

Mindfulness-Based Stress Reduction as a Stress Management Intervention for Cancer Care: A Systematic Review

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Abstract

Cancer is acknowledged as a source of stress for many individuals, often leading to suffering, which can be long-lasting. Mindfulness-based stress reduction offers an effective way of reducing stress among cancer patients by combining mindfulness meditation and yoga in an 8-week training program. The purpose of this study was to inspect studies from October 2009 to November 2015 and examine whether mindfulness-based stress reduction can be utilized as a viable method for managing stress among cancer patients. A systematic search from Medline, CINAHL, and Alt HealthWatch databases was conducted for quantitative articles involving mindfulness-based stress reduction interventions targeting cancer patients. A total of 13 articles met the inclusion criteria. Of these 13 studies, 9 demonstrated positive changes in either psychological or physiological outcomes related to anxiety and/or stress, with 4 describing mixed results. Despite the limitations, mindfulness-based stress reduction appears to be promising for stress management among cancer patients.

Keywords

mindfulness-based stress reduction, mind-body interventions, stress, anxiety, cancer

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Cancer is widely acknowledged as a significant source of stress for individuals who receive a cancer diagnosis, with initial cancer diagnoses and subsequent associated experiences often leading to the development of distress, including depression and anxiety.¹⁻³ In fact, one study discovered almost half of patients with cancer report the emotional effects of cancer as being more difficult to process than physical or practical effects⁴ and many outcomes such as sleep disturbances tend to even last among cancer patients for years after the end of treatment.⁵⁻⁷ Existing studies have found that disease-related distress across multiple types of cancer, including breast, colorectal, prostate, leukemia, and lymphoma, is related to psychosocial adjustment and quality of life.⁸⁻¹¹

Because of advancements in detection and treatment, an increasing number of cancer patients are surviving long term, heightening the need for psychosocial interventions aimed at decreasing stress among cancer patients. Various methods such as support groups,^{12,13} psychoeducation,^{14,15} and physical activity^{16,17} have been found to help manage and disrupt the negative effects of cancer-related stressors. One stress management technique that has shown great potential in multiple populations is the concept of mindfulness, which originally has its origins in Buddhism and can be found in the *Abhidhamma* and the *Visuddhimagga*, a summary of the portion that deals with

meditation. Kabat-Zinn¹⁸ defined mindfulness as a moment-to-moment awareness, which is cultivated by intentionally paying attention to the present moment, with an attitude of acceptance and openness, lacking judgment, and striving.^{19,20} This state of mind allows an individual to experience thoughts and feelings in a way that accentuates their subjectivity and transient nature.²¹ Mindfulness has been associated with increased health outcomes in both clinical and nonclinical populations, many of which are often related to cancer diagnoses, treatment, and recovery. In fact, Kabat-Zinn reported improvements in pain, body image, activity levels, medical symptoms, mood, affect, somatization, anxiety, depression, and self-esteem.²² As seen in other studies, benefits of mindfulness range from helping clinical populations cope with chronic pain,²² fatigue,²³ stress reduction,^{24,25}

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various forms of cancer,²⁶ heart disease,²⁷ type-2 diabetes,²⁸ psoriasis,²⁹ and insomnia.³⁰

Mindfulness-based stress reduction (MBSR)¹⁹ is a frequently cited example of mindfulness training that has been widely used in clinical and nonclinical settings and has shown to possess the potential to decrease stress and depression. MBSR programs have been researched extensively and reported positive results in clinical and nonclinical populations, including cancer patients,³¹⁻³⁴ mixed illness populations,³⁵⁻³⁷ health care professionals,³⁸ continuing education students,³⁹ and college undergraduates.⁴⁰ MBSR teaches individuals to perceive circumstances and thoughts in a nonjudgmental manner without reacting to them thoughtlessly and helps people to develop a more involuntary consciousness of experiences.⁴¹

Mindfulness-based stress reduction has shown positive effects on quality of life and decreased stress symptoms in patients with varying cancer diagnoses.⁴² MBSR contains a theory that intention, attention, and attitude, the 3 pillars of mindfulness, lead to *reperceiving*, or a shift that allows us to be deeply with our experience as opposed to covering it with conscious or unconscious interpretation,⁴³ an idea that is extremely significant with regard to cancer care. Moment to moment awareness is meaningful for many cancer patients who often possess anxiety about the past and the future. Continuous stress may lead to unproductive rumination and worry that consumes energy, reinforces the experience of stress itself, and often fuels depression and anxiety.⁴⁴ Additionally, this exaggerated stress can challenge resilience aspects⁴⁵⁻⁴⁷ such as hope,⁴⁸ which is of great importance in cancer experiences.

Mindfulness-based stress reduction sessions include training on mindfulness practices that are body scanning, meditation, and techniques from hatha yoga. The body scanning requires paying attention to various body parts and sensations within the body, starting from feet to head. Meditation entails focus on breathing, an awareness of the rising and falling of the abdomen, along with a “nonjudgmental awareness” of the thoughts and diversions that arise in the mind. Mindful movement is based on techniques (asanas) of Hatha yoga, and involves moving the body using a series of physical postures that help with strength, balance, flexibility, and awareness of the body. While performing these exercises, when thoughts deviate the mind, an effort is made to return to the task at hand. Participants are also instructed to practice a sense of informal awareness on emotions, thoughts, and cognitions that occur while performing day-to-day activities, such as walking, eating, driving, working, talking, and so on.⁴⁹ The program is based on training the mind to be aware using simple, secular (nonreligious) meditation techniques. The program helps alter one’s relationship with stressful thoughts and events by reducing reaction to everyday emotions and improving thoughtful actions.⁵⁰ From a Western paradigm, the rationale is that when individuals practice MBSR, both formally during meditation and informally in day-to-day activities, an awakening occurs.⁵¹

Mindfulness-based stress reduction techniques have demonstrated positive effects on mood, sleep, and physiological markers among cancer patients who have completed treatment. For

example, MBSR has been found to have positive effects on the moods and symptoms of stress among cancer patients both immediately following and 6 months after completing the MBSR course.^{31,33} These studies also found that breast and prostate cancer patients showed enhanced quality of life, decreased stress symptoms, improved sleep quality, and improved immune functioning when practicing MBSR post-treatment.⁵² Women with treated breast cancer reported improved sleep quality related to MBSR⁵³ and MBSR has also been related to decreased rates of prostate-specific antigen increase for patients with biochemical recurrence of prostate cancer after prostatectomy.⁵⁴

Benefits of the standardized full-length MBSR curriculum are thoroughly documented, and the time commitment is substantial. The full-length standard MBSR program is one of the most extensively researched mindfulness practices. MBSR’s standard curriculum is conducted in a structured 8-week group format, during which participants meet weekly for 2.5-hour group sessions in addition to one 6-hour daylong retreat, for a total of 26 contact hours. Unfortunately, most people do not have the time, resources, or accessibility needed to participate in extensive meditation programs.⁵⁵ Specifically among newly diagnosed cancer patients, the early treatment period is a reported time of immense stress, fatigue, feeling unwell, and lacking the ability to attend eight weekly classes and a full-day retreat. Recent research suggests that less class time may be particularly beneficial for patients with physiological distress who are unable to engage in long instructional periods.⁵⁶ However, among newly diagnosed cancer patients, the majority of studies require patients to attend classes,⁵⁷⁻⁶⁰ while only a few have examined individual delivery of MBSR to patients outside a didactic framework.⁶¹

A literature review published in 2011 examined all trials through October 2009 that had studied the effects of mindfulness-based stress reduction on stress management in cancer care.³⁴ The study summarized the results from 13 such trials and found positive effects of MBSR, though there were methodological shortcomings and the number of studies was too small. Since October 2009, several additional studies have been published in this area. Hence, the aim of this review was to examine these additional studies and assess whether MBSR can be an effective alternative and complementary approach for stress reduction in cancer care.

Questions being addressed in this review include the following: Has MBSR been found to be efficacious in decreasing stress in cancer care since the 2009 review? Are there sufficient data available to draw conclusions regarding the efficacy of MBSR in stress management among cancer patients? What are the methodological limitations of present research studies and how can these be addressed in future research? What are the common outcome measures evaluated by studies and which are more important for future studies?

Methods

A systematic review of studies involving MBSR interventions in cancer care was the method used in this study. To be included in this study

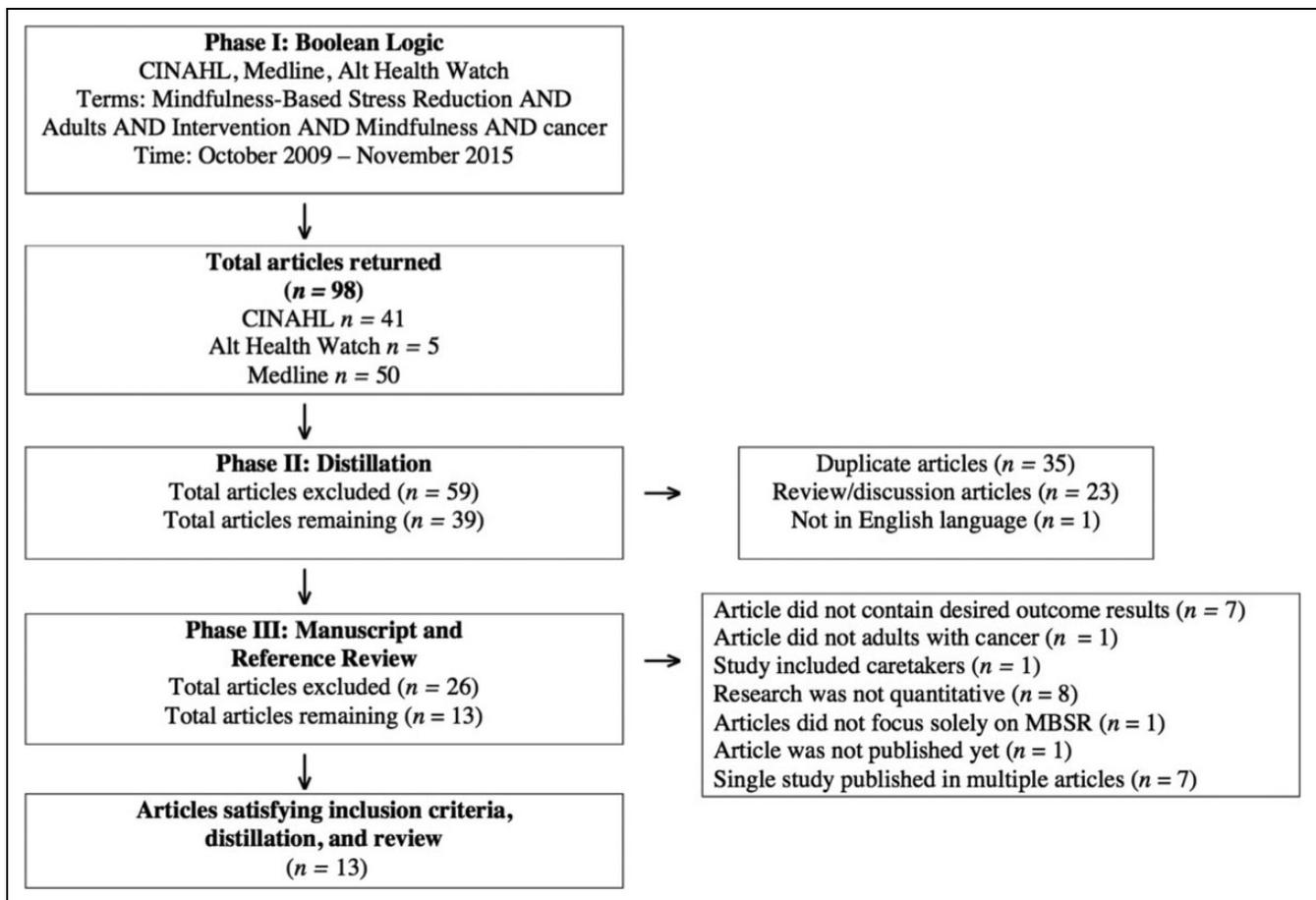


Figure 1. The 3-step data extraction process.

the article must meet the following criteria: (1) published in the English language; (2) included in following databases—CINAHL (Cumulative Index to Nursing and Allied Health), Medline, or Alt HealthWatch; (3) published between October 2009 and November 2015; (4) include any MBSR as an intervention; (5) use any quantitative study design for evaluation; (6) conducted in adults with a cancer diagnosis (older than 18 years); (7) examine outcome measures related to stress and anxiety; and (8) include evaluation results as opposed to mere description of the protocol. Articles were excluded from this review due to the following criteria: studies that (1) did not evaluate the intervention or implemented a quantitative design; (2) did not sample patients who had previously been diagnosed with cancer; (3) did not include selected outcome measures; (4) utilized other stress reduction strategies; (5) did not index in any of the following databases—CINAHL, Medline, or Alt HealthWatch; and (6) were multiple articles published about one study.

Three phases of data review were conducted for this study (Figure 1). To identify studies meeting these criteria, Medline, Alt HealthWatch, and CINAHL database searches were performed for phase I. Boolean terms used to identify studies meeting the criteria included “Mindfulness-Based Stress Reduction AND Adults AND Intervention AND Mindfulness AND Cancer” for the time period October 2009 to November 2015.

Using the above terms/phrases 98 articles were returned from Medline ($n = 50$), Alt HealthWatch ($n = 5$), and CINAHL ($n = 41$). Phase II included preliminary distillation of the articles by eliminating

duplicates ($n = 35$), review/discussion/other articles ($n = 23$), and studies not in the English language ($n = 1$). In Phase III comprising manuscript review of the remaining articles ($n = 39$), articles were eliminated that did not contain desired outcome results ($n = 7$), did not focus solely on MBSR ($n = 1$), did not involve individuals with cancer ($n = 1$), did not have quantitative results ($n = 8$), involved caretakers as well as patients ($n = 1$), and were multiple articles based on one study ($n = 7$). Hence the remaining articles ($n = 13$) satisfied the eligibility criteria.

Results

As a result of the data extraction process, 13 articles were found satisfying the eligibility criteria. Table 1 summarizes the studies, including the year of publication, authors/country where the study was performed, study design and sample size, age of participants, intervention modality, intervention dosage, outcome measures, and the salient findings. The studies are arranged by year of publication in the ascending order starting from 2009. Within a given year, studies are arranged alphabetically by the last name of the first author.

Of the 13 interventions, the majority were conducted in the United States ($n = 7$),^{63,65,67,69,70,73,74} followed by Canada ($n = 3$).^{64,66,72} One each was implemented in Sweden,⁶² Denmark,⁷¹ and the United Kingdom.⁶⁸ Of the

Table 1. Summary of Mindfulness-Based Stress Reduction Interventions for Cancer Patients October 2009 and November 2015 (n = 13).

Year	Authors/Country	Design and Sample	Age	Intervention		Outcome Measures	Salient Findings
				Modality	Dosage		
2010	Branstrom et al ^{62/} Sweden	Randomized control trial (n = 71), experimental (n = 32), and waitlist control (n = 39) sample consisting of 70 women and 1 man	51.8 ± 9.86 years, mean of 52.25 years in treatment group and 51.48 years in waitlist control group	MBSR	8 weekly 120-minute classes that included experiential and group exercises (16 hours + home practice)	<ul style="list-style-type: none"> • Five-Facet Mindfulness Questionnaire • Perceived Stress Scale • HADS • Impact of Event Scale Revised • Positive States of Mind • Coping Self-Efficacy Scale • Cortisol sampling 	<ul style="list-style-type: none"> • Significant decrease in perceived stress and posttraumatic avoidance symptoms and increased positive states of mind ($P < .05$) • Experimental group reported significant increase in Five-Facet Mindfulness Questionnaire scores compared with controls • No significant effects of mindfulness on depression and anxiety scores • No overall effects on cortisol levels at 3- or 6-month follow-up • Significant effect of moderate showing different intervention effect on awakening cortisol among those with varying cortisol baseline levels • Among those with low baseline levels of cortisol, there was an increase from baseline to 3-month follow-up • Among those with high baseline levels of cortisol there was a decrease from baseline to 3-month follow-up • No association between changes in psychological outcomes and cortisol levels
2011	Matchim et al ^{63/} United States	Quasi-experimental, pre- and posttest control group design (n = 32), experimental (n = 15) and waitlist control (n = 17), sample consisting of women diagnosed with stage 0-II	Mean of 61.47 years in treatment group and 56.87 years in TAU control group	MBSR	8-10 weekly 120-minute classes that included experiential and group exercises, at home practice 45 min/d for 6 d/wk, 7- to 8-hour silent retreat	<ul style="list-style-type: none"> • Profile of Mood States • Calgary Symptoms of Stress Inventory 	<ul style="list-style-type: none"> • Significant difference in mean systolic ($P < .05$) and diastolic ($P < .001$) blood pressure in experimental group compared with control group at 1-month follow-up

(continued)

Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
		breast cancer with a minimum of 3 months after completing active treatment				<ul style="list-style-type: none"> • Five-Facet Mindfulness Questionnaire • Heart rate, respiratory rate, blood pressure • Cortisol sampling 	<ul style="list-style-type: none"> • Mean heart rate of experimental group was significantly lower than control group at 1-month follow-up ($P < .05$) • Mean respiratory rate was significantly lower than control group at intervention completion ($P < .05$) and 1-month follow-up ($P < .01$) • No significant differences in cortisol level, mood disturbance scores, or symptoms of stress between groups at any time point • Means in mindfulness state of experimental group were significantly higher than control group postintervention ($P < .05$) and at 1-month follow-up ($P \leq .001$); significant increases in mindfulness state within intervention group postintervention ($P < .05$) and at 1-month follow-up ($P < .01$) • Significant reductions in depressive symptomatology ($P < .0001$), perceived stress ($P < .0001$), and medical symptoms ($P < .0001$) over time • Significant effect on cortisol awakening response with cortisol levels showing a prolonged increase after awakening at postintervention assessment period ($P < .05$)
2011	Matousek et al ^{64/} Canada	Pretest-posttest design ($n = 33$), sample consisted of women who had completed treatment for breast cancer	28-72 years, mean age of 55.9 ± 10.8 years	MBSR	8 weekly 150-minute classes, a 6-hour silent retreat after the sixth week (26 hours of instruction + home practice)	<ul style="list-style-type: none"> • Center for Epidemiologic Studies—Depression Scale • Medical Symptom Checklist • Perceived Stress Scale-10 • Cortisol sampling 	<ul style="list-style-type: none"> • Means in mindfulness state of experimental group were significantly higher than control group postintervention ($P < .05$) and at 1-month follow-up ($P \leq .001$); significant increases in mindfulness state within intervention group postintervention ($P < .05$) and at 1-month follow-up ($P < .01$) • Significant reductions in depressive symptomatology ($P < .0001$), perceived stress ($P < .0001$), and medical symptoms ($P < .0001$) over time • Significant effect on cortisol awakening response with cortisol levels showing a prolonged increase after awakening at postintervention assessment period ($P < .05$)

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Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
2012	Altschuler et al ^{65/} United States	Single-group descriptive pilot study (n = 23), sample consisted of oncology patients who scored ≥ 8 on HADS	31-70 years, with mean of 56 years	Audio-based MBSR	Participants asked to listen to study CDs containing MBSR instructions at least 5 days a week for 12 weeks and maintain study diaries of meditation practices (45-75 minutes per day of listening plus time for journaling)	<ul style="list-style-type: none"> HADS Profile of Mood States Functional Assessment of Cancer Functional Assessment of Chronic Illness Therapy–Spiritual 	<ul style="list-style-type: none"> Mean HADS scores declined (mean change = -6.1 points, $P < .05$) indicating less distress and drop from “severe” to “moderate” symptoms Patients reported that participation improved their mood and quality of life and helped them cope better with diagnosis and treatment
2012	Campbell et al ^{66/} Canada	Quasi-experimental design (n = 76), experimental (n = 45) and control (n = 31) group, sample consisted of female cancer patients who had completed all chemotherapy treatments except adjuvant therapy	53.21 \pm 8.93 years	MBSR	8 weekly 90-minute classes, 6-hour retreat between sixth and seventh week of program (18 hours)	<ul style="list-style-type: none"> Mindful Attention Awareness Scale Rumination-Reflection Questionnaire–Rumination Subscale Meditation Log Blood pressure 	<ul style="list-style-type: none"> Significant increases in levels of mindful attentiveness and decreased ruminative thinking, but no difference in blood pressure when compared with controls When assigned to “higher BP” and “lower BP” conditions based on mean BP values at week 1, “higher BP” participants had lower systolic blood pressure at week 8 relative to control group
2012	Henderson et al ^{67/} United States	Randomized control trial (n = 172), MBSR (n = 53), NEP (nutrition education program) (n = 52), and UC (n = 58), sample consisted of women diagnosed with stage I or II breast cancer within the previous 2 years	20-65 years (mean age 49.8 \pm 8.4 years)	MBSR, nutrition education	7 weekly 2.5- to 3.5-hour classes, one 7.5-hour silent retreat, 3 monthly 2.5-hour sessions for BRIDGES-only participants following completion of MBSR	<ul style="list-style-type: none"> Functional Assessment of Cancer Therapy Beck Depression Inventory-I Beck Anxiety Inventory Symptom Checklist-90–Revised Rosenberg Self-Esteem Scale UCLA Loneliness Scale Mental Adjustment to Cancer Scale 	<ul style="list-style-type: none"> Significant effects of MBSR on primary measures of quality of life and coping outcomes compared with NEP, UC, or both ($P < .05$) Significant between-group contrasts favored MBSR group at 4 months and included meaningfulness, depression, paranoid ideation, hostility, anxiety, unhappiness, and emotional control ($P < .05$). However, significant results were not maintained at 12 months, with the exception of spirituality

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Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
2012	Hoffman et al ^{68/} United Kingdom	Randomized controlled design (n = 229), experimental group (MBSR + UC) (n = 114) and waitlist control group (UC) (n = 115), sample consisted of women diagnosed with stage 0-III breast cancer, within 2 months, 2 years after completion of surgery and adjuvant radiation ± chemotherapy	18-80 years old, experimental group had mean age of 49.0 ± 9.26 years, control group had mean age of 50.1 ± 9.14 years	MBSR	8 weekly 2-hour classes (first and eighth class were 2.25 hours), one 6-hour silent retreat in the sixth week, at home practice 40-45 min/d for 6-7 d/wk (22.5 hours + home practice)	<ul style="list-style-type: none"> • Sense of Coherence Scale • Courtauld Emotional Control Scale • Profile of Mood States • Functional Assessment of Cancer Therapy–Breast (FACT-B) • Functional Assessment of Cancer Therapy–Endocrine Symptoms (FACT-ES) • World Health Organization Five-Item Well-being Questionnaire (WHO-5) 	<ul style="list-style-type: none"> • Significant differences at 8 and 12 weeks between groups for Profile of Mood States total mood disturbance, anxiety, depression (8 weeks only), anger (12 weeks only), vigor, fatigue, and confusion (8 weeks only), FACT-B, FACT-ES, and WHO-5
2012	Lengacher et al ^{69/} United States	Two-armed randomized controlled design with randomization stratified by stage of cancer (0-III) and treatment received (radiation therapy vs radiation therapy and chemotherapy). experimental group (MBSR + UC) (n = 41) and waitlist control group (UC) (n = 43), sample consisted of patients diagnosed with stage 0-III breast cancer who received lumpectomy and adjuvant radiation ± chemotherapy	Patients (n = 84) had mean age of 58 ± 9 years, 27.4% were 65 years of age or older	MBSR (Breast Cancer)	6 weekly 120-minute classes (12 hours of instruction + home practice)	<ul style="list-style-type: none"> • Intracellular Immunostaining (estimate of number of Th1 and Th2 cells) • Four-color flow symmetry (percentage of lymphocyte subsets) 	<ul style="list-style-type: none"> • Significant decrease in the mean percentage of activated T cells in the control group compared with slight increase in experimental group (P = .002) • Significant reduction in the mean Th1/Th2 ratio in the control group not observed in experimental group (P = .03)

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Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
2012	Lerman et al ^{70/} United States	Randomized controlled study design (n = 68), experimental (n = 48), waitlist control (n = 20), sample consisted of female cancer patients who had completed treatment	Experimental group had mean age of 57.5 ± 10.5 years, control group had mean age of 56.4 ± 9.8 years	MBSR	8 weekly 120-minute classes, a 4-hour silent retreat during the sixth week, at home practice 7 d/wk, 45 min/d (20 hours of instruction + home practice)	<ul style="list-style-type: none"> European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Symptoms of Stress Inventory Symptoms Checklist-90-Revised (SCL-90-R) 	<ul style="list-style-type: none"> Significant increases in quality of life measures (P = .005), 6 of the 8 symptoms of stress scores (P ≤ .049), and on both SCL-90-R subscales (P ≤ .0234)
2013	Andersen et al ^{71/} Denmark	Randomized controlled trial (n = 336), experimental (n = 168), and TAU control (n = 168), sample consisted of women operated on for breast cancer state I-III 3-18 months previously	18-75 years, mean of 53.9 ± 10.1 years in treatment group and 54.4 ± 10.5 years in TAU control group	MBSR	8 weekly 120-minute sessions, 5-hour silent retreat after seventh week of program (21 hours of instruction + home practice)	<ul style="list-style-type: none"> Medical Outcome Study Sleep Scale Symptom Checklist-90-Revised Hot Flush Score Center for Epidemiological Studies—Depression Scale 	<ul style="list-style-type: none"> Improvements reported in sleep quality at all follow-up times in both groups, although only significant postintervention (P = .03) Significant between-group differences in somnolence between baseline and 6-month follow-up (P = .02) Significant differences between groups in levels of anxiety (P = .0002) and depression (P = .0367) after 12 months Participants with higher levels of baseline anxiety and depression showed significantly greater decrease in intervention group throughout follow-up and no differences among least affected participants
2013	Garland et al ^{72/} Canada	Pretest-posttest design (n = 268)	26-78 years (mean age 53.50 ± 10.59 years)	MBSR	8 weekly classes, 6-hour silent retreat	<ul style="list-style-type: none"> Mindful Attention Awareness Scale Five-Facet Mindfulness Questionnaire 	<ul style="list-style-type: none"> Levels of mindfulness increased significantly over the course of the program (P < .001) Significant improvements found in scores for stress and mood outcomes

(continued)

Table 1. (continued)

Year	Authors/Country	Design and Sample	Age	Intervention Modality	Intervention Dosage	Outcome Measures	Salient Findings
2014	Lengacher et al ^{73/} United States	Two-armed randomized controlled study design (n = 142), experimental (MBSR + UC) (n = 74), waitlist control (UC) (n = 68), sample consisted of women who had been diagnosed with stage 0-III breast cancer, received treatment with a lumpectomy and/or mastectomy, and completed adjuvant radiation therapy or radiation therapy and chemotherapy at least 2 weeks prior to enrollment	Mean age of 55.31 ± 9.84 years, experimental group had mean age of 55.42 ± 10.49 years, control group had mean age of 55.19 ± 9.15 years	MBSR (Breast Cancer)	6 weekly 120-minute classes, at home practice 15-45 min/d, 7 d/wk (12 hours of instruction + home practice)	<ul style="list-style-type: none"> • Calgary Symptoms of Stress Inventory • Profile of Mood States • Telomerase activity • Telomere length • Concerns About Recurrence Scale • Center for Epidemiological Studies—Depression Scale • State-Trait Anxiety Scale • Perceived Stress Scale • Cognitive and Affective Mindfulness Scale—Revised 	<ul style="list-style-type: none"> • Telomerase activity increased steadily over 12 weeks in experimental group compared with essentially no increase in control ($P < .01$) • No between-group difference observed for telomerase length
2014	Reich et al ^{74/} United States	Two-armed randomized controlled study design (n = 41), experimental (MBSR + UC) (n = 17), waitlist control (UC) (n = 24), sample consisted of women who had been diagnosed with stage 0-III breast cancer and completed adjuvant radiation therapy or chemotherapy 2-12 weeks prior to enrollment	Experimental group had mean age of 58.0 ± 10.3 years, control group had mean age of 58.2 ± 9.5 years	MBSR (Breast Cancer)	6 weekly 120-minute classes, at home practice 15-45 minutes daily, 7 d/wk (12 hours of instruction + home practice)	<ul style="list-style-type: none"> • MD Anderson Symptom Inventory • Peripheral blood lymphocytes 	<ul style="list-style-type: none"> • Symptom cluster scores tended to go down across both groups, but were only significant for the fatigue cluster ($P = .003$) and in the gastrointestinal cluster ($P = .035$) • Multiple baseline biomarkers were significantly positively related to 6-week symptom improvement

Abbreviations: BRIDGES, Breast Research Initiative for Determining Effective Strategies for Coping with Breast Cancer Study; HADS, Hospital Anxiety and Depression Scale; MBSR, mindfulness-based stress reduction; TAU, treatment as usual; UC, usual care.

13 interventions, 8 were randomized controlled designs,^{62,67-71,73,74} 2 used quasi experimental designs,^{63,66} and 3 used pretest posttest design.^{64,65,72} The mean sample size calculated for all 13 studies in this review was 121.15 with a range of 23 to 336. Total sample sizes (n) were typically between 40 to 200 with 3 studies⁶³⁻⁶⁵ having sample sizes less than 40 and 3 studies^{68,71,72} having sample sizes more than 200. The samples with which the MBSR interventions for stress management were conducted were in patients with breast cancer (n = 8) and a variety of cancer types (n = 5).^{62,65,66,70,72}

The duration of MBSR interventions varied from 12 to 26 hours plus home practice. One pilot study did not utilize traditional MBSR practices, but rather utilized CDs containing MBSR instructions for cancer patients, where participants listened to the CDs and maintained study diaries of meditation practices.⁶⁵ The mode of duration was 8 weeks (n = 8). The most common outcome measure was a score on the Profile of Mood States, which was utilized by 4 studies.^{63,65,68,72} Other common measures used were the Five-Facet Mindfulness Questionnaire,^{62,63,72} the Perceived Stress Scale,^{62,64,73} the Functional Assessment of Cancer Therapy,^{65,67,68} and the Symptoms Checklist-90-Revised.^{67,70,71} Psychological outcome measures alone were used by 6 studies^{65,67,68,70,71,72} while physiological outcome measures alone were used by 2 studies.^{69,74} Physiological outcomes measures were examined along with psychological measures by 5 interventions^{62-64,66,73} and included heart rate variability, respiratory rate, blood pressure, salivary cortisol, telomerase activity, telomere length, and peripheral blood lymphocytes.

Discussion

The aim of this review was to look studies published from October 2009 to November 2015 and examine whether MBSR can be an alternative and complementary therapeutic approach for stress reduction among cancer patients. A total of 13 studies met the inclusion criteria. The first question that this review addressed was, *Has mindfulness-based stress reduction been found to be efficacious in decreasing stress in otherwise healthy individuals since the 2008 review?* From the 13 studies, a majority (n = 9) demonstrated positive changes in psychological or physiological outcome measures related to stress,⁶⁴⁻⁷² while 4 studies had mixed results.^{62,63,73,74} These findings are in consonance with the previous review published in 2009 that found positive results. Of the 9 studies that have shown positive results, 5 used randomized controlled designs.⁶⁷⁻⁷¹ This type of design is considered the most rigorous design type, as it utilizes pretests and posttests, randomizes the participants or the participant group into a control and an experimental group, and minimizes potential threats to internal and external validity. In this design, changes in pretest and posttest scores can be contrasted by levels of intervention.

While pretest posttest design is the least costly and the simplest to conduct, this design is unable to minimize threats to internal validity such as maturation and history because of the lack of a control group for comparison. Without having a

control group, the findings from these studies must be interpreted with caution. Future studies should utilize the more robust randomized control design or, when it is not feasible, the group randomized control design.

The second and third questions this review examined were: *Are there sufficient data available to draw conclusions regarding the efficacy of mindfulness-based stress reduction in stress management among cancer patients?* and *What are the methodological limitations of present research studies and how can these be addressed in future research?* The review looked at 13 studies of which 8 were randomized controlled designs. Based on these studies, certain conclusions can be made but limitations need to be continually considered.

Apart from the design type, several other limitations should be examined while deciphering the efficacy of MBSR in stress management among cancer patients. The majority of included studies were conducted in patients who had recently received a breast cancer diagnosis.^{63,64,67-69,71,73,74} This could result in potential lack of generalizability biases that reduce the significance of examined findings to patients with other types of cancer diagnoses. The main methodological shortcomings were small sample size, self-selection, lack of generalizability, and the impracticality of conducting meditation studies under a double blind condition. However, all the reviewed studies provided significant results in the same direction, emphasizing the nonspecific and potentially specific effect of MBSR for stress reduction among cancer patients.

A second limitation is the administration of self-rated scales, which could be influenced by social desirability. A third limitation was that participants were most often Caucasian females, limiting the generalizability to minority populations, and enhancing the necessity of further research in more diverse populations. An important final limitation is the differing durations of the studies and partially differing study designs, which could influence final values. However, apart from the adapted version for the participants who listened to CDs at home and journaled their meditation experiences, MBSR techniques, programs, and lessons with home practice were not drastically different across the studies.

The sample sizes in this review were relatively small, with only 3 studies having a sample size more than 200. Power calculations and sample size justifications are generally missing from most of the reviewed studies. There have been no large-scale, longitudinal studies that have been conducted with this research problem; therefore, future research should look at the possibility of conducting large scale, longitudinal studies. If the customary MBSR program is going to be modified for shorter duration interventions, a shortened version should be standardized specifically for cancer patients who are dealing with many physiological and psychological restraints.

The final question that this review aimed to answer was, *What are the common outcome measures measured by studies and which ones are more important for future studies?* Both psychological and physiological measures were used alone by the studies though the combination of psychological and physiological measures were most frequently used by the majority

of studies. The most common outcome measure was a mood disturbance score, which was utilized by 4 studies and was measured mainly by Profile of Mood States.⁷⁵ Physiological measures that can be used by future studies are heart rate (and its variability), blood pressure, and, if possible, salivary cortisol.

Conclusions

As cancer rates continue to increase along with diagnosis-related distress, the need for stress reduction techniques among cancer patients remains a critical concern and MBSR serves as a promising stress reduction technique. A total of 13 interventions from October 2009 to November 2015 looked at MBSR and its efficacy in decreasing stress in individuals with a new cancer diagnosis or having received cancer treatment. Of these reviewed studies, all 13 interventions were able to find some positive effects in psychological or physiological outcome measures related to stress, even in those studies that displayed both positive and negative outcomes. Despite the limitations of not all studies using randomized controlled design, having smaller sample sizes, lacking generalizability, and having different outcome measures, MBSR is a promising modality for stress management among cancer patients. All practitioners working with individuals with a new or recurrent cancer diagnosis, or patients after treatment, must include MBSR as one of the approaches for stress reduction as part of cancer care.

Author Contributions

SER and MS conceptualized the study, developed the inclusion criteria, collected the data, developed the table, analyzed the data, and prepared the manuscript.

Declaration of Conflicting Interests

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Ethical Approval

This study did not warrant institutional review board review as no human subjects were involved.

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