Psycho-Oncology
Psycho-Oncology **18**: 571–579 (2009)
Published online 20 November 2008 in Wiley InterScience (www.interscience.wiley.com). **DOI**: 10.1002/pon.1400

Review

Mindfulness-based stress reduction and cancer: a meta-analysis

Dianne Ledesma and Hiroaki Kumano*
[1]*Department of Stress Science and Psychosomatic Medicine, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan*

**Correspondence to: Department of Stress Science and Psychosomatic Medicine, Graduate School of Medicine, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8655, Japan. E-mail: hikumano-tky@umin.ac.jp*

Received: 20 September 2007
Revised: 12 March 2008
Accepted: 1 May 2008

Abstract

***Objective*: This meta-analysis was conducted to investigate the effects of mindfulness-based stress reduction (MBSR) on the mental and physical health status of various cancer patients.**

***Methods*: Ten studies (randomized-controlled trials and observational studies) were found to be eligible for meta-analysis. Individual study results were categorized into mental and physical variables and Cohen's effect size *d* was computed for each category.**

***Results*: MBSR may indeed be helpful for the mental health of cancer patients (Cohen's effect size $d = 0.48$); however, more research is needed to show convincing evidence of the effect on physical health (Cohen's effect size $d = 0.18$).**

***Conclusion*: The results suggest that MBSR may improve cancer patients' psychosocial adjustment to their disease.**

Keywords: cancer; oncology; effect size; meta-analysis; mindfulness meditation

Introduction

The diagnosis of an illness like cancer results in a complex set of physical and psychological issues that in turn may contribute to depression and anxiety in patients [1]. Twenty to twenty-five percent of cancer patients are thought to have major depression and the greater the physical disability and pain due to cancer, the more frequent the depressive symptoms and syndromes [2,3]. Other illness sequelae, such as post-surgery cancer-related fatigue due to chemotherapy or radiotherapy, and sleep disturbance have also been widely reported [4,5].

Psychosocial oncologic interventions have proven largely effective in improving the quality of life and coping abilities of cancer patients, and in reducing their emotional distress and feelings of isolation [6–9].

Among these psychosocial interventions, mindfulness meditation has shown some efficacy in promoting relaxation and reducing psychological stress. Mindfulness, based on Buddhist meditation, refers to a 'particular way of paying attention', or a 'moment-to-moment awareness', where the subject remains non-judgmental and accepting of the different sensations, thoughts, and perceptions that cross one's mind [10]. It has similarly been described as the non-judgmental observation of the ongoing stream of internal and external stimuli as they arise [11]. An operational working definition of mindfulness offered by Jon Kabat-Zinn is that it is 'the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment' [12]. The most commonly cited method of mindfulness training used in clinical populations is the mindfulness-based stress reduction (MBSR) program developed by Kabat-Zinn and colleagues [10]. The MBSR program, offered by the Center for Mindfulness in Medicine, Health Care, and Society at the University of Massachusetts Medical Center, is a structured, group-formatted, 8–10 week course that patients attend once a week for an average of 2 and a half hours, with homework assignment of 45 min per day, 6 days a week, and a whole-day session within the training period [10,13]. The main components of the program involve three mindfulness meditation practices that include the body scan, which involves 'sweeping' through the body mentally from feet to head; mindfulness of breath and other perceptions; and Hatha yoga postures, designed to develop mindfulness during movement [13].

Various literatures have already described the efficacy of MBSR on different patient populations, citing reduced pain, distress and anxiety, and improved mood [13–16]. Several reviews of the efficacy of MBSR on patient populations have also been published [11,17–23]. Bishop [17], in his review, while noting the inadequacy of available literature on MBSR-based interventions and the inherent methodological problems in many of the published data, concluded that MBSR holds some promise as a behavioral intervention [17]. Similarly, Baer [11] concluded that mindfulness-based interventions may alleviate a variety of mental health problems for a variety of patients and non-patients, and improve psychological functioning [11]. A meta-analytic review conducted by Grossman *et al.* [18] showed that MBSR as a behavioral intervention for different patient and non-patient populations has a moderate effect in helping a broad range of individuals cope with their clinical and non-clinical problems [18]. Finally, a non-meta-analytic, systematic review by Kabat-Zinn [15] underscored the health promoting effects of MBSR in complementing conventional biomedical treatment as a comprehensive healing approach for cancer patients [19].

Yet despite the fact that several reviews have been published, none have given any empirical basis for determining the efficacy of MBSR on cancer patients alone. This study, therefore, through a formal meta-analytic approach, aims to establish a quantitative assessment of the health benefits that may be derived by cancer patients after undergoing an MBSR intervention, and add weight to current literature on cancer and mindfulness that could not be provided by previous studies.

Methods

The following criteria were required for inclusion in the meta-analysis: (1) must involve the use of MBSR intervention as a psychosocial intervention for a period of 6–15 weeks, (2) must involve cancer patients of any age, gender, or stage of disease, (3) must report at least one quantitative outcome measure (physical or mental health measure), (4) must be in English, (5) must have been published in or prior to 2007.

An electronic search using the following databases was done: Medline, Science Direct, Dissertation Abstracts International, PsychInfo, PsychLit, Web of Science, CINAHL, and the Cochrane Library. The following keywords were used: *mindful*, insight meditation, Vipassana, mindfulness-based, cancer, neoplasm, lymphoma, sarcoma, and carcinoma*. Although our criteria necessitated publications to be written in English, publications done in other countries, or published in other languages but with abstracts at least written in English, were also searched. All retrieved studies and their cited references were inspected to ensure no studies were missed. Studies included in eight mindfulness meditation reviews that were retrieved were also checked. For conference presentations, the first authors of studies marked for inclusion were contacted and copies of their published or in-press manuscripts were received. We also inquired of the authors of any ongoing research and unpublished material.

Coding of descriptive factors of eligible studies was done by the first author (D. L.), which was then verified by the second author (H. K.).

The effect of MBSR on health status measures was separated into physical health and mental health subgroups. Data from standardized and validated scales with established internal consistencies were included. Under the 'mental health' subgroup, scales measuring anxiety, depression, stress, and the psychological components of quality of life were included. Under 'physical health', physical parameters and symptoms (e.g. levels of immunity, dietary fat, hormonal indices), and the physical component of self-report questionnaires (e.g. cardiopulmonary, gastrointestinal, or central or neurologic symptoms) were included. To assure uniformity, only immediate, post-intervention data (after a 6–15 week course) were used to calculate the effect size. For studies that collected data on a series of time points, only the data from the first time point (immediately post-intervention) were used. All data were then entered into a Microsoft Excel® spreadsheet, with one spreadsheet for effect size calculations and another for study descriptors. All decisions regarding the inclusion and computation of data were agreed upon by both authors (D. L. and H. K.).

To calculate Cohen's d effect size, formulas provided by Wilson and Lipsey were followed [24]. The effect size was initially calculated by getting the difference between the means (for randomized studies the difference between the intervention and control groups; for observational studies the difference between post-treatment and pre-treatment scores), and dividing the difference by their respective pooled standard deviations. In calculating the final effect size in randomized-controlled studies, the difference between the computed post-treatment effect size and pre-treatment effect size per health measure per study group was determined since the patients' baseline values could have varied among studies [18]. To reduce the bias of one study contributing many effect sizes to the total calculations, effect sizes computed from different scales within one study were averaged under two constructs: mental health and physical health [24]. Each study then contributed only one average effect size under mental health, and under physical health. In conducting the within-group analysis of observational studies (post-treatment versus pretreatment scores), a global estimation of $r = 0.7$ was used as the correlation between scores, since correlation coefficients could not be determined for all scales [18]. All effect sizes were then corrected for small sample bias [24].

The resultant average effect sizes were aggregated across studies by computing for a mean effect size weighted by the number of subjects, with

DOI. 10.1002/pon

Table 1. Descriptive factors of included studies

Author	Year	N[a]	Mean age (years)	Type of cancer	Status of cancer	Treatment status	Concurrent treatment	Type and duration of mindfulness training	Outcome measures
RCT:									
Herbert *et al.*	2001	157	50	Breast	Mixed[b]	Eighty-seven in active treatment	Chemotherapy, radiation, tamoxifen	15 weeks (based on UM-SRC program)	PHY: body mass; 7DDR-dietary fat, complex carbohydrates, fiber
Monti *et al.*	2005	93	53.6	Breast, gynecologic, hematologic, neurologic, rectal, other	Mixed	Seventy-four in active treatment	Chemotherapy, radiation, treatment for side effects or other outpatient cancer-related procedures	8-week MBAT (2 and 1/2 h/session)	PSY: distress, QOL (SCL-90-R, SF-36 mental health component), PHY: SF-36 physical health components
Shapiro *et al.*	2003	41	57	Breast	In remission	Within two-year post-treatment	Not specified	6 weeks (2-h sessions), one 6-h silent retreat	PSY: sleep latency, quality of sleep, feelings upon awakening, total sleep; QOL, psychological distress (POMS), sense of control (SCI), anxiety (STATE), depression (BDI), sense of coherence (SOC), worry (PENN)
Speca *et al.*	2000	90	50.8	Breast, ovarian, prostate, NHL, melanoma, endometrial, colon, cervical, other	Mixed	Not specified	Not specified	7-week MBSR program (90 min per session)	PSY: mood (POMS), stress (SOSI mental health component), PHY: SOSI physical health components
Non-RCT:									
Carlson *et al.*[c]	2003	42	54.5	Breast, prostate	Mixed	At least 3 months post-surgery; not currently being treated with chemotherapy, radiation, or hormone therapy (except tamoxifen/goserelin)	Eighteen patients using tamoxifen	8-week MBSR program (90 min/session); 3-h silent retreat at week 6/7	PSY: QOL (EORTC QLQ-C30) mood (POMS), stress (SOSI mental health components), PHY: counts of lymphocytes, WBC, natural killer cells, B cells, T cells
Carlson *et al.*[c]	2004	42	54.5	Breast, prostate	Mixed	At least 3 months post-surgery; not currently being treated with chemotherapy, radiation, or hormone therapy (except tamoxifen/goserelin)	Tamoxifen/goserelin	8-week MBSR program (90 min/session); 3-h silent retreat at week 6/7	PHY: cortisol, melatonin, DHEAS
Carlson *et al.*	2005	63	54	Breast, prostate, ovarian, NHL	Mixed	Not specified	Not specified	8-week MBSR program (90 min/session); 3-h silent retreat at week 6	PSY: sleep (PSQI), stress (SOSI mental health components), mood and fatigue (POMS) PHY: SOSI physical health components
Garland *et al.*	2007	60	52.17	Breast, prostate, colorectal, lung, ear/nose/throat, brain, skin, lymphatic, other	Not specified		Not specified	8-week MBSR program (90 min/session); 3-h silent retreat at week 6/7	PSY: post-traumatic growth (PTGI-R); spirituality (FACIT-Sp); stress (SOSI mental health components), mood (POMS) PHY: SOSI physical health components

DOI. 10.1002/pon

Table 1. (*Continued*)

Author	Year	N[a]	Mean age (years)	Type of cancer	Status of cancer	Treatment status	Concurrent treatment	Type and duration of mindfulness training	Outcome measures
Saxe *et al.*	2001	10	67.4	Prostate	Nine in remission	Post-radical prostatectomy	Not specified	12 weekly classes of 3–4 h each (based on UM-SRC program)	PHY: rate of PSA increase and doubling time
Tacon *et al.*	2005	27	53.3	Breast	Mixed	In active treatment	Three patients undergoing radiation or chemotherapy, or surgery; 24 patients taking oral medication	8-week MBSR program-UM (once a week, 90 min/session)	PSY: mental adjustment (MAC) and health locus of control (MHLC)

RCT, randomized, controlled trials; non-RCT, non-randomized, controlled trials; NHL-non-Hodgkin's lymphoma; MBSR, mindfulness-based stress reduction; MBAT, mindfulness-based art therapy; UM-SRC, University of Massachussetts Stress Reduction Clinic; PSY, psychological measures; PHY, physical measures; 7DDR, 7-day diet recall; QOL, quality of life; SCL-90-R, Symptoms Checklist Revised; SF-36, Medical Outcomes Study Short-Form Health Survey; POMS, Profile of Mood States; SOSI, Symtpoms of Stress Inventory; SCI, Shapiro Control Inventory; STATE, Speilberger State Anxiety Inventory; BDI, Beck Depression Inventory; SOC, Sense of Coherence; PENN, Penn State Worry Questionnaire; DHEAS, Dehydroepiandrosterone sulfate; PSQI, Pittsburgh Sleep Quality Index; PTGI-R, Post-Traumatic Growth Inventory-Revised, FACIT-Sp, Functional Assessment of Chronic Illness Therapy—Spiritual Well-Being; PSA, Prostate-Specific Antigen; MAC, Mental Adjustment to Cancer, MHLC, Mental Health Locus of Control.

[a]Patients who completed post-assessment.

[b]Patients either with active disease or in remission.

[c]Same subjects used.

confidence intervals and the computation of a z score calculated based on this mean and its standard error. Homogeneity testing was done to determine if all the effect sizes estimated the same population effect size, and a file-drawer test conducted where appropriate to determine publication bias. Four sets of mean effect sizes were thus determined: mental health and physical health mean effect sizes for the randomized-controlled studies and observational studies.

Results

We retrieved 15 original studies that involved cancer populations, but only 10 reports, comprising 583 individuals who completed pre- and post-assessment, were included in the meta-analysis. Studies that were found but not retrieved used mindfulness meditation for non-cancer patient populations, while other studies involved non-patient populations. Among those retrieved, two were excluded since they were follow-up studies [25,26], thus outside of the required time frame for this meta-analysis. Another study reported inadequate data for the immediate post-intervention follow-up, providing more detailed data only for the one-year follow-up [27]. Another study investigated MBSR in a heterogeneous patient population, of which only 12% of the patient sample had cancer and no subgroup data were reported [14]. A fifth study was excluded since it did not utilize MBSR therapy [28]. Of the remaining eligible studies, all were published, with four being randomized, controlled, and the other six being observational.

Generally, patients had a high level of education (an average of 15 years of formal education from the studies that provided such data), and a mean age of 54.75, except for the prostate cancer patients who were generally older (mean age 67.4) (Table 1).

With 9 of the 10 eligible studies focusing on breast cancer, majority of the patients who participated were female, comprising 79% of the total cancer patient population meta-analyzed (Table 2). The modal stage of various types of cancer was Stage II, with patients either still in active disease or in remission while participating in the MBSR programs. Of the total pre-intervention patient population from seven studies that reported the breakdown of cancer staging (two studies overlapped patients), 81% of participants were in early stages (Stages 0–II), with the remaining 19% in late stages (Stages III–IV).

The mean drop-out rate for seven studies that reported such data (two studies overlapped patients) was 23%. The most frequently cited reasons for dropping out were scheduling conflicts, cancer-related treatment, and/or complications and health-related problems [29–31]. However, patients

DOI. 10.1002/pon

Table 2. Studies by type of cancer, proportion of patients by cancer stage (pre-intervention values), and drop-out rate

	Type of cancer							Stage of cancer		Drop-outs
Author	**Breast**	**Prostate**	**Hematologic**	**Gynecologic**	**Gastro-intestinal**	**Neurologic**	**Other**	**Stages 0–II**	**Stages III–IV**	**Drop-outs (%)**
Herbert *et al.*	172							172		9
Monti *et al.*	51		13	19		5	23	57	54	16
Shapiro *et al.*	63							63		35
Speca *et al.*	45	4	10	6	7		24	51	39	17
Carlson *et al.*[a]	33[b]	9[b]						59		29
Carlson *et al.*[a]	33[b]	9[b]						59		29
Carlson *et al.*	37	4	4	4			14	[c]	[c]	0
Garland	34	3			5	2	16	[c]	[c]	[c]
Saxe *et al.*		10						7	2	0
Tacon *et al.*	27							[c]	[c]	32.5
Total[d]	462	30	27	29	12	7	77	409	95	

[a]Same subjects used.
[b]Only post-intervention data;
[c]No data.
[d]Carlson *et al.*'s subjects counted only once.

Table 3. Computed mean effect sizes for mental and physical health measures

Type of study	***k***	***N***	***d***	**95% CI**	***p***
A. *Mental health measures*					
RCT	3	224	0.37	0.10–0.64	<0.003
Observational	4	192	0.5	0.39–0.62	<0.0001
Overall	7	416	0.48	0.38–0.59	<0.0001
B. *Physical health measures*					
RCT	3	340	0.17	–0.07–0.40	—
Observational	5	176	0.18	0.07–0.29	<0.0009
Overall	8	516	0.18	0.08–0.28	<0.0001

k, number of studies; *N*, number of patients; *d*, effect size; RCT, randomized, controlled studies.

with more advanced stages of cancer were not more likely to drop out than those in the earlier stages, and participants in the control group were not more likely to drop out than those in the treatment group [32]. Some studies also reported that those who dropped out had higher baseline POMS scores in depression, anger, and confusion than those who completed the study [31,32].

Mental health variables

For the mental health variables of all controlled studies, a moderate mean effect size $d = 0.37$ (95% CI .10–0.64, $p < 0.003$, two-tailed) was calculated [33]. Calculation of the Q statistic showed homogeneity of effect sizes ($\chi^2 = 5.12$, df = 2, $p = 0.0773$). These data represent a total of 224 individuals, with 116 receiving intervention (see Table 3).

For the mental health variables of all observational studies, we computed a moderate mean effect size $d = 0.50$ (95% CI .39–0.62, $p < 0.0001$, two-tailed), representing data from 192 cancer patients undergoing MBSR intervention. The Q test also showed homogeneity ($\chi^2 = -19.23$, df = 3).

The overall mental health effect size (of both controlled and observational studies) showed a moderate mean effect size $d = 0.48$ (95% CI 0.38–0.59, $p < 0.0001$, two-tailed). We also found homogeneity in the overall data ($\chi^2 = -13.34$, df = 6), thus we can assume that all the mental health effect sizes estimate the same population effect.

A file-drawer test to determine publication bias was conducted [24], and showed that 10 unpublished studies with zero effect sizes were needed to reduce the mean effect size to 0.2 (upper limit of a small effect size), and this was deemed unlikely.

Physical health variables

For physical health variables of all controlled studies, we obtained a small mean effect size $d = 0.17$, which was not statistically significant (95% CI −0.07 to 0.40). Computation for the Q statistic showed homogeneity of effect sizes ($\chi^2 = 2.43$, df = 2, $p = 0.2963$). These data represent a total of 340 individuals, with 149 in the intervention group (Table 3).

For physical health variables of all observational studies, a small mean effect size $d = 0.18$ (95% CI 0.07–0.29, $p < 0.0009$, two-tailed) was calculated. Computing for the Q statistic showed the data to be heterogeneous ($\chi^2 = 26.27$, df = 4), thus an adjusted mean effect size using a random effects model was determined, showing a value of $d = 0.19$ which was, however, not statistically significant (95% CI −0.01 to 0.38). The data represent 176 cancer patients who underwent MBSR intervention.

DOI. 10.1002/pon

Data from both randomized and observational studies showed an overall physical health mean effect size $d = 0.18$ (95% CI 0.08–0.28, $p < 0.0003$, two-tailed). This mean effect size also failed the homogeneity test ($\chi^2 = 28.72$, df = 7), and therefore must also be interpreted with caution. Applying a random effects model, the mean effect size was $d = 0.18$, which remained significant (95% CI 0.03–0.33).

A file-drawer test to determine publication bias was also conducted, and showed that 136 unpublished studies with zero effect size were needed to reduce the small effect size to one with no effect (0.01), and this was deemed unlikely.

Discussion

Many cancer patients are willing to undergo different kinds of alternative therapies for various reasons, such as stress reduction, to help boost their immune systems, to deepen their appreciation for their religious upbringing, or to relieve some psychic discomfort [34,35].

Our study revealed that recruited patients were predominantly in the early stages of cancer (either in active treatment or in remission), were mostly women with breast cancer, and had an average high level of education, giving us a general picture of the kinds of cancer patients willing to try MBSR therapy. That most of the patients were in early stage cancer points to the idea that physical ability to go to the study site and complete the intervention is an important factor and, in some studies, was an important inclusion criterion [36,37].

Our results show the efficacy of a mindfulness meditation-based psychosocial intervention for cancer patients in dealing with psychosocial stresses brought about by the disease (mental health mean effect size $d = 0.35$ for randomized studies, $d = 0.50$ for observational studies). Specifically, it aids patients in relieving anxiety, stress, fatigue and general mood and sleep disturbance, and helps in improving the psychological aspects of their quality of life.

Qualitative studies of the experiences of cancer patients practicing mindfulness meditation have reported that mindfulness became a disciplined approach that helped patients improve the quality of their lives and made them feel more open to new and novel experiences, less vulnerable to stress, more tolerant of negative aspects of self and others, and caused greater appreciation for life as a meaningful process [35,38]. At the same time, patients were less emotionally reactive and had greater tolerance for strong emotions when they did arise [35]. Since the core of mindfulness meditation is remaining in a non-judgmental awareness of the present moment, this can readily be understood as a consequence of continuous practice. This may also be a strong contributing factor to the improvement of depressive symptoms in cancer, as Spiegel and Giese-Davise [3] noted that one factor that may moderate the relationship between depression and cancer is the management of the depressive feelings [3].

However, it is possible that patients' attitudes toward the intervention itself may have been a factor for improvement in mental health. In the randomized studies, positive anticipation in terms of the patients randomized to treatment groups may have contributed to the success of the treatment for them. Conversely, patients assigned to the control group may have felt disappointment and may not have improved as much spontaneously over time as they would have otherwise [32].

Our data are consistent with Grossman *et al.*'s [18] meta-analysis, which reported mean effect sizes of $d = 0.54$ and 0.50 for mental health variables from randomized and observational studies, respectively [18], and is also consistent with the post-intervention effect size of $d = 0.59$ from mixed populations reported by Baer [11].

Meta-analysis of the physical health variables showed a small mean effect size in both controlled ($d = 0.17$) and observational studies ($d = 0.18$). These data are in contrast to Grossman *et al.*'s [18] study that found physical health mean effect sizes of $d = 0.53$ (controlled studies) and $d = 0.42$ (observational studies) [18].

Our meta-analysis was severely limited by the small number of eligible studies available, leading us to incorporate studies reporting on physiological parameters and those summarizing self-report questionnaires. Grossman *et al.*'s [18] study reported mean effect sizes only from self-report questionnaires [18], thus the disparity in our results would point to the mitigating effect on the overall mean effect size of physiological parameter studies, which generally reported no significance.

In fact, an analysis of the included studies showed that one of the three controlled studies and two of the five observational studies noted no or very little significant changes in physical parameters (e.g. body mass, dietary fat, complex carbohydrates, fiber, hormone and immune levels) [30,31,39], while the rest of the studies presented improved outcomes on self-report questionnaires (e.g. cardiopulmonary, gastrointestinal, or central or neurologic symptoms) [29,32,40,41]. One study on the other hand was distinct in that although it measured a physical parameter (prostate-specific antigen (PSA) levels and doubling time) it showed a large mean effect size. However, it contributed little to the overall effect size due to its small sample size of 10 patients [36].

With an increase in the number of studies analyzing the effects using either self-report questionnaires or physiological parameters, it is possible to separately meta-analyze results in order to

DOI. 10.1002/pon

improve homogeneity. Indeed, computing separately for the total physical health measures in the present analysis, the mean effect size of studies reporting self-questionnaire results increased to $d = 0.26$ (95% CI 0.13–0.38, $p < 0.0001$, two-tailed), bringing it closer to Grossman *et al.*'s [18] results. On the other hand, using only physiological parameter studies for meta-analysis showed a decreased effect size $d = 0.06$ (95% CI -0.08 to 0.22). Still, with the promise shown by Saxe *et al.*'s [36] study on PSA levels, further studies using physiological parameters could improve our knowledge in this area.

Because self-report questionnaires are filled out by the patients themselves, it is possible that subjective assessments still come into play when assessing physical variables, where, if the patient feels mentally relaxed because of the meditation, it may influence the patient's own assessment of his or her physical symptoms in a positive way. The yoga component of the intervention programs could have also contributed to patients' more positive assessment of their physical symptoms post-intervention, as highlighted by a pilot study of yoga for breast cancer survivors, which reported increased flexibility and a trend toward improvement in SOSI scales over time [42].

Determination of the physiological parameters after only a short time post-intervention may also have been a factor in the resulting small mean effect size, as also the fact that many of the patients were in the early stages of cancer, and were more or less physically functional in terms of their endocrine or immune systems. Carlson *et al.* [30] cited in their study that the patients had high levels of functioning from the beginning, hence proposing that the MBSR program may be only moderately effective for early stage breast and prostate cancer patients [30].

Conversely, a few of the studies reporting physical health measures also included patients who were still in active treatment [29,39]. It is thus possible that patients who were still undergoing chemotherapy, radiotherapy, and other forms of cancer treatment would show very little improvement in the physical component assessments. In contrast, patients who were in remission at the time of enrollment in the study of Saxe *et al.* [36] showed considerable improvement in their physiological and physical symptom parameters [36].

In this meta-analysis, only four controlled studies were found to be eligible, thus an additional six observational studies were included in order to increase the number of analyzable data. Although more studies could have been included, factors such as methodological inconsistencies and inadequate reporting of results limited the number of eligible studies.

Among the included studies, most had small sample sizes and there was a lack of information about the therapists (only a few studies explicitly reported the utilization of MBSR program-trained instructors), patient compliance with at-home exercises, and the cancer staging of patients post-intervention. The varying styles of implementation of this intervention may also have confounded the results. Further, MBSR programs include not just meditation *per se*, but also psycho-education and yoga, thus it is difficult to pinpoint which aspect contributes most to the observed improvements in the patients. It is also unclear as to how the patients are deemed to have achieved a state of mindfulness or have just achieved a simple state of mental relaxation. Intention-to-treat analyses were provided by only one study [32], highlighting the methodological weakness of studies in this area.

Finally, our conclusions should be taken cautiously since our meta-analysis relied to a larger extent on data from observational studies, and thus may have been affected by the inherent methodological weakness present in such studies.

Since Grossman *et al.*'s [18] meta-analysis of MBSR in patient populations, more studies, in particular randomized, controlled types, involving cancer patients have been conducted. This reflects the increasing clinical interest in MBSR in the overall treatment of cancer patients, as well as the possibility of improving methodological techniques in assessing the effects of MBSR.

The small number of studies included in this meta-analysis point to our inability to generalize these results to the overall cancer population. However, the homogeneity of results found among the mental health variables allows us to conclude that MBSR is effective in improving the psychosocial conditions of breast cancer patients.

The inconsistency of the physical health measures reflects the inadequate amount of information currently available on the efficacy of MBSR in this aspect. However, exceptional results for PSA levels show the promise of further research in this area. More methodologically sound researches on MBSR with larger sample sizes are needed to validate the overall results.

References

1. Holland JC. Psychological care of patients: psycho-oncology's contribution. ACS Award Lecture. *J Clin Oncol* 2003;**21**(23s): 253s–265s.
2. Sellick SM, Crooks DL. Depression and cancer: an appraisal of the literature for prevalence, detection, and practice guideline development for psychological interventions. *Psycho-Oncology*. 1999;**8**(4):315–333.
3. Spiegel D, Giese-Davise J. Depression and cancer: mechanisms and disease progression. *Biol Psychiatry* 2003;**54**:269–282.
4. Theobald DE. Cancer pain, fatigue, distress, and insomnia in cancer patients. *Clin Cornerstone* 2004; **6**(Suppl 1D): S15–S21.

DOI. 10.1002/pon

5. Young KE, White C. The prevalence and moderators of fatigue in people who have been successfully treated for cancer. *J Psychosom Res* 2006;**60**:29–38.
6. Blake-Mortimer J, Gore-Felton C, Kimerling R, Turner-Cobb JM, Spiegel D. Improving the quality of life among patients with cancer: a review of the effectiveness of group psychotherapy. *Eur J Cancer* 1999;**35**(11): 1581–1586.
7. Rehse B, Pukrop R. Effects of psychosocial interventions on quality of life in adult cancer patients: a meta-analysis of 37 published controlled outcome studies. *Patient Educ Couns* 2003;**50**:179–186.
8. van der Pompe G, Antoni M, Visser A, Garssen B. Adjustment to breast cancer: the psychobiological effects of psychosocial interventions. *Patient Educ Couns* 1996;**28**:209–219.
9. Newell SA, Sanson-Fisher RW, Savolainen NJ. Systematic review of psychological therapies for cancer patients: overview and recommendations for future research. *J Natl Cancer Inst* 2002;**94**(8):558–584.
10. Kabat-Zinn J. *Full Catastrophe Living: Using the Wisdom of Your Body and Mind to Face Stress, Pain and Illness*. Bantam Dell 1990.
11. Baer RA. Mindfulness training as a clinical intervention: a conceptual and empirical review. *Clin Psychol: Sci Practice Summer* 2003;**10**(2):125–143.
12. Kabat-Zinn J. Mindfulness-based interventions in context: past, present and future (Commentary). *Clin Psychol: Sci Practice Summer* 2003;**10**(2):144–156.
13. Kabat-Zinn J. An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: theoretical considerations and preliminary results. *General Hospital Psychiatry* 1982;**4**:33–47.
14. Reibel DK, Greeson JM, Brainard GC, Rosenzweig S. Mindfulness-based stress reduction and health-related quality of life in a heterogeneous patient population. *General Hospital Psychiatry* 2001;**23**:183–192.
15. Kabat-Zinn J. Influence of a mindfulness meditation-based stress reduction intervention on rates of skin clearing in patients with moderate to severe psoriasis undergoing phototherapy (UVB) and photochemotherapy (PUVA). *Psychosomatic Med* 1998;(5): 625–632.
16. Miller JJ, Fletcher K, Kabat-Zinn J. Three-year follow-up and clinical implications of a mindfulness meditation-based stress reduction intervention in the treatment of anxiety disorders. *General Hospital Psychiatry* 1995; **17**:192–200.
17. Bishop SR. What do we really know about mindfulness-based stress reduction? *Psychosom Med* 2002;**64**(1): 71–83.
18. Grossman P, Niemann L, Schmidt S, Walach H. Mindfulness-based stress reduction and health benefits: a meta-analysis. *J Psychosom Res* 2004;**57**:35–43.
19. Mackenzie MJ, Carlson LE, Speca M. Mindfulness-based stress reduction (MBSR) in oncology: rationale and review. *Evidence-based Integr Med* 2005;**2**(3):1–2.
20. Matchim Y, Armer JM. Measuring the psychological impact of mindfulness meditation on health among patients with cancer: a literature review. *Oncol Nurs Forum* 2007;**34**(5).
21. Smith JE, Richardson J, Hoffman C, Pilkington K. Mindfulness-based stress reduction as supportive therapy in cancer care: systematic review. *J Adv Nurs* 2005;**52**(3):260–266.
22. Toneatto T, Nguyen L. Does mindfulness meditation improve anxiety and mood symptoms? A review of the controlled research. *La Revue Canadienne de Psychiatrie* 2007;**52**(4).
23. Ott MJ, Norris RL, Bauer-Wu SM. Mindfulness meditation for oncology patients. *Integr Cancer Ther* 2006;**5**:98–108.
24. Lipsey MW, Wilson DB. *Practical Meta-analysis*. Sage Publications: Thousand Oaks, CA, 2001.
25. Carlson LE, Ursuliak Z, Goodey E, Angen M, Speca M. The effects of a mindfulness-based stress reduction program on mood symptoms of stress in cancer outpatients: 6-month follow-up. *Support Care Cancer* 2001;**9**:112–123.
26. Carlson LE, Speca M, Patel KD, Faris P. One year pre-post intervention follow-up of psychological, immune, endocrine and blood pressure outcomes of mindfulness-based stress reduction (MBSR) in breast and prostate cancer outpatients. *Brain, Behav, Immunity*. 2007, doi: 10.1016/j.bbi.2007.04.002.
27. Adams SA, Matthews CE, Wilcox S, Hurley TG, Herbert JR. Leisure time physical activity attenuates weight gain in women with breast cancer. *Med Sci Sports Exerc* 2002;**34**(5):S250.
28. Cohen L, Warneke C, Fouladi RT, Rodriguez MA, Chaoul-Reich A. Psychological adjustment and sleep quality in a randomized trial of the effects of a Tibetan yoga intervention in patients with lymphoma. *Cancer* 2004;**100**(10):2253–2260.
29. Monti DA, Peterson C, Kunkel EJ, Hauck WW, Pequignot E, Rhodes L, Brainard GC. A randomized, controlled trial of mindfulness-based art therapy (MBAT) for women with cancer. *Psycho-Oncology* 2006;**15**(5):363–373.
30. Carlson LE, Speca M, Patel KD, Goodey E. Mindfulness-based stress reduction in relation to quality of life, mood, symptoms of stress and levels of cortisol,dehydroepiandrosterone sulfate (DHEAS) and melatonin in breast and prostate cancer outpatients. *Psychoneuroendocrinology* 2004;**29**:448–474.
31. Carlson LE, Speca M, Patel KD, Goodey E. Mindfulness-based stress reduction in relation to quality of life, mood, symptoms of stress, and immune parameters in breast and prostate cancer outpatients. *Psychosom Med* 2003;**65**:571–581.
32. Speca M, Carlson LE, Goodey E, Angen M. A randomized, wait-list controlled clinical trial: the effect of a mindfulness meditation-based stress reduction program on mood and symptoms of stress in cancer outpatients. *Psychosom Med* 2000;**62**:613–622.
33. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. Academic Press: New York, 1988.
34. Shen J, Andersen R, Albert PS, Wenger N, Glaspy J, Cole M, Shekelle P. Use of complementary/alternative therapies by women with advance-stage breast cancer. *BMC Complementary Alternative Med* 2002; **2**:8.
35. Bonadonna R. Experiencing impermanence: toward a theory of living mindfully with cancer (dissertation). Nursing, Medical University of South Carolina, Charleston, SC, 2000.
36. Saxe GA, Hebert JR, Carmody JF, Kabat-Zinn J, Rosenzweig PH, Jarzobski D, Reed GW, Blute RD. Can diet in conjunction with stress reduction affect the rate of increase in prostate specific antigen after biochemical recurrence of prostate cancer? *J Urol* 2001;**166**:2202–2207.
37. Tacon A, Caldera Y, Ronaghan C. Mindfulness-based stress reduction in women with breast cancer. *Families, Systems Health* 2005;**22**(2):193–203.
38. Young R. The experience of cancer patients practicing mindfulness meditation. *Saybrook Institute, US. Dissertation Abstracts International: Section B: The Sciences and Engineering* 2002;**63**(5-B): 2603.

DOI. 10.1002/pon

39. Herbert JR, Ebbeling CB, Olendzki BC, Hurley TG, Ma Y, Saal N, Ockene JK, Clemow L. Change in women's diet and body mass following intensive intervention for early-stage breast cancer. *J Am Diet Assoc* 2001;**101**(4): 421–431.
40. Carlson LE, Garland SN. Impact of mindfulness-based stress reduction (MBSR) on sleep, mood, stress and fatigue symptoms in cancer outpatients. *Int J Behav Med* 2005;**12**(4):278–285.
41. Garland SN, Carlson LE, Cook S, Lansdell L, Speca M. A non-randomized comparison of mindfulness-based stress reduction and healing arts programs for facilitating post-traumatic growth and spirituality in cancer outpatients. *Support Care Cancer* 2007, doi 10.1007/s00520-007-0280-5.
42. Culos-Reed SN, Carlson LE, Daroux LM, Hately-Aldous S. A pilot study of yoga for breast cancer survivors: physical and psychological benefits. *Psycho-Oncology* 2006;**15**(10):891–897.