depression.

dStatistical analysis was based on the results of the meta-analyses.
of training or home practice recommended. Mindfulness-based stress reduction programs typically provided 20 to 27.5 hours of training during 8 weeks. The other mindfulness meditation trials provided about half this amount. Transcendental meditation trials were estimated to provide 16 to 39 hours in 3 to 12 months, whereas other mantra meditation programs provided about half this amount. Only 5 of the trials reported the trainers’ actual meditation experience (ranging from 4 months to 25 years), and 6 reported the trainers’ actual teaching experience (ranging from 0-15.7 years). Fifteen trials studied psychiatric populations, including those with anxiety, depression, stress, chronic worry, and insomnia. Five trials studied smokers and alcoholics, 5 studied populations with chronic pain, and 16 studied populations with diverse medical problems, including those with heart disease, lung disease, breast cancer, diabetes mellitus, hypertension, and human immunodeficiency virus infection.

The strength of evidence concerning the outcomes is shown in Figure 1. We found it difficult to draw comparative effectiveness conclusions owing to the large heterogeneity of type and strength of the many comparators. Therefore, we present our results first for all the comparisons with nonspecific active controls (efficacy) and then for those with specific active controls (comparative effectiveness).

The direction and magnitude of effect is derived from the relative difference between groups in the change score. In our efficacy analysis (Figure 1A), we found low evidence of no effect or insufficient evidence that mantra meditation programs had an effect on any of the psychological stress and well-being outcomes we examined. Mindfulness meditation programs had moderate evidence of improved anxiety (ES, 0.38 [95% CI, 0.12-0.64] at 8 weeks and 0.22 [0.02-0.43] at 3-6 months), depression (0.30 [0.00-0.59] at 8 weeks and 0.23 [0.05-0.42] at 3-6 months), and pain (0.33 [0.03-0.62]) and low evidence of improved stress/distress and mental health-related quality of life. We found low evidence of no effect or insufficient evidence of an effect of meditation programs on positive mood, attention, sleep, and weight. We also found insufficient evidence that meditation programs had an effect on health-related behaviors affected by stress, including substance use and sleep.

In our comparative effectiveness analyses (Figure 1B), we found low evidence of no effect or insufficient evidence that any of the meditation programs were more effective than exercise, progressive muscle relaxation, cognitive-behavioral group therapy, or other specific comparators in changing any outcomes of interest. Few trials reported on potential harms of meditation programs. Of the 9 trials reporting this information, none reported any harms of the intervention.

We could not conduct any quantitative tests (eg, funnel plots) for publication bias because few studies were available for most outcomes, and many were excluded from the meta-analysis owing to missing data. We reviewed the clinicaltrials.gov registration database to identify trials completed 3 or more years ago that prespecified our outcomes of interest and did not publish at all or did not publish all prespecified outcomes. We found 5 trials that appeared to have been completed before January 1, 2010, that did not publish all the outcomes they had prespecified and 9 trials for which we could not find an associated publication. Because only 6 outcomes were excluded from the analyses of the relative difference in change scores between groups, whereas 16 outcomes were...
| Source                      | Meditation Program | Type of Active Control | Study Quality | No. of Hours Program | Program Duration/Study Duration | Outcomes (End of Treatment/End of Study) | Population | No. of Patients |
|----------------------------|--------------------|------------------------|---------------|----------------------|-------------------------------|-----------------------------------------|------------|----------------|}
| Henderson et al,**68 2012  | MBSR               | NSAC                   | Fair          | 25                   | UC                            | Anxiety (NS/NS), depression (+/†), positive affect (+/Ø) | Breast cancer | 100            |
| Gaylord et al,**43 2011    | MBSR               | NSAC                   | Fair          | 23†                  | Y-NS                          | Anxiety (Ø/+), depression (Ø/Ø), stress/distress (Ø/+), pain (⊥/+), positive affect (Ø/†) | IBS         | 75             |
| Schmidt et al,**64 2011    | MBSR               | NSAC                   | Fair          | 27                   | 42                            | Anxiety (Ø/+), depression (Ø/†), sleep (Ø/Ø), pain (Ø/Ø) | Fibromyalgia | 109            |
| Gros et al,**44 2010       | MBSR               | NSAC                   | Fair          | 27                   | Y-NS                          | Anxiety (†/†), depression (⊥/†), positive affect (Ø/†), mental QOL (Ø/ Ø), sleep (Ø/†), pain (Ø/Ø) | Organ transplant | 137           |
| Morone et al,**55 2009     | MBSR               | NSAC                   | Good          | 12                   | 42                            | Anxiety (↔/↑), depression (↑/↑), positive affect (Ø/↑), mental QOL (Ø/↑), sleep (↑/↑), pain (↑/↑) | Low back pain | 35             |
| Whitebird et al,**72 2013  | MBSR               | NSAC                   | Fair          | 25                   | 26.7                          | Anxiety (Ø/Ø), depression (Ø/Ø), stress/distress (Ø/Ø), mental QOL (Ø/Ø) | Dementia caregivers | 78             |
| SeyedAlinaghi et al,**67 2012 | MBSR             | NSAC                   | Poor          | 25†                  | Y-NS                          | Stress/distress (⊥/⊥), anxiety (⊥/⊥) | HIV         | 171            |
| Pbert et al,**60 2012       | MBSR               | NSAC                   | Good          | 26                   | 24                            | Stress/distress (⊥/+), mental QOL (⊥/+), anxiety (⊥/⊥), depression (⊥/⊥) | Asthma      | 82             |
| Olen et al,**58 2010       | MM                 | NSAC                   | Fair          | 9                    | Y-NS                          | Depression (⊥/NA), stress/distress (⊥/NA), mental QOL (⊥/⊥), anxiety (⊥/⊥), depression (⊥/⊥) | Dementia caregivers | 19             |
| Garland et al,**42 2010    | MM                 | NSAC                   | Fair          | UC                   | 17.5                          | Stress/distress (⊥/⊥), anxiety (⊥/⊥), positive affect (⊥/⊥) | Alcoholism  | 37             |
| Mularski et al,**56 2009   | MM                 | NSAC                   | Poor          | 8                    | Y-NS                          | Stress/distress (Ø/NA), mental QOL (⊥/NA) | COPD        | 49             |
| Lee et al,**50 2007        | MM                 | NSAC                   | Fair          | 8                    | Y-NS                          | Anxiety (⊥/⊥), depression (⊥/⊥), mental QOL (⊥/⊥), anxiety (⊥/⊥), depression (⊥/⊥) | Anxiety     | 41             |
| Malarkey et al,**53 2013    | MM                 | NSAC                   | Good          | 9                    | 18.5                          | Depression (NS/NA), stress/distress (NS/NA), sleep (NS/NA) | CRP level >3.0 mg/L | 186            |
| Chiesa et al,**39 2012     | MBCT               | NSAC                   | Fair          | 16                   | UC                            | Anxiety (⊥/NA), depression (⊥/NA), positive affect (⊥/NA) | Depression  | 18             |
| Hoge et al,**78 2013       | MBSR               | NSAC                   | Fair          | 20                   | 18.7                          | Anxiety (⊥/⊥), sleep (⊥/⊥), mental QOL (⊥/⊥), anxiety (⊥/⊥), depression (⊥/⊥) | Anxiety     | 89             |
| Nakamura et al,**79 2013   | MM                 | NSAC                   | Fair          | 6                    | UC                            | Depression (Ø/†), stress/distress (⊥/⊥), positive affect (Ø/Ø), sleep (⊥/⊥) | Cancer and insomnia | 38             |
| Wong et al,**74 2011       | MBSR               | Pain AC                | Good          | 27                   | Y-NS                          | Anxiety (Ø/Ø), depression (Ø/Ø), mental QOL (Ø/Ø), pain (Ø/Ø) | Chronic pain | 99             |
| Gross et al,**45 2011      | MBSR               | Drug                   | Fair          | 26                   | 36                            | Anxiety (Ø/Ø), depression (Ø/Ø), mental QOL (Ø/Ø), pain (Ø/Ø) | Insomnia    | 27             |
| Koszycki et al,**71 2007   | MBSR               | CBGT                   | Poor          | 27.5                 | 28                            | Anxiety (⊥/⊥), depression (⊥/⊥), anxiety (⊥/⊥), depression (⊥/⊥) | Anxiety     | 53             |
| Barrett et al,**74 2012    | MBSR               | Exercise               | Fair          | 20                   | 42                            | Anxiety (Ø/Ø), stress/distress (Ø/Ø), positive affect (Ø/Ø), mental QOL (Ø/Ø), sleep (Ø/Ø) | Cold/URI in past year | 98             |
Table 2. Study Descriptions (continued)

<table>
<thead>
<tr>
<th>Source</th>
<th>Meditation Program</th>
<th>Type of Active Control</th>
<th>Study Quality</th>
<th>No. of Hours</th>
<th>Outcomes (End of Treatment/End of Study)</th>
<th>Population</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jazaieri et al,48 2012</td>
<td>MBSR Exercise</td>
<td>Poor</td>
<td>25 Y-NS</td>
<td>28.3</td>
<td>Anxiety (↑/Ø), depression (↑/↑), stress/distress (↑/NA), positive affect (↑/NA)</td>
<td>Social anxiety disorder</td>
<td>56</td>
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<tr>
<td>Moritz et al,54 2006</td>
<td>MBSR Spirituality</td>
<td>Good</td>
<td>12 Y-NS</td>
<td>8 wk/3 mo</td>
<td>Anxiety (↑/NA), depression (↑/NA), stress/distress (↑/↑), positive affect (↑/NA), mental QOL (↑/NA), pain (↑/NA)</td>
<td>Mood disturbance (POMS)</td>
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<tr>
<td>Plews-Ogan et al,63 2005</td>
<td>MBSR Massage</td>
<td>Poor</td>
<td>20 Y-NS</td>
<td>8 wk/3 mo</td>
<td>Mental QOL (↑/↑), pain (↑/↑)</td>
<td>Chronic pain</td>
<td>23</td>
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<tr>
<td>Hebert et al,66 2001</td>
<td>MBSR Nutrition education</td>
<td>Fair</td>
<td>45 UC</td>
<td>15 wk/12 mo</td>
<td>Eating habits (Ø/Ø), weight (Ø/Ø)</td>
<td>Breast cancer</td>
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<tr>
<td>Philippot et al,61 2012</td>
<td>MBCT Relaxation</td>
<td>Fair</td>
<td>13.5 Y-NS</td>
<td>6 wk/3 mo</td>
<td>Anxiety (↑/↑), depression (↑/↑)</td>
<td>Tinnitus</td>
<td>25</td>
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<tr>
<td>Segal et al,66 2010</td>
<td>MBCT Drug</td>
<td>Good</td>
<td>23 Y-NS</td>
<td>8 wk/20 mo</td>
<td>Depression (NA/↑)</td>
<td>Depression</td>
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<tr>
<td>Kuyken et al,69 2008</td>
<td>MBCT Drug</td>
<td>Good</td>
<td>24 Y-NS</td>
<td>37.5</td>
<td>Depression (NA/↑), mental QOL (++/+), stress/distress (↑/↑), positive affect (↑/NA)</td>
<td>Depression</td>
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<td>Piet et al,62 2010</td>
<td>MBCT CBGT</td>
<td>Fair</td>
<td>16 Y-NS</td>
<td>8 wk/NA</td>
<td>Anxiety (↑/NA), depression (↑/NA), stress/distress (↑/NA)</td>
<td>Social phobia</td>
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<td>Delgado et al,60 2010</td>
<td>MM PMR</td>
<td>Fair</td>
<td>10 Y-NS</td>
<td>5 wk/NA</td>
<td>Anxiety (↑/NA), depression (↑/NA), stress/distress (↑/NA), positive affect (↑/NA)</td>
<td>Worriers</td>
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<tr>
<td>Wolever et al,73 2012</td>
<td>MM Viniyoga</td>
<td>Fair</td>
<td>14 UC</td>
<td>12 wk/NA</td>
<td>Depression (↑/NA), stress/distress (↑/NA), sleep (↑/NA), pain (↑/NA)</td>
<td>Stressed employees</td>
<td>186</td>
</tr>
<tr>
<td>Miller et al,53 2012</td>
<td>MM Smart Choices</td>
<td>Poor</td>
<td>25 Y-NS</td>
<td>12 wk/6 mo</td>
<td>Eating (↑/↑), weight (↑/Ø)</td>
<td>Diabetes mellitus</td>
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<td>Brewer et al,37 2011</td>
<td>MM Lung Association FFS</td>
<td>Poor</td>
<td>12 Y-NS</td>
<td>4 wk/4 mo</td>
<td>Smoking (↑/+), age (↑)</td>
<td>Smokers</td>
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</tr>
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<td>Brewer et al,36 2009</td>
<td>MM CBT</td>
<td>Poor</td>
<td>9 UC</td>
<td>9 wk/NA</td>
<td>Alcohol abuse (Ø/NA)</td>
<td>Alcoholism</td>
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</tr>
<tr>
<td>Arch et al,75 2013</td>
<td>MM CBT</td>
<td>Fair</td>
<td>18 UC</td>
<td>29.2</td>
<td>Anxiety (↑/↑), depression (↑/↑)</td>
<td>Anxiety</td>
<td>105</td>
</tr>
<tr>
<td>Omidi et al,80 2013</td>
<td>MBCT CBT</td>
<td>Poor</td>
<td>16 Y-NS</td>
<td>56</td>
<td>Anxiety (↑/NA), depression (↑/NA)</td>
<td>Depression</td>
<td>60</td>
</tr>
<tr>
<td>Ferraioli and Harris,77 2013</td>
<td>MM SBPT</td>
<td>Poor</td>
<td>16 UC</td>
<td>8 wk/5 mo</td>
<td>Stress/distress (↑/+), age (↑)</td>
<td>Stressed parents</td>
<td>15</td>
</tr>
<tr>
<td>Paul-Labrador et al,86 2006</td>
<td>TM NSAC</td>
<td>Good</td>
<td>39 Y-NS</td>
<td>16 wk/NA</td>
<td>Anxiety (↑/NA), depression (↑/NA), stress/distress (↑/NA), pain (↑/NA)</td>
<td>CAD</td>
<td>103</td>
</tr>
<tr>
<td>Jayadevappa et al,76 2007</td>
<td>TM NSAC</td>
<td>Good</td>
<td>22.5 Y-NS</td>
<td>90</td>
<td>Depression (↑/NA), stress/distress (↑/NA), positive affect (↑/NA), pain (↑/↑)</td>
<td>CHF</td>
<td>23</td>
</tr>
<tr>
<td>Schneider et al,53 2012</td>
<td>TM NSAC</td>
<td>Good</td>
<td>78 Y-NS</td>
<td>1310</td>
<td>Depression (NA/↑), weight (NA/NS)</td>
<td>CAD</td>
<td>201</td>
</tr>
<tr>
<td>Smith,69 1976</td>
<td>TM NSAC</td>
<td>Poor</td>
<td>UC</td>
<td>87.5</td>
<td>Anxiety (↑/NA)</td>
<td>Anxiety</td>
<td>41</td>
</tr>
<tr>
<td>Elder et al,41 2006</td>
<td>TM NSAC</td>
<td>Fair</td>
<td>UC</td>
<td>90</td>
<td>Weight (Ø/NA)</td>
<td>Diabetes mellitus</td>
<td>54</td>
</tr>
<tr>
<td>Castillo-Richmond et al,38 2000</td>
<td>TM NSAC</td>
<td>Poor</td>
<td>UC</td>
<td>120.6</td>
<td>Weight (NA/NA)</td>
<td>AA with hypertension</td>
<td>60</td>
</tr>
<tr>
<td>Chhatre et al,76 2013</td>
<td>TM NSAC</td>
<td>Fair</td>
<td>24 Y-NS</td>
<td>112</td>
<td>Depression (NA/↑), stress/distress (NA/↑)</td>
<td>HIV</td>
<td>20</td>
</tr>
</tbody>
</table>

(continued)
mates ranged from 0.22 to 0.38 for anxiety symptoms and the range of clinical conditions (Table 2). During the course of 2 years, the evidence was insufficient to indicate that meditation programs alter health-related behaviors affected by stress, and low-grade evidence suggested that meditation programs do not influence weight. Although uncontrolled studies have usually found a benefit of meditation, very few controlled studies have found a similar benefit for the effects of meditation programs on health-related behaviors affected by stress.17,19

In the 20 RCTs examining comparative effectiveness,18 mindfulness and mantra programs did not show significant effects when the comparator was a known treatment or therapy. A lack of statistically significant superiority compared with a specific active control (eg, exercise) only addresses the question of equivalency or noninferiority if the trial is suitably powered. A lack of statistically significant superiority compared with a nonspecific active control, yielding an ES of 0.33 from the meta-analysis. This effect is variable across painful conditions and is based on the results of 4 trials, of which 2 were conducted in patients with musculoskeletal pain,15,64 1 trial in patients with irritable bowel syndrome,15 and 1 trial in a population without pain.16,17 Visceral pain had a large and statistically significant relative 30% improvement in pain severity, whereas musculoskeletal pain showed 5% to 8% improvements that were considered nonsignificant.

Overall, the evidence was insufficient to indicate that meditation programs alter health-related behaviors affected by stress, and low-grade evidence suggested that meditation programs do not influence weight. Although uncontrolled studies have usually found a benefit of meditation, very few controlled studies have found a similar benefit for the effects of meditation programs on health-related behaviors affected by stress.17,19

Our review indicates that meditation programs can reduce the negative dimensions of psychological stress. Mindfulness meditation programs, in particular, show small improvements in anxiety, depression, and pain with moderate evidence and small improvements in stress/distress and the mental health component of health-related quality of life with low evidence when compared with nonspecific active controls. Mantra meditation programs did not improve any of the outcomes examined, but the strength of this evidence varied from low to insufficient. Although meditation programs generally seek to improve the positive dimensions of health, the evidence from a small number of studies did not show any effects on positive affect or well-being for any meditation program. We found no evidence of any harms of meditation programs, although few trials reported on harms. One strength of our review is the focus on RCTs with active controls, which should give clinicians greater confidence that the reported benefits are not the result of nonspecific effects (eg, attention and expectations) that are seen in trials using a waiting list or usual-care control condition.

Anxiety, depression, and stress/distress are different components of negative affect. When we combined each component of negative affect, we saw a small and consistent signal that any domain of negative affect is improved in mindfulness programs when compared with a nonspecific active control. The ESs were small but significant for some of these individual outcomes and were seen across a broad range of clinical conditions (Table 2). During the course of 2 to 6 months, the mindfulness meditation program ES estimates ranged from 0.22 to 0.38 for anxiety symptoms and 0.23 to 0.30 for depressive symptoms. These small effects are comparable with what would be expected from the use of an antidepressant in a primary care population but without the associated toxicities. In a study using patient-level meta-analysis, Fournier et al81 found that for patients with mild to moderate depressive symptoms, antidepressants had an ES of 0.11 (95% CI, −0.18 to 0.41), whereas for those with severe depression, antidepressants had an ES of 0.17 (−0.08 to 0.43) compared with placebo.

Among the 9 RCTs* evaluating the effect on pain, we found moderate evidence that mindfulness-based stress reduction reduces pain severity to a small degree when compared with a nonspecific active control, yielding an ES of 0.33 from the meta-analysis. This effect is variable across painful conditions and is based on the results of 4 trials, of which 2 were conducted in patients with musculoskeletal pain,15,64 1 trial in patients with irritable bowel syndrome,15 and 1 trial in a population without pain.16,17 Visceral pain had a large and statistically significant relative 30% improvement in pain severity, whereas musculoskeletal pain showed 5% to 8% improvements that were considered nonsignificant.

Abbreviations: AA, African American; AC, active control; CAD, coronary artery disease; CBGT, cognitive behavioral group therapy; CBT, cognitive behavioral therapy; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; CRP, C-reactive protein; CSM, clinically standardized meditation; FFS, Freedom From Smoking program; HIV, human immunodeficiency virus; IBS, irritable bowel syndrome; MBCT, mindfulness-based cognitive therapy; MBSR, mindfulness-based stress reduction; mental QOL, mental component of health-related quality of life; MM, mindfulness meditation; NA, not available; NS, not significant; NSAC, nonspecific active control; PMR, progressive muscle relaxation; POMS, Profile of Mood States; SBPT, skills-based parent training program; TM, transcendental meditation; UC, unclear; URI, upper respiratory tract infection; Y-NS, homework was prescribed but amount not specified; Ø, no effect (within ±5%), −improved and statistically significant; +improved and statistically significant; −improved and statistically significant.

*SI conversion factor: To convert CRP to nanomoles per liter, multiply by 9.524.

†References 43, 44, 47, 54, 63, 64, 73, 74

‡References 34, 36, 37, 40, 45, 46, 48, 49, 51, 53, 54, 57, 61-63, 66, 70, 71, 73-75, 77, 80

Discussion

Our review indicates that meditation programs can reduce the negative dimensions of psychological stress. Mindfulness meditation programs, in particular, show small improvements in anxiety, depression, and pain with moderate evidence and small improvements in stress/distress and the mental health component of health-related quality of life with low evidence when compared with nonspecific active controls. Mantra meditation programs did not improve any of the outcomes examined, but the strength of this evidence varied from low to insufficient. Although meditation programs generally seek to improve the positive dimensions of health, the evidence from a small number of studies did not show any effects on positive affect or well-being for any meditation program. We found no evidence of any harms of meditation programs, although few trials reported on harms. One strength of our review is the focus on RCTs with active controls, which should give clinicians greater confidence that the reported benefits are not the result of nonspecific effects (eg, attention and expectations) that are seen in trials using a waiting list or usual-care control condition.

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Table 2. Study Descriptions (continued)

<table>
<thead>
<tr>
<th>Source</th>
<th>Meditation Program</th>
<th>Type of Active Control</th>
<th>Study Quality</th>
<th>No. of Hours</th>
<th>Program Duration/Study Duration</th>
<th>Outcomes (End of Treatment/End of Study)</th>
<th>Population</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bormann et al,56 2006</td>
<td>Mantra</td>
<td>NSAC</td>
<td>Fair</td>
<td>7.5</td>
<td>Y-NS</td>
<td>10 wk/6 mo</td>
<td>Anxiety (Ø/NA), stress/distress (Ø/Ø)</td>
<td>HIV</td>
</tr>
<tr>
<td>Taub et al,70 1994</td>
<td>TM</td>
<td>Biofeedback</td>
<td>Fair</td>
<td>19</td>
<td>UC</td>
<td>4 wk/NA</td>
<td>Alcohol (Ø/NA)</td>
<td>Alcoholism</td>
</tr>
<tr>
<td>Lehrer et al,51 1983</td>
<td>CSM</td>
<td>PMR</td>
<td>Fair</td>
<td>7.5</td>
<td>Y-NS</td>
<td>5 wk/6 mo</td>
<td>Anxiety (Ø/NA), depression (↓↓↓↓)</td>
<td>Anxiety</td>
</tr>
<tr>
<td>Murphy et al,57 1986</td>
<td>CSM</td>
<td>Running</td>
<td>Poor</td>
<td>8</td>
<td>37.5</td>
<td>8 wk/NA</td>
<td>Alcohol (Ø/NA)</td>
<td>Alcoholism</td>
</tr>
</tbody>
</table>
rolled patients with cardiac disease, whereas only 1 enrolled risk of bias.

tencies in the body of evidence, deficiencies in power, and are indicated to address uncertainties caused by inconsis-
studies in primary care and disease-specific populations

tery of mental and emotional processes.

of expertise needed to improve outcomes that depend on mas-
for 8 weeks), and the participants likely did not achieve a level
trials that have evaluated mortality.65 However, many of the
lenging. Long-term trials may be optimal to examine the ef-
tration programs, the challenges in acquiring such skills or medi-
relate to the way the research community conceptualizes medi-
from Eastern traditions that emphasize lifelong growth. The trans-
in addressing psychological stress.

Clinical Implications and Future Directions

Despite the limitations of the literature, the evidence sug-
that mindfulness meditation programs could help re-
due anxiety, depression, and pain in some clinical popula-
tions. Thus, clinicians should be prepared to talk with their
that a meditation program could have in

Future research in meditation would benefit by address-
remaining methodological and conceptual issues. All
forms of meditation, including mindfulness and mantra, im-
ply that more time spent meditating will yield larger effects.
Most forms, but not all, present meditation as a skill that re-
quires expert instruction and time dedicated to practice. Thus,
more training with an expert and practice in daily life should
lead to greater competency in the skill or practice, and greater
competency or practice would presumably lead to better out-
comes. However, when compared with other skills that re-
quire training, such as writing, the amount of training or the
dose afforded in the trials was quite small, and generally the
training was offered during a fairly short period. These 3 com-
ponents—trainer expertise, amount of practice, and skill—
require further investigation. We were unable to examine the
extent to which trainer expertise influences clinical outcome
because teacher qualifications were not reported in detail in
most trials. Trials need to document the amount of training
instructors provide and patients receive and the amount of
home practice patients complete. These measures will allow
future investigators to examine questions about dosing re-
lated to outcome.

Limitations

Some of the trials we reviewed were implemented before modern standards for clinical trials were established. Thus, many
did not report key design characteristics to enable an accu-
rate assessment of the risk of bias. Most trials were not regist-
ered, did not standardize training using trainers who met
specified criteria, did not specify primary and secondary out-
comes a priori, did not power the trial based on the primary
outcomes, did not use CONSORT recommendations for report-
ing results, or did not operationalize and measure the prac-
tice of meditation by study participants.83

We could not draw definitive conclusions about effect modifiers, such as dose and duration of training, because of
the limited details provided in the publications of the trials. Despite our focus on RCTs using active controls, we were un-
able to detect a specific effect of meditation on most out-
comes, with the majority of our evidence grades being insuf-
ficient or low. These evidence grades were mostly driven by 2
important evaluation criteria: the quality of the trial and in-
consistencies in the body of evidence. Trials primarily had the
following 4 biases: lack of blinding of outcome assessment, high
attrition, lack of allocation concealment, and lack of intention-
to-treat analysis. The reasons for inconsistencies in the body
of evidence may have included the differences in the par-
ticular clinical conditions and the type of control groups the
studies used. Another possibility is that the programs had
no real effect on many of the outcomes that had inconsistent
findings.

Despite the limitations of the literature, the evidence sug-
ests that mindfulness meditation programs could help re-
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Meditation for Psychological Stress and Well-being


Therapies that lie outside the spectrum of traditional, science-based clinical medicine and surgery are often labeled as complementary or alternative. These therapies range from herbal remedies and dietary supplements to meditation and acupuncture, and they derive from Eastern and Western traditions. Use is widespread and often promoted by commercial interests and practitioners, with prevalence estimates exceeding 50%. Their popularity derives in part from being available without prescription and the supposition that the label of natural makes them safe and preferable to pharmacologic and surgical treatments. Despite widespread use, many complementary therapies still lack a rigorous evidence base. The relative scarcity of scientifically derived data on efficacy and safety stems from a number of factors, ranging from a lack of financial incentives for practitioners and suppliers (why study something that is already profitable and accepted by patients?) to difficulty measuring outcomes. This unacceptable state of affairs for treatments that consume billions of health care dollars annually in the United States alone provided the stimulus for establishing at the National Institutes of Health a National Center for Complementary and Alternative Medicine in 1991. Its mission is “to define, through rigorous scientific investigation, the usefulness and safety of complementary and alternative medicine interventions and their roles in improving health and health care.” The Agency for Healthcare Research and Quality shares this mission. Their sponsorship and funding have begun to generate and make available scientific evidence on a wide variety of complementary therapies.

Among complementary measures, meditation has occupied a special position, revered in religious circles and Eastern societies for centuries and rediscovered in the West in the mid-20th century by psychologists such as Abraham Maslow who were interested in its potential for enhancing human consciousness and experience. Widespread medical application followed about 10 years later, popularized by such bestselling books as The Relaxation Response by Herbert Benson. Mindfulness techniques, which seek to enhance self-awareness, and mantra methods, which aim for transcendence, have been applied widely to treat stress and stress-related conditions and are becoming popular for use in everyday life by a public that finds itself increasingly distracted and disrupted by endless interruptions and stressors.

In this issue, Goyal and colleagues from The Johns Hopkins University report on their examination of best available evidence for the efficacy and comparative effectiveness of meditation. In their Agency for Healthcare Research and Quality-sponsored systematic review and meta-analysis of methodologically sound studies of mindful and transcendental forms of meditation, they attempt to address efficacy and comparative effectiveness with regard to psychological stress and well-being. They focus their review on best evidence, derived from randomized clinical trials involving patients with a mental health or physical condition and using active controls for determination of efficacy and comparative effectiveness. The active control studies are subcategorized by whether the control involves a nonspecific measure, such as education (which helps determine efficacy by controlling for time, attention, and expectation), or a specific intervention, such as exercise or progressive muscle relaxation (which provides for a comparative effectiveness assessment). They also grade studies for strength of evidence based on assessments for risk of bias, directness, consistency, and precision and categorized according to degree of confidence in the results by likelihood that further research would change the level of confidence.

Only 3% of published trials examined met their inclusion criteria, making for a review of 47 trials of mindfulness-based stress reduction (MBSR) or transcendental (mantra-based) meditation. With the exception of MBSR studies providing moderate evidence of improvement in anxiety, depression, and pain and low evidence of improvement in stress/distress and mental health-related quality of life, the investigators found low levels of evidence of no effect or insufficient evidence of effect for improvements by MBSR or transcendental meditation in any of the other variables of psychological stress or well-being examined. In the comparative-effectiveness analysis, they found little evidence of any benefit compared with specific active measures, such as exercise, progressive muscle relaxation, or cognitive behavioral therapy.