

Review

The efficacy of mindfulness-based stress reduction on mental health of breast cancer patients: a meta-analysis

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Abstract

Objective: This study aims to investigate the evidence of the efficacy of mindfulness-based stress reduction (MBSR) in improving stress, depression and anxiety in breast cancer patients.

Methods: An extensive systematic electronic review (PubMed, Embase, CINAHL, PsycINFO, Scopus, Ovid, Web of Science and The Cochrane Library) and a hand search were carried out from 15 October 2011 to 30 November 2011 to retrieve relevant articles using 'mindfulness' or 'mindfulness-based stress reduction' and 'breast cancer' as keywords. Information about the baseline characteristics of the participants, interventions and findings on perceived stress, depression and anxiety was extracted from each study.

Results: Nine published studies (two randomised controlled trials, one quasi-experimental case-control study and six one-group, pre-intervention and post-intervention studies) up to November 2011 that fulfilled the inclusion criteria were analysed. The pooled effect size (95% CI) for MBSR on stress was 0.710 (0.511–0.909), on depression was 0.575 (0.429–0.722) and on anxiety was 0.733 (0.450–1.017).

Conclusion: On the basis of these findings, MBSR shows a moderate to large positive effect size on the mental health of breast cancer patients and warrants further systematic investigation because it has a potential to make a significant improvement on mental health for women in this group.

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Introduction

The incidence of breast cancer and the number surviving after treatment of this disease are increasing across the world [1–4]. The 5-year survival rate has reached 80–95% in many countries [5–7], and, therefore, survivors may develop long-term physical and psychological effects of the disease itself, or its treatment (e.g. mastectomy, radiation therapy and chemotherapy, used alone or in combination).

Psychological distress is common among breast cancer patients [8,9]. It has been reported that the frequency of intrusive thoughts in the minds of breast cancer survivors is related to psychological distress [10]. The prevalence of clinical depression in breast cancer patients ranges between 11% and 20% [11–14] and 16% for anxiety disorder [15]. In a study on newly diagnosed breast cancer patients, 41% of the women rated their distress level in the clinically significant range on the 'Distress Thermometer', 11% had major depression, and 10% had posttraumatic stress disorder [11]. In a European study on this group, 16% of participants were categorised as depressed, which was inversely correlated to quality of life [16].

Apart from pharmacotherapy [17], psychotherapeutic intervention is recommended in treatment guidelines in distressed cancer patients [18].

Over recent years, there has been an increasing interest in mindfulness interventions. The growing number of research projects investigating this approach attests to the benefits of mindfulness in helping people improve their physical and mental health. The Mental Health

Foundation 2010 [19] described mindfulness as 'a way of paying attention. It means consciously bringing awareness to our experience, in the present moment, without making judgements about it.' Most of the time, people are on 'automatic pilot', caught up in their experience and reacting automatically, especially when feeling stressed. Staying consciously aware of what is happening, that is, being mindful, allows people to observe and accept what they are currently experiencing, in their bodies, minds and the world around them. This provides *opportunities* for individuals to make more considered decisions about how to respond to what is happening.

Mindfulness interventions are often regarded as part of the cognitive behavioural tradition. They differ from traditional cognitive behavioural therapies in that they do not encourage people to challenge their thoughts and they are not goal directed.

Mindfulness-based stress reduction (MBSR) is a psycho-educational training initially developed by Kabat-Zinn for chronic pain patients and stress-related conditions [20,21]. It is a group programme commonly conducted for 8 weeks, with weekly 2.5-h sessions and one full retreat day. The participants are given a CD containing instructions for home practice for 45 min per day, 6 days a week. The main components of MBSR are the body scan, breathing meditation, walking meditation, mindful movement and psycho-education. The participants learn effective ways of handling moods and emotions by becoming aware, from moment to moment, of thoughts, feelings, bodily sensations and the world around them. Each session includes education about

stress including information on the physiology of stress and the stress response, and the effect of different interpretations of stress on its impact.

Mindfulness-based stress reduction offers a secular mindfulness meditation programme that benefits health, particularly improvement in mental health [22]. Several studies have demonstrated the beneficial effects of MBSR on stress reduction and mental health in individuals with cancer [23–27], arthritis [28,29], diabetes [30], organ transplants [31,32], psychiatric disorders [33,34] and in stressed non-clinical populations [35–37]. Previous systematic review [38] and meta-analysis of MBSR and cancer suggested that MBSR may improve cancer patients' mental health affected by their disease [39]. Another systematic review by Shennan *et al.* [40] reported five different types of mindfulness-based interventions (the majority were MBSR, two were mindfulness-based cognitive therapy, one brief mindfulness training, two psycho-educational studies with a core mindfulness component and one 'one to one' mindfulness meditation) used in adults with cancer. There were significant improvements in anxiety, depression, stress and sexual difficulties with all the interventions.

A systematic review on MBSR for breast cancer survivors was completed by Matchim *et al.* [41]. Studies included some in women with breast cancer alone and some in heterogeneous cancer populations where breast cancer was the most common diagnosis. They reported three studies with large effect sizes on perceived stress and state anxiety, and moderate effect sizes on mood symptoms.

Reported limitations in the review included small numbers of eligible studies, heterogeneous cancer diagnoses in the studies and the methodological limitations. *At the time of preparing this paper, there was no published meta-analysis on the effect of MBSR on mental health in the patients with breast cancer alone.* Breast cancer diagnosis is of particular concern because the increasing *survival rate means* that many more people are living with the uncertainty of possible relapse, possible repeated treatment and needing an intervention for possible psychological problems. Furthermore, women in general, who are most commonly affected by breast cancer, are more likely to develop depression and anxiety [42]. Therefore, this paper investigates the efficacy of MBSR on *stress, depression and anxiety* in breast cancer survivors.

Methods

The review procedure was guided by PRISMA (preferred reporting items for systematic reviews and meta-analyses) statement [43]. Ethical Committee Review was not necessary for the literature review, as no confidential data were included.

Selection of studies

Electronic databases of published papers prior to November 2011 were searched through PubMed, Embase, CINAHL, PsyArticles, PsycINFO, Scopus, Ovid, Web of Science and The Cochrane Library using a combination of mindfulness or 'mindfulness-based stress reduction' and 'breast

cancer' as keywords yielding 625 references in English. Each abstract was read, and those reporting effects of MBSR on psychological impact of breast cancer were retrieved and appraised as the primary studies for the meta-analysis. Lists of references from each paper were searched, and appropriate primary studies were retrieved. Authors were contacted for full paper if abstract was only available online. To reinforce validity, two independent investigators studied the papers coming to a consensus on decisions to include studies. Inclusion criteria were as follows: (i) use of MBSR as the intervention; (ii) breast cancer patients; (iii) trials looking at the effects on mental health (stress, depression or anxiety); and (iv) sufficient data were reported for the calculation of standardised effect size. Studies on mixed cancer participants and/or mixed interventions were excluded. Multiple publications were excluded to avoid double counting.

Calculation of effect size, *d*

We intended to measure the pooled effect size of MBSR on the psychological domains perceived stress, depression, anxiety and quality of life. Effect size is a measurement of the strength of the relationship between two variables of studied populations. Effect size on means is the standardised mean difference between two populations. *Cohen's d* is defined as the mean difference between two populations divided by the standard deviation for the data. The mean effect size in this meta-analysis was calculated by using the software Comprehensive Meta-Analysis version-2 programme. To interpret the resulting number, we used a general guide developed by Cohen: <0.1 = trivial effect, 0.1–0.3 = small effect, 0.3–0.5 = moderate effect and 0.5 = large difference effect [44].

All of the primary articles included studied the same psychological variables, but the measure of effect was made using different instruments and thus different scales. Hence, the result from this measurement process cannot be combined directly [45]. Therefore, the first step was to obtain an estimate effect size for each study in a common metric, $d_i = (\text{mean}_e - \text{mean}_c) / \text{SD}_{pi}$ where d_i is the common metric that measures effect size in the i th study, mean_e is the mean in the experiment (or exposed) group, mean_c is the mean in the control (or unexposed) group and SD_{pi} is the pool estimate of the standard deviation of the effect measured for each study. For the effect size for uncontrolled one-group studies, the means for pre-intervention and post-intervention are mean_e and mean_c in the formula. Where effect size was already calculated and described in the primary studies, it was computed directly into the programme.

The heterogeneity was examined by calculating the I^2 index, which expresses the percentage of the total variation across studies due to heterogeneity. I^2 values of 25%, 50% and 75% are equivalent to low, moderate and high heterogeneities, respectively [46]. Even though all the study populations included were breast cancer patients, we assumed that no two studies were the same. Therefore, a *random or mixed effects model* was the appropriate model to choose for a reliable result. We further assessed the presence of publication bias by using the funnel plot. The method is known as 'Trim and Fill' [47], a nonparametric method for estimating the number of missing studies.

Results

Selected studies

Thirty-three studies of the effects of MBSR on mental health in patients with cancer (including breast cancer) were found. Twenty-four studies were excluded (19 studies were in mixed cancer populations, two studies were reported *multiple times*, two did not study impact on mental health and one had inadequate data to calculate the effect size). Nine studies [48–56] were included in the analyses. Figure 1 shows the flow diagram of the study selection.

The nine studies included two randomised controlled trials (RCTs) [51,53], one quasi-experimental case-control study [54] and six one-group, pre-intervention and post-intervention studies [48–50,52,55,56]. All the studies were conducted in the USA or Canada. The baseline profiles of the participants in the nine included studies are shown in Table 1. The study participants were all women with breast cancer with mean age of 45.4 to 61.5 years, the number in each study ranging from 13 to 163 subjects. At least two-thirds of participants had secondary education, and more than 90% were Caucasian. The majority of participants had completed their breast cancer treatment. All the studies used the standard of 8 weeks MBSR training except that for Lengacher *et al.* [51], where it was 6 weeks. Only three studies reported that the MBSR training was facilitated by a trained psychologist.

Effect size

Table 2 shows the outcomes of the analysed studies. The mean effect size with 95% confidence intervals (CI) for each psychological domain is demonstrated. Of the nine studies, eight studies [48–52,54–56] reported data on stress, seven studies [48–53,55] measured depression and only four studies [51,52,55,56] measured anxiety. Three studies [51,52,55] measured all three mental health domains.

The pooled mean effect size for eight studies ($N=307$) on stress was 0.710 (95% CI: 0.511–0.909, $p=0.000$). The heterogeneity was low ($Q=11.288$, $p=0.127$, $I^2=37.99$). However, one RCT by Lengacher *et al.* ($N=82$) produced a non-significant difference on perceived stress between the MBSR and the usual care group, $d=0.368$ (95% CI: -0.069 – 0.804 , $p=0.099$). The pooled mean effect size on stress for all non-RCT studies was 0.757 (95% CI: 0.553–0.961, $p=0.000$). With the outlier being removed [55], the pooled mean effect size on stress was 0.667 (95% CI: 0.501–0.833, $p=0.000$). They were homogeneous ($Q=1.501$, $p=0.913$, $I^2=0.000$). The funnel plot (Figure 2) shows slight asymmetrical distribution of the eight studies on each side of the central line. The ‘Trim and Fill’ method based on the random effects model showed that two studies were missing on the right side of the mean effect but no missing studies on the left side. The imputed pooled mean effect size became 0.796 (95% CI: 0.594, 0.998).

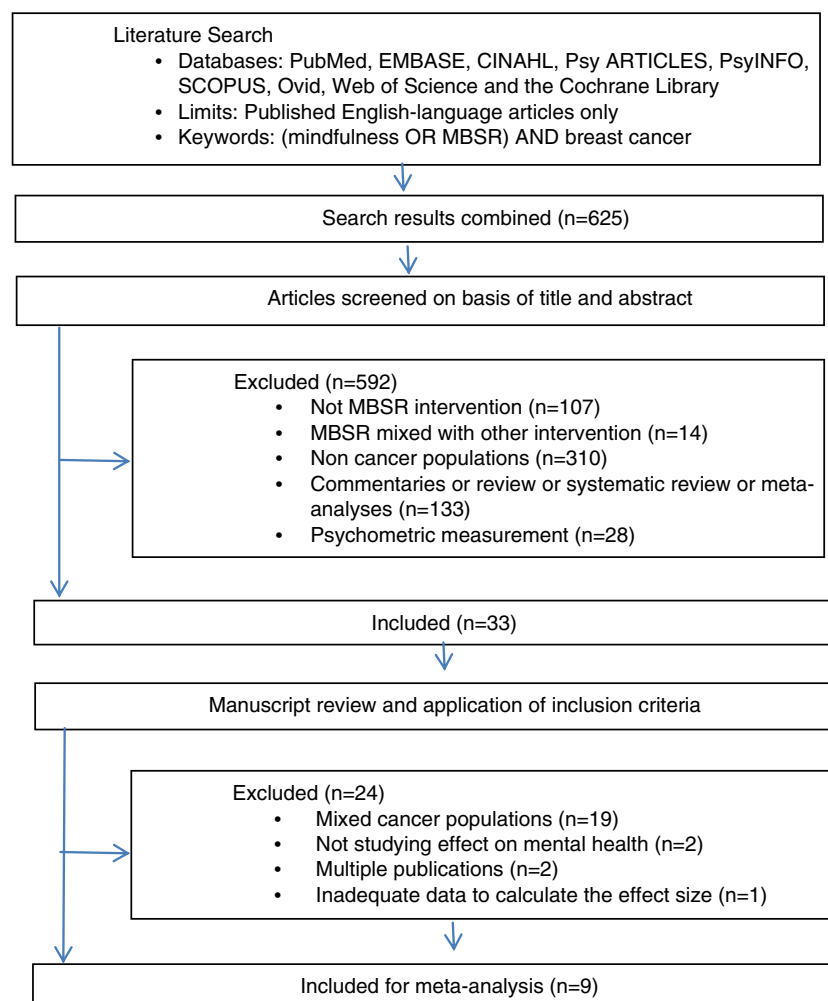


Figure 1. The flow diagram of study selection

Table 1. The baseline profiles of participants in the selected studies

Study	Place of study	Total N	Mean age (year)	Education	Marital status	Ethnic	Cancer stage	Chemo/radiation during study
Lengacher et al. [51]	USA (cancer centre, Florida)	82 MBSR:40 UC: 42	57.5	≥college: 31 (78%) vs 29 (70%)	No data available	Caucasian: 35 (88%) vs 33 (79%)	MBSR vs UC Stage 0: 5 (12%) vs 9 (21%) Stage I: 26 (63%) vs 19 (44%) Stage II: 7 (17%) vs 12 (28%) Stage III: 3 (7%) vs 3 (7%)	Completed
Henderson et al. [53]	USA (hospital and community, Massachusetts)	163 MBSR: 53 NEP: 52 UC: 58	49.8	MBSR vs NEP vs UC ≥college: 44 (83%) vs 39 (75%) vs 43 (74%)	MBSR vs NEP vs UC Stable union: 39 (74%) vs 35 (67%) vs 43 (74%)	MBSR vs NEP vs UC Caucasian: 51 (96%) vs 48 (92%) vs 56 (97%)	MBSR vs NEP vs UC Stage I: 29 (55%) vs 31 (59%) vs 30 (52%) Stage II: 24 (45%) vs 21 (41%) vs 28 (48%) Stages 0-II: All except I vs 4 are unknown	MBSR vs NEP vs UC Chemotherapy: 7 (13%) vs 5 (10%) vs 7 (12%) Radiation: 12 (22%) vs 14 (27%) vs 14 (24%) Completed
Matchim et al. [54]	USA (cancer centres in Midwest)	36 MBSR: 19 Non-MBSR: 17	56.8 vs 61.5		Married: 15 (80%) vs 11 (65%)	Caucasian: 17 (87%) vs 17 (100%)		Completed
Tacon et al. [55]	USA (breast centre, Texas)	27	53.3	≥college: 18 (68%)	Married: 21 (76%)	Caucasian: 25 (92%)	Localised: 23 (85%) Metastatic: 4 (15%)	3 (11%) on chemotherapy or radiation
Tacon [56]	USA (southwestern community)	40	45.4	≥college: 27 (68%)	Married: 24 (61%)	Caucasian: 38 (94%)		16 (40%) on chemotherapy or radiation
Dobkin [48]	Canada (hospitals)	13	54.0	University degree: 11 (85%)				All except I had completed treatment
Matousek and Dobkin [50]	Canada (hospitals and community)	59	56.4	≥college: 52 (88%)			Stages 0-II: 39 (66%) Stages III and IV: 8 (14%)	Completed
Matousek et al. [49]	Canada (community, Montreal)	33	55.9	≥college: 30 (91%)	Married: 15 (65%)	Caucasian: 24 (73%)	Stage I: 13 (39%) Stage II: 12 (36%)	Completed
Lengacher et al. [52]	USA (cancer centre and University of South Florida)	17	57 ± 9	≥college: 15 (89%)	Married: 14 (84%)	Caucasian: 16 (94%)	Stage 0: 5 (26%) Stage I: 14 (74%)	Completed

MBSR, mindfulness-based stress reduction; NEP, Nutrition Education Program; UC, usual care.

For the seven studies ($N=392$) that included a *measure of depression*, the pooled effect size of 0.575 (95% CI: 0.429–0.722, $p=0.000$) is considered a moderate effect size. The test for heterogeneity revealed the absence of heterogeneity of the seven studies analysed ($Q=4.217$, $p=0.647$, $I^2=0.000$). In the two RCTs by Lengacher

et al. and Henderson *et al.*, the effect sizes for depression were 0.488 (95% CI: 0.049–0.928, $p=0.029$) and 0.371 (95% CI: –0.015–0.757, $p=0.059$), respectively. The mean pooled effect size of the two RCTs ($N=245$) was 0.422 (95% CI: 0.132–0.712, $p=0.004$). For the five non-RCTs alone, $d=0.628$ (95% CI: 0.458–0.797,

Table 2. Outcomes of the selected studies

Study	Design	Total N	MBSR duration (weeks)	Outcome measures	Effect size (95% CI)
Lengacher <i>et al.</i> [51]	RCT 2 arms: MBSR and UC	82	6	State-Trait Anxiety Inventory	0.488 (0.049, 0.928)
		MBSR: 40		Centre for Epidemiological Studies Depression Scale	0.488 (0.049, 0.928)
		UC: 42		Perceived Stress Scale	0.368 (–0.069, 0.804)
Henderson <i>et al.</i> [53]	RCT 3 arms: i.e. MBSR, NEP and UC	163	8	Symptom Checklist-90-Revised	0.371 (–0.015, 0.757)
		MBSR: 53		Depression	
		NEP: 52 UC: 58			
Matchim <i>et al.</i> [54]	Non-RCT Quasi-experimental pre-test and post-test with control group	36	8	Calgary Symptoms of Stress Inventory	0.437 (–0.225, 1.100)
Tacon <i>et al.</i> [55]	Non-RCT One-group MBSR Pre-intervention and post-intervention	27	8	Current level of stress	1.451 (0.911, 1.992)
				Spielberger's state-trait measure of anxiety	0.953 (0.498, 1.407)
Tacon [56]	Non-RCT One-group MBSR Pre-intervention and post-intervention	40	8	Spielberger's state-trait measure of anxiety	0.976 (0.599, 1.352)
				Centre for Epidemiological Studies Depression Scale	0.579 (0.244, 0.914)
Dobkin [48]	Non-RCT One-group MBSR Pre-intervention and post-intervention	13	8	Symptom Distress Scale	0.610 (0.273, 0.948)
				Centre for Epidemiological Studies Depression Scale	0.444 (–0.126, 1.013)
Matosek and Dobkin [50]	Non-RCT One-group MBSR Pre-intervention and post-intervention	59	8	Perceived Stress scale	0.879 (0.239, 1.519)
				Centre for Epidemiological Studies Depression Scale	0.629 (0.350, 0.908)
Matousek <i>et al.</i> [49]	Non-RCT One-group MBSR Pre-intervention and Post-intervention	33	8	Centre for Epidemiological Studies Depression scale	0.553 (0.279, 0.827)
				Perceived Stress Scale	0.900 (0.496, 1.304)
Lengacher <i>et al.</i> [52]	Non-RCT One-group MBSR Pre-intervention and post-intervention	17	8	Perceived Stress Scale	0.796 (0.404, 1.187)
				State Trait Anxiety Inventory	0.708 (0.177, 1.240)
				Centre for Epidemiological Studies Depression Scale	0.438 (–0.060, 0.935)
					0.721 (0.244, 0.914)

MBSR, mindfulness-based stress reduction; CI, confidence interval; NEP, Nutrition Education Program; RCT, randomised controlled trial.

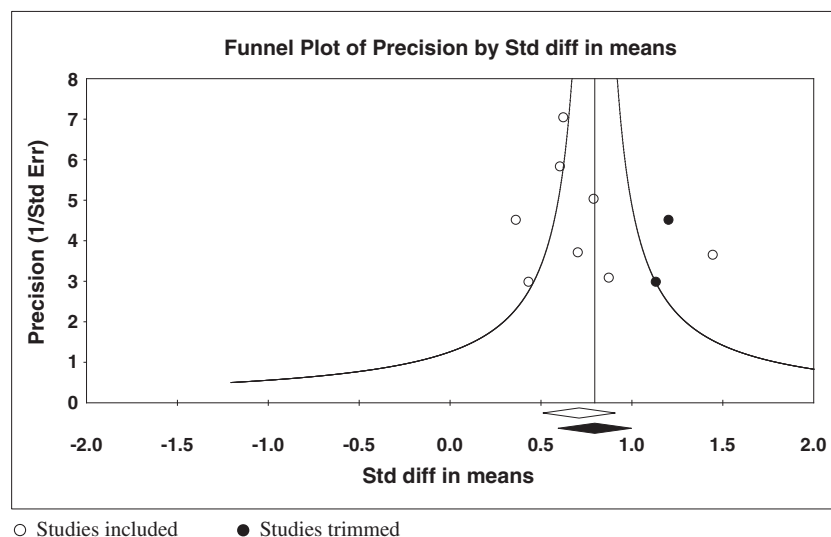


Figure 2. The funnel plot of effect size on measured stress for the observed and imputed studies

$p=0.000$). Similarly, there was an absence of heterogeneity ($Q=2.624, p=0.623, I^2=0.000$). The studies were equally dispersed on either side of the overall effect. Using ‘Trim and Fill’, this study found that there were no missing studies on both sides and the pooled effect size value was unchanged.

For the four studies ($N=166$) that included a *measure of anxiety*, the pooled effect size was 0.733 (95% CI: 0.450–1.017, $p=0.000$), which is a large significant effect. The heterogeneity was moderate ($Q=5.019, p=0.170, I^2=40.23$). One RCT by Lengacher *et al.* ($N=82$) reported $d=0.488$ (95% CI: 0.049–0.928, $p=0.029$), and the pooled effect size of the three non-RCTs was 0.816 (95% CI: 0.493–1.139, $p=0.000$). The heterogeneity was lower ($Q=3.241, p=0.198, I^2=38.295$). The Forest plots for stress, depression and anxiety are shown in Figure 3.

Discussion

This study found evidence that the use of MBSR in women with breast cancer can have an important impact on improving mental health by a reduction in perceived stress, depression and anxiety. This meta-analysis was conducted with a mixed group of study designs. Because there were only two RCTs, we *chose* to incorporate the non-randomised studies to increase the eligibility of analysable data.

However, sub-analysis of effect size was carried out separately for the randomised and non-randomised studies.

The overall effect size on stress was 0.710 ($d=0.368$ for randomised study, $d=0.757$ for non-randomised studies). The value for the randomised study is similar to the overall effect of MBSR on psychological distress reported by Bohlmeijer *et al.* [57], which is 0.32. However, our finding was only based on one study. Their meta-analysis was conducted on 10 RCTs of MBSR on mental health of adults with a chronic medical disease. There were two cancer studies [27,58] included in their analyses, where one study was on MBSR among mixed cancer population and the other was on mindfulness-based art therapy. Another meta-analysis [39], which included 10 studies (randomised and observational studies) on patients with cancer, predominantly breast cancer, found that the overall effect of MBSR on mental health was 0.48 ($d=0.35$ for randomised studies, $d=0.50$ for observational studies). Our study focused solely on women with breast cancer who received an MBSR intervention only.

For depression, the overall effect size found was 0.575 ($d=0.422$ for the RCTs, $d=0.628$ for the non-randomised studies), and there were no missing studies. Again, these effect sizes were larger than those for depression found by Bohlmeijer *et al.* [57], which is 0.26. Similar findings by Grossman *et al.* [22] from a meta-analysis of 10 studies

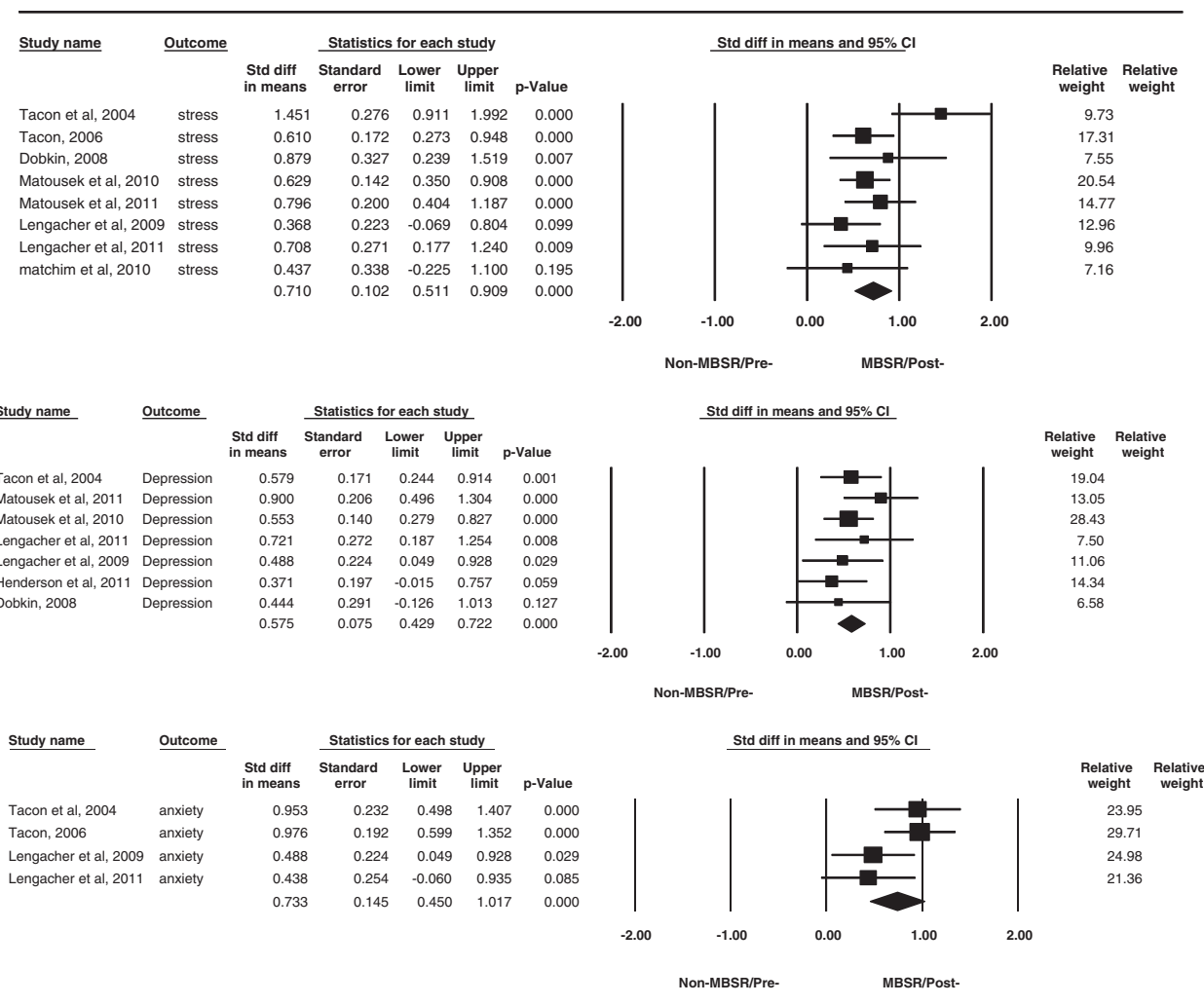


Figure 3. Effects of mindfulness-based stress reduction (MBSR) on stress, depression and anxiety in breast cancer patients

on mental health benefits of MBSR among medical patients found a medium effect size. Of the 10 studies they analysed, seven were RCTs ($d=0.54$) and three had a quasi-experimental design ($d=0.50$).

There were only four studies that reported data on anxiety, with overall effect size of 0.733 ($d=0.488$ for one RCT, $d=0.816$ for the non-randomised studies) in our study. Integrating MBSR in the treatment of breast cancer patients is more effective than usual care in reducing anxiety. The reduction in anxiety and promoting a shift towards an internal locus of control in women with breast cancer would have the effect of empowerment, which is known to be associated with better health outcomes [55].

Our findings support the evidence of significant efficacy of MBSR on alleviating stress, depression and anxiety in patients with breast cancer. The overall effect size is moderate to large. This is consistent with the findings by Matchim *et al.* [41], who reported large effect sizes for anxiety and perceived stress in breast cancer patients. It is possible that MBSR helps improve mental health by reducing rumination past events and worry about the future in women with breast cancer. Rumination is defined as a coping response to negative mood involving self-focused attention, and the ruminative response style has been found to predict new onset of major depressive episode [59,60]; therefore, decreased rumination would be protective against depression. MBSR reduces rumination and improves symptoms of depression in patients with mood disorders [61]. The reduction of rumination after MBSR was also found in women with cancer [62].

There are other possible factors that may explain the impact of MBSR. The levels of distress, depression and anxiety at baseline among the participants in included studies were high and had decreased significantly post-intervention. Low initial scores of perceived stress were not significantly different post-MBSR [54]. The majority of participants studied were highly educated Caucasians, and attitudes toward the intervention itself may have influenced the improvement in mental health. Speca *et al.* [27] found that the degree of adherence to the programme and the length of practice time significantly predicted change scores of mood disturbance and symptoms of stress.

The effect size for randomised studies tends to be slightly larger than the findings in previous meta-analyses of MBSR on chronic illnesses. However, this meta-analysis is limited by the very small number of eligible randomised studies and *small sample size, which may produce biased results and statistical type I error*. Therefore, the conclusion that MBSR has good efficacy must be interpreted with caution. In fact, the effect size is so large for the non-randomised studies of MBSR in breast

cancer population when it was analysed separately. Non-randomised trials are at risk of selection bias, where individuals seeking help are more likely to participate in the intervention with positive expectations of it. Another limitation was the probable non-inclusion of some studies because of inadequate data reported and unpublished undetected studies, which may have been overcome by direct contact with primary authors. However, publication bias assessment by using 'Trim and Fill' estimated two missing studies on the right side of the funnel plot, indicating that the effect size is even larger if these are taken into account (imputed $d=0.796$) for stress.

These findings cannot be generalised to all breast cancer patients because larger studies more representative of the population of women with breast cancer are needed, for example, in non-Caucasians and those with a lower level of education. One study of MBSR in a multi-ethnic population of low-income women with abnormal pap smears had a very high attrition rate (84%) even though there was a significant improvement in anxiety in this group [63]. Similarly in common with previous reviews and meta-analyses, methodological inconsistency, poor data reporting, inconsistency in the qualifications of the trainers/facilitators and inadequate statistical power are among other limitations of this meta-analysis. It is clear that there is a need for adequately powered RCTs [64], to be carried out not only to examine the impact of MBSR on negative aspects of mental health but also to measure the positive outcomes of MBSR in women with breast cancer such as enhancement of vitality, resilience, self-confidence and positive mood.

Conclusions

Despite the limitations of this systematic review and meta-analysis, we have found a positive, moderate-to-large effect size of MBSR in reducing perceived stress, depression and anxiety in women with breast cancer. The improvement in overall mental health in breast cancer patients following MBSR could arise from a variety of benefits associated with the training. Therefore, MBSR can be recommended to breast cancer patients as an option as part of their rehabilitation to help maintain a better quality of life in the longer term.

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