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The effects of mindfulness-based stress reduction therapy on mental health of adults with a chronic medical disease: A meta-analysis

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Abstract

Objectives: The objective of this study was to examine the effectiveness of mindfulness-based stress reduction (MBSR) on depression, anxiety and psychological distress across populations with different chronic somatic diseases. **Methods:** A systematic review and meta-analysis were performed to examine the effects of MBSR on depression, anxiety, and psychological distress. The influence of quality of studies on the effects of MBSR was analyzed. **Results:** Eight published, randomized controlled outcome studies were included. An overall effect size on depression of 0.26 was found, indicating a small effect of MBSR on depression. The effect size for anxiety was 0.47. However, quality of the studies was found to moderate this effect size. When the studies of lower quality were excluded, an effect size of 0.24 on anxiety was found. A small effect size (0.32) was also found for psychological distress. **Conclusions:** It can be concluded that MBSR has small effects on depression, anxiety and psychological distress in people with chronic somatic diseases. Integrating MBSR in behavioral therapy may enhance the efficacy of mindfulness based interventions.

Keywords: Mindfulness; Mental health; Depression; Chronic medical disease; Meta-analysis

Introduction

Many chronic somatic diseases are highly prevalent in industrialized countries. About 45% of healthy 40-year-old men and 30% of healthy 40-year-old women, for example, will develop coronary heart disease in later life [1]. It is estimated that 85% of older adults is affected by one or more chronic diseases [2]. In more recent studies that defined chronic pain as pain of >3 months duration, prevalence rates of chronic pain ranged from 10.8–23.7% [3,4]. For mental disorders, the presence of chronic somatic diseases is a risk factor. An increased risk of developing an anxiety disorder has been found among people with arthritis [5], coronary heart diseases [6]. An increased prevalence of depression has been found for many chronic physical somatic diseases in both cross-sectional and longitudinal studies, e.g., cardiovascular diseases [6], cancer [7], and arthritis [5]. It is estimated that between 20% and 30% of cancer patients will experience depressive symptomatology [8,9].

Mindfulness-based stress reduction (MBSR) is a treatment for psychological distress, depressive symptoms, and anxiety for people with chronic disease that is rapidly growing in popularity in the United States. Developed by Kabat-Zinn [10,11], the MBSR program consists of 8–10 sessions for groups of up to 30 participants. Central here is the practice of mindfulness. Mindfulness is the skill to non-judgmentally observe emotions, sensations, or cognitions. Mindfulness is moment-to-moment awareness and is trained through meditation exercises that have been adapted from Buddhist traditions. Besides these meditation skills, yoga exercises and psycho-education are also part of the program. Whereas MBSR was originally developed for people with chronic pain, it was later also applied to people with chronic diseases such as cancer [12], fibromyalgia [13], and heart failure [14]. Apart from MBSR, mindfulness is also an

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important component of other treatments such as acceptance and commitment therapy [15], dialectic behavioral treatment [16], and cognitive therapy [17].

Two meta-analyses have so far studied the effects of MBSR on mental health [18,19]. Grossman et al. [18] conducted a meta-analysis of 20 controlled and uncontrolled studies on the effects of MBSR on physical and mental health of medical and non-medical samples. They found an effect size of d=0.54 for controlled studies on mental health. No effect sizes for specific symptomatology (depression, anxiety) were reported. Baer [19] included both controlled and uncontrolled studies focusing on populations with somatic diseases, clinical populations, and nonclinical populations. Effect sizes of d=0.70 for anxiety (eight studies) and d=0.84 for depression (five studies) across the different populations were reported. Average effect sizes at posttreatment across medical and psychological outcomes of d=0.37 were found for patients with chronic pain and d=0.55 for patients with other somatic disorders. Both meta-analyses included only two published, controlled studies on the effects of mindfulness on mental health in populations with somatic diseases. No effect sizes for depression and anxiety in these populations were calculated. Qualities of studies that might moderate the effects on mental health were not systematically analyzed.

On the basis of the fact that, in recent years, many more controlled studies on MBSR in somatic medical populations have been published, we decided to conduct a new meta-analysis on the effects of MBSR in people with chronic somatic diseases. The objective was to analyze the overall effects of MBSR on psychological distress, depression, and anxiety.

Methods

Selection of studies

Studies were selected through a search of two computerized databases of the literature: Medline and PsychINFO Medline (1966–2008) yielded 5512 results using mindfulness as keyword and randomized controlled trial as limitation. PsychINFO (1960–2008) yielded 1114 results, using mindfulness as keyword. The abstracts of potentially eligible studies were read and those that reported effects of MBSR on populations with chronic somatic diseases were retrieved and studied, as were the primary studies used in earlier meta-analyses [18,19]. Furthermore, the reference lists of retrieved studies were examined and those that possibly met inclusion criteria were collected. We included studies in which (1) the effects of MBSR (2) on adults (3) with a chronic medical disease[1] (4) were compared to a control condition (5) in a randomized controlled trial and in which (6) sufficient data were reported for the calculation of standardized effect sizes.

Data extraction

Outcome measures of mental health were included. Mental health constructs comprised scales such as overall psychological distress, depression, and anxiety. All decisions on the inclusion and allocation of outcome measures or moderators were based on consensus between two of the authors, E. Bohlmeijer and R. Prenger. Relevant data for each measure included in the analysis were extracted and entered into Comprehensive Meta-Analysis version 2.2.021 (CMA). If data were available, we examined immediate, pre- to postintervention change to assess both the effects of mindfulness and follow-up effects.

Methodology and calculation of effect sizes, d, from primary studies

In a meta-analysis the effects found in the primary studies are converted into a standardized metric effect size which is no longer placed on the original measurement scale and can therefore be compared with measures from other scales [20]. Standardized effect sizes, d, are calculated as $d=(M_1-M_0)/Sd_0$; where, M_1 and M_0 are the means at post- and pretest, and Sd_0 is the pre-test standard deviation of measures of depression. The standardized effect sizes, d, show by how many standard units (z scores) a group has progressed after treatment at t_1 as compared with their mean baseline score at t_0.

We were interested in obtaining the effect size of the experimental effect minus the effect (of spontaneous recovery) in the control group. Therefore, we calculated the standardized pre to post change score of both the experimental group (d_E) and the control group (d_C). Then we calculated their difference, i.e., $\Delta(d)=d_E-d_C$. These incremental effect sizes show by how many standard units the experimental group has been removed from the control group. An effect size of 0.5 thus indicates that the mean of the experimental group is half a standard deviation larger than the mean of the control group. Lipsey and Wilson [21] have shown that an effect size of .56–1.2 can be assumed as large, whereas effect sizes of .33–.55 are moderate, and effect sizes of 0–.32 are small.

For this meta-analysis, Hedges' g effect sizes were calculated using CMA. Hedges' g is a variation of Cohen's d that corrects for biases due to small sample sizes [22]. If no means and standard deviations were reported, other test statistics (χ^2, T, F) were converted into Hedges' g.

Basically, meta-analysis amounts to pooling individual effect sizes (Hedges' g) and obtaining a best overall estimate of the treatment effect within its 95% confidence interval (95% CI). To calculate pooled mean effect sizes, we used the computer program CMA, developed for support in meta-analysis. As we expected considerable heterogeneity, we

[1] Chronic illnesses refer to any conditions which involve some disability, caused by irreversible pathological change. We also included illnesses that need not be irreversible but cause enduring disability (e.g., cancer).

conducted all analyses using the random effects model. We conducted a meta-analysis of relevant studies on depression, anxiety and overall psychological distress. We assessed heterogeneity by calculating the I^2-statistic that is an indicator of heterogeneity in percentages. A value of 0% indicates no observed heterogeneity, and larger values show increasing heterogeneity, with 25% as low, 50% as moderate, and 75% as high heterogeneity [23]. We also calculated the Q-statistic, but only report whether this was significant or not. Q is distributed as chi-square with degree of freedom equal to the number of studies minus 1. A significant Q statistic implies the presence of one or more moderating variables operating on the observed effect size. For the moderating effect of quality of studies, a meta-regression analysis was conducted according to the procedures implemented in CMA.

Coding of study quality

We assessed the quality of each study using seven criteria. These criteria were based on an authoritative review of empirically supported psychotherapies [24] and on the criteria proposed by the Cochrane Collaboration to assess the methodological validity of the study [25]:

(1) participants met diagnostic criteria for a chronic somatic disorder (as assessed by a physician);
(2) the study referred to the use of a treatment manual (either a published manual, or a manual specifically designed for the study);
(3) the therapists who conducted the therapy were trained for the specific therapy, either specifically for this study or as a general training;
(4) treatment integrity was checked during the study (by supervision of the therapists during treatment or by recording of treatment sessions or by systematic screening of protocol adherence by a standardized measurement instrument);
(5) data were analyzed with intention-to-treat analyses, in which all persons who were assigned to the treatment and control conditions were initially included in the analyses;
(6) the study had a minimal level of statistical power to find significant effects of the treatment and included (in total) 50 or more persons in the comparison between treatment and control group (this allows the study to find standardized effect sizes of 0.80 and larger, assuming a statistical power of 0.80 and alpha of 0.05);
(7) The study reported that randomization was conducted by an independent (third) party (this variable was positive if an independent person did the randomization, when a computer program was used to assign patients to conditions, or when sealed envelopes were used); this was only coded when patients were randomly assigned to conditions.

The quality of the study was assessed as high when all seven criteria were met, medium when five or six criteria were met, and low when four or less criteria were met. The quality of the studies was assessed by two independent raters. The inter-rater reliability was 93%.

Results

Selected studies

Fifty-three studies were found. Eight studies met the inclusion criteria [12,14,26–31]. Twenty-six studies were excluded because the effects of mindfulness had been studied on nonmedical populations. Fifteen studies did not use a control group or a randomization procedure, and four studies were excluded because insufficient data were available for calculating effect sizes. Characteristics of the selected studies are presented in Table 1. There was a large diversity in the chronic somatic diseases of the populations that were treated, namely cancer, chronic pain, fibromyalgia, chronic fatigue, and rheumatoid arthritis. In general, the participants were adults with a mean age between 45 and 55. In one study, the subjects were on average 75 years of age. In six studies, almost all participants were women. Seven studies used a waiting list control group. In one study, the control group was offered an alternative intervention. In one study, attrition rate was higher than 25%. Three studies reported follow-up data. Three studies used measures of overall psychological distress, six used specific instruments for depression or mood, and five studies used specific instruments for stress or anxiety. All studies used instruments with good psychometric properties. In six studies, the sample size was larger than 50. One study was coded as high quality, five studies as medium quality, and two studies as low quality.

Effects

The overall mean effect size for six studies on depression was 0.26 (95% CI: 0.18–0.34), with absence of heterogeneity (I^2=0; Table 2). This effect is statistically significant (Z=P<.001) and can be considered a small effect. The number of studies needed to make the results of the meta-analysis nonsignificant was 31, indicating that the finding is robust. Quality of studies was not found to be significant related to the effect-size. For anxiety, an effect size of d=0.47 was found that can be as moderate. Heterogeneity was considerable (I^2=53.95). We also found that the quality of studies was significantly related to the effect size, with a slope of −0.25 (95% CI: −0.46 to −.05; P<.05). This indicated that with each reduction of 1 point (on the scale of 7), the effect size is reduced by 0.25. For the two studies of medium and high quality an effect-size of d=0.24 was found. For overall psychological

Table 1
Selected characteristics of included studies

Study	Medical condition	Conditions	n	Attrition rate[a] <25%	Measurements	%W[b]	Age (m)	Outcome measures	Quality of study	ES pre-post	ES pre FU
Astin et al. [26]	Fibromyalgia	MBSR Education support group	64 64	-	Pre Post FU 16 wk	98.4 100	47	BDI	Medium	0.01	0.18
Monti et al. [27]	Cancer	MBAT WL	56 55	+	Pre Post	100	53	SCL-90-R Anxiety SCL-90 Depression SCL-90 SF-36-MHC	Medium	0.30 0.23 0.26 0.38	
Morone et al. [28]	Chronic lower back pain	MBSR WL	19 18	+	Pre Post FU 3mn	56	75	SF-36-MHC	Medium	0.17	
Pradhan [29]	Rheumatoid arthritis	MBSR WL	31 32	+	Pre Post FU 6mn	87.3	54	SCL-90-R Depression SCL-90	High	0.28 0.16	0.44 0.50
Sephton et al. [31]	Fibromyalgia	MBSR WL	51 40	+	Pre Post FU 2mn	100	48	BDI	Medium	0.64	0.43
Speca [12]	Cancer	MBSR WL	91 109	+	Pre Post	95	51	POMS POMS anxiety POMS depression SOSI SOSI-anxiety SOSI-depression	Medium	0.80 0.82 0.71 0.51 0.24 0.34	
Surawy [30]	Chronic fatigue syndrome	MBSR WL	9 8	+	Pre Post	55	18–65	HADS-A HADS-D	Low	0.74 0.10	
Tacon et al. [14]	Heart disease	MBSR WL	10 10	+	Pre Post	100	60	STAI	Low	1.12	

W, Women, ES, Effect-size; BDI, Beck Depression Inventory; WL, Waiting-list; SCL-90-R, Symptom Checklist-90-Revised; HADS-A, Hospital Anxiety and Depression Scale-Anxiety; HADS-D, Hospital Anxiety and Depression Scale-Depression; POMS, Profile of Mood States; STAI, State Trait Anxiety Inventory; SOSI, Symptoms of Stress Inventory.

[a] Total number of dropouts form study divided by number of participants which were randomized. + indicates that attrition rate was below 25%.
[b] Number of women divided by the total number of participants.

distress, an effect-size of 0.32 (95% CI: 0.13–0.50) was found with absence of heterogeneity.

Discussion

We examined the effects of mindfulness-based stress reduction on depression, anxiety, and psychological distress in people with chronic somatic diseases by conducting a meta-analysis of eight randomized controlled trials. An overall effect on depression of 0.26 was found. This effect size is considerably lower than the effect size for depression (0.86) found by Baer [19]. Baer, however, conducted a meta-analysis across different populations and also included non-controlled studies. The finding is also in contrast with the effects of psychotherapy on depression in people with chronic somatic diseases, e.g., Refs. [32,33]. What could explain the small effect size of MBSR? One possible factor is a ceiling effect. Pradhan [29], for example, reported that the mean baseline level of depressive symptoms was lower than reported in the literature on rheumatoid arthritis. The scores on the Beck Depression Inventory of the participants at baseline in the Astin [26] study fall in the mild range (14–19). As a consequence, there is less room for

Table 2
Mean effect-sizes for MBSR

Number of studies	Hedges *g*	95%CI	*Z*	*Q*-value	I^2
Depression (6 studies)	0.26	0.18–0.34	6.203**	4.16	0
Depression (medium and high quality studies)	0.27	0.19–0.35	6.39**	5.66	29.32
Anxiety (4 studies)	0.47	0.11–0.83	2.57*	6.5	53.95
Anxiety (medium and high quality studies)	0.24	0.10–0.38	3.39**	2.02	50.53
Psychological distress (3 studies)	0.32	0.13–0.50	3.36**	0.28	0

* $P<.05$.
** $P<.001$.

improvement. Another possible explanation is related to the treatment format. MBSR has been developed as a treatment for stress for people with chronic pain, and not as a specific treatment for depression. Another variant of mindfulness, the mindfulness-based cognitive therapy (MBCT), adapted the MBSR program for people with a history of depression and incorporated elements of cognitive therapy [34]. Central in this program (MBCT) is the process of "decentering." Patients learn to disidentify with negative emotions and thoughts and to experience them as passing mental events. In a multicenter trial with patients with recurrent depression MBCT was found to effectively reduce relapse rates with 44% in comparison to treatment as usual [35]. In order to enhance the effects of mindfulness specifically on depression in people with chronic physical diseases, it may be warranted to adapt the original MBSR program in a similar way (e.g., to focus more elaborately on the detachment of depression-related thoughts and the enhancement of activity scheduling).

An overall effect on anxiety of 0.47 was found. However, the effect-sizes varied systematically with the quality of the studies. When the two studies with lower quality were excluded, an overall effect of 0.24 was found. This finding is similar to other recent meta-analyses in the field of psychotherapy and pharmacotherapy for depression that found indications that the effects of psychotherapy had been overestimated in earlier meta-analyses [36–38]. An overall effect on psychological distress of 0.32 was found. This effect size is substantially lower than was found in an earlier meta-analysis by Grossman et al. [18], who reported an overall effect size of 0.54 for medical and non-medical populations. An explanation could be that Grossman et al. included quasi-experimental studies, which may lead to an overestimation of effects. However, only three randomized controlled trials were included, so the results must be considered with caution. Again, integrating mindfulness within cognitive behavioral therapy may prove to be more effective for reducing anxiety and psychological distress in people with chronic physical diseases. Roemer et al. [39] developed acceptance-based behavior therapy (ABBT) drawing from acceptance and commitment therapy and mindfulness based cognitive therapy. Thirty-one patients with generalized anxiety disorder (GAD) were randomly assigned to immediate ABBT or delayed treatment. At posttreatment, 77% of the patients in the treatment group compared with 17% of those waiting for treatment no longer met criteria for GAD [39]. Also, large reductions in self-reports anxiety symptoms were found that were maintained at 9 month follow-up assessment.

We found only one study that met all quality criteria. This may well be an underestimation, because a conservative method of assessing the quality was used. When a quality criterion was not reported in a paper, we coded this criterion as negative. However, the lack of reporting may in some cases have also been caused by the lack of space in journals or a tradition of reporting certain characteristics but not others. We therefore recommend interpreting the findings with respect to quality with some care.

Limitations and implications

An important limitation was that we did not include unpublished studies. Inclusion of unpublished studies would have allowed for a direct contrast between published and unpublished studies. A second limitation was that not enough follow-up data were available to conduct a meta-analysis of the long-term effects of MBSR. A third limitation was that we were not able to systematically study whether baseline levels of psychological distress and depression were associated with outcomes of studies due to the use of different instruments and lack of criteria for severity in some instruments.

Despite these limitations, we conclude that MBSR has small effects on depression, anxiety, and psychological distress in people with chronic physical diseases. However, this outcome may be an underestimation on the basis of ceiling effects in studies. We recommend that these new studies include sufficient people with moderate to high levels of anxiety and depression in particular to prevent a ceiling effect and to include follow-up measurements. Secondly, we recommend integrating the MBSR program in cognitive behavioral therapy. As we discussed earlier, this has been done for different target groups (e.g., people with is history of depression [34,40], people with general anxiety disorder [39]). Adapting programs in a similar way for people with chronic somatic diseases may contribute to increase the effectiveness of mindfulness based interventions.

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