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The Effect of Mindfulness-Based Therapy on Anxiety and Depression: A Meta-Analytic Review

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Abstract

BACKGROUND—Although mindfulness-based therapy has become a popular treatment, little is known about its efficacy.

OBJECTIVES—To conduct an effect size analysis of this popular intervention for anxiety and mood symptoms in clinical samples.

DATA SOURCES—A literature search was conducted using PubMed, PsycInfo, the Cochrane Library, and manual searches.

REVIEW METHODS—The search identified 39 studies totaling 1,140 participants receiving mindfulness-based therapy for a range of conditions, including cancer, generalized anxiety disorder, depression, and other psychiatric or medical conditions.

RESULTS—Effect size estimates suggest that mindfulness-based therapy was moderately effective for improving anxiety (Hedges' $g = 0.63$) and mood symptoms (Hedges' $g = 0.59$) from pre to post-treatment in the overall sample. In patients with anxiety and mood disorders, this intervention was associated with effect sizes (Hedges' g) of 0.97 and 0.95 for improving anxiety and mood symptoms, respectively. These effect sizes were robust, unrelated to publication year or number of treatment sessions, and were maintained over follow-up.

CONCLUSION—These results suggest that mindfulness-based therapy is a promising intervention for treating anxiety and mood problems in clinical populations.

Keywords

Mindfulness; Therapy; Anxiety Disorders; Depression; Efficacy

The Effect of Mindfulness-Based Therapy on Anxiety and Depression: A Meta-Analytic Review

Derived from ancient Buddhist and Yoga practices, mindfulness-based therapy (MBT), which includes mindfulness-based cognitive therapy (MBCT; e.g., Segal, Williams, & Teasdale, 2002) and mindfulness-based stress reduction (MBSR; e.g., Kabat-Zinn, 1982), has become a very popular form of treatment in contemporary psychotherapy (e.g., Baer, 2003; Bishop, 2002; Hayes, 2004; Kabat-Zinn, 1994; Salmon, Lush, Jablonski, & Sephton, 2009). Several of the applications of MBT (such as MBCT) have been designed as relapse prevention strategies rather than to reduce acute symptoms. Other studies have examined MBT as a symptom-

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focused treatment. The present study is a review of MBT as a therapy to reduce acute symptoms of anxiety and depression.

Mindfulness refers to a process that leads to a mental state characterized by nonjudgmental awareness of the present moment experience, including one's sensations, thoughts, bodily states, consciousness, and the environment, while encouraging openness, curiosity, and acceptance (Bishop et al., 2004; Kabat-Zinn, 2003; Melbourne Academic Mindfulness Interest Group, 2006). Bishop and colleagues (2004) distinguished two components of mindfulness, one that involves self-regulation of attention and one that involves an orientation toward the present moment characterized by curiosity, openness, and acceptance. The basic premise underlying mindfulness practices is that experiencing the present moment nonjudgmentally and openly can effectively counter the effects of stressors, because excessive orientation toward the past or future when dealing with stressors can be related to feelings of depression and anxiety (e.g., Kabat-Zinn, 2003). It is further believed that, by teaching people to respond to stressful situations more reflectively rather than reflexively, MBT can effectively counter experiential avoidance strategies, which are attempts to alter the intensity or frequency of unwanted internal experiences (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). These maladaptive strategies are believed to contribute to the maintenance of many, if not all emotional disorders (Bishop et al., 2004; Hayes, 2004). In addition, the slow and deep breathing involved in mindfulness meditation may alleviate bodily symptoms of distress by balancing sympathetic and parasympathetic responses (Kabat-Zinn, 2003). For example, in the case of MBSR (Kabat-Zinn, 1982), the three key components are sitting meditation, Hatha Yoga, and body scan, which is a sustained mindfulness practice in which attention is sequentially directed throughout the body (Kabat-Zinn, 2003).

A number of reviews have recently been conducted to examine the efficacy of MBT (Baer, 2003; Carmody & Baer, 2009; Grossman, Niemann, Schmidt, & Walach, 2004; Ledesma & Kumano, 2008; Mackenzie, Carlson, & Speca, 2005; Matchim & Armer, 2007; Ott, Norris, & Bauer-Wu, 2006; Praissman, 2008; Smith, Richardson, Hoffman, & Pilkington, 2005; Teixeira, 2008; Toneatto & Nguyen, 2007; Winbush, Gross, & Kreitzer, 2007). In fact, it could be argued that the field has become saturated with qualitative reviews on MBT. These reviews generally suggest that MBT may be beneficial to reduce stress, anxiety, and depression. However, the vast majority of these reviews are qualitative in nature and do not quantify the size of the treatment effect. In contrast, only a few reviews applied meta-analytic methods to quantify the efficacy of this treatment (Baer, 2003; Grossman, Niemann, Schmidt, & Walach, 2004; Ledesma & Kumano, 2008). [1] One of these reviews focused on MBT for stress reduction in cancer patients (Ledesma & Kumano, 2008), whereas another study examined the efficacy of mindfulness for treating distress associated with general physical or psychosomatic problems, such as chronic pain, coronary artery disease, and fibromyalgia (Grossman et al., 2004). The results of these reviews were encouraging, suggesting that MBSR is moderately effective for reducing distress associated with physical or psychosomatic illnesses. However, both reviews were based on a small number of studies with relatively small sample sizes per study. The two reviews that specifically examined the effects of MBT on mood and anxiety symptoms came to divergent conclusions (Baer, 2003; Toneatto & Nguyen, 2007). Whereas Baer (2003) interpreted the literature as suggesting that MBT may be helpful in treating anxiety and mood disorders, Toneatto and Nguyen (2007) concluded that MBT has no reliable effect for these problems.

[1]Two additional meta-analyses have examined the efficacy of Acceptance and Commitment Therapy (ACT), which includes mindfulness techniques (Powers, Zum Vörde Sive Vörding, & Emmelkamp, 2009; Öst, 2008). Mindfulness exercises in ACT are firmly rooted in the behavioral analytic model of ACT, which is different from mindfulness-based cognitive-behavioral therapy. Furthermore, mindfulness is a relatively small aspect of ACT when compared to the other treatment components, and the two recently published meta-analyses on ACT are comprehensive and still up to date. Therefore, we did not include ACT in our discussion and analyses and instead followed more closely the general approach by Baer (2003) and Toneatto & Nguyen (2007).

In sum, although a very popular treatment, it remains unclear whether MBT is effective for reducing mood and anxiety symptoms. Therefore, the goal of the present study was to provide a quantitative, meta-analytic review of the efficacy of MBT for improving anxiety and mood symptoms in clinical populations. For this purpose, we reviewed treatment studies examining the effects of MBT on anxiety and depression in psychiatric and medical populations.

We tested the hypothesis that MBT is an effective treatment for reducing symptoms of anxiety and depression, especially among patients with anxiety disorders and depression. Furthermore, we expected that MBT reduces symptoms of anxiety and depression in chronic medical conditions, such as cancer, which may be experienced by patients as an effect of their physical condition and potential side-effects of treatments.

Methods

Searching

Studies were identified by searching PubMed, PsycInfo, and the Cochrane Library. Searches were conducted for studies published between the first available year and April 1, 2009 using the search term *mindfulness* combined with the terms *meditation, program, therapy*, or *intervention* and *anxi*, depress*, mood*, or *stress*. Additionally, an extensive manual review was conducted of reference lists of relevant studies and review papers extracted from the database searches. Articles determined to be related to the topic of mindfulness were selected for further examination.

Selection

Studies were selected if: (1) they included a mindfulness-based intervention, (2) they included a clinical sample (i.e., participants had a diagnosable psychological or physical/medical disorder); (3) they included adult samples (ages 18-65); (4) the mindfulness program was not coupled with Acceptance and Commitment Therapy or Dialectic Behavior Therapy; (5) included a measure of anxiety and/or mood symptoms at both pre- and post-intervention; and (6) provided sufficient data to perform effect size analyses (i.e., means and standard deviations, *t* or *F* values, change scores, frequencies, or probability levels). Studies were excluded if the sample overlapped either partially or completely with the sample of another study meeting inclusion criteria for the meta-analysis. In these cases, we selected for inclusion the study with the larger sample size or more complete data for measures of anxiety and depression symptoms. For studies that provided insufficient data but were otherwise appropriate for the analyses, authors were contacted for supplementary data.

Because the vast majority of studies meeting our criteria employed MBSR, MBCT (Segal et al., 2002), or interventions modeled upon MBSR or MBCT, we excluded studies in which the intervention differed substantially from MBSR and MBCT in length (i.e., two sessions as opposed to the typical eight). Furthermore, we excluded studies in which the MBT was not delivered in person (i.e., audio-taped or internet-delivered interventions).

Validity Assessment

In order to address publication bias, we computed the *fail-safe N* (Rosenthal, 1991; Rosenthal & Rubin, 1988) using the following formula: $X=\frac{K\left(K\bar{Z}^{2}-2.706\right)}{2.706}$. In this formula, K is the number of studies in the meta-analysis and $\bar{Z}$ is the mean Z obtained from the K studies. The effect size can be considered robust if the required number of studies (X) to reduce the overall effect size to a non-significant level exceeds $5K + 10$ (Rosenthal, 1991). In addition, we constructed a funnel plot to examine the publication bias. No publication bias results in a funnel

plot that is symmetrical around the mean effect size. The Trim and Fill method examines whether negative or positive trials are over or under-represented, accounting for the sample size (i.e., where the missing studies would need to fall to make the plot symmetrical). This information can then be used to re-calculate the effect size estimate.

Data Abstraction

For each study, two of the authors (AAW, ATS) selected psychometrically validated measures of depression and anxiety symptoms. In cases where data from only select subscales of a measure were reported, authors were contacted for anxiety and depression subscale data. Three of the authors (AAW, ATS, DO) extracted numerical data from the studies. Data were extracted to analyze changes from pre to post treatment, pre treatment to follow-up, and intent-to-treat (ITT) with last observation carried forward method.

Study Characteristics

We examined whether the effect sizes varied as a function of study characteristics (type of mindfulness-based therapy, study year, number of treatment sessions, quality of study) and clinical characteristics (disorder targeted by the intervention) by using meta-regression analyses. To investigate the effects of categorical moderator variables, we examined 95% confidence intervals. All analyses were completed manually or by using the software program Comprehensive Meta-Analysis, Version 2 (Borenstein, Hedges, Higgins, & Rothstein, 2005).

Quantitative Data Synthesis

Effect sizes for continuous measures of anxiety and depression were calculated using pre-post treatment differences (within-group) for uncontrolled studies and also for controlled studies using Hedges' *g* and its 95% confidence interval.[2] The magnitude of Hedges' *g* may be interpreted using Cohen's (1988) convention as small (0.2), medium (0.5), and large (0.8).

The correlation between pre-and post-treatment measures is needed in order to calculate the pre-post effect sizes. This correlation could not be determined from the study reports. Therefore, we followed the recommendation by Rosenthal (1993) and assumed a conservative estimation of $r = 0.7$. We calculated an average Hedges' *g* effect size for studies that included measures of severity of anxiety symptoms and a separate Hedges' *g* effect size for measures of depressive symptom severity.

Effect size estimates were pooled across studies in order to obtain a summary statistic. The effect size estimates were calculated using the random-effects model rather than the fixed-

[2]Hedges' *g* is a variation of Cohen's *d* that corrects for biases due to small sample sizes (Hedges & Olkin, 1985). Within-group effect size were calculated using the following formula: $d=\left(\frac{\bar{Y}_1-\bar{Y}_2}{S_{Difference}}\right)\sqrt{2(1-r)}$, where $\bar{Y}_1$ is the pretreatment sample mean, $\bar{Y}_2$ is the posttreatment sample mean, $S_{Difference}$ is the standard deviation of the difference, and *r* is the correlation between pretreatment and posttreatment scores. Hedges' *g* can be computed by multiplying *d* by correction factor $\mathrm{J}(df)=1-\frac{3}{4df-1}$, where *df* is the degrees of freedom to estimate the within-group standard deviation.

The controlled effect sizes were computed using the following formula: $g=\frac{\bar{\Delta}_{MBT}-\bar{\Delta}_{CONT}}{\sqrt{\frac{(n_{MBT}-1)SD^2_{CONT}+(n_{CONT}-1)SD^2_{MBT}}{(n_{total}-2)}}}\times\left(1-\frac{3}{4(n_{MBT}+n_{CONT})-9}\right)$, where $\bar{\Delta}$ is the mean pre- to posttreatment change, *SD* is the standard deviation of posttreatment scores, *n* is the sample size, *MBT* refers to the mindfulness-based therapy condition, and *CONT* refers to the control condition.

effects model because the studies included were not functionally identical (Hedges & Vevea, 1998; Moses, Mosteller, & Buehler, 2002). Effect size estimates for ITT and follow-up data were also calculated in the manner described above.

Assessment of Pre-Treatment Symptom Severity

If symptoms of anxiety or depression are not elevated at baseline, there may be little room for improvement over the course of treatment. In order to assess whether the symptoms of anxiety and depression at pre-treatment were elevated in samples not diagnosed with anxiety or mood disorders (e.g., individuals with cancer, pain or other medical problems), we compared scores on the measures of anxiety and depression used in the relevant studies with cutoff scores that mark an elevated level. Specifically, we calculated 95% confidence intervals for the pre-treatment means on all anxiety and depression measures for which established or suggested clinical cutoff scores are available. If the lower bound of the 95% confidence interval was greater than or equal to the cutoff score, we considered the sample to have an elevated level of anxiety or depression at pre-treatment.

In cases where different cutoff scores were recommended for males and females (e.g., the State-Trait Anxiety Inventory), we chose the higher cutoff score in order to be more conservative. The cutoff scores utilized were as follows: Beck Anxiety Inventory: 10 (Beck & Steer, 1990); Beck Depression Inventory: 10 (Beck, Steer, & Garbin, 1988; Kendall, Hollon, Beck, Hammen, & Ingram, 1987); Beck Depression Inventory-II: 14 (Beck, Steer, & Brown, 1996); Beck Depression Inventory- Short Form: 5 (Beck & Beck, 1972); Center for Epidemiologic Studies Depression Scale: 16 (Boyd, Weissman, Thompson, & Meyer, 1977; Radloff, 1991); Hospital Anxiety and Depression Scale: 8 for each subscale (Zigmond & Snaith, 1983); Profile of Mood States- Anxiety subscale: 16 (Higginson, Fields, Koller, & Tröster, 2001); Profile of Mood States- Depression subscale: 14 (Griffith et al., 2005); Symptom Checklist 90- Revised-Anxiety subscale: 0.75 (Schmitz, Hartkamp, & Frake, 2000); Symptom Checklist 90- Revised-Depression subscale: 0.73 (Schmitz et al., 2000); State-Trait Anxiety Inventory: 40 for each subscale (Leong, Farrell, Helme, & Gibson, 2007).

Results

Trial Flow

Our study selection process is illustrated in Figure 1. Of the 727 articles identified in our initial searches as potentially relevant, 39 studies met our selection criteria and were included in the meta-analysis. The characteristics of the included studies are shown in Table 1. These studies included a total of 1,140 patients who received MBT. The most common disorder studied was cancer (n = 9), followed by generalized anxiety disorder (n = 5), depression (n = 4), chronic fatigue syndrome (n = 3), panic disorder (n = 3), fibromyalgia (n = 3), chronic pain (n = 2), social anxiety disorder (n = 2), attention-deficit hyperactivity disorder (n = 1), arthritis (n = 1), binge eating disorder (n = 1), bipolar disorder (n = 1), diabetes (n = 1), heart disease (n = 1), hypothyroidism (n = 1), insomnia (n = 1), organ transplant (n = 1), stroke (n = 1), and traumatic brain injury (n = 1). Many studies targeted more than one disorder, and thus the sum of the above numbers exceeds the total number of studies included. In addition, one study used a sample of patients meeting criteria for any mood disorder (either current or lifetime), one study included patients with heterogeneous anxiety and mood disorders, and one study used a sample of patients with heterogeneous medical diagnoses. All included studies provided data for continuous measures of anxiety and/or depressive symptom severity at pre and post-treatment.

Study Characteristics

Using the following modified Jadad criteria (Jadad et al., 1996) to provide a relative index of the quality of included studies, the design of each study was evaluated as follows: (1) the study

was described as randomized; (2) participants were adequately randomized; (3) the study was described as double blind; (4) the method of double blinding was appropriate; and (5) a description of drop-outs and withdrawals was provided. One point was assigned for each criterion met for a maximum of 5 points. As shown in Table 1, total Jadad scores for included studies ranged from 0 to 3, with a median of 1 ($M = 1.23$; $SD = 0.77$). Two independent ratings of Jadad criteria were performed; inter-rater reliability was $r = 0.96$. Disagreements were resolved through discussion.

Quantitative Data Synthesis

Pre-post effect size—The average pre-post effect size estimate (Hedges' *g*) based on the 39 studies was 0.63 (95% *CI*: 0.53-0.73, $p < .01$) for reducing anxiety, and 0.59 (95% *CI*: 0.51-0.66, $p < .01$) for reducing depression. The details of these analyses are depicted in Tables 2 and 3.

Publication bias—The effect size observed for measures of depressive symptom severity for uncontrolled trials and MBT of controlled trials corresponded to a *z*-value of 21.82, indicating that 4,302 studies with an effect size of zero would be necessary to nullify this result (i.e., for the combined 2-tailed *p*-value to exceed .05). The fail-safe *N* for measures of anxiety disorder severity was 4,150 (*z*-value = 21.74). We also constructed funnel plots, which are depicted in Figures 2 and 3. Using the Trim and Fill method, the number of missing studies that would need to fall to the left of the mean effect size in order to make the plot symmetric was $n = 7$ studies for the analysis of anxiety measures and $n = 10$ for the analysis of depression measures. Assuming a random-effects model, the new imputed mean effect size was Hedges' $g = 0.51$ (95% *CI*: .39-.63) for anxiety and Hedges' $g = 0.50$ (95% *CI*: 0.42-.58) for depression. In sum, these analyses suggest that the effect size estimates of the pre-post analyses are unbiased.

Effect sizes of studies with participants showing elevated levels of anxiety or depression—A total of 10 studies used MBT in patients without a clinically defined anxiety or mood disorder, but met our criteria for elevated levels of anxiety at pre-treatment: two studies in cancer populations (Tacon, Caldera, & Ronaghan, 2004; Tacon, Caldera, & Ronaghan, 2005), four studies in populations with pain (Grossman, Tiefenthaler-Gilmer, Raysz, & Kesper, 2007; Lush et al., 2009; Sagula & Rice, 2004; Rosenzweig et al., 2009), three studies in populations with other medical problems (Schulte, 2007; Surawy, Roberts, and Silver, 2005 Studies 1 and 2), and one study using a sample with Binge Eating Disorder (Kristeller & Hallett, 1999). The average pre-post effect size estimate (Hedges' *g*) based on these studies was 0.67 (95% *CI*: 0.47-0.87, $p < .01$). The fail-safe *N* was robust at 401 (*z*-value = 12.55). The average pre-post effect size estimate (Hedges' *g*) for the 15 studies that did not have elevated levels of anxiety symptoms at pre-treatment was 0.53 (95% *CI*: 0.42-0.64, $p < .01$). This result was also robust (fail-safe $N = 774$; *z*-value = 14.21).

A total of 8 studies met our criteria for elevated levels of depressive symptoms at pre-treatment: four studies in populations with pain (Lush et al., 2009; Sagula & Rice, 2004; Sephton et al., 2007; Rosenzweig et al., 2009), two studies in populations with other medical problems (Bedard et al., 2003; Reibel, Greeson, Brainard, & Rosenzweig, 2001), one study using a sample with Binge Eating Disorder (Kristeller & Hallett, 1999), and one study using a sample with ADHD (Zylowska et al., 2008). The average pre-post effect size estimate (Hedges' *g*) based on these studies was 0.53 (95% *CI*: 0.44-0.61, $p < .01$). The fail-safe *N* was 296 (*z*-value = 12.08), indicating that these results are also robust. The average pre-post effect size estimate (Hedges' *g*) for the 16 studies that did not have elevated levels of depressive symptoms at pre-treatment was 0.50 (95% *CI*: 0.39-0.61, $p < .01$). This result was also robust (fail-safe $N = 667$; *z*-value = 12.80).

Controlled effect sizes—Sixteen of the identified studies included a control or comparison group. Eight of these studies compared a MBT to a waitlist control, 3 to treatment-as-usual (TAU), and 5 to an active treatment comparison. Because patients in the waitlist control conditions typically received treatment-as-usual, we pooled together studies employing a waitlist control condition with those employing a TAU control condition. The random-effects analysis of the controlled studies employing a waitlist or TAU comparison condition yielded a mean Hedges' *g* effect size of 0.41 (95% *CI*: 0.23-0.59, $z = 4.35$, $p < .01$) for continuous measures of depressive symptom severity, and 0.33 (95% *CI*: 0.11-0.54, $z = 2.97$, $p < .01$) for anxiety symptom severity. The random-effects analysis of the controlled studies employing an active treatment comparison condition yielded a mean Hedges' *g* effect size of 0.50 (95% *CI*: 0.26-0.74, $z = 4.06$, $p < .01$) for continuous measures of depressive symptom severity, and 0.81 (95% *CI*: 0.35-1.27, $z = 3.47$, $p < .01$) for anxiety symptom severity. However, the fail-safe *N*s for controlled studies for measures of depression and anxiety disorder severity were $n = 35$ studies ($z = 4.31$) and $n = 11$ ($z = 3.08$) for waitlist controlled and TAU studies, and $n = 19$ studies ($z = 4.21$) and $n = 42$ ($z = 5.97$) for active treatment controlled studies, respectively. These results suggest that the effect size for anxiety disorder severity for active treatment controlled studies is robust. However, the effect sizes for the controlled studies are unreliable and should be considered preliminary.

Intent-to-Treat Analyses—For the six studies that reported ITT data for continuous measures of anxiety or depression symptom severity, we examined effect sizes for MBT from pre- to post-treatment. Three studies reported ITT data for anxiety measures. The effect size for the pooled data was Hedges' $g = 1.06$ (95% *CI*: 0.29-1.84, $p = .007$). Six studies reported ITT data for depression measures. The effect size for this pooled data was Hedges' $g = 0.55$ (95% *CI*: 0.43-0.67, $p < .001$). The fail-safe *N* for measures of anxiety severity was 42 (*z*-value = 7.55), indicating that 42 studies with an effect size of zero would be necessary to nullify this result. The fail-safe *N* for measures of depression severity was 123 (*z*-value = 9.07). Given the small number of studies for these analyses, these results should be interpreted with caution.

Effects at Follow-Up—To examine long-term outcome, we further conducted an effect size analysis for MBT from pre-treatment to the last available follow-up point. A total of nineteen studies reported follow-up data for measures of anxiety or depression symptoms. The mean length of follow-up was 27 weeks ($SD = 32$), with a median of 12 weeks. Seventeen studies reported follow-up data for anxiety measures. The effect size for the pooled data was Hedges' $g = 0.60$ (95% *CI*: 0.48-0.71, $p < .001$). Eighteen studies reported follow-up data for depression measures. The effect size for this pooled data was Hedges' $g = 0.60$ (95% *CI*: 0.48-0.72, $p < .001$). The fail-safe *N* for measures of anxiety symptoms at follow-up was 806 (*z*-value = 13.63), and of depression symptoms at follow-up was 952 (*z*-value = 14.38), suggesting that both effect size estimates can be considered robust.

Moderator Analyses

In order to explore possible predictors of treatment outcome, we conducted moderator analyses only for the within-subject data from participants receiving a MBT.

Treatment Target—In order to examine whether MBT for patients with anxiety disorders and depression results in greater reductions of symptoms of anxiety and depression than MBT for other patients, we compared effect sizes for continuous measures of anxiety and depression symptoms across the following 4 diagnostic categories: anxiety disorders, mood disorders, cancer, and pain.

MBT showed significant effects for reducing anxiety symptoms in individuals with anxiety disorders ($n = 7$ studies; Hedges' $g = 0.97$, 95% *CI*: 0.72-1.22, $p < .01$), followed by individuals

with cancer (n = 8 studies; Hedges' g = 0.64, 95% *CI*: 0.45-0.82, $p < .01$), and pain disorders (n = 5 studies; Hedges' g = 0.44, 95% *CI*: 0.21-0.68, $p < .01$). However, the intervention had no significant effect on anxiety symptoms in individuals with depression (n = 1 study; Hedges' g = 0.12, 95% *CI*: −0.50-0.74, p = 0.70).

Similarly, MBT was effective for reducing depressive symptoms in individuals with a diagnosis of depression (n = 4 studies; Hedges' g = 0.95, 95% *CI*: 0.71-1.18, $p < .01$), followed by individuals with an anxiety disorder (n = 6 studies; Hedges' g = 0.75, 95% *CI*: 0.58-0.92, $p < .01$), pain (n = 6 studies; Hedges' g = 0.51, 95% *CI*: 0.39-0.63, $p < .01$), and cancer (n = 7 studies; Hedges' g = 0.45, 95% *CI*: .34-0.56, $p < .01$).

Type of mindfulness-based intervention—We compared pre-post effect sizes for MBCT and MBSR on both depression and anxiety symptom severity. Nine studies employing MBCT reported data from measures of depressive symptom severity. The mean effect size for this pooled data was Hedges' g = 0.85 (95% *CI*: 0.71-1.00, $p < .01$). Nineteen studies employing MBSR reported data from measures of depressive symptom severity, and the effect size for the pooled data was Hedges' g = 0.49 (95% *CI*: 0.42-0.56, $p < .01$). Six studies employing MBCT reported data from measures of anxiety symptom severity, and the mean effect size for this pooled data was Hedges' g = 0.79 (95% *CI*: 0.45-1.13, $p < .001$). Twenty studies employing MBSR reported data from measures of anxiety symptom severity, and the effect size for the pooled data was Hedges' g = 0.55 (95% *CI*: 0.44-0.66, $p < .001$). These results suggest that MBCT and MBSR are both effective for reducing anxiety and depression from pre to post-treatment.

Publication year—Hedges' g was not moderated by publication year for either depression (B = −0.002, SE = 0.011, p = 0.86) or anxiety symptoms (B = 0.00007, SE = 0.015, p = 0.99).

Treatment length—Hedges' g was not moderated by number of treatment sessions for either depression (B = −0.051, SE = 0.041, p = 0.21) or anxiety symptom severity (B = −0.074, SE = 0.055, p = 0.18).

Study Quality—Jadad score did not moderate Hedges' g for either depression (B = −0.0017, SE = 0.048, p = 0.96) or anxiety symptoms (B = −0.013, SE = 0.042, p = 0.85).

Discussion

MBT is an increasingly popular form of therapy for anxiety and mood problems. Two earlier reviews on the effects of MBT on symptoms of anxiety and depression came to contradictory conclusions with regards to the efficacy of these interventions (Baer, 2003; Toneatto & Nguyen, 2007). Since the publication of these reviews, a sufficient number of clinical trials have been published that justifies a comprehensive effect size analysis of this promising treatment.

Our review of the literature identified 727 articles, of which we analyzed 39 studies to derive effect size estimates. The results showed that the uncontrolled pre-post effect size estimates were in the moderate range for reducing anxiety symptoms (Hedges' g = 0.63) and depressive symptoms (Hedges' g = 0.59). MBT in patients with anxiety disorders and depression was associated with large effect sizes (Hedges' g) of 0.97 (95% *CI*: 0.72-1.22) and 0.95 (95% *CI*: 0.71-1.18) for improving anxiety and depression, respectively.

Among individuals with disorders other than anxiety disorders or depression, but who had elevated levels of symptoms of anxiety and depression, MBT was moderately strong (effect sizes of 0.67 and 0.53, respectively), but not significantly greater than among those with

relatively lower pre-treatment levels of anxiety and depression (0.53 and 0.50). These results suggest that MBT improves symptoms of anxiety and depression across a relatively wide range of severity and even when these symptoms are associated with other disorders, such as medical problems. It is possible that MBT is associated with a general reduction in stress, perhaps by encouraging patients to relate differently to their physical symptoms so that when they occur their consequences are less disturbing.

It should be noted that two of the four studies investigating depression focused on patients with chronic or treatment-resistant depression (Barnhofer et al., 2009; Kenny & Williams, 2007), and therefore the effect sizes for these studies might be lower than would otherwise be expected. It should also be noted that the effects of MBT on depression and anxiety in chronic conditions, such as cancer, might be smaller because patients may experience physical symptoms listed on depression or anxiety scales as a result of their physical condition or as potential side-effects of medical treatments. In addition, effect sizes for depression and anxiety symptoms in populations with cancer, pain, or other medical conditions may be smaller than effect sizes in populations with anxiety or mood disorders due to a floor effect: that is, patients with a low level of anxiety or depression at pre-treatment may show a relatively smaller degree of improvement after treatment than those with a high level at pre-treatment.

Earlier quantitative and qualitative reviews that were most closely related to our study include the studies by Baer (2003) and Toneatto and Nguyen (2007). Baer (2003) reported an average pre-post effect size of $d = 0.59$ based on 15 studies that were weighed by sample size. However, the dependent variables were not restricted to anxiety and depression measures but were based on a range of symptom measures, including measures of stress, pain, memory, and binge eating. Therefore, it is difficult to directly compare the effect size estimates found in our study with those reported by Baer.

In contrast to Baer (2003), Toneatto and Nguyen (2007) focused only on anxiety and depression measures. Although published very recently, this review identified only 15 studies that measured anxiety and depression in patients treated with MBT for a variety of problems, including medical conditions (pain, cancer and heart disease). The study also examined non-clinical populations (i.e., community samples). The authors concluded that MBT does not have reliable effects on anxiety and depression. Our study suggests that this conclusion was premature and unsubstantiated. The authors included only controlled studies, thereby excluding a substantial portion of the MBT research. In addition, it is unclear how many studies were identified, how many were excluded, and for what reasons, because this information was not provided. Furthermore, the authors did not conduct an effect size analysis or apply any other standard meta-analytic procedures. Instead, the conclusion was based solely on a qualitative review of a very small number of studies. Finally, their findings were largely based on patients without anxiety disorders or depression. As our review demonstrated, MBT is most efficacious for reducing symptoms of anxiety and depression in populations with mood or anxiety disorders.

In addition to changes from pre to post, we also examined controlled effect sizes. These effect sizes were smaller but still significant (Hedges' $g = 0.50$ and 0.81 for reducing symptoms of depression and anxiety in active treatment controlled studies, and Hedges' $g = 0.41$ and 0.32 in waitlist and TAU controlled studies). However, the fail-safe *N* analysis suggested that, except for measures of anxiety symptom severity in active controlled studies, the results of the controlled effect size analyses were unreliable due to the small number of studies. Similarly, although significant, the ITT effect sizes (Hedges' $g = 1.06$ and 0.55 for reducing symptoms of depression and anxiety, respectively) should only be considered preliminary. In contrast, the pre-post effect sizes were robust. A meta-analysis of the effects of psychological placebo conditions in anxiety disorder trials (Smits & Hofmann, 2009) yielded a pre- to post-treatment

effect size (Hedges' *g*) of 0.45 (95% CI: 0.35-0.46), suggesting that the effect sizes associated with MBT are significantly greater than the placebo effect size.

In general, the observed effect sizes were unrelated to publication year, treatment length, or study quality. Finally, the follow-up data suggested that the effects were maintained at follow-up (with a median follow-up period of 12 weeks). It should be noted that conventional CBT (i.e., without mindfulness procedures) is also quite effective for depression and anxiety disorders (e.g., Butler, Chapman, Forman, & Beck, 2006; Hofmann & Smits, 2008a). In their review of meta-analyses examining the efficacy of conventional CBT for unipolar depression, generalized anxiety disorder, panic disorder with or without agoraphobia, social anxiety disorder, and PTSD, Butler et al. (2006) estimated the effect size to be 0.95 (*SD*: 0.08). Future studies should directly compare the efficacy, cost-effectiveness, patient (and therapist) preference, treatment acceptability, and attrition of conventional CBT and MBT.

In sum, our findings are encouraging and support the use of MBT for anxiety and depression in clinical populations. This pattern of results suggests that MBT may not be diagnosis-specific, but, instead, may address processes that occur in multiple disorders by changing a range of emotional and evaluative dimensions that underlie general aspects of wellbeing. Therefore, MBT may have general applicability. At the same time, a number of limitations should be noted. Most importantly, the results of this study are limited to the meta-analytic technique and, therefore, are dependent on the study selection criteria, the quality of the included studies, expectancy effects, and statistical assumptions about the true values of the included studies (Henggeler, Schoenwald, Swenson, & Borduin, 2006; Hofmann & Smits, 2008b; Moses et al., 2002; Rief & Hofmann, 2008). In order to limit any possible biases, we adopted a relatively conservative approach. Following the recommendations by Moses et al. (2002) and Hedges and Vevea (1998), we analyzed the effect sizes using a random effect model and quantified the quality of the included studies using modified Jadad criteria, which we considered in our analyses as a possible moderator variable. Because we used modified Jadad criteria, the Jadad scores cannot be directly compared with other meta-analytic studies.

Despite the popularity of MBT, relatively few clinical trials have specifically examined this treatment in anxiety disorders and depression. However, a relatively large number of studies have examined changes in anxiety and depressive symptoms in a range of psychiatric and medical disorders. We decided to examine all available studies that reported changes in anxiety and depressive symptoms during the course of MBT. As a result, the included studies differ in the disorders targeted and also in their methodological quality. However, the Jadad scores did not moderate the effect size estimate. Furthermore, it should be noted that the quality and homogeneity of the studies included in the meta-analysis was considerably better than that of studies used for other recently published meta-analytic reviews of established but poorly validated psychodynamic interventions (Leichsenring & Rabung, 2008; Leichsenring, Rabung, & Leibing, 2004). Moreover, the fail-safe *N* and funnel plot analyses suggest that the results for uncontrolled pre-post effect sizes are robust and unlikely to be the effect of a publication bias or number of treatment sessions and were maintained over an average 27 week follow-up period (median: 12 weeks).

Perhaps the most important bias of meta-analyses is the expectancy effect. Cotton and Cook (1982) recommended early on that the investigators of meta-analyses explicitly state their personal view with regards to the outcome in order to acknowledge and possibly avoid the expectancy effect. At the outset of our review, we were rather critical toward the efficacy of MBT. We expressed our personal view in an earlier theoretical article (Hofmann & Asmundson, 2008) and were fully prepared to report non-significant or only small effects of MBT. We were surprised to find these effects to be rather robust and strong. Therefore, we

believe that the expectancy bias was unlikely to be a significant contributor to the results, which generally support the efficacy of MBT.

In order to avoid other common methodological pitfalls of meta-analyses (e.g., Hofmann & Smits, 2008b), we decided to apply relatively liberal selection criteria by including any studies that used MBT while examining treatment related changes in anxiety and depression. Nevertheless, it is important to interpret the findings in the context of the study criteria, because the average effect size estimate is a direct function of these criteria.

Another limitation was the fact that it was possible to calculate a controlled effect size for only 16 of the 39 trials, and except for measures of anxiety symptom severity in active treatment controlled studies, the effect size estimates were not reliable due to a considerable publication bias. However, the pre-post treatment effects were robust and unlikely to be the result of a psychological placebo because the observed effect size is greater than what would be expected from a psychological placebo (Smits & Hofmann, 2009). Nevertheless, future studies are needed to clearly establish the efficacy of MBT in randomized controlled trials.

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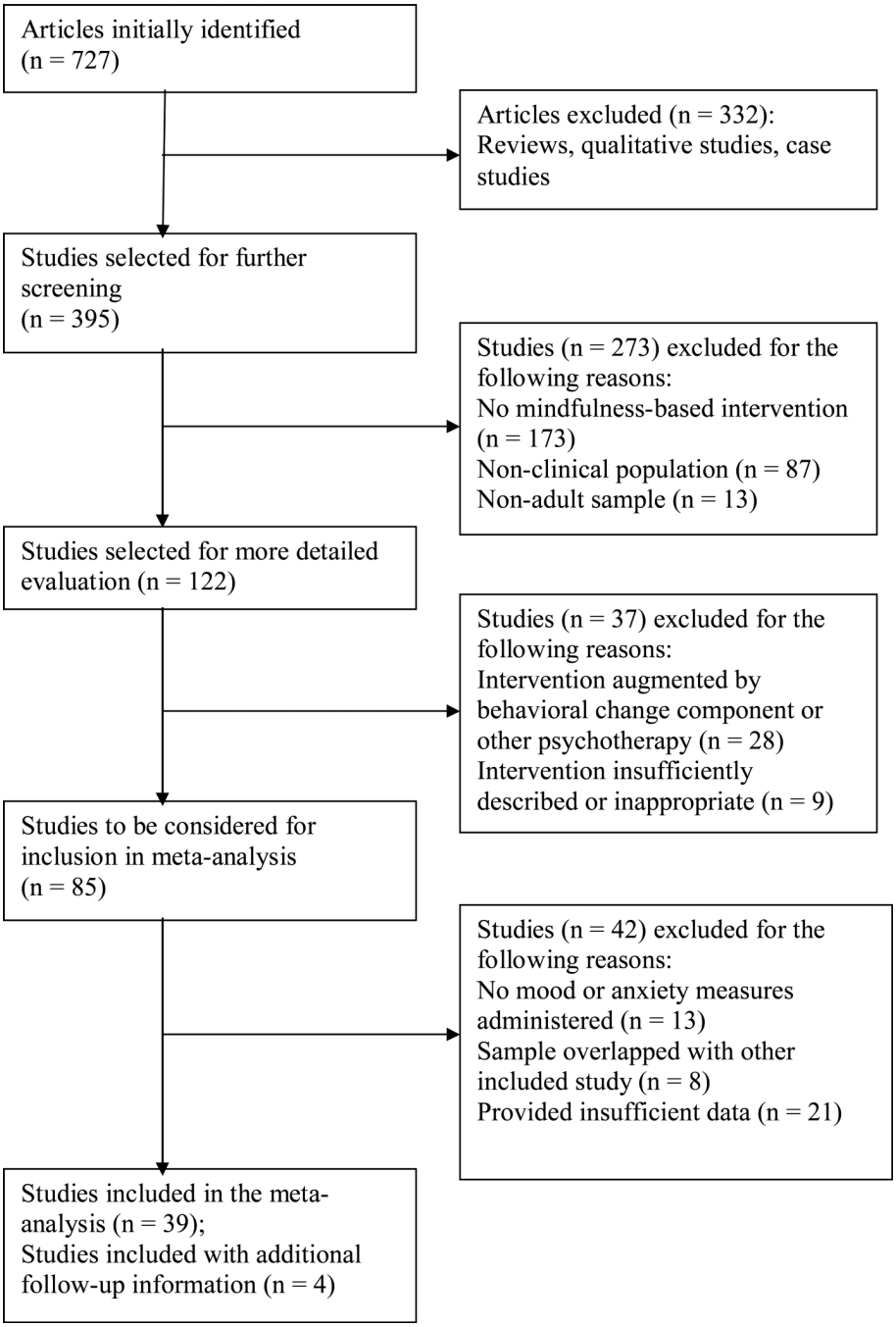

Figure 1.
Flow diagram of study selection process.

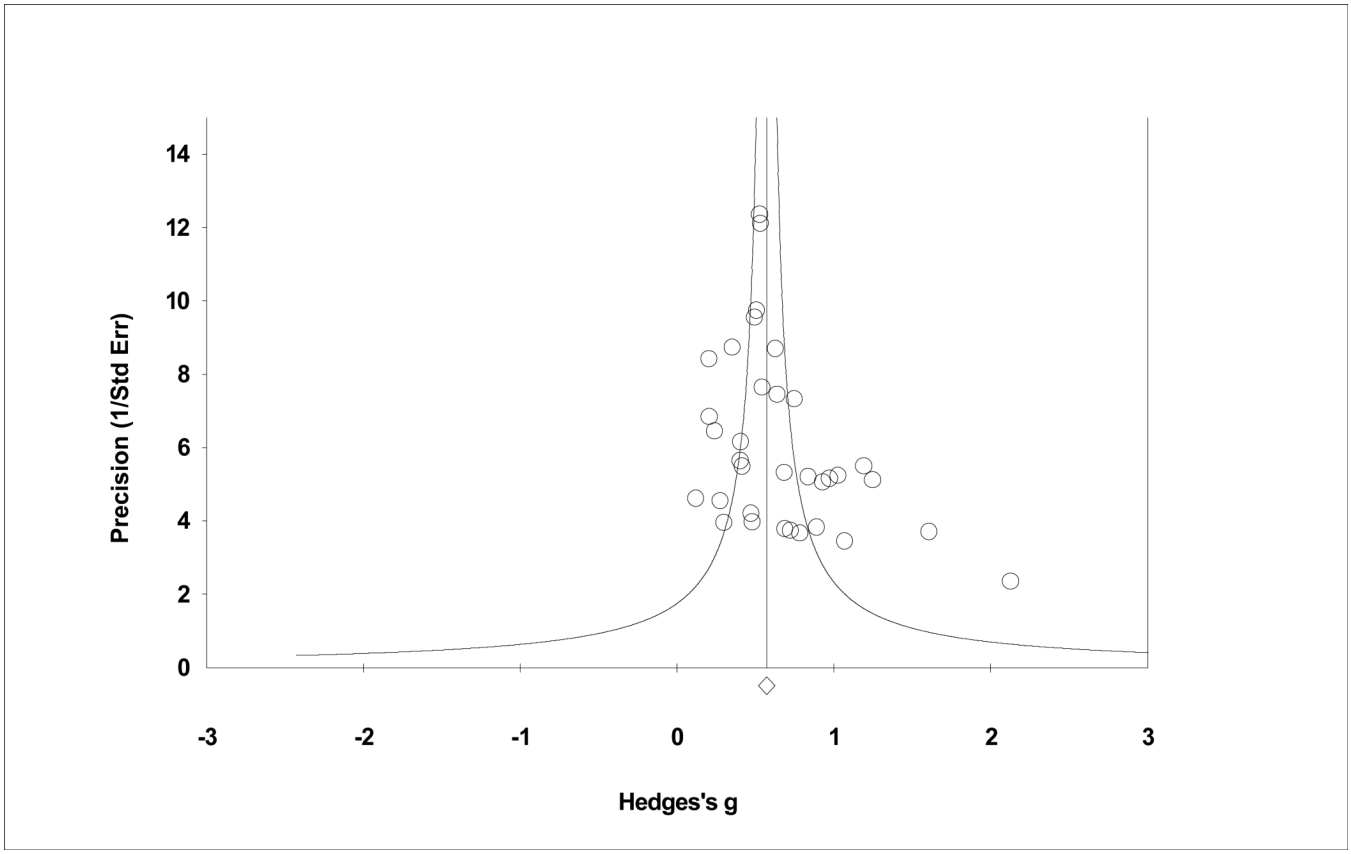

Figure 2.
Funnel plot of precision by Hedges' *g* for anxiety measures. Note that in the absence of a publication bias, the studies should be distributed symmetrically with larger studies appearing toward the top of the graph and clustered around the mean effect size and smaller studies toward the bottom.

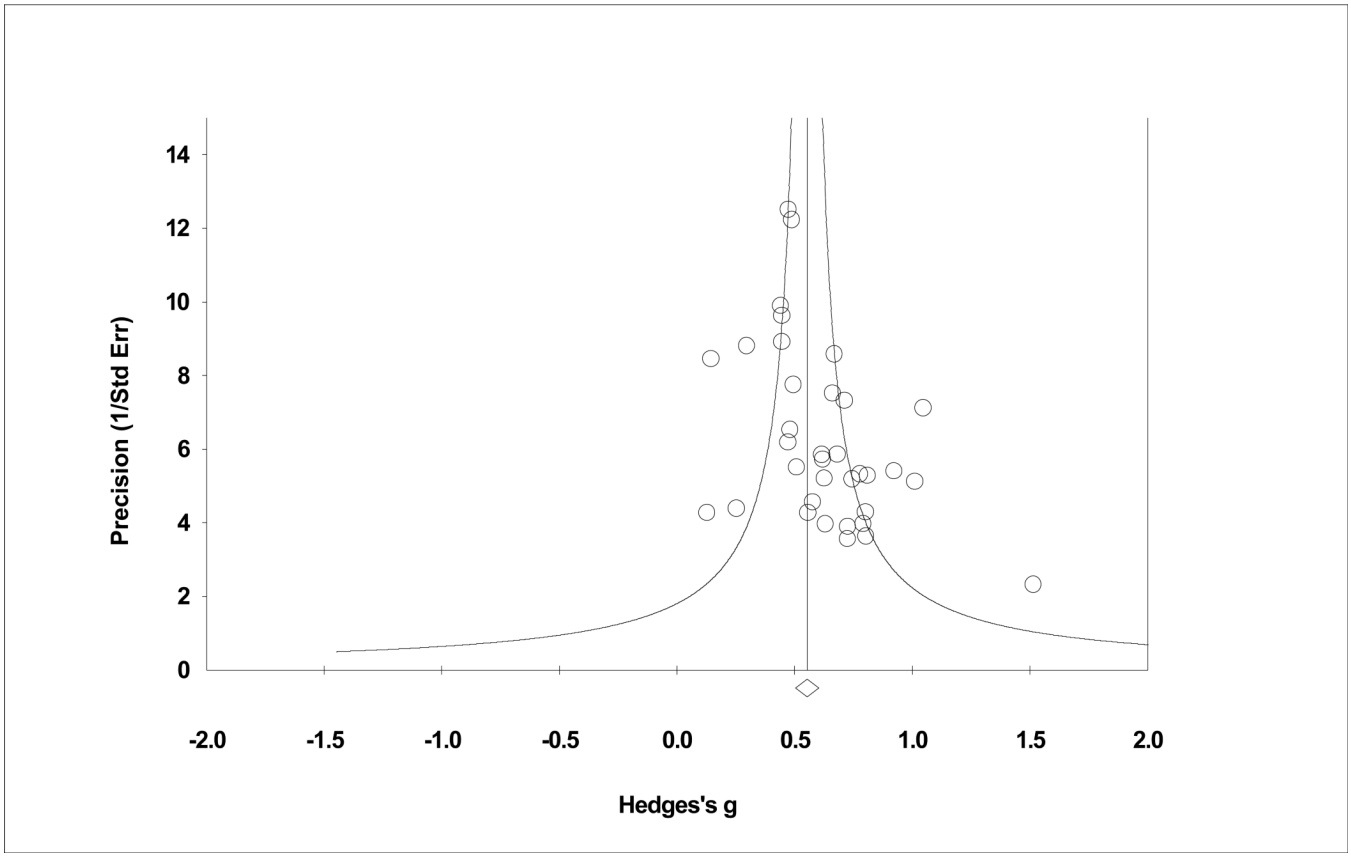

Figure 3.
Funnel plot of precision by Hedges' *g* for depression measures.

Table 1

Description of Studies

Study	Year	Primary Disorder Targeted by Intervention	Number of Tx Sessions	Mindfulness Intervention (*N*)	Comparison Condition (*N*)	Total Sample Size	Anxiety Measures	Depression Measures	Jadad Score
Barnhofer et al.	2009	Depression	8	MBCT (14)	TAU, excluding individual psychotherapy (14)	28		BDI-II	3
								BSS	
Bedard et al. & *Bedard et al.	2003	Traumatic	12	MBSR approach (10)	Dropouts used as controls (3)	13	SCL-90-R anxiety subscale	BDI-II	1
	2005	brain injury						SCL-90-R depression subscale	
Bogels et al.	2006	SAD	9	Mindfulness and Task Concentration Training (9)	None	9	FNE		1
							SCS		
							SFA		
							SPAI social phobia subscale		
							SPB		
Carlson et al. & *Carlson et al.	2003	Cancer	8 + 3-hr retreat	MBSR (42)	None	42	POMS anxiety subscale	POMS depression subscale	1
	2007						SOSI anxiety/fear subscale	SOSI depression subscale	
Carlson & Garland	2005	Cancer	8 + 3-hr retreat	MBSR (63)	None	63	POMS anxiety subscale	POMS depression subscale	0
							SOSI anxiety/fear subscale	SOSI depression subscale	
Craigie et al.	2008	GAD	9	MBCT (20)	None	20	BAI	BDI-II	1
							DASS21 anxiety subscale	DASS21 depression subscale	
							PSWQ		
Dobkin	2008	Breast cancer	8	MBSR (13)	None	13		CES-D	0
Evans et al.	2008	GAD	8	MBCT (11)	None	11	BAI	BDI-II	1
							POMS anxiety subscale		
							PSWQ		
*Finucane & Mercer	2006	Depression Anxiety	8	MBCT (11)	None	11	BAI	BDI-II	1
Garland et al.	2007	Cancer	8 + 3-hr retreat	MBSR (60)	Healing though the Creative Arts (44)	104	POMS anxiety subscale	POMS depression subscale	1
							SOSI anxiety/fear subscale	SOSI depression subscale	
Grossman	2007	Fibromyalgia	8 + 1-day retreat	MBSR (39)	Educational social support group with relaxation training (13)	52	HADS anxiety subscale	HADS depression subscale	1
							IPR anxiety subscale	IPR depression subscale	

Study	Year	Primary Disorder Targeted by Intervention	Number of Tx Sessions	Mindfulness Intervention (*N*)	Comparison Condition (*N*)	Total Sample Size	Anxiety Measures	Depression Measures	Jadad Score
Kabat-Zinn et al.	1992	GAD	8 + 1-day retreat	MBSR (22)	None	22	BAI	BDI	1
		PD					HAM-A	HAM-D	
							MSCL anxiety subscale		
							SCL-90-R anxiety subscale		
Kenny & Williams	2007	MDD	8	MBCT (46)	None	46		BDI	1
		BPAD (depressed phase)							
Kievet-Stijnen et al.	2008	Cancer	8 + 1-day retreat	MBSR (47)	None	47	POMS anxiety subscale	POMS depression subscale	1
Kim et al.	2009	GAD	8	MBCT (24)	Anxiety disorder education program (22)	46	BAI	BDI	1
		PD					HAM-A	HAM-D	
							SCL-90-R anxiety subscale	SCL-90-R depression subscale	
Kingston et al.	2007	MDD	8	MBCT (6)	TAU (11)	17		BDI	1
								RS	
Koszycki et al.	2007	SAD	8 + 1-day retreat	MBSR (22)	CBGT (18)	40	IPSM	BDI-II	2
							LSAS		
							SIAS		
							SPS		
Kreitzer et al.	2005	Organ transplant	8	MBSR (19)	None	19	STAI state anxiety subscale	CES-D	1
Kristeller & Hallett	1999	BED	7	Mindfulness meditation training (18)	None	18	BAI	BDI	1
Lee et al.	2007	GAD	8	Meditation-based stress management (21)	Educational program (20)	41	HAM-A	BDI	2
		PD					SCL-90-R anxiety subscale	HAM-D	
								SCL-90-R depression subscale	
							STAI		
Lengacher et al.	2009	Breast cancer	6	MBSR (40)	Usual care (42)	82	STAI	CES-D	2
Lush et al.	2009	Fibromyalgia	8	MBSR (24)	None	24	BAI	BDI	1
Moustgaard	2005	Stroke	9	Adapted MBCT (23)	None	23	BAI	BDI-II	1
							HADS anxiety subscale	HADS depression subscale	
Pradhan et al.	2007	Arthritis	8	MBSR (31)	Waitlist (32)	63	SCL-90-R anxiety subscale	SCL-90-R depression subscale	3
Ramel et al.	2004	Mood disorders (current or lifetime)	8 + half-day retreat	MBSR (11)	Waitlist (11)	22	STAI	BDI	1
								DAS	

Study	Year	Primary Disorder Targeted by Intervention	Number of Tx Sessions	Mindfulness Intervention (*N*)	Comparison Condition (*N*)	Total Sample Size	Anxiety Measures	Depression Measures	Jadad Score
								RSQ rumination subscale	
Ree & Craigie	2007	Anxiety, Mood (heterogeneous sample)	8	MBCT (23)	None	23	DASS anxiety subscale	BDI DASS depression subscale	1
Reibel et al.	2001	Heterogeneous medical diagnoses	8 + 1-day retreat	MBSR (103)	None	103	SCL-90-R anxiety subscale	SCL-90-R depression subscale	1
Rosenzweig et al.	2007	Diabetes	8 + 1-day retreat	MBSR (11)	None	11	SCL-90-R anxiety subscale	SCL-90-R depression subscale	1
Rosenzweig et al.	2009	Chronic pain	8 + 1-day retreat	MBSR (99)	None	99	SCL-90-R anxiety subscale	SCL-90-R depression subscale	1
Sagula & Rice	2004	Chronic pain	8	Mindfulness meditation program (39)	Waitlist or medical assistance (18)	57	STAI	BDI- Short Form	1
Schulte	2007	Hypothyroidism	8	MBCT (8)	None	8	STAI	BDI-II	1
Sephton et al.	2007	Fibromyalgia	8 + 1-day retreat	MBSR (51)	Waitlist (39)	90		BDI	3
Speca et al. & *Carlson et al.	2000 2001	Cancer	7	MBSR (53)	Waitlist (37)	90	POMS anxiety subscale SOSI anxiety/fear subscale	POMS depression subscale SOSI depression subscale	3
Surawy et al.	2005	Chronic Fatigue Syndrome							
Study 1			8	Mindfulness training based on MBSR and MBCT (9)	Waitlist (8)	17	HADS anxiety subscale	HADS depression subscale	2
Study 2			8	Mindfulness training based on MBSR and MBCT (10)	None	10	HADS anxiety subscale	HADS depression subscale	1
Study 3			8	Mindfulness training based on MBSR and MBCT (9)	None	9	HADS anxiety subscale	HADS depression subscale	1
Tacon et al.	2003	Heart disease	8	MBSR (9)	Waitlist (9)	18	STAI state anxiety subscale		2
Tacon et al.	2004	Breast cancer	8	MBSR (27)	None	27	STAI state anxiety subscale		0
Tacon et al.	2005	Breast cancer	8	MBSR (30)	None	30	STAI state anxiety subscale		0
Zylowska et al.	2008	ADHD	8	Mindful Awareness Practices for ADHD (24)	None	24	BAI	BDI	1

Note: ADHD = Attention Deficit Hyperactivity Disorder; BED = Binge Eating Disorder; BPAD = Bipolar Affective Disorder; GAD = Generalized Anxiety Disorder; MDD = Major Depressive Disorder; OCD = Obsessive Compulsive Disorder; PD = Panic Disorder; SAD = Social Anxiety Disorder; MBCT = Mindfulness-Based Cognitive Therapy (Segal et al., 2002); MBSR = Mindfulness-Based Stress Reduction (Kabat-Zinn, 1982); TAU= Treatment as usual; BAI = Beck Anxiety Inventory (Beck & Steer, 1990); BDI = Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961); BDI-II = Beck Depression Inventory II (Beck, Steer, & Brown, 1996); BDI- Short Form = Beck Depression Inventory- Short Form (Beck & Beck, 1972); BSS = Beck Scale for Suicidal Ideation (Beck & Steer, 1991); CES-D = Center for Epidemiologic Studies Depression Scale (Radloff, 1977); DAS = Dysfunctional Attitudes Scale (Weissman & Beck, 1978); DASS = Depression Anxiety Stress Scales (Lovibond & Lovibond, 1996); DASS21 = Depression Anxiety Stress Scales- Short Form (Lovibond & Lovibond, 1996); FNE = Fear of Negative Evaluation Scale (Leary, 1983); HADS = Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983); HAM-A = Hamilton Anxiety Rating Scale (Hamilton, 1959); HAM-D = Hamilton Depression Rating Scale (Hamilton, 1960); IPR = Inventory of Pain Regulation (Schermelleh-Engel, 1995); IPSM = Interpersonal Sensitivity Measure (Boyce & Parker, 1989); LSAS = Liebowitz Social Anxiety Scale (Liebowitz, 1987); MSCL = Medical Symptom Checklist (Kabat-Zinn, 1982); POMS = Profile of Mood States (McNair et al., 1971); PSWQ = Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990); RS = Rumination Scale (Nolen-Hoeksema & Morrow, 1991); RSQ = Response Style Questionnaire (Nolen-Hoeksema & Morrow, 1991); SCL-90-R = Hopkins Symptom Checklist- Revised (Derogatis, 1983); SCS = Self Consciousness Scale (Fenigstein, Scheier, & Buss, 1975); SFA = Self-Focused Attention Scale (Bögels, Alberts, & de Jong, 1996); SIAS = Social Interaction Scale (Mattick & Clarke, 1988); SOSI = Symptoms

of Stress Inventory (Leckie & Thompson, 1979); SPAI = Social Phobia and Anxiety Inventory (Turner, Beidel, Dancu, & Stanley, 1989); SPB = Social Phobic Belief Scale (Voncken, Bögels, & De Vries, 2003); SPS = Social Phobia Scale (Mattick & Clarke, 1988); STAI = State-Trait Anxiety Inventory (Speilberger, Gorsuch, & Lushene, 1970).

*Denotes studies providing follow-up data not included in initial study

Table 2

Effect size analysis of studies examining the efficacy of mindfulness-based therapy on anxiety symptoms in various disorders.

Category Targeted Disorder	Study	Hedges' *g*	95% Confidence Interval	*p*-value
Anxiety Disorders				
GAD	Craigie et al., 2008	0.69	0.32 – 1.06	<0.01
	Evans et al., 2008	0.89	0.38 – 1.41	0.02
GAD/Panic Disorder	Kabat-Zinn et al., 1992	0.84	0.46 – 1.22	<0.01
	Kim et al., 2009	1.61	1.08 – 2.14	<0.01
	Lee et al., 2007	2.13	1.29 – 2.97	<0.01
SAD	Bogels et al., 2006	0.48	−0.01 – 0.98	0.06
	Koszycki et al., 2007	0.93	0.54 – 1.32	<0.01
Subtotal Anxiety Disorders		0.97	0.73 – 1.22	<0.01
Depression	Ramel et al., 2004	0.12	−0.30 – 0.55	0.70
Pain Disorders				
Arthritis	Pradhan et al., 2007	0.21	−0.08 – 0.50	0.15
Chronic Pain	Rosenzweig et al., 2009	0.54	0.37 – 0.70	<0.01
	Sagula & Rice, 2004	0.64	0.38 – 0.91	<0.01
Fibromyalgia	Grossman, 2007	0.55	0.29 – 0.80	<0.01
	Lush et al., 2009	0.24	−0.06 – 0.55	0.12
Subtotal Pain Disorders		0.44	0.22 – 0.67	<0.01
Cancer				
Breast Cancer	Lengacher et al., 2009	0.75	0.48 – 1.02	<0.01
	Tacon et al., 2004	1.25	0.87 – 1.64	<0.01
	Tacon et al., 2005	1.19	0.84 – 1.55	<0.01
Breast/ Prostate Cancer	Carlson et al., 2003	0.21	−0.03 – 0.44	0.08
Heterogeneous	Carlson & Garland, 2005	0.51	0.31 – 0.71	<0.01
	Garland et al., 2007	0.50	0.29 – 0.70	<0.01
	Kieviet-Stijnen et al., 2008	0.36	0.13 – 0.58	<0.01
	Speca et al., 2000	0.63	0.41 – 0.86	<0.01
Subtotal Cancer		0.63	0.45 – 0.81	<0.01
Medical Problems				
Chronic Fatigue	Surawy et al., 2005 (1)	0.69	0.17 – 1.21	0.01
	Surawy et al., 2005 (2)	1.07	0.50 – 1.64	<0.01
	Surawy et al., 2005 (3)	0.73	0.20 – 1.25	0.01
Diabetes	Rosenzweig et al., 2007	0.28	−0.15 – 0.71	0.21
Heart Disease	Tacon et al., 2003	0.79	0.25 – 1.32	<0.01
Heterogeneous	Reibel et al., 2001	0.53	0.37 – 0.69	<0.01
Hypothyroidism	Schulte, 2007	0.30	−0.20 – 0.80	0.23
Organ Transplant	Kreitzer et al., 2005	0.41	0.06 – 0.76	0.02
Stroke	Moustgaard, 2005	0.98	0.59 – 1.36	<0.01

Category Targeted Disorder	Study	Hedges' *g*	95% Confidence Interval	*p*-value
TBI	Bedard et al., 2003	0.47	0.01 – 0.94	0.05
Subtotal Medical Problems		0.61	0.41 – 0.80	<0.01
Other				
ADHD	Zylowska et al., 2008	0.68	0.35 – 1.02	<0.01
Anxiety/ Mood	Ree & Craigie, 2007	0.62	0.28 – 0.95	<0.01
BED	Kristeller & Hallett, 1999	0.63	0.25 – 1.00	<0.01
Overall Total		0.63	0.53 – 0.73	<0.01

Note. The Table shows effect size estimates (Hedges' *g*), the 95% confidence intervals, and the significance test of changes in anxiety symptoms from before to after a mindfulness-based intervention in various psychiatric and medical disorders.

ADHD = Attention Deficit Hyperactivity Disorder; BED = Binge Eating Disorder; GAD = Generalized Anxiety Disorder; SAD = Social Anxiety Disorder; TBI = Traumatic Brain Injury.

Table 3

Effect size analysis of studies examining the efficacy of mindfulness-based therapy on depressive symptoms in various disorders.

Category Targeted Disorder	Study	Hedges'*g*	95% Confidence Interval	*p*-value
Anxiety Disorders				
GAD	Craigie et al., 2008	0.75	0.37 – 1.13	<0.01
	Evans et al., 2008	0.56	0.10 – 1.02	0.02
GAD/Panic Disorder	Kabat-Zinn et al., 1992	0.81	0.44 – 1.18	<0.01
	Kim et al., 2009	0.92	0.56 – 1.29	<0.01
	Lee et al., 2007	0.78	0.41 – 1.15	<0.01
SAD	Koszycki et al., 2007	0.62	0.28 – 0.96	<0.01
Subtotal Anxiety Disorders		0.75	0.58 – 0.91	<0.01
Depression	Barnhofer et al., 2009	0.80	0.35 – 1.26	<0.01
	Kingston et al., 2007	1.52	0.67 – 2.36	<0.01
	Kenny & Williams, 2007	1.05	0.77 – 1.32	<0.01
	Ramel et al., 2004	0.63	0.14 – 1.13	0.01
Subtotal Depression		0.95	0.71 – 1.18	<0.01
Pain Disorders				
Arthritis	Pradhan et al., 2007	0.48	0.18 – 0.78	<0.01
Chronic Pain	Rosenzweig et al., 2009	0.49	0.33 – 0.65	<0.01
	Sagula & Rice, 2004	0.71	0.45 – 0.98	<0.01
Fibromyalgia	Grossman, 2007	0.50	0.24 – 0.75	<0.01
	Lush et al., 2009	0.47	0.16 – 0.79	<0.01
	Sephton, 2007	0.45	0.23 – 0.67	<0.01
Subtotal Pain Disorders		0.51	0.39 – 0.63	<0.01
Cancer				
Breast Cancer	Dobkin et al., 2008	0.58	0.15 – 1.01	0.01
	Lengacher et al., 2009	0.66	0.40 – 0.92	<0.01
Breast/ Prostate Cancer	Carlson et al., 2003	0.15	−0.09 – 0.38	0.22
Heterogeneous	Carlson & Garland, 2005	0.44	0.24 – 0.64	<0.01
	Garland et al., 2007	0.45	0.24 – 0.65	<0.01
	Kieviet-Stijnen et al., 2008	0.30	0.07 – 0.52	0.01
	Speca et al., 2000	0.67	0.44 – 0.90	<0.01
Subtotal Cancer		0.45	0.34 – 0.55	<0.01
Medical Problems				
Chronic Fatigue	Surawy et al., 2005 (1)	0.13	−0.33 – 0.59	0.58
	Surawy et al., 2005 (2)	0.25	−0.19 – 0.70	0.26
	Surawy et al., 2005 (3)	0.80	0.26 – 1.35	<0.01
Diabetes	Rosenzweig et al., 2007	0.79	0.30 – 1.29	<0.01
Heterogeneous	Reibel et al., 2001	0.48	0.32 – 0.63	<0.01
Hypothyroidism	Schulte, 2007	0.73	0.18 – 1.28	0.01

Category Targeted Disorder	Study	Hedges' *g*	95% Confidence Interval	*p*-value
Organ Transplant	Kreitzer et al., 2005	0.51	0.15 – 0.87	0.01
Stroke	Moustgaard, 2005	1.01	0.63 – 1.40	<0.01
TBI	Bedard et al., 2003	0.73	0.22 – 1.23	<0.01
Subtotal Medical Problems		0.58	0.47 – 0.70	<0.01
Other				
ADHD	Zylowska et al., 2008	0.68	0.35 – 1.02	<0.01
Anxiety/ Mood	Ree & Craigie, 2007	0.62	0.28 – 0.95	<0.01
BED	Kristeller & Hallett, 1999	0.63	0.25 – 1.00	<0.01
Overall Total		0.59	0.51 – 0.66	<0.01

Note. The Table shows effect size estimates (Hedges' *g*), the 95% confidence intervals, and the significance test of changes in depressive symptoms from before to after a mindfulness-based intervention in various psychiatric and medical disorders.

ADHD = Attention Deficit Hyperactivity Disorder; BED = Binge Eating Disorder; GAD = Generalized Anxiety Disorder; SAD = Social Anxiety Disorder; TBI = Traumatic Brain Injury.

Improving the quality of reports of meta-analyses of randomized controlled trails: the QUOROM statement checklist

Heading	Subheading	Descriptor	Reported? (Y/N)	Page number
Title		Identify the report as a meta-analysis [or systematic review] of RCTs	Yes	1
Abstract		Use a structured format[27]	Yes	2
		Describe		
	Objectives	The clinical question explicitly	Yes	2
	Data Sources	The databases (ie, list) and other information sources	Yes	2
	Review Methods	The selection criteria (ie, population, intervention, outcome, and study design); methods for validity assessment, data abstraction, and study characteristics, and quantitative data synthesis in sufficient detail to permit replication	Yes	2
	Results	Characteristics of the RCTs included and excluded; qualitative and quantitative findings (ie, point estimates and confidence intervals); and subgroup analyses	Yes	2
	Conclusion	The main results	Yes	2
		Describe		
Introduction		The explicit clinical problem, biological rationale for the intervention, and rationale for review	Yes	5
Methods	Searching	The information sources, in detail[28] (eg, databases, registers, personal files, expert informants, agencies, hand-searching), and any restrictions (years considered, publication status,[29] language of publication[30,31])	Yes	6
	Selection	The inclusion and exclusion criteria (defining population, intervention, principal outcomes, and study design[32])	Yes	6-7
	Validity assessment	The criteria and process used (eg, masked conditions, quality	Yes	7

Heading	Subheading	Descriptor	Reported? (Y/N)	Page number
		assessment, and their findings[33–36])		
	Data abstraction	The process or processes used (eg, completed independently, in duplicate)[35,36]	Yes	7-8
	Study characteristics	The type of study design, participants' characteristics, details of intervention, outcome definitions, &c,[37] and how clinical heterogeneity was assessed	Yes	8
	Quantitative data synthesis	The principal measures of effect (eg, relative risk), method of combining results (statistical testing and confidence intervals), handling of missing data; how statistical heterogeneity was assessed;[38] a rationale for any a-priori sensitivity and subgroup analyses; and any assessment of publication bias[39]	Yes	8-10
Results	Trial flow	Provide a meta-analysis profile summarising trial flow (see figure)	Yes	10-11; 55
	Study characteristics	Present descriptive data for each trial (eg, age, sample size, intervention, dose, duration, follow-up period)	Yes	11
	Quantitative data synthesis	Report agreement on the selection and validity assessment; present simple summary results (for each treatment group in each trial, for each primary outcome); present data needed to calculate effect sizes and confidence intervals in intention-to-treat analyses (eg 2×2 tables of counts, means and SDs, proportions)	Yes	11-17
Discussion		Summarise key findings; discuss clinical inferences based on internal and external validity; interpret the results in light of the totality of available evidence; describe potential biases in the review process (eg, publication bias); and suggest a future research agenda	Yes	17-24

Quality of reporting of meta-analyses