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Health Effects of Mindfulness-Based Stress Reduction (MBSR): A Review of Systematic Reviews and Meta-Analyses

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Addiction

- A systematic review by Goldberg *et al.*¹ that evaluated studies published up to January 2017, showed only one small quasi-experimental MBSR study on addiction (n=30), that demonstrated significant improvements in drug cravings in those addicted to drugs.² There were many more studies that used customized MBI's such as Mindfulness-Based Relapse Prevention (MBRP) and Mindfulness-Oriented Recovery Enhancement (MORE), with promising evidence.

Adiposity

- A systematic review by Carriere *et al.*³ that evaluated mindfulness studies on weight loss published up to March 2017, showed no studies of unmodified MBSR on weight loss. It included one study that used a modified MBSR. This lack of data limits abilities to understand impacts of MBSR on adiposity. Most mindfulness interventions studied for impacts on weight loss were customized to individuals wanting to lose weight

Anxiety

- Overall, evidence is building on the impacts of MBSR on anxiety symptoms. While MBSR is not yet at the stage of evidence to be recommended as a first line treatment for anxiety, systematic reviews and meta-analyses below suggest potential effects. Evidence will clarify as further studies contribute to the literature.
- In a systematic review and meta-analyses by Li *et al.*⁴ on randomized controlled trials using MBSR in older/elderly participants published between 1990 and November 2017, three MBSR studies were identified that were all compared to wait-list control groups.⁵⁻⁷ The meta-analysis demonstrated a nonsignificant impact of MBSR on older adults' anxiety symptoms with a SMD of $g = -0.31$ (95% CI = -0.70 to 0.08; $P = 0.12$), suggesting a small to medium effect. Note that with only three studies and a total sample size of 130 participants, low statistical power was likely an issue affecting statistical significance.
- In a systematic review of MBSR in "healthy" individuals for studies published up to September 2014, six studies with control groups were identified that evaluated impacts on anxiety.⁸ They showed an overall Hedge's g of 0.64 ($p < 0.00001$), suggesting moderate effect size. This review included modified MBSR interventions such as phone-delivered, low dose and a web-based delivery. It included randomized controlled trials, along with uncontrolled and non-randomized controlled trials.
- A systematic review and meta-analysis of MBI RCTs published prior to July 2014 in participants with current depression or anxiety disorder demonstrated medium to large effects for the MBIs on depressive symptoms that were significant (Hedges $g = -0.73$, 95% CI = -0.09 to -1.36), and medium effect sizes were demonstrated for anxiety symptoms that were non-significant (Hedges $g = -0.55$, 95% CI = 0.09 to -1.18). Moderator analyses suggested no significant differences between MBCT and MBSR on depressive and anxiety symptoms ($p = 0.52$), but effects of MBSR on primary symptom severity showed medium to large non-significant effects with Hedges $g = -0.75$ (95% CI = -1.81 to 0.31, $p = 0.16$; $n = 272$) and a significant effect of MBCT with a small to medium effect size (Hedges $g = -0.39$, 95% CI = -0.63 to -0.15, $p = 0.01$; $n = 278$).⁹

Asthma

- There is not much evidence on the role of MBSR in asthma. In a systematic review on MBSR in participants with long-term physical conditions¹⁰, one study was identified that measured impacts of MBSR on asthma. This RCT showed clinically significant improvements from baseline in quality of life (differential change in Asthma Quality of Life Questionnaire score for MBSR vs control: 0.66 (95% CI 0.30 to 1.03; $p < 0.001$)) but not in lung function (morning PEF, PEF variability and forced expiratory volume in 1 s).¹¹

Blood Pressure

- A 2014 systematic review and meta-analysis of randomized controlled trials of MBSR or MBCT showed that in 5 studies (n=286) there was a small but significant overall improvement in blood pressure for participants that went through mindfulness-based interventions vs. controls (standardized mean difference of -0.78; 95% CI: -1.46, -0.09).¹² When the study with the largest effects was removed from the meta-analysis, findings became null.¹² None of the mindfulness interventions were customized to participants with elevated blood pressure, but instead taught mindfulness techniques applied to either stress reduction or preventing depression relapse.¹²
- A 2018 systematic review on papers published during the years 2012-2017 suggested similar findings.¹³

Burnout

- In a systematic review of MBSR in “healthy” individuals, for studies published up to September 2014, five studies with control groups were identified that evaluated impacts on burnout.⁸ They showed an overall Hedge’s g of 0.26 (p<0.01), suggesting small effect size. This review included modified MBSR interventions such as phone-delivered, low dose and a web-based delivery. It included randomized controlled trials, along with uncontrolled and non-randomized controlled trials.

Cancer

- A systematic review and meta-analysis of 14 clinical trial MBSR studies (n=1,505) of participants with breast cancer demonstrated statistically significant results for MBSR on physiological function (SMD = 0.28, P = 0.008), cognitive function (SMD = 1.48, P = 0.01), fatigue (SMD = - 0.66, P = 0.004), emotional wellbeing (SMD = 1.01, P = 0.003), anxiety (SMD = - 0.54, P = 0.02), depression (SMD= - 0.61, P = 0.02), stress (SMD = - 0.48, P = 0.004), distress (SMD = - 0.56, P = 0.0002) and mindfulness (SMD= 0.94, P = 0.03). Although the effects on pain, sleep quality, and global quality of life were in the expected direction, they were not statistically significant (P > 0.05). Included studies were those published prior to February-May 2018. Note that this systematic review only included clinical trials with control groups, but some were RCTs, and others were not. The Newcastle-Ottawa Quality Assessment Scale (NOS) was used to evaluate methodological quality of non-randomized studie.¹⁴

Cognitive Effects

- A systematic review and meta-analysis of four clinical trial MBSR studies (n=1505) of participants with breast cancer demonstrated statistically significant results were found on cognitive function (SMD = 1.48, P = 0.01). Included studies were those published prior to February-May 2018. Note that this systematic review only included clinical trials with control groups, but some were RCTs, and others were not. The Newcastle-Ottawa Quality Assessment Scale (NOS) was used to evaluate methodological quality of non-randomized studies.¹⁴
- In a systematic review of 18 MBSR/MBCT studies published between 2000 and February 2015, there was little evidence for MBSR/MBCT influencing attention or executive function. There was preliminary evidence for improvements in working memory and autobiographical memory as well as cognitive flexibility and meta-awareness. Short-term mindfulness meditation training did not enhance theorized attentional pathways. Note that this study did not stratify findings by MBSR vs. MBCT.¹⁵

Cost Effectiveness

- A systematic review¹⁶ on cost effectiveness of third wave therapies that were published prior to May 2016 identified one MBSR cost-effectiveness study. This study,¹⁷ focused on breast cancer survivors, compared MBSR (six weekly 2-hour format, excluding the 1-day, 8-hour retreat) with treatment as usual, which consisted of standard posttreatment clinic visits, with patients specifically asked not to use or practice mindfulness/meditation. At 3-month follow-up, MBSR was more cost-effective than treatment as usual from the provider and patients' perspective.
- A systematic review of acceptance and mindfulness-based interventions published up to November 2017 identified 10 cost-effectiveness studies, of which one was focused on MBSR. This assessment of MBSR for mental health disorders observed a reduction in mean insurance costs per case treated.¹⁸ Specifically, the mean health insurance plan cost for the cases dropped by \$244 to \$279, while the mean costs for the controls increased between \$3 and \$18. However, the study was a partial economic evaluation and met a lesser number of criteria in the quality assessment than the full economic evaluations.
- A cost effectiveness randomized controlled trial study on MBSR for low back pain demonstrated, compared to usual care, the mean incremental cost per participant to society of cognitive behavioral therapy (CBT) was \$125 (95% CI: -4103, 4307) and of MBSR was -\$724 (CI: -4386, 2778). This provided a net savings of \$724 for MBSR compared to usual care. Incremental costs per participant to the health plan were \$495 for CBT over usual care and -\$982 for MBSR, and incremental back-related costs per participant were \$984 for CBT over usual care and -\$127 for MBSR.¹⁹ These costs (and cost savings) were associated with statistically significant gains in quality-adjusted life years (QALYs) over usual care.

Depression

- A systematic review and meta-analysis of nine clinical trial MBSR studies (n=1196) of participants with breast cancer demonstrated statistically significant results for MBSR on depression (SMD= - 0.61, P = 0.02).¹⁴ Included studies were those published prior to February-May 2018. Note that this systematic review only included clinical trials with control groups, but some were RCTs, and others were not. The Newcastle-Ottawa Quality Assessment Scale (NOS) was used to evaluate methodological quality of non-randomized studies.
- In a systematic review and meta-analyses by Li et al.⁴ on studies using MBSR in older/elderly participants published between 1990 and November 2017, four MBSR studies were found on MBSR, that were all compared to wait-list control. The meta-analysis demonstrated a nonsignificant impact of MBSR on older adults' depression with a SMD of g = -0.74 [95% CI = -1.68 to 0.20]; P = 0.12. Note that with four studies and a total sample size of 330 participants, low statistical power may have been an issue affecting statistical significance.
- In a systematic review (no meta-analysis) on effects of MBSR on employee's mental health in articles published prior to October 2015, depression was examined in five studies.²⁰ Two studies found a significant decrease of depression in the TG and in the TG compared to CG, one study reported a significant reduction in the TG, and the other two studies mentioned no significant results. In summary, it is plausible that MBSR results in decreased levels of depression, but no meta-analysis was performed.
- A systematic review by Goldberg *et al.*¹ on mindfulness intervention for psychiatric disorders, which evaluated studies published up to January 2017, showed only three MBSR studies on depression.
- In a systematic review and meta-analysis on impacts of RCTs of MBSR on depressive symptoms in young people aged 12-25 y, 18 studies (n=2,042) showed that relative to the control groups (e.g., no treatment, treatment as usual, or active control), MBSR had moderate effects in reducing depressive symptoms at the end of intervention (Hedges' g = -

0.45; 95% CI: -0.63, -0.27).²¹ No statistically significant effects were found in follow-up (Hedges' $g = -0.24$, 95% CI: -0.54, 0.06) which may be due to a lack of statistical power ($k=7$ studies), as the power to detect a population effect of 0.30 was 0.70.

- In a systematic review of MBSR in "healthy" individuals (not well defined what healthy is) for studies published up to September 2014, four studies with control groups were identified that evaluated impacts on depression.⁸ They showed an overall Hedge's g of 0.80 ($p < 0.00001$), suggesting large effect size. This review included modified MBSR interventions such as phone-delivered, low dose and a web-based delivery. It included randomized controlled trials, along with uncontrolled and non-randomized controlled trials.
- A systematic review of MBSR vs. Cognitive Behavioral Therapy (CBT) vs. standard care, of publications prior to October 2017 included 21 studies: 13 CBT vs control ($n=1095$), 7 MBSR vs control ($n=545$) and 1 MBSR vs CBT vs control ($n=341$). Of the 21 articles, 12 were determined to be of fair or good quality. Findings, using Bayesian network meta-analyses, for change in depression revealed clinically important advantages relative to control for MBSR and CBT, but no evidence of an important difference between MBSR and CBT was found.³³

Effect Modifiers

- In a systematic review of 28 MBSR or MBCT studies published prior to the end of 2015, a meta-analysis demonstrated significant correlation (correlation coefficient= 0.264 ; $p < 0.0001$) of home mindfulness practice amount with intervention outcomes.²²

Fatigue

- A systematic review and meta-analysis of seven studies reported fatigue involving 1082 participants. MBSR had a positive effect on fatigue compared with control conditions; this effect was statistically significant (SMD= -0.66 , 95%CI [-1.11 , -0.20], $P = 0.004$). Included studies were those published prior to February-May 2018. Note that this systematic review only included clinical trials with control groups, but some were RCTs, and others were not. The Newcastle-Ottawa Quality Assessment Scale (NOS) was used to evaluate methodological quality of non-randomized studies.¹⁴

Fibromyalgia Syndrome

- In a systematic review and meta-analysis of papers published prior to September 2013, six trials were identified ($n=674$ fibromyalgia syndrome participants).²³ Analyses revealed low quality evidence for short term improvement of quality of life (SMD= -0.35 ; 95% CI= -0.57 to -0.12 ; $P=0.002$) and pain (SMD= -0.23 ; 95% CI -0.46 to -0.01 ; $P=0.04$) after MBSR, when compared to usual care; and for short-term improvement of quality of life (SMD= -0.32 ; 95% CI -0.59 to -0.04 ; $P=0.02$) and pain (SMD= -0.44 ; 95% CI -0.73 to -0.16 ; $P=0.002$) after MBSR, when compared to active control interventions. Long-term effects on quality of life and pain were not statistically significant. Effects were not robust against bias.

HIV/AIDS

- A systematic review was published on 11 studies that examined MBSR as an intervention for HIV positive populations.²⁴ Of the studies, six were randomized designs, one was a quasi-experimental design, and the remaining four were pre- and post-test designs. The preliminary outcomes support MBSR to decrease emotional distress with mixed evidence for impact on disease progression. Effect sizes were generally small to moderate in magnitude.

Irritable Bowel Syndrome

- Two systematic reviews^{10,25} identified one study²⁶ that suggested MBSR group had significantly greater improvement in IBS symptom severity than controls at posttreatment;

however, there were no differences between groups at 6-month follow-up. There was no effect on quality of life at posttreatment or at 6-month follow-up. Impacts of MBSR on IBS appear to be minimally studied.

Mediators

- In a systematic review of mediation studies for MBSR or MBCT, the most consistent, the consistent finding was that greater self-reported change in mindfulness mediated superior clinical outcomes.²⁷ However, there are few studies to date formally evaluating mediation. This review included RCTs and controlled trials published prior to July 2015, and included four studies examining mechanisms of mindfulness interventions in those with comorbid psychological and physical health problems, and 14 studies in those with psychological conditions.
- A systematic review of 20 papers published prior to October 2014 focused on performing a meta-analysis using structural equation modeling mediation analyses evaluating mechanisms by which MBCT or MBSR influence health outcomes.²⁸
 - o Mental health outcomes (depression, anxiety, stress, distress, negative affectivity) were the most commonly assessed across studies (k = 18).
 - o The most commonly tested mechanism across studies was mindfulness (k = 16), followed by rumination (k = 7), worry and concerns (k = 5), and self-compassion (k = 3).
 - o In the 12 RCTs and 4 quasi-experimental studies (n=1109) which examined mindfulness as a mediator in studies of MBCT/MBSR, findings showed support for mindfulness as a mediator, using structural equation modeling. A Sobel test demonstrated that mindfulness significantly partially mediated the effects of MBIs on mental health outcomes (p<.001).
 - o In the 5 RCTs and 3 quasi-experimental studies (n=586) which examined mindfulness as a mediator in studies of MBCT/MBSR, findings showed support for repetitive negative thinking as a mediator, using structural equation modeling. A Sobel test demonstrated that repetitive negative thinking significantly partially mediated the effects of MBIs on mental health outcomes (p<.001).
 - o Self-compassion was shown to be a significant mediator in one of three studies that evaluated it.
 - o Cognitive and emotional reactivity was shown to be a significant mediator in both studies that tested it.
 - o Many plausible mechanisms remain that have been proposed in theoretical frameworks, such as attentional control, interoceptive awareness. This systematic review did not identify any studies which have tested these variables as mediators of MBCT or MBSR.

Pain

- A systematic review of MBSR vs. Cognitive Behavioral Therapy vs. standard care, of publications prior to October 2017 included 21 studies: 13 CBT vs control (n=1095), 7 MBSR vs control (n=545) and 1 MBSR vs CBT vs control (n=341). Of the 21 articles, 12 were determined to be of fair or good quality. Findings for change in physical functioning, pain intensity and depression revealed clinically important advantages relative to control (p<0.05) for MBSR and CBT, but no evidence of an important difference between MBSR and CBT was found.³³
- A systematic review of MBI's by Goldberg et al.¹ that evaluated studies published up to January 2017, showed k=12 (n=1532) studies with in active control groups, and k=8 studies with specific active control (n=945) focused on pain. They did not perform a meta-analysis

specific for MBSR. Finding showed that MBI's had significant effects on pain compared to inactive controls, but not compared to specific active controls.

- In a systematic review and meta-analysis of MBSR/MBCT studies published prior to June 2017, five randomized controlled trials (two on tension-type headache; one on migraine; two with mixed samples) with a total of 185 participants were included.²⁹ Three of these studies were MBSR. Compared to usual care, MBSR/MBCT did not improve headache frequency (three randomized controlled trials; standardized mean difference =0.00; 95% confidence interval =-0.33,0.32) or headache duration (three randomized controlled trials; standardized mean difference =-0.08; 95% confidence interval =-1.03, 0.87). Similarly, no significant difference between groups was found for pain intensity (five randomized controlled trials; standardized mean difference =-0.78; 95% confidence interval =-1.72, 0.16), with borderline significant p-value of 0.08. Due to the low number, small scale and often high or unclear risk of bias of included randomized controlled trials, the results are imprecise; this may be consistent with either an important or negligible effect. More rigorous trials with larger sample sizes are needed.
- In an AHRQ-funded systematic review and meta-analysis on non-pharmacologic treatments for chronic pain on paper published up to November 2017, evidence on MBSR was as follows:³⁰
 - o *Lower back pain:*
 - There was no evidence of differences between mindfulness-based stress reduction (MBSR) versus usual care or an attention control in short-term function (4 trials, pooled SMD -0.25, 95% CI -0.53 to 0.04), intermediate-term function (1 trial, SMD -0.20, 95% CI -0.47 to 0.06) or long-term function (1 trial, SMD -0.20, 95% CI -0.47 to 0.06) (Strength of Evidence: low).
 - MBSR was associated with slightly greater effects than usual care or an attention control on short-term pain (3 trials, pooled difference -0.73 on a 0 to 10 scale, 95% CI -1.18 to -0.28), after excluding two poor-quality trials; MBSR was also associated with small effects on intermediate-term pain (1 trial, difference -0.75, 95% CI -1.17 to -0.33), with no statistically significant effects on long-term pain (1 trial, SMD -0.22, 95% CI -0.64 to 0.20) (Strength of Evidence: moderate for short term, low for intermediate and long term).
 - o *Fibromyalgia*
 - No clear short-term effects of MBSR were seen on function compared with waitlist or an attention control (mean difference 0 to 0.06 on a 0-10 scale) in two trials (Strength of Evidence: moderate).
 - No clear short-term effects of MBSR on pain (mean difference 0.1 on a 0-100 VAS pain scale in one trial; mean difference -1.38 to -1.59 on the affective and -0.28 to -0.71 on the sensory dimension [scales not reported] of the Pain Perception Scale in one trial) compared with waitlist or an attention control in two trials (Strength of Evidence: moderate). Intermediate and long-term outcomes were not reported.
 - o Note that many MBSR interventions included were modified (e.g. shorter durations of classes), and the systematic review only used Medline, Cochrane and clinicaltrials.gov databases to search for papers.
- A systematic review by a similar group as the AHRQ report above on randomized clinical trials published up to November 2016 demonstrated MBSR (Strength of Evidence: moderate) is effective for treating chronic low back pain³¹.
- A systematic review and meta-analysis on MBSR for lower back pain on papers published prior to June 2016 found seven RCTs involving 864 patients with low back pain³². The search strategy included Medline, Cochrane, EMBASE, PsychInfo, and other databases (more databases than above AHRQ review). Compared with usual care, MBSR was

associated with short-term improvements in pain intensity (4 RCTs; mean difference [MD], -0.96 point on a numerical rating scale [95% CI, -1.64 to -0.34 point]; standardized mean difference [SMD], -0.48 point [CI, -0.82 to -0.14 point]) and physical functioning (2 RCTs; MD, 2.50 [CI, 0.90 to 4.10 point]; SMD, 0.25 [CI, 0.09 to 0.41 point]) that were not sustained in the long term (see figure below). Between-group differences in disability, mental health, pain acceptance, and mindfulness were not significant at short- or long-term follow-up. Compared with an active comparator (e.g. health education, cognitive behavioral therapy), MBSR was not associated with significant differences in short- or long-term outcomes. No serious adverse events were reported.

Physical Functioning

- A systematic review of MBSR vs. Cognitive Behavioral Therapy vs. standard care, of publications prior to October 2017 included 21 studies: 13 CBT vs control (n=1095), 7 MBSR vs control (n=545) and 1 MBSR vs CBT vs control (n=341). Of the 21 articles, 12 were determined to be of fair or good quality. Findings for change in physical functioning, pain intensity and depression revealed clinically important advantages relative to control for MBSR and CBT, but no evidence of an important difference between MBSR and CBT was found (see figure below).³³
- A systematic review and meta-analysis of 14 clinical trial MBSR studies (n=1505) of participants with breast cancer demonstrated statistically significant results were found of MBSR on physical function (SMD = 0.28, P = 0.008) (Figure below). Included studies were those published prior to February-May 2018. Note that this systematic review only included clinical trials with control groups, but some were RCTs, and others were not. The Newcastle-Ottawa Quality Assessment Scale (NOS) was used to evaluate methodological quality of non-randomized studies.¹⁴

PTSD:

- A systematic review of papers published prior to November 2015 identified 5 MBSR RCT studies evaluating impacts on PTSD. Of the three studies on PTSD symptoms, there was an overall effect size of standardized mean difference (SMD) = -0.43 (95% CI: -2.23, 1.37), favoring MBSR. Of the three studies on depressive symptoms in those with PTSD, there was an overall SMD effect size of -0.48 (95% CI: -1.63, 0.68), favoring MBSR. Statistical power may be an issue, given only three studies went into each meta-analysis.

Quality of Life:

- In a systematic review and meta-analysis of papers published prior to September 2013, six trials were identified (n=674 fibromyalgia syndrome participants)²³. Analyses revealed low quality evidence for short term improvement of quality of life (SMD=-0.35; 95% CI -0.57 to -0.12; P=0.002) and pain (SMD=-0.23; 95% CI -0.46 to -0.01; P=0.04) after MBSR, when compared to usual care; and for short-term improvement of quality of life (SMD=-0.32; 95% CI -0.59 to -0.04; P=0.02) and pain (SMD=-0.44; 95% CI -0.73 to -0.16; P=0.002) after MBSR, when compared to active control interventions. Long-term effects on quality of life and pain were not statistically significant. Effects were not robust against bias.
- In a systematic review of MBSR in “healthy” individuals (not well defined what healthy is) for studies published up to September 2014, four studies with control groups were identified that evaluated impacts on quality of life⁸. They showed an overall Hedge’s g of 0.53 (p<0.00001), suggesting moderate effect size. This review included modified MBSR interventions such as phone-delivered, low dose and a web-based delivery. It included randomized controlled trials, along with uncontrolled and non-randomized controlled trials.

Sleep:

- A systematic review and meta-analyses was performed on mindfulness RCTs with either non-specific or specific active controls published through May 2018. Eighteen trials with 1654 participants were included. At posttreatment and follow-up, there was low strength of evidence that mindfulness meditation interventions had no effect on sleep quality compared with specific active controls (ES 0.03 (95% CI -0.43 to 0.49)) and (ES -0.14 (95% CI -0.62 to 0.34)), respectively. Additionally, there was moderate strength of evidence that mindfulness meditation interventions significantly improved sleep quality compared with nonspecific active controls at postintervention (ES 0.33 (95% CI 0.17-0.48)) and at follow-up (ES 0.54 (95% CI 0.24-0.84)). These preliminary findings suggest that mindfulness meditation may be effective in treating some aspects of sleep disturbance. See figures below for more detail. Note that yellow highlighted studies in Figure 2 are MBSR. This suggests effect of MBSR, but a specific meta-analysis just for MBSR was not done, which is a gap in the literature.

Stress

- A systematic review and meta-analysis of 6 clinical trial MBSR studies of participants with breast cancer demonstrated statistically significant results were found of MBSR on stress (SMD = - 0.48, P = 0.004), distress (SMD = - 0.56, P = 0.0002) and mindfulness (SMD= 0.94, P = 0.03). Included studies were those published prior to February-May 2018. Note that this systematic review only included clinical trials with control groups, but some were RCTs, and others were not. The Newcastle-Ottawa Quality Assessment Scale (NOS) was used to evaluate methodological quality of non-randomized studies.¹⁴
- In a systematic review of 9 studies evaluating mindfulness interventions on biological measures of stress in workplace settings published prior to September 2017, findings were mixed and generally few.³⁴ Four of the studies used MBSR. Specifically, mindfulness interventions were found to be effective at reducing cortisol production, as indicated by lowered high and low diurnal cortisol slopes. However, no changes were found for cortisol awakening response or concentrations for single a.m. and p.m. time-points. In one or two studies, MBIs also improved autonomic balance, assessed by heart rate variability coherence measures, but not blood pressure. Sympathetic nervous system reactivity as measured by salivary alpha amylase was also reduced following mindfulness intervention in one study.
- In a systematic review of MBSR in “healthy” individuals for studies published up to September 2014, nine studies with control groups were identified that evaluated impacts on stress.⁸ They showed an overall Hedge’s g of 0.74 (p<0.00001), suggesting a fairly large effect size. This review included modified MBSR interventions such as phone-delivered, low dose and a web-based delivery. It included randomized controlled trials, along with uncontrolled and non-randomized controlled trials.
- In a systematic review of RCTs published through November 2012 with active control groups, mindfulness interventions were shown to have low evidence on improving stress vs. non-specific active controls, and not to outperform active controls. These interventions included MBSR and other mindfulness programs.³⁵

Substance Use

- A systematic review and meta-analysis was performed on randomized and non-randomized controlled trials, utilizing mindfulness-based and mindfulness-informed interventions.³⁶ All studies focused on alcohol and drug use disorders, and were published through August 2017. Thirty-seven studies were included (n = 3,531 patients). Of these, only two were MBSR. Overall, the meta-analyses of all mindfulness interventions showed null effect sizes for attrition rate and overall mental health. Small effect sizes were detected in abstinence, levels of perceived stress, and avoidance coping strategies. Moderate effect sizes were

revealed in anxiety and depressive symptoms. Large effect sizes were associated to levels of perceived craving, negative affectivity, and post-traumatic symptoms.

Workplace

- In a systematic review of MBSR-informed interventions in workplace settings on articles published up to October 2015,²⁰ two studies evaluated impacts on anxiety, and showed significant improvements on anxiety.^{37,38} In a systematic review (no meta-analysis) on effects of MBSR on employee's mental health in articles published prior to October 2015, depression was examined in five studies.²⁰ Two studies found a significant decrease of depression in the TG and in the TG compared to CG, one study reported a significant reduction in the TG, and the other two studies mentioned no significant results. In summary, it is plausible that MBSR results in decreased levels of depression, but no meta-analysis was performed. This review included MBSR-informed interventions as low dose as four 30-minute sessions.
- For the Janssen et al systematic review,²⁰ 24 articles were identified, describing 23 studies: 22 on the effects of MBSR and 1 on the effects of MBSR in combination with some aspects of MBCT. Since no study focused exclusively on MBCT, its effects are not described in this systematic review. Of the 23 studies, 2 were of high methodological quality, 15 were of medium quality and 6 were of low quality. A meta-analysis was not performed due to the emergent and relatively uncharted nature of the topic of investigation, the exploratory character of this study, and the diversity of outcomes in the studies reviewed. Based on their analysis, the strongest outcomes were reduced levels of emotional exhaustion (a dimension of burnout), stress, psychological distress, depression, anxiety, and occupational stress. Improvements were found in terms of mindfulness, personal accomplishment (a dimension of burnout), (occupational) self-compassion, quality of sleep, and relaxation. This review included MBSR-informed interventions as low dose as four 30-minute sessions.
- In a systematic review of 9 studies evaluating mindfulness interventions on biological measures of stress in workplace settings published prior to September 2017, findings were mixed and generally few³⁴. Four of the studies used MBSR (they don't identify which ones). Specifically, mindfulness interventions were found to be effective in reducing cortisol production, as indicated by lowered high and low diurnal cortisol slopes. However, no changes were found for cortisol awakening response or concentrations for single a.m. and p.m. time-points. See figure below. In one or two studies, MBIs also improved autonomic balance, assessed by heart rate variability coherence measures, but not blood pressure. Sympathetic nervous system reactivity as measured by salivary alpha amylase was also reduced following MBI in one study.
- In a systematic review of MBSR/MBSR-informed interventions (controlled and uncontrolled studies) in health care professionals published prior to January 2015, seven studies specifically measured empathy in HCPs. Five (5/7, 71%) studies found that MBSR improves HCPs empathy. All measures were self-descriptions of empathy.³⁹

References

1. Goldberg SB, Tucker RP, Greene PA, et al. Mindfulness-based interventions for psychiatric disorders: A systematic review and meta-analysis. *Clinical psychology review*. 2018;59:52-60.
2. Iranshahri B, Jenaabadi H. The Effectiveness of Mindfulness Therapy in Controlling under Treatment Addicts' Drug Cravings. *Open Journal of Medical Psychology*. 2015;4:88-98.
3. Carriere K, Khoury B, Gunak MM, Knauper B. Mindfulness-based interventions for weight loss: a systematic review and meta-analysis. *Obes Rev*. 2018;19(2):164-177.

4. Li SYH, Bressington D. The effects of mindfulness-based stress reduction on depression, anxiety, and stress in older adults: A systematic review and meta-analysis. *Int J Ment Health Nurs*. 2019.
5. Jansen P, Dahmen-Zimmer K, Kudielka BM, Schulz A. Effects of Karate Training Versus Mindfulness Training on Emotional Well-Being and Cognitive Performance in Later Life. *Res Aging*. 2017;39(10):1118-1144.
6. Moss AS, Reibel DK, Greeson JM, et al. An adapted mindfulness-based stress reduction program for elders in a continuing care retirement community: quantitative and qualitative results from a pilot randomized controlled trial. *J Appl Gerontol*. 2015;34(4):518-538.
7. Zhang JX, Liu XH, Xie XHea. Mindfulness based stress reduction for chronic insomnia in adults older than 75 years: A randomized, controlled, single-blind clinical trial. *Explore: The Journal of Science and Healing*. 2015;11:180-185.
8. Khoury B, Sharma M, Rush SE, Fournier C. Mindfulness-based stress reduction for healthy individuals: A meta-analysis. *J Psychosom Res*. 2015;78(6):519-528.
9. Strauss C, Cavanagh K, Oliver A, Pettman D. Mindfulness-based interventions for people diagnosed with a current episode of an anxiety or depressive disorder: a meta-analysis of randomised controlled trials. *PLoS One*. 2014;9(4):e96110.
10. Crowe M, Jordan J, Burrell B, Jones V, Gillon D, Harris S. Mindfulness-based stress reduction for long-term physical conditions: A systematic review. *Aust N Z J Psychiatry*. 2016;50(1):21-32.
11. Pbert L, Madison JM, Druker S, et al. Effect of mindfulness training on asthma quality of life and lung function: a randomised controlled trial. *Thorax*. 2012;67(9):769-776.
12. Abbott RA, Whear R, Rodgers LR, et al. Effectiveness of mindfulness-based stress reduction and mindfulness based cognitive therapy in vascular disease: A systematic review and meta-analysis of randomised controlled trials. *J Psychosom Res*. 2014;76(5):341-351.
13. Solano Lopez AL. Effectiveness of the Mindfulness-Based Stress Reduction Program on Blood Pressure: A Systematic Review of Literature. *Worldviews Evid Based Nurs*. 2018.
14. Zhang Q, Zhao H, Zheng Y. Effectiveness of mindfulness-based stress reduction (MBSR) on symptom variables and health-related quality of life in breast cancer patients- a systematic review and meta-analysis. *Support Care Cancer*. 2019;27(3):771-781.
15. Lao SA, Kissane D, Meadows G. Cognitive effects of MBSR/MBCT: A systematic review of neuropsychological outcomes. *Consciousness and cognition*. 2016;45:109-123.
16. Feliu-Soler A, Cebolla A, McCracken LM, et al. Economic Impact of Third-Wave Cognitive Behavioral Therapies: A Systematic Review and Quality Assessment of Economic Evaluations in Randomized Controlled Trials. *Behavior therapy*. 2018;49(1):124-147.
17. Lengacher CA, Kip KE, Reich RR, et al. A Cost-Effective Mindfulness Stress Reduction Program: A Randomized Control Trial for Breast Cancer Survivors. *Nurs Econ*. 2015;33(4):210-218, 232.
18. Knight RW, Bean J, Wilton AS, Lin E. Cost-effectiveness of the mindfulness-based stress reduction methodology. *Mindfulness*. 2015;6:1379-1386.
19. Herman PM, Anderson ML, Sherman KJ, Balderson BH, Turner JA, Cherkin DC. Cost-effectiveness of Mindfulness-based Stress Reduction Versus Cognitive Behavioral Therapy or Usual Care Among Adults With Chronic Low Back Pain. *Spine (Phila Pa 1976)*. 2017;42(20):1511-1520.
20. Janssen M, Heerkens Y, Kuijer W, van der Heijden B, Engels J. Effects of Mindfulness-Based Stress Reduction on employees' mental health: A systematic review. *PLoS One*. 2018;13(1):e0191332.

21. Chi X, Bo A, Liu T, Zhang P, Chi I. Effects of Mindfulness-Based Stress Reduction on Depression in Adolescents and Young Adults: A Systematic Review and Meta-Analysis. *Frontiers in psychology*. 2018;9:1034.
22. Parsons CE, Crane C, Parsons LJ, Fjorback LO, Kuyken W. Home practice in Mindfulness-Based Cognitive Therapy and Mindfulness-Based Stress Reduction: A systematic review and meta-analysis of participants' mindfulness practice and its association with outcomes. *Behaviour research and therapy*. 2017;95:29-41.
23. Lauche R, Cramer H, Dobos G, Langhorst J, Schmidt S. A systematic review and meta-analysis of mindfulness-based stress reduction for the fibromyalgia syndrome. *J Psychosom Res*. 2013;75(6):500-510.
24. Riley KE, Kalichman S. Mindfulness-based stress reduction for people living with HIV/AIDS: preliminary review of intervention trial methodologies and findings. *Health Psychol Rev*. 2015;9(2):224-243.
25. Thakur ER, Shapiro J, Chan J, et al. A Systematic Review of the Effectiveness of Psychological Treatments for IBS in Gastroenterology Settings: Promising but in Need of Further Study. *Dig Dis Sci*. 2018.
26. Zernicke KA, Campbell TS, Blustein PK, et al. Mindfulness-based stress reduction for the treatment of irritable bowel syndrome symptoms: a randomized wait-list controlled trial. *Int J Behav Med*. 2013;20(3):385-396.
27. Alsubaie M, Abbott R, Dunn B, et al. Mechanisms of action in mindfulness-based cognitive therapy (MBCT) and mindfulness-based stress reduction (MBSR) in people with physical and/or psychological conditions: A systematic review. *Clinical psychology review*. 2017;55:74-91.
28. Gu J, Strauss C, Bond R, Cavanagh K. How do mindfulness-based cognitive therapy and mindfulness-based stress reduction improve mental health and wellbeing? A systematic review and meta-analysis of mediation studies. *Clinical psychology review*. 2015;37:1-12.
29. Anheyer D, Leach MJ, Klose P, Dobos G, Cramer H. Mindfulness-based stress reduction for treating chronic headache: A systematic review and meta-analysis. *Cephalalgia*. 2019;39(4):544-555.
30. Skelly AC, Chou R, Dettori JR, et al. Noninvasive Nonpharmacological Treatment for Chronic Pain: A Systematic Review. *AHRQ Publication No 18-EHC013-EF*. 2018.
31. Chou R, Deyo R, Friedly J, et al. Nonpharmacologic Therapies for Low Back Pain: A Systematic Review for an American College of Physicians Clinical Practice Guideline. *Ann Intern Med*. 2017;166(7):493-505.
32. Anheyer D, Haller H, Barth J, Lauche R, Dobos G, Cramer H. Mindfulness-Based Stress Reduction for Treating Low Back Pain: A Systematic Review and Meta-analysis. *Ann Intern Med*. 2017;166(11):799-807.
33. Khoo EL, Small R, Cheng W, et al. Comparative evaluation of group-based mindfulness-based stress reduction and cognitive behavioural therapy for the treatment and management of chronic pain: A systematic review and network meta-analysis. *Evid Based Ment Health*. 2019;22(1):26-35.
34. Heckenberg RA, Eddy P, Kent S, Wright BJ. Do workplace-based mindfulness meditation programs improve physiological indices of stress? A systematic review and meta-analysis. *J Psychosom Res*. 2018;114:62-71.
35. Goyal M, Singh S, Sibinga EM, et al. Meditation programs for psychological stress and well-being: A systematic review and meta-analysis. *JAMA internal medicine*. 2014;174(3):357-368.
36. Cavicchioli M, Movalli M, Maffei C. The Clinical Efficacy of Mindfulness-Based Treatments for Alcohol and Drugs Use Disorders: A Meta-Analytic Review of

- Randomized and Nonrandomized Controlled Trials. *Eur Addict Res.* 2018;24(3):137-162.
37. Vega BR, Melero-Llorente J, Perez CB, Cebolla S, Mira J, Valverde Cea. Impact of mindfulness training on attentional control and anger regulation processes for psychotherapists in training. . *Psychotherapy Research.* 2014;24(2):202-213.
 38. Roeser RW, Schonert-Reichl KA, Jha A, Cullen M, Wallace L, Wilensky Rea. Mindfulness training and reductions in teachers stress and burnout: results of two randomized, waitlist-control field trials. *Psychology.* 2013. :<https://doi.org/10.1037/a0032093>.
 39. Lamothe M, Rondeau E, Malboeuf-Hurtubise C, Duval M, Sultan S. Outcomes of MBSR or MBSR-based interventions in health care providers: A systematic review with a focus on empathy and emotional competencies. *Complement Ther Med.* 2016;24:19-28.