

## **Review: Multiple Sclerosis and Related Disorders**

# The effectiveness of emotional wellness programs on mental health outcomes for adults with multiple sclerosis: a systematic review and meta-analysis

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## Abstract

**Background:** People with multiple sclerosis (MS) have a greater prevalence of depression and anxiety than the general population. Emotional wellness programs (any psychological or psychosocial interventions that focus on awareness, acceptance, managing, or challenging thoughts and feelings) could be important for people with MS. However, there have been no reviews on the effectiveness of emotional wellness programs for people with MS. The objective of this review was to determine the effectiveness of emotional wellness programs on mental health outcomes for adults with MS.

**Inclusion criteria:** Randomised controlled trials (RCTs) and quasi-experimental trials evaluating emotional wellness programs for adults with any form of MS were included. Mental health outcomes included were depression, anxiety, quality of life, and stress. The comparator groups were waitlist controls, usual care, or another intervention.

**Methods:** This review was registered with PROSPERO (registration number CRD42019131082) and conducted in accordance with PRISMA guidelines. CINAHL, Cochrane, MEDLINE, PsycInfo, Web of Science, ProQuest Dissertations and Theses, Cochrane register of Controlled Trials, and Google Scholar were searched for English- language publications. Titles and abstracts were initially screened, followed by a screen of full text articles. Studies were critically appraised for methodological quality using the JBI standardised critical appraisal checklists. Data were extracted on intervention details, study outcome measures, behaviour change techniques, and results. Random effects meta-analyses were performed for outcomes assessed in at least five studies, with results reported as the standardised mean difference (SMD).

**Results:** This review comprised 25 RCTs and four quasi-experimental studies ( $n$  participants=2323); 21 were included in meta-analyses. Meta-analyses produced statistically significant results favouring the interventions (SMD (95% CI) for depression -0.55 (-0.87, -0.24); anxiety -0.42 (-0.70, -0.14); quality of life 0.28 (0.14, 0.43); and stress -1.00 (-1.58, -0.43)). The most commonly used behaviour change techniques were behaviour practice/rehearsal, social comparison, and social support.

**Conclusions:** This review provides evidence to support the effectiveness of emotional wellness programs for improving mental health outcomes in adults with MS. However, these findings should be interpreted with caution given the high degree of heterogeneity between the studies, and potential for biases in analysis due to missing data and/or incomplete reporting.

**Keywords:** Anxiety; behavior change techniques; depression; emotional wellness; quality of life; stress

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# 1. Introduction

The prevalence of depression and anxiety is greater among people with MS (pwMS) than in the general population.<sup>1</sup> These mental health co-morbidities are underdiagnosed and undertreated in pwMS,<sup>2</sup> impacting on quality of life.<sup>3</sup> These co-morbidities impose limitations on daily life activities<sup>4</sup> and are strongly associated with fatigue,<sup>5</sup> which is described as the most common and disabling symptom of MS.<sup>6</sup> According to a recent systematic review, higher levels of stress (as measured by basal cortisol levels) may be associated with depression, anxiety, and MS progression.<sup>7</sup> Given the relationship between mental health and quality of life, interventions that address depression and anxiety may reasonably improve quality of life for pwMS.<sup>3</sup>

Wellness is a high priority for pwMS,<sup>8</sup> and may enhance health-related quality of life.<sup>9</sup> There is interest from pwMS in learning how to manage their MS with diet and exercise, and to develop strategies to manage depression and other mood changes to achieve emotional wellness,<sup>8</sup> i.e. the ability to manage and adapt to stresses and difficult circumstances in one's life.<sup>10</sup> Given this need, the United States National MS Society established the Wellness Research Working Group, which has defined three approaches for wellness in MS: diet, exercise, and emotional wellness.<sup>11</sup> Determining the effectiveness of these approaches has been identified as areas of future research priority.<sup>8</sup> Effective education programs employ a number of recognised techniques to support change in the targeted behaviours, as identified by Michie et al. in their 93-item behaviour change technique (BCT) taxonomy.<sup>12</sup> Identifying which BCTs are used in emotional wellness programs for pwMS could help characterise elements of effective programs. This review will focus on emotional wellness programs, defined as any psychological (e.g. cognitive behavioural therapy) or psychosocial (e.g. supportive group interactions or non-directive counselling) interventions that focus on awareness, acceptance, managing, or changing/challenging thoughts and feelings, including feelings of depression, anxiety, and stress.<sup>13</sup> Such programs (including those using cognitive behaviour therapy<sup>14</sup> and mindfulness techniques<sup>15 16</sup>) have been reported as effective for improving mental health in pwMS.

To our knowledge, there have been no systematic reviews focusing solely on the effectiveness of emotional wellness programs for pwMS. Several reviews have examined self-management interventions or strategies for pwMS (skills to manage the daily emotional, physical, and social aspects of living with a chronic condition);<sup>17-19</sup> wellness interventions (nutrition, exercise, and emotional wellness, for people with progressive MS,<sup>20</sup> and people with chronic disabling conditions including MS<sup>21</sup>); mindfulness;<sup>22</sup> and stress-management.<sup>23</sup> Overall, accumulating evidence from reviews supports such interventions for improving mental health; however, it is difficult to make definitive conclusions due to the small number of included studies and methodological heterogeneity. Furthermore, identification of BCTs used in this field is lacking. The primary objective of this review was to determine the effectiveness of emotional wellness programs on mental health outcomes

(depression, anxiety, quality of life, and stress) for adults with MS. The secondary objective was to assess BCTs used in emotional wellness programs for adults with MS.

## 2. Methods

This systematic review was carried out according to an *a priori* protocol (registration number: PROSPERO CRD42019131082), in accordance with the Joanna Briggs Institute (JBI) methodology for systematic reviews of effectiveness.<sup>24</sup>

### 2.1 Inclusion criteria

This review considered studies involving adults with a clinical diagnosis of MS. The included interventions were emotional wellness programs (any structured psychological or psychosocial interventions) running for more than one session. The interventions were in any format (in-person, online, or via telephone), and individual or group-based. To be eligible for inclusion, content/topics of programs must have been standardised for all participants (i.e. individualised programs were excluded). Programs based on exercise or diet were excluded. Eligible comparators were: waitlist control group, usual care comparator group (no intervention), or another intervention. Outcomes of interest were depression, anxiety, quality of life, and stress. This review included quantitative studies (randomized controlled trials (RCTs) and quasi-experimental trials) published in the English language.

### 2.2 Search strategy

A three-step search strategy was adopted following JBI guidelines. In brief, an initial search limited to MEDLINE and CINAHL was undertaken to identify articles (Appendix A), followed by a full search strategy. The search was conducted in April 2019 and updated in September 2019. No limitations were applied based on publication date. To account for differences in Medical Subject Headings (MeSH) terms and Boolean operators, the search strategy was adapted for each information source. For published literature, we searched CINAHL, Cochrane, MEDLINE, PsycInfo, and Web of Science; for unpublished studies and grey literature, we searched Cochrane Central Register of Controlled Trials, ProQuest Dissertations and Theses, and Google Scholar. Reference lists of all included studies and were screened for additional studies.

### 2.3 Study selection

All citations were uploaded into EndNote X9 (Clarivate Analytics, PA, USA). Titles and abstracts were screened by RDR. Potentially relevant studies were imported into the JBI System for the Unified Management, Assessment and Review of Information (JBI SUMARI) (2019, Joanna Briggs Institute, Adelaide, Australia). Two independent reviewers (AB and RDR) screened full text articles for final inclusion. Any disagreements between the reviewers were resolved through discussion.

## 2.4 Assessment of methodological quality

The first author (RDR) assessed methodological quality using the JBI critical appraisal checklists for quasi-experimental trials and RCTs.<sup>24</sup> For a study to receive a positive ('yes') rating for each question, the required information had to be clearly stated in the article. If the reporting was vague, the item was rated as 'unclear'. If reporting was insufficient, the study received a poor ('no') rating. Studies scoring less than 50% overall were excluded from statistical synthesis due to poor methodological quality, but were included in the narrative review.

## 2.5 Data extraction

The following data were extracted: aim, study characteristics (authors, year, country), participant details (type of MS, sample size, age, sex, duration of MS), intervention details (type, number of study arms, description of intervention, type of comparator group, duration and number of sessions, delivery method), BCTs (classified according to the BCT taxonomy by Michie and colleagues<sup>12</sup>), behaviour change theory used, tools used to measure outcomes (Appendix B), and results. Authors were contacted to request missing data, and a second request was sent four weeks later, where required. Missing post-intervention standard deviation (SD) scores were calculated using confidence interval (CI) values with the following formula (sample sizes were less than 60):

$$SD = \sqrt{n} \times (\text{upper limit CI} - \text{lower limit CI}) / t \text{ value}$$

t values were obtained by entering =TINV(1-0.95,n-1) into a Microsoft Excel spreadsheet.<sup>25</sup>

## 2.6 Data synthesis and meta-analysis

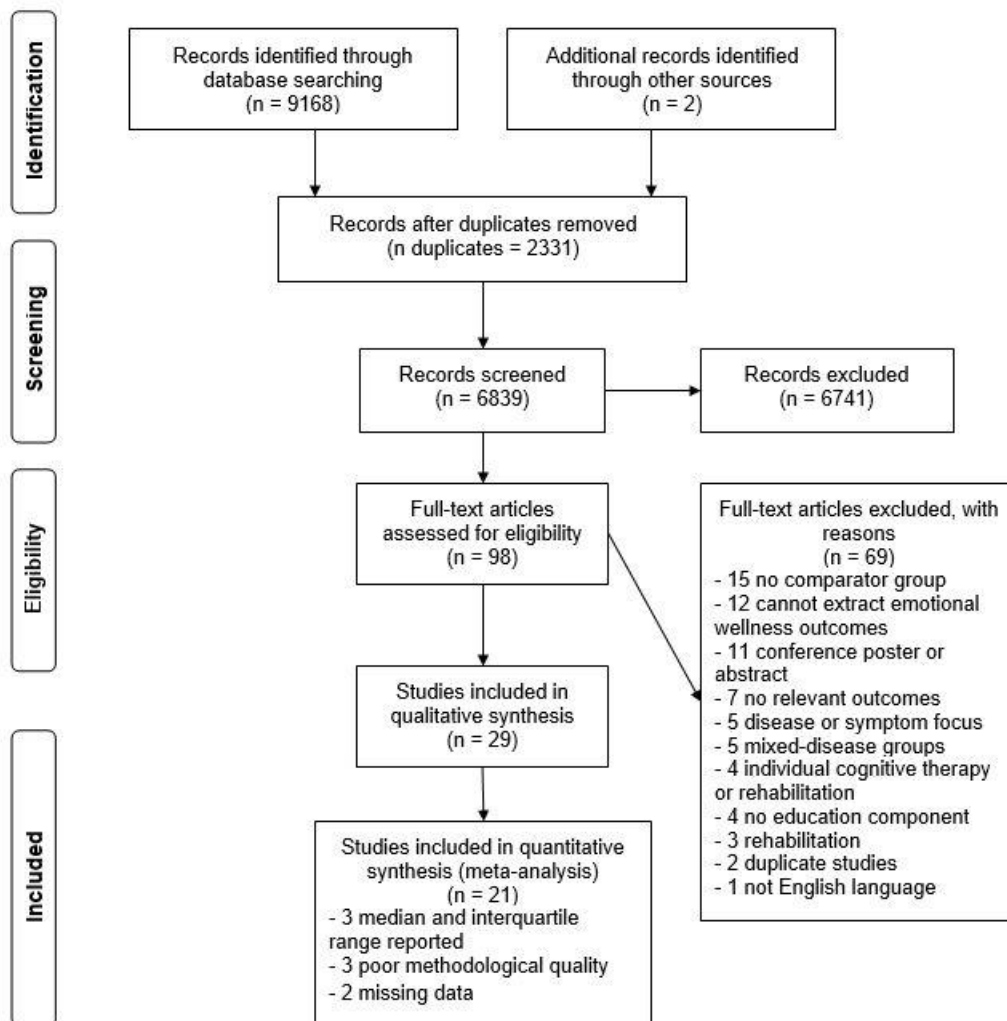
Data were pooled with statistical meta-analysis using JBI SUMARI (2019, Joanna Briggs Institute, Adelaide, Australia). Effect sizes were expressed as post-intervention standardized mean differences (SMDs), and their 95% confidence intervals (CIs). An SMD of 0.2 = small effect size; 0.5 = medium; and 0.8 = large.<sup>26</sup> Statistical analyses were performed using a random effects meta-analysis regression model with inverse variance. Statistical heterogeneity was assessed using the standard chi-squared test (Cochran Q test;  $P < 0.10$  signified significant heterogeneity<sup>27</sup>), and the  $I^2$  index (where 25%, 50%, and 75% indicated low, moderate, and high degrees of heterogeneity, respectively<sup>28</sup>). Subgroup analyses were conducted as follows: intervention duration (eight weeks or more); method of delivery (in-person); comparator type (waitlist control); and intervention type (mindfulness only). Using meta-regression, we investigated potential predictors to explain high degrees of heterogeneity for outcomes with at least ten studies (depression and anxiety).<sup>29</sup> For each outcome, the following covariates were included in a single meta-regression model: mean participant age (years), mean time since diagnosis (years), percentage of females, in-person intervention (vs. teleconference/videoconference), minimum eight week intervention (vs. less than eight weeks), studies with waitlist comparators (vs. active comparators), and mindfulness intervention (vs. other). To test for publication bias, funnel plots were generated, and the Egger's test for asymmetry (where  $P < 0.05$  indicates bias) using the "trim and fill" method was performed for outcomes with at least ten

studies<sup>30</sup> (depression, anxiety, and quality of life). Stata software (StataCorp, College Station, TX, USA) was used for meta-regression analyses and tests of publication bias.

### 3. Results

#### 3.1 Search results

Database searches retrieved 9168 articles. Once duplicates were removed, 6839 articles were screened by title and abstract. Full text articles were accessed for the remaining studies, and 69 were excluded (Appendix C). We included 29 studies in the narrative review, with 21 studies included in the meta-analyses (16 reporting depression; 16 anxiety; 12 quality of life; and 7 stress) (**Figure 1**). Eight studies were not used in meta-analyses for the following reasons: three studies reported median and interquartile range (IQR) instead of mean and standard deviation (SD);<sup>31-33</sup> three scored too low on assessment of methodological quality;<sup>34-36</sup> and two had missing data.<sup>37, 38</sup>



**Figure 1** PRISMA flowchart of article screening process<sup>39</sup>

### 3.2 Methodological quality and publication bias

Studies were appraised for methodological quality using the JBI critical appraisal checklists for quasi-experimental studies and RCTs.<sup>24</sup> Four studies were quasi-experimental trials<sup>40-43</sup> (**Table 1**), and the remaining studies were RCTs<sup>14-16, 31-38, 44-57</sup> (**Table 2**). None of the quasi-experimental trials included multiple measurements of the outcome both pre- and post- intervention (Q5, **Table 1**), and only two trials stated the reliability of the tools.<sup>40, 42</sup>

**Table 1** Assessment of methodological quality for quasi-experimental studies

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Score %
Calandri <i>et al.</i> <sup>40</sup>	Y	Y	Y	Y	N	Y	Y	Y	Y	89
Crescentini <i>et al.</i> <sup>41</sup>	Y	Y	Y	Y	N	N	Y	U	Y	67
Hoogerwerf <i>et al.</i> <sup>42</sup>	Y	Y	Y	Y	N	Y	Y	Y	Y	89
Tesar <i>et al.</i> <sup>43</sup>	Y	Y	Y	Y	N	Y	Y	U	Y	78
<b>Total %</b>	100	100	100	100	0	75	100	50	100	

Y, yes; N, no; U, unclear.

JBI critical appraisal checklist for quasi-experimental studies: Q1: Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?; Q2: Were the participants included in any comparisons similar?; Q3: Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?; Q4: Was there a control group?; Q5: Were there multiple measurements of the outcome both pre and post the intervention/exposure?; Q6: Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?; Q7: Were the outcomes of participants included in any comparisons measured in the same way?; Q8: Were outcomes measured in a reliable way?; Q9: Was appropriate statistical analysis used?

After contacting authors for missing data, three RCTs<sup>34-36</sup> were excluded due to scoring less than 50% overall (Appendix D). The excluded studies did not report randomization, allocation concealment, blinding of outcome assessors, or potential differences between completers and drop-out participants. Blinding of those delivering the interventions was not possible in any of the studies. Participant blinding was achieved in only one study: Ehde and colleagues<sup>48</sup> informed participants that both the self-management intervention and the comparator educational program were equivalent treatments as a way of blinding to the intervention. Seventeen studies either did not adequately report whether follow-up was complete, or did not describe differences between groups in relation to drop-outs.<sup>15, 16,</sup>

32, 33, 36-38, 44, 47-51, 53-55, 57

**Table 2** Assessment of methodological quality for experimental studies

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Score %
Alschuler <i>et al.</i> <sup>44</sup>	Y	Y	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	77
Amiri <i>et al.</i> <sup>38</sup>	U	U	Y	N	U	U	Y	Y	Y	Y	Y	Y	Y	61
Bahrani <i>et al.</i> <sup>45</sup>	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y	Y	Y	77

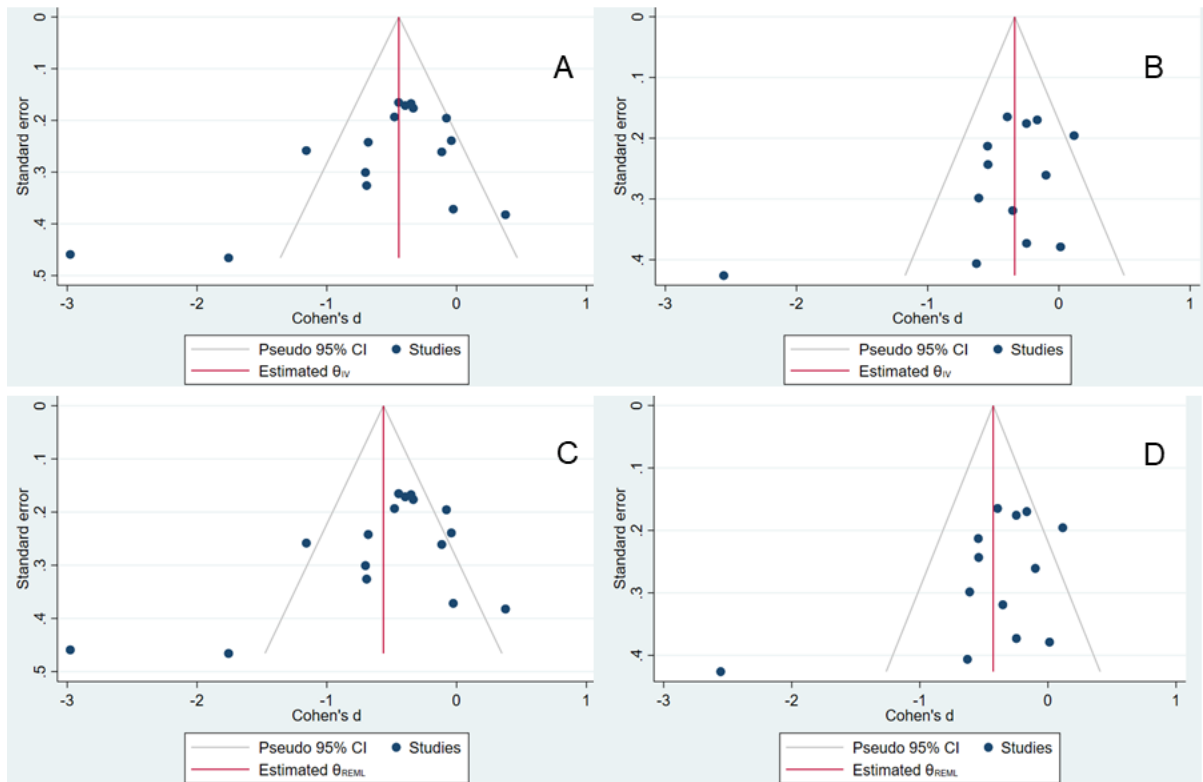
Barlow <i>et al.</i> <sup>46</sup>	Y	Y	Y	N	N	U	Y	N	Y	Y	Y	Y	Y	69	
Bogosian <i>et al.</i> <sup>47</sup>	Y	Y	Y	N	N	Y	Y	Y	Y	Y	U	Y	Y	77	
Cavalera <i>et al.</i> <sup>16</sup>	Y	Y	Y	U	N	U	Y	Y	Y	Y	U	Y	Y	69	
das Nair <i>et al.</i> <sup>31</sup>	Y	Y	Y	N	N	Y	Y	N	Y	Y	U	Y	Y	69	
Ehde <i>et al.</i> <sup>48</sup>	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	U	Y	Y	85	
Ennis <i>et al.</i> <sup>49</sup>	Y	Y	Y	N	N	Y	Y	Y	Y	Y	U	Y	Y	77	
Forman <i>et al.</i> <sup>32</sup>	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	85	
Grossman <i>et al.</i> <sup>50</sup>	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	85	
Graziano <i>et al.</i> <sup>51</sup>	U	Y	Y	N	N	U	Y	Y	Y	Y	Y	Y	Y	69	
Kolahkaj <i>et al.</i> <sup>52</sup>	Y	Y	Y	N	N	U	Y	N	Y	Y	Y	Y	Y	69	
Lincoln <i>et al.</i> <sup>53</sup>	Y	Y	Y	N	N	Y	Y	Y	Y	Y	U	Y	Y	77	
Nordin <i>et al.</i> <sup>33</sup>	Y	Y	Y	N	N	Y	Y	Y	Y	Y	U	Y	Y	77	
Pahlavanzadeh <i>et al.</i> <sup>14</sup>	Y	U	Y	N	N	N	Y	N	Y	Y	Y	Y	Y	61	
Sanaeinasab <i>et al.</i> <sup>54</sup>	U	U	Y	N	N	U	Y	Y	Y	Y	U	Y	Y	54	
Schwartz <i>et al.</i> <sup>37</sup>	U	U	Y	N	N	U	Y	Y	Y	Y	U	Y	Y	54	
Senders <i>et al.</i> <sup>55</sup>	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	85	
Shahdadi <i>et al.</i> <sup>56</sup>	Y	Y	Y	N	N	U	U	N	Y	Y	Y	U	Y	54	
Simpson <i>et al.</i> <sup>15</sup>	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	85	
Stuifbergen <i>et al.</i> <sup>57</sup>	Y	Y	U	N	N	U	Y	Y	Y	Y	Y	Y	Y	69	
<b>Excluded studies</b>															
Haji-Adineh <i>et al.</i> <sup>36</sup>	N	U	U	N	N	U	Y	Y	Y	Y	Y	Y	Y	N	46
Khayeri <i>et al.</i> <sup>34</sup>	U	U	Y	N	N	U	U	U	Y	Y	Y	Y	Y	46	
Rigby <i>et al.</i> <sup>35</sup>	U	U	Y	N	N	U	Y	N	Y	Y	U	Y	Y	46	
Total %	72	72	92	4	0	44	92	68	100	100	60	96	96		

Y, yes; N, no; U, unclear.

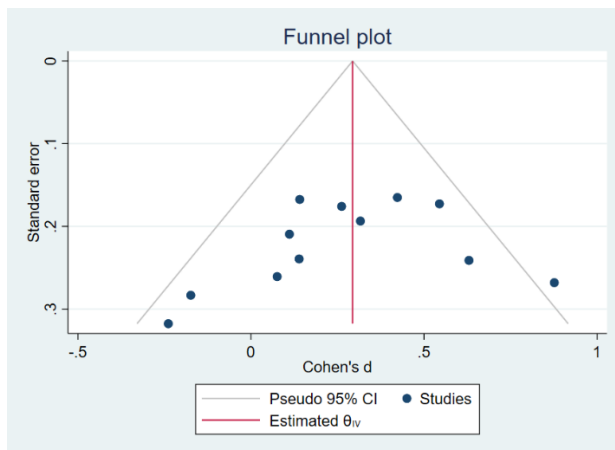
Q1: Was true randomization used for assignment of participants to treatment groups?; Q2: Was allocation to groups concealed?; Q3: Were treatment groups similar at the baseline?; Q4: Were participants blind to treatment assignment?; Q5: Were those delivering treatment blind to treatment assignment?; Q6: Were outcomes assessors blind to treatment assignment?; Q7: Were treatment groups treated identically other than the intervention of interest?; Q8: Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analysed?; Q9: Were participants analysed in the groups to which they were randomized?; Q10: Were outcomes measured in the same way for treatment groups?; Q11: Were outcomes measured in a reliable way?; Q12: Was appropriate statistical analysis used?; Q13: Was the trial design appropriate for the topic, and any deviations from the standard RCT design accounted for in the conduct and analysis?

**Figures 2A and 2B** suggest the presence of publication bias for depression and anxiety (Egger's  $P=0.02$ , and  $0.04$ , respectively). We undertook sensitivity analyses using the trim and fill method:<sup>58</sup> the resulting funnel plots were asymmetrical, indicating the potential presence of publication bias (**Figures 2C and 2D**). Publication bias was not evident for quality of life (Egger's  $P=0.29$ ) (**Figure 3**).





**Figure 2** Funnel plots for depression and anxiety without trim and fill (A and B, respectively), and with trim and fill (C and D, respectively)



**Figure 3** Funnel plot for quality of life, without trim and fill

### 3.3 Study characteristics

Studies included in this review were conducted in Iran,<sup>14, 34, 36, 38, 45, 52, 54, 56</sup> the United Kingdom,<sup>15, 31, 32, 35, 46, 47, 49, 53</sup> the United States,<sup>37, 44, 48, 55, 57</sup> Italy,<sup>16, 40, 51</sup> Austria,<sup>43</sup> the Netherlands,<sup>42</sup> Sweden,<sup>33</sup> and Switzerland.<sup>50</sup> The majority compared the intervention to a treatment as usual group<sup>14, 34, 36, 38, 41, 43, 45, 50, 52, 54, 56</sup> or a waitlist control group.<sup>15, 32, 40, 42, 44, 46, 47, 49, 53, 57</sup> The remaining studies used other programs or information sessions as the comparators.<sup>16, 31, 33, 35, 37, 48, 51</sup> Two-thirds of the included

studies reported power calculations or adequately justified the sample size.<sup>14, 15, 34-37, 42, 44, 45, 47, 48, 50, 52, 53, 55-57</sup> However, four were underpowered at post-intervention analysis due to drop-outs,<sup>14, 44, 53, 56</sup> and one did not state if all participants completed the trial.<sup>34</sup> Consequently, less than half of the studies reported sufficient power to detect intervention effects. See Appendix E for characteristics of included studies.

### 3.4 Participant characteristics

Baseline data were collected from 2323 participants ( $n$  intervention=1142;  $n$  comparator=1181). Data were missing from nine studies: eight did not report participant disease duration;<sup>14, 32, 34, 36, 38, 48, 51, 52</sup> one did not report participant age;<sup>14</sup> mean age was not available for one study;<sup>52</sup> and one did not report sex.<sup>53</sup> From the studies with complete data, the median (IQR) number of participants in the intervention and comparator groups was 35 (40.5) and 31 (46.0), respectively. The mean (SD) age was 43.7 (7.6) years for participants in the intervention groups, and 44.1 (7.9) years for participants in the comparator groups. Mean (SD) disease duration was 9.0 (3.9) and 9.7 (4.4) years in the intervention and comparator groups, respectively. Participants were mostly female in both the intervention (77%) and comparator groups (76%). The majority of the studies included participants with all types of MS;<sup>14-16, 31, 32, 34-36, 38, 40, 41, 43-46, 51-57</sup> five included participants with only relapsing-remitting and progressive MS;<sup>33, 37, 42, 48, 50</sup> and one included participants with only progressive MS.<sup>47</sup> Seven studies did not report MS type.<sup>34, 35, 43, 46, 52, 54, 56</sup>

### 3.5 Intervention characteristics

Intervention programs were based on the following concepts according to their authors: mindfulness,<sup>15, 16, 36, 38, 41, 42, 45, 47, 50, 52, 55</sup> adjustment to MS,<sup>31, 32, 53</sup> cognitive behavioural principles,<sup>14, 40, 51</sup> other psychological therapies,<sup>33-35, 43, 44</sup> coping skills,<sup>37, 54</sup> self-management,<sup>46, 48</sup> health promotion/wellness,<sup>49, 57</sup> and self-care.<sup>56</sup> The duration of sessions ranged from 45 minutes<sup>33, 56</sup> up to three hours.<sup>49, 57</sup> The shortest regular session lasted 45-60 minutes per session,<sup>48</sup> and the longest lasted three hours per session.<sup>49</sup> Two interventions included a day-long retreat mid-way through the program, lasting six<sup>55</sup> or seven<sup>50</sup> hours. One intervention did not report session duration.<sup>33</sup> The shortest intervention lasted two weeks<sup>56</sup> and the longest was 15 weeks.<sup>33</sup> The total number of sessions ranged from three<sup>35</sup> to nine;<sup>56</sup> eight sessions was the most common.<sup>14-16, 34, 36-38, 40-42, 45, 47, 49, 50, 52, 55, 57</sup> The majority of interventions ran once a week<sup>14-16, 35-38, 41, 43-50, 52, 54, 55, 57</sup> or once a fortnight.<sup>31, 32, 51, 53</sup> Nearly all of the interventions were conducted in group settings<sup>14-16, 32-38, 40-47, 49-55, 57</sup> and nearly all of the interventions were in-person.<sup>14, 15, 31-38, 40-43, 45, 46, 49-55, 57</sup> Two interventions were individual programs using standardised content/topics,<sup>31, 48</sup> and delivery method was not specified in one study.<sup>56</sup> Two programs were telephone-based,<sup>44, 48</sup> and one was conducted via videoconference.<sup>47</sup>

### 3.6 Behaviour change techniques and theories

There were sufficient details in 28 studies to code BCTs (one study did not provide any intervention information<sup>56</sup> so BCTs could not be assigned). Of the 93 different BCTs, a total of 37 were used across the interventions (**Table 3**). The mean number of BCTs used was eight (range, four to 18). The

most commonly used BCTs were: behaviour practice/rehearsal (25 studies<sup>14-16, 31-34, 36-38, 40-43, 45-55</sup>); social comparison (17 studies<sup>14-16, 32, 35-37, 40, 43-45, 49, 51, 53-55, 57</sup>); social support (unspecified) (15 studies<sup>16, 31, 32, 34, 35, 37, 38, 40, 44-46, 49, 51, 53, 55</sup>); credible source, i.e. program facilitated by an accredited, relevant health professional (14 studies<sup>15, 16, 33, 35, 37, 40, 42, 44, 45, 47, 49, 51, 52, 57</sup>); and reduce negative emotions (14 studies<sup>14, 15, 34, 37, 38, 40, 41, 43-45, 48, 51, 55, 57</sup>).

1 **Table 3** Behaviour change techniques used in included studies

	<i>Alschulaer et al.</i>	<i>Amiri et al.</i>	<i>Bahrani et al.</i>	<i>Barlow et al.</i>	<i>Bogosian et al.</i>	<i>Calandri et al.</i>	<i>Cavalera et al.</i>	<i>Crescentini et al.</i>	<i>das Nair et al.</i>	<i>Edhe et al.</i>	<i>Ennis et al.</i>	<i>Forman et al.</i>	<i>Graziano et al.</i>	<i>Grossman et al.</i>	<i>Haji-Adineh et al.</i>	<i>Hoogerwerf et al.</i>	<i>Khayeri et al.</i>	<i>Kolahkaj et al.</i>	<i>Lincoln et al.</i>	<i>Nordin et al.</i>	<i>Pahlavanzadeh et al.</i>	<i>Rigby et al.</i>	<i>Sanaeinansab et al.</i>	<i>Schwartz et al.</i>	<i>Senders et al.</i>	<i>Shahdadi et al.</i>	<i>Simpson et al.</i>	<i>Stuifbergen et al.</i>	<i>Tesar et al.</i>	Total n (%)
Goal setting (behaviour)																														2 (6.9)
Problem solving																														13 (44.8)
Goal setting (outcome)																														12 (41.4)
Action planning																														6 (20.7)
Review behaviour goal(s)																														4 (13.8)
Review outcome goal(s)																														3 (10.3)
Behavioural contract																														2 (6.9)
Monitoring behaviour by others without feedback																														1 (3.4)
Feedback on behaviour																														5 (17.2)
Self-monitoring behaviour																														11 (37.9)
Self-monitoring outcome(s)																														6 (20.7)
Monitoring outcome(s) by others without feedback																														3 (10.3)

Biofeedback									1																																			1 (3.4)				
Social support (unspecified)																																													15 (51.7)			
Social support (emotional)																																												2 (6.9)				
Instruction how to perform a behaviour																																													13 (44.8)			
Information on antecedents																																												1 (3.4)				
Information about health consequences																																												8 (27.6)				
Information about social and environmental consequences																																													1 (3.4)			
Monitoring emotional consequences																																													1 (3.4)			
Information about emotional consequences																																												5 (17.2)				
Demonstration of the behaviour																																														12 (41.4)		
Social comparison																																														17 (58.6)		
Prompts/cues																																															12 (41.4)	
Reduce prompts/cues																																															1 (3.4)	
Behavioural practice/ rehearsal																																															25 (86.2)	
Credible source																																																14 (48.3)
Non-specific reward																																																2 (6.9)



3 Five studies reported an underlying behaviour change theory: either cognitive behaviour therapy  
 4 principles<sup>31, 32, 53</sup> or self-efficacy theory.<sup>46, 57</sup> Of those, two out of four studies reported improvement in  
 5 depression;<sup>32, 53</sup> one out of three reported improvement in anxiety;<sup>53</sup> and two out of three reported  
 6 greater quality of life.<sup>53, 57</sup> The studies measuring stress did not report any behaviour change theories.

### 7 3.7 Review findings

8 Results have been grouped according to the outcomes of interest: depression, anxiety, quality of life,  
 9 and stress. **Table 4** presents a summary of the findings relating to program effectiveness and  
 10 outcomes.

11

12 **Table 4:** Effectiveness of emotional wellness programs on mental health outcomes

Outcome	Number of studies	Evidence of effectiveness	
		Improvement	No improvement
Depression	25	14 <sup>a</sup>	12 <sup>b</sup>
Anxiety	21	10 <sup>c</sup>	13 <sup>b,c</sup>
Quality of life	13	6	7
Stress	8	6	2

13 <sup>a</sup>Lincoln *et al.*<sup>53</sup> reported depression scores from the Beck Depression Inventory and the Hospital Anxiety  
 14 Depression Scale. Both results are included in the table.

15 <sup>b</sup>Rigby *et al.*<sup>35</sup> evaluated the intervention group against two comparator groups (group one: social discussion  
 16 group plus booklet; group two: information booklet only). Both comparisons are included in the table.

17 <sup>c</sup>Crescentini *et al.*<sup>41</sup> reported anxiety from both the state and trait scores of the State-Trait Anxiety Inventory. Both  
 18 results are included in the table.

19

#### 20 3.7.1 Depression

21 Twenty five studies measured depression.<sup>14-16, 31-38, 40-48, 50-53, 55</sup> Relative to the comparators, 13 studies  
 22 reported statistically significant improvements in depression scores.<sup>14-16, 32, 34, 36, 38, 42, 45, 47, 50, 52, 53</sup> One  
 23 study reported an improvement in the comparator group, but only from one of the two tools they used  
 24 to measure depression.<sup>33</sup> The most frequently used tool to measure depression was the Hospital  
 25 Anxiety and Depression Scale (HADS; reported in nine studies<sup>16, 31-33, 35, 42, 46, 47, 53</sup>) followed by the  
 26 Beck Depression Inventory (BDI; seven studies<sup>31, 33, 36, 38, 41, 43, 53</sup>). Three studies<sup>31, 33, 53</sup> reported two  
 27 measures of depression (BDI and HADS). The most frequently used BCTs were: behavioural  
 28 practice/rehearsal (23 studies<sup>14-16, 31-34, 36-38, 40-43, 45-48, 50-53, 55</sup>); social comparison (14 studies<sup>14-16, 32, 35-37,</sup>  
 29 <sup>40, 43-45, 51, 53, 55</sup>); and social support (unspecified) (14 studies<sup>16, 31, 32, 34, 35, 37, 38, 40, 44-46, 51, 53, 55</sup>). Of the 13  
 30 effective interventions, all used behaviour practice/rehearsal as a BCT, followed by demonstration of  
 31 the behaviour (seven studies<sup>14, 16, 32, 34, 45, 47, 53</sup>), social comparison (seven studies<sup>14-16, 32, 36, 45, 53</sup>), and  
 32 framing/reframing (seven studies<sup>14, 16, 32, 36, 38, 45, 53</sup>).

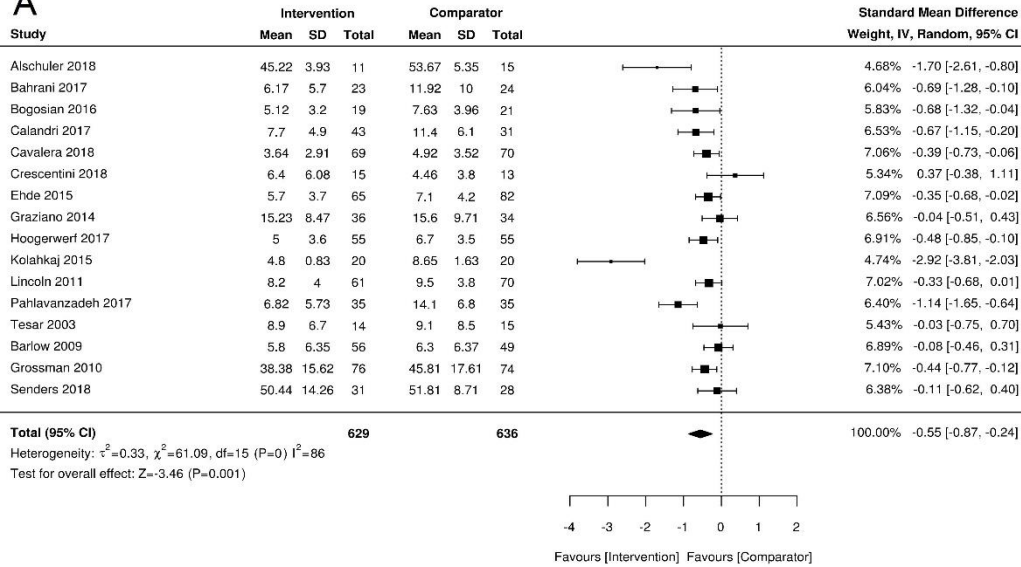
#### 33 3.7.2 Depression meta-analysis

34 Sixteen studies were included in statistical meta-analysis.<sup>14, 16, 40-48, 50-53, 55</sup> One study<sup>53</sup> reported  
 35 multiple measures of depression (BDI and HADS); the HADS score was included in meta-analysis as  
 36 this tool was more frequently used by other included studies.<sup>16, 46, 47</sup> Meta-analysis included 1265

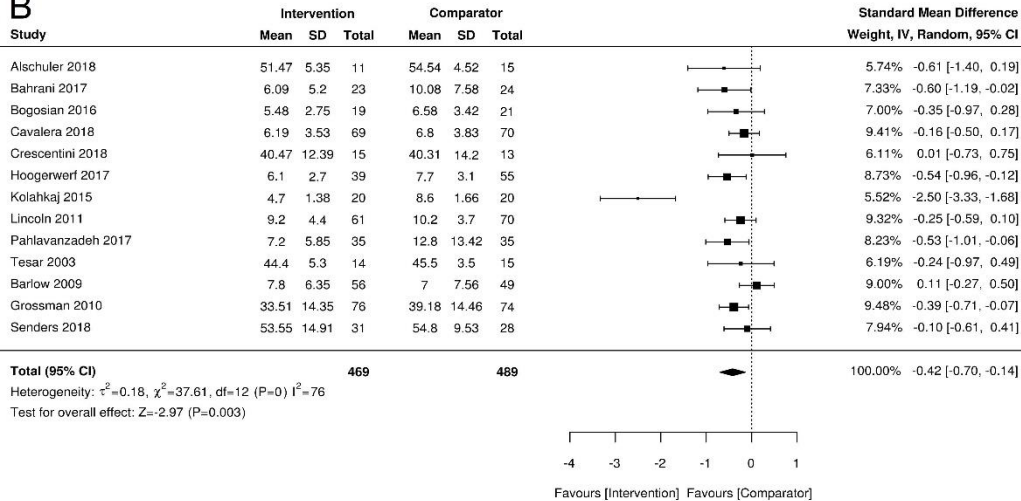
37 participants (629 received the intervention), and resulted in a statistically significant medium effect,  
38 favouring the intervention (SMD -0.55; 95% CI -0.87, -0.24;  $P=0.001$ ) (**Figure 4**). Heterogeneity was  
39 high ( $I^2=86\%$ ; chi-squared  $P<0.001$ ). Subgroup analysis was performed to examine the robustness of  
40 the findings. Overall, there was minimal change in the findings when grouped by: minimum eight-  
41 week interventions (SMD -0.59; 95% CI -0.97, -0.21;  $P=0.002$ ;  $I^2=87\%$ ; chi-squared  $P<0.001$ ); in-  
42 person interventions (SMD -0.51; 95% CI -0.92, -0.11;  $P=0.013$ ;  $I^2=88\%$ ; chi-squared  $P<0.001$ );  
43 waitlist control/usual care comparators (SMD -0.69; 95%CI -1.12, -0.26;  $P=0.002$ ;  $I^2=89\%$ ; chi-  
44 squared  $P<0.001$ ); and mindfulness interventions (SMD -0.63; 95%CI -1.22, -0.04;  $P=0.037$ ;  $I^2=92\%$ ;  
45 chi-squared  $P<0.001$ ).



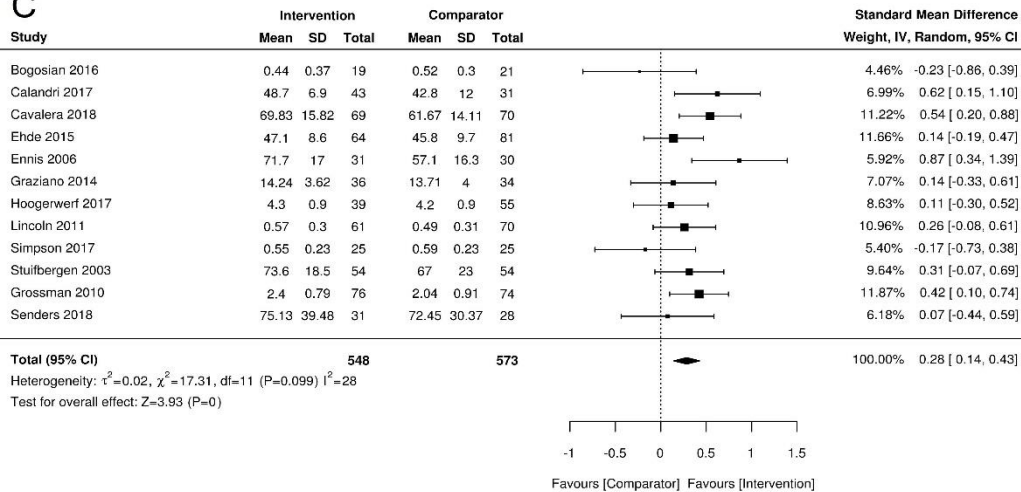
### A



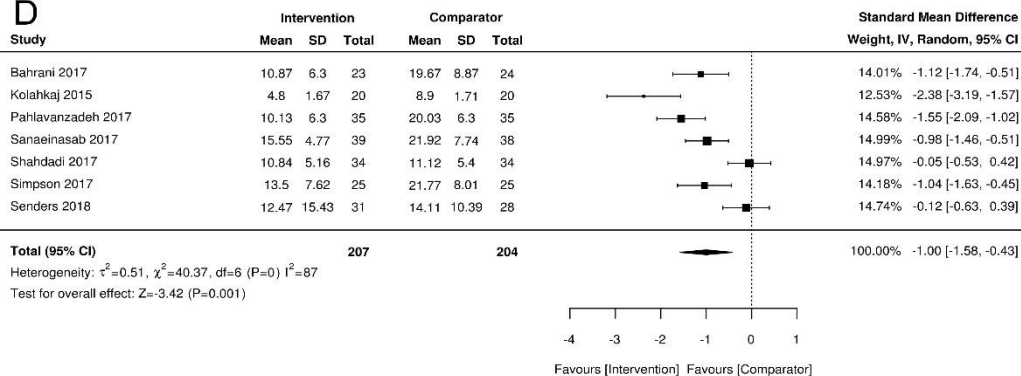
### B



### C



### D



47 **Figure 4** Forest plots for mental health outcomes: depression (A), anxiety (B), quality of life (C), and  
 48 stress (D)  
 49 CI, confidence interval; IV, inverse variance; SD, standard deviation

50

### 51 3.7.3 Depression meta-regression

52 Studies with missing data on time since diagnosis,<sup>14, 48, 52</sup> mean age,<sup>14, 52</sup> and percentage of females  
 53 were excluded from meta-regression.<sup>53</sup> Higher percentage of females, minimum eight week  
 54 intervention (vs. less than eight weeks), and waitlist comparator (vs. active comparator), were  
 55 statistically significant inverse predictors of depression. In-person interventions and mindfulness  
 56 interventions were statistically significantly less effective, compared to  
 57 teleconference/videoconference and non-mindfulness interventions, respectively, at reducing  
 58 depression (**Table 5**). These five factors accounted for all variability in effect size estimates between  
 59 studies (residual  $I^2 = 0\%$ , adjusted  $R^2 = 100\%$ ).

60

61 **Table 5** Multivariable meta-regression showing statistically significant predictors of depression<sup>a</sup>

Predictor	Estimate	95% CI	P value
Percentage of females, per 1%	-0.16	-0.26, -0.01	0.002
In-person (vs. teleconference/videoconference)	0.73	0.30, 1.17	0.001
Minimum 8 weeks (vs. less than eight weeks)	-0.95	-1.67, -0.24	0.009
Waitlist comparator (vs. active comparator)	-0.62	-1.14, -0.10	0.019
Mindfulness intervention (vs. other)	0.69	0.08, 1.31	0.026

62 <sup>a</sup>Depression was measured using the following tools: the Beck Depression Inventory; the Center for  
 63 Epidemiologic Studies Depression Scale; the Depression, Anxiety and Stress Scales; the Hospital Anxiety and  
 64 Depression Scale; and the Patient-Reported Outcomes Measurement Information System. Higher scores indicate  
 65 greater severity.  
 66

### 67 3.7.4 Anxiety

68 Twenty one studies measured anxiety.<sup>14-16, 31-35, 37, 38, 41-47, 50, 52, 53, 55</sup> Relative to comparators, ten  
 69 studies reported statistically significant improvements in anxiety scores<sup>14, 16, 35, 38, 41, 42, 45, 50, 52, 53</sup>  
 70 (including one study that reported a beneficial effect in trait anxiety but not state anxiety,<sup>41</sup> and  
 71 another that reported improved anxiety compared to only one of two comparator groups – the  
 72 ‘information booklet only’ group, but not the ‘social discussion plus booklet’ group<sup>35</sup>). The most  
 73 frequently used tool to measure anxiety was the HADS (used in nine studies<sup>16, 31-33, 35, 42, 46, 47, 53</sup>),  
 74 followed by the State-Trait Anxiety Inventory (STAI; used in four studies<sup>38, 41, 43, 50</sup>) The most frequently  
 75 used BCTs were: behavioural practice/rehearsal (18 studies<sup>14-16, 31-34, 37, 38, 41-43, 45-47, 50, 53, 55, 59</sup>); social  
 76 support (unspecified) (12 studies<sup>16, 31, 32, 34, 35, 37, 38, 44-46, 53, 55</sup>); and social comparison (11 studies<sup>14-16, 32,</sup>  
 77 <sup>35, 37, 43-45, 53, 55</sup>). Of the ten effective interventions, eight used behaviour practice/rehearsal as a BCT.<sup>14,</sup>  
 78 <sup>16, 38, 42, 45, 50, 52, 53</sup> Five studies used social support (unspecified),<sup>16, 35, 38, 45, 53</sup> five used social  
 79 comparison,<sup>14, 16, 35, 45, 53</sup> and five used framing/reframing.<sup>14, 16, 38, 45, 53</sup>

### 80 3.7.5 Anxiety meta-analysis

81 Thirteen studies were included in statistical meta-analysis.<sup>14, 16, 41-47, 50, 52, 53, 55</sup> One study<sup>41</sup> reported  
82 trait and state anxiety subscales; the state score was used in meta-analysis as it measures current  
83 anxiety levels. Meta-analysis included 958 participants (469 received the intervention), and resulted in  
84 a statistically significant medium effect, favouring the intervention (SMD -0.42; 95% CI: -0.70, -0.14;  
85  $P=0.003$ ). Heterogeneity was high ( $I^2=76\%$ ; chi-squared  $P<0.001$ ) (**Figure 4**). Subgroup analysis was  
86 performed to examine the robustness of the findings. Overall, there was minimal change in SMD and  
87 heterogeneity when grouped by: minimum eight-week interventions (SMD -0.44; 95% CI -0.82, -0.07;  
88  $P=0.02$ ;  $I^2=86\%$ ; chi-squared  $P<0.001$ ); in-person interventions (SMD -0.46; 95% CI -0.84, -0.07;  
89  $P=0.02$ ;  $I^2=84\%$ ; chi-squared  $P<0.001$ ); waitlist control/usual care comparators (SMD -0.49; 95% CI -  
90 0.83, -0.15;  $P=0.005$ ;  $I^2=80\%$ ; chi-squared  $P<0.001$ ); and mindfulness interventions (SMD -0.54; 95%  
91 CI -1.02, -0.06;  $P=0.028$ ;  $I^2=87\%$ ; chi-squared  $P<0.001$ ).

### 92 3.7.6 Anxiety meta-regression

93 Studies with missing data on time since diagnosis,<sup>14, 52</sup> mean age,<sup>14, 52</sup> and percentage of females  
94 were excluded from meta-regression.<sup>53</sup> Minimum eight week intervention duration (vs. less than eight  
95 weeks) was the only statistically significant predictor of anxiety, with an inverse association (estimate -  
96 0.39, 95% CI -0.77, -0.01,  $P=0.048$ ). This factor accounted for all variability in effect size estimates  
97 between studies (residual  $I^2 = 0\%$ , adjusted  $R^2 = 100\%$ ).

### 98 3.7.8 Quality of Life

99 Thirteen studies measured quality of life.<sup>15, 16, 32, 40, 42, 47-51, 53, 55, 57</sup> Relative to comparators, six studies  
100 reported significant improvements in quality of life scores.<sup>16, 40, 49, 50, 53, 57</sup> The most frequently used tool  
101 to measure quality of life was the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36;  
102 used in four studies<sup>32, 49, 55, 57</sup>). The most frequently used BCTs were: behavioural practice/rehearsal  
103 (12 studies<sup>15, 16, 32, 40, 42, 47-51, 53, 55</sup>); social comparison (nine studies<sup>15, 16, 32, 40, 49, 51, 53, 55, 57</sup>); credible  
104 source (eight studies<sup>15, 16, 40, 42, 47, 49, 51, 57</sup>); and goal setting (outcome) (eight studies<sup>32, 40, 48-51, 53, 57</sup>). Of  
105 the six effective interventions, five used behaviour practice/rehearsal<sup>16, 40, 49, 50, 53</sup> and five used goal  
106 setting (outcome)<sup>40, 49, 50, 53, 57</sup>.

### 107 3.7.9 Quality of life meta-analysis

108 Twelve studies were included in statistical meta-analysis.<sup>15, 16, 40, 42, 47-51, 53, 55, 57</sup> One study<sup>50</sup> reported  
109 multiple measures of quality of life (the Hamburg Quality of Life Questionnaire in Multiple Sclerosis  
110 (HAQUAMS) and the Profile of Health-Related Quality of Life in Chronic Disorders): the HAQUAMS  
111 score was included in meta-analysis as this tool is specific to an MS population. Meta-analysis  
112 included 1121 participants (548 received the intervention), and resulted in a statistically significant  
113 small effect, favouring the intervention (SMD 0.28; 95% CI: 0.14-0.43;  $P<0.001$ ). Heterogeneity was  
114 low-to-moderate ( $I^2=28\%$ ; chi-squared  $P=0.099$ ) (**Figure 4**). Subgroup analysis was performed to  
115 examine the robustness of the findings. Heterogeneity was not statistically significant when grouped  
116 by minimum eight-week interventions (SMD 0.27; 95% CI 0.10, 0.43;  $P=0.001$ ;  $I^2=28\%$ ; chi-squared  
117  $P=0.11$ ) and in-person interventions (SMD 0.30; 95% CI 0.15, 0.46;  $P<0.001$ ;  $I^2=15\%$ ; chi-squared

118  $P=0.168$ ). Heterogeneity increased to 'moderate' when studies were grouped by waitlist control/usual  
119 care comparators (SMD 0.30; 95%CI 0.09, 0.50;  $P=0.004$ ;  $I^2=43\%$ ; chi-squared  $P=0.066$ ) and  
120 mindfulness only (SMD 0.19; 95% CI -0.05, 0.44;  $P=0.125$ ;  $I^2=48\%$ ; chi-squared  $P=0.096$ ). Meta-  
121 regression analysis was not undertaken because heterogeneity was low-to-moderate.

### 122 3.7.10 Stress

123 Eight studies measured stress.<sup>14, 15, 34, 45, 52, 54-56</sup> Relative to comparators, six studies reported  
124 significant improvements in stress scores.<sup>14, 15, 45, 52, 54, 56</sup> The tools used to measure stress were the  
125 Depression, Anxiety and Stress Scales (five studies<sup>14, 34, 45, 52, 56</sup>) and the Perceived Stress Scale  
126 (three studies<sup>15, 54, 55</sup>). The most frequently used BCT was behavioural practice/rehearsal (seven  
127 studies<sup>14, 15, 34, 45, 52, 54, 55</sup>). Five studies used social comparison,<sup>14, 15, 45, 54, 55</sup> prompts/cues,<sup>14, 15, 34, 54, 55</sup>  
128 and reduce negative emotions.<sup>14, 15, 34, 45, 55</sup> Of the six effective interventions, behaviour  
129 practice/rehearsal was used in five.<sup>14, 15, 45, 52, 54</sup>

### 130 3.7.11 Stress meta-analysis

131 Seven studies were included in statistical meta-analysis.<sup>14, 15, 45, 52, 54-56</sup> Meta-analysis included 411  
132 participants (207 received the interventions), and resulted in a statistically significant large effect,  
133 favouring the intervention (SMD -1.00; 95% CI -1.58, -0.43;  $P=0.001$ ). Heterogeneity was high  
134 ( $I^2=87\%$ ; chi-squared  $P<0.001$ ) (**Figure 4**). Due to the small number of studies, subgroup analysis and  
135 meta-regression were unable to be performed.

136

## 137 4. Discussion

### 138 4.1 Summary of findings

139 This systematic review and meta-analysis included 29 studies with 2323 participants, and investigated  
140 the effectiveness of emotional wellness programs on depression, anxiety, quality of life, and stress in  
141 adults with MS. Three-quarters of participants were female; consistent with the sex-distribution of the  
142 disease.<sup>60</sup> The mean age was 44 years, and participants had been diagnosed with MS for an average  
143 of nine years. The emotional wellness programs were based on several approaches, including  
144 mindfulness, self-management interventions, cognitive behavioural principles or other psychological  
145 therapies, adjustment to MS, health promotion/wellness, coping skills, and self-care instruction. The  
146 most common number of sessions was eight (conducted once a week or once a fortnight). The  
147 majority of studies compared the intervention group to a waitlist control group or a treatment as usual  
148 group. Sample sizes were generally small (intervention median=35; comparator median=31); the  
149 smallest study had 11 participants in the intervention group. At post-intervention, less than half of the  
150 studies were adequately powered to detect statistically significant effects.

151

152 Results from meta-analyses showed favourable effects of the interventions: decreasing stress (large  
153 effect); reducing depression and anxiety (medium effect); and improving quality of life (small effect).

154 Many interventions lasted for eight weeks and were implemented in-person; however, subgroup  
155 analyses did not produce noteworthy changes in effect estimates compared with the main models. As  
156 such, there is insufficient evidence to make recommendations on optimal program duration or format.  
157 However, we acknowledge that the analyses may have been underpowered to detect significant  
158 changes given the small number of studies that were fewer than eight weeks in duration, and that  
159 were not conducted in-person.

160

161 The mean number of BCTs used across all interventions was eight. Behaviour practice/rehearsal was  
162 used in nearly all of the studies; social comparison and social support were both frequently used. Of  
163 the efficacious studies, behaviour practice/rehearsal was the most commonly used BCT. A large  
164 number of studies did not report an underlying behaviour change theory.

## 165 4.2 Comparison with existing literature

166 We found emotional wellness programs effective at improving depression, anxiety, quality of life, and  
167 stress in adults with MS. Consistent with our findings, a recent meta-analysis on psychosocial  
168 interventions for pwMS (minimum  $n$  intervention participants=20) reported statistically significant small  
169 effect sizes on depression and anxiety, and a greater effect size for health-related quality of life.<sup>61</sup>  
170 Likewise, Simpson and colleagues recently published a meta-analysis on mindfulness interventions  
171 for pwMS, reporting that mindfulness was moderately effective at treating depression (SMD 0.35; 95%  
172 CI 0.17-0.53), anxiety (SMD 0.35; 95% CI 0.15-0.55), and stress (SMD 0.55; 0.25-0.85).<sup>62</sup> Venasse  
173 and colleagues drew the same conclusion when examining mindfulness interventions for people with  
174 progressive MS (level B evidence; probably effective), but only three studies were included in their  
175 review.<sup>20</sup> Similarly, systematic reviews on self-management interventions (2017)<sup>17</sup> and stress-  
176 management interventions (2014)<sup>23</sup> both reported beneficial effects on mental health and quality of life  
177 outcomes for pwMS. However, both reviews included a small number of studies (10<sup>17</sup> and eight<sup>23</sup>),  
178 which varied considerably in quality.

179

180 The most commonly used BCTs in interventions that improved mental health outcomes were  
181 behaviour practice/rehearsal (participants were encouraged to practice the skills) and social  
182 comparison (participants were given the opportunity to discuss topics with peers). These findings  
183 provide some guidance for the design of future emotional wellness programs for pwMS. In previous  
184 reviews of self-management interventions for pwMS, goal setting was associated with improvements  
185 in depression and anxiety,<sup>17</sup> and general instruction, barrier identification practice, and social support  
186 were commonly used BCTs.<sup>18</sup> Differences in the commonly used BCTs in our findings and in the  
187 aforementioned reviews may be attributed to their specific focus on self-management interventions  
188 (empowering individuals to manage their symptoms, treatment, psychosocial, and lifestyle aspects of  
189 the disease), whereas the interventions in our review were broader in scope. Two reviews on physical  
190 activity behaviour in pwMS reported different BCTs compared with our study: goal setting was the  
191 most common in one study,<sup>63</sup> while social support was the most common in the other.<sup>64</sup> This  
192 highlights the variability in effective BCTs used in interventions for pwMS. Similar to our findings, a

193 recent review on lifestyle behaviour change for preventing the progression of kidney disease found  
194 that social support and behaviour practice/rehearsal were frequently used in effective interventions.<sup>65</sup>

195

196 Few studies included in our review reported the use of specific behaviour change theories, despite  
197 describing behaviour change techniques. These results are consistent with two reviews (one on self-  
198 management interventions for pwMS<sup>18</sup> and the other on wellness interventions for pwMS<sup>21</sup>), which  
199 reported that studies were rarely based on behaviour change theories. The social cognitive theory  
200 and the transtheoretical model of change are two theories commonly used in the MS literature for  
201 wellness<sup>21</sup> and physical activity behaviour change.<sup>63, 66</sup> Given the complexities surrounding behaviour  
202 change, the use of appropriate theory-based interventions would strengthen research in this area.

### 203 4.3 Strengths and limitations of this review

204 This review was undertaken using a thorough search strategy that was developed in consultation with  
205 a Health Sciences librarian. The methods were guided by the JBI guidelines for systematic reviews of  
206 effectiveness<sup>24</sup> and the PRISMA checklist of items for reporting systematic reviews.<sup>39</sup> Studies  
207 included were RCTs and quasi-experimental trials with valid comparator groups, of which only three  
208 were excluded for poor methodological quality. The main limitations of this review pertain to the  
209 relatively small sample sizes of the included studies, the heterogeneous nature of the interventions,  
210 and potential publication bias. The number of studies in meta-analyses was less than 20, and the  
211 mean sample size was less than 80. As such, the  $I^2$  index and the chi-squared  $P$  values should be  
212 interpreted with caution.<sup>67</sup> Furthermore, less than half of the studies were adequately powered to  
213 detect statistically significant changes in mental health outcomes post-intervention. Due to incomplete  
214 reporting, the effect of baseline mental health and disability status could not be investigated as  
215 potential covariates.

216

## 217 5. Conclusions

218 Despite the limitations pertaining to heterogeneity and sample size, there is evidence to support the  
219 effectiveness of emotional wellness programs for improving mental health outcomes in pwMS. While  
220 we cannot draw firm conclusions regarding optimal program characteristics, the majority of the  
221 included studies were conducted in group settings, in-person, and were run once a week or once a  
222 fortnight for eight sessions. Future studies would benefit from exploring adherence rates and follow-up  
223 data in order to assess the feasibility and long-term effectiveness of emotional wellness programs.  
224 Improved reporting of BCTs in future studies would enable researchers to identify those that are most  
225 effective for pwMS.

226

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231 developing the search strategy.

232

## 233 References

- 234 1. Boeschoten RE, Braamse AMJ, Beekman ATF, et al. Prevalence of depression and anxiety in  
235 Multiple Sclerosis: A systematic review and meta-analysis. *Journal of the Neurological Sciences*  
236 2017; 372: 331-341. DOI: 10.1016/j.jns.2016.11.067.
- 237 2. Marrie RA. Comorbidity in multiple sclerosis: implications for patient care. *Nature Reviews*  
238 *Neurology* 2017; 13. DOI: 10.1038/nrneurol.2017.33.
- 239 3. Moss B, Rensel M and Hersh C. Wellness and the role of comorbidities in multiple sclerosis.  
240 *The Journal of the American Society for Experimental NeuroTherapeutics* 2017; 14: 999-1017. DOI:  
241 10.1007/s13311-017-0563-6.
- 242 4. Marck C, Neate S, Taylor K, et al. Prevalence of comorbidities, overweight and obesity in an  
243 international sample of people with multiple sclerosis and associations with modifiable lifestyle factors.  
244 *PLoS One* 2016; 11:e0148573. DOI: 10.1371/journal.pone.0148573.
- 245 5. Berrigan IL, Fisk DJ, Patten BS, et al. Health-related quality of life in multiple sclerosis: Direct  
246 and indirect effects of comorbidity. *Neurology* 2016; 86: 1417-1424. DOI:  
247 10.1212/WNL.0000000000002564.
- 248 6. Pommerich UM, Brincks J and Christensen ME. Is there an effect of dietary intake on MS-  
249 related fatigue? – A systematic literature review. *Multiple Sclerosis and Related Disorders* 2018; 25:  
250 282-291. DOI: 10.1016/j.msard.2018.08.017.
- 251 7. Pereira GM, Soares NM, de Souza AR, et al. Basal cortisol levels and the relationship with  
252 clinical symptoms in multiple sclerosis: a systematic review. *Arq Neuro-Psiquiatr* 2018; 76: 622-634.  
253 DOI: 10.1590/0004-282X20180091.
- 254 8. Dunn M, Bhargava P and Kalb R. Your patients with multiple sclerosis have set wellness as a  
255 high priority - and the national multiple sclerosis society is responding. *US Neurology* 2015; 11: 80-86.  
256 DOI: 10.17925/USN.2015.11.02.80.
- 257 9. Thompson AJ, Baranzini SE, J. G, et al. Multiple sclerosis. *The Lancet* 2018; 391: 1622-1636.  
258 DOI: 10.1016/S0140-6736(18)30481-1
- 259 10. National Institutes of Health. Your Healthiest Self. Emotional Wellness Toolkit. 2018.
- 260 11. Motl RW, Mowry EM, Ehde DM, et al. Wellness and multiple sclerosis: The National MS  
261 Society establishes a Wellness Research Working Group and research priorities. *Multiple Sclerosis*  
262 *Journal* 2017; 1: 1-6. DOI: 10.1177/1352458516687404.

- 263 12. Michie S, Richardson M, Johnston M, et al. The Behavior Change Technique Taxonomy (v1)  
264 of 93 Hierarchically Clustered Techniques: Building an International Consensus for the Reporting of  
265 Behavior Change Interventions. *Annals of Behavioral Medicine* 2013; 46: 81-95. DOI:  
266 10.1007/s12160-013-9486-6.
- 267 13. Roscoe LJ. Wellness: A Review of Theory and Measurement for Counselors. *Journal of*  
268 *Counseling & Development* 2009; 87: 216-226. DOI: 10.1002/j.1556-6678.2009.tb00570.x.
- 269 14. Pahlavanzadeh S, Abbasi S and Alimohammadi N. The effect of group cognitive behavioral  
270 therapy on stress, anxiety, and depression of women with multiple sclerosis. *Iranian Journal of*  
271 *Nursing and Midwifery Research* 2017; 22: 271. DOI: 10.4103/1735-9066.212987.
- 272 15. Simpson R, Mair FS and Mercer SW. Mindfulness-based stress reduction for people with  
273 multiple sclerosis - a feasibility randomised controlled trial. *BMC Neurology* 2017; 17: 94. DOI:  
274 10.1186/s12883-017-0880-8.
- 275 16. Cavallera C, Rovaris M, Mendozzi L, et al. Online meditation training for people with multiple  
276 sclerosis: A randomized controlled trial. *Multiple Sclerosis Journal* 2019; 25: 610-617. DOI:  
277 10.1177/1352458518761187.
- 278 17. Kidd T, Carey N, Mold F, et al. A systematic review of the effectiveness of self-management  
279 interventions in people with multiple sclerosis at improving depression, anxiety and quality of life.  
280 *PLoS one* 2017; 12: e0185931-e0185931. DOI: 10.1371/journal.pone.0185931.
- 281 18. Plow MA, Finlayson M and Rezac M. A Scoping Review of Self-Management Interventions for  
282 Adults With Multiple Sclerosis. *PM R* 2011; 3: 251-262. DOI: 10.1016/j.pmrj.2010.11.011.
- 283 19. Rae-Grant AD, Turner AP, Sloan A, et al. Self-management in neurological disorders:  
284 Systematic review of the literature and potential interventions in multiple sclerosis care. *Journal of*  
285 *Rehabilitation Research & Development* 2011; 48: 1087-1099. DOI: 10.1682/JRRD.2010.08.0159.
- 286 20. Venasse M, Edwards T and Pilutti L. Exploring wellness interventions in progressive multiple  
287 sclerosis: an evidence-based review. *Current Treatment Options in Neurology* 2018; 20: 1-14. DOI:  
288 10.1007/s11940-018-0497-2.
- 289 21. Stuifbergen AK, Morris M, Jung JH, et al. Benefits of wellness interventions for persons with  
290 chronic and disabling conditions: A review of the evidence. *Disability and Health Journal* 2010; 3: 133-  
291 145. DOI: 10.1016/j.dhjo.2009.10.007.
- 292 22. Simpson R, Booth J, Lawrence M, et al. Mindfulness based interventions in multiple sclerosis  
293 - a systematic review. *BMC Neurology* 2014; 14: 15-15. DOI: 10.1186/1471-2377-14-15.
- 294 23. Reynard AK, Sullivan AB and Rae-Grant A. A systematic review of stress-management  
295 interventions for multiple sclerosis patients. *International Journal of MS Care* 2014; 16: 140-144. DOI:  
296 10.7224/1537-2073.2013-034.
- 297 24. Tufanaru C, Munn Z, Aromataris E, et al. Chapter 3: Systematic reviews of effectiveness. In:  
298 Aromataris E and Munn Z, (eds.). *Joanna Briggs Institute Reviewer's Manual*. The Joanna Briggs  
299 Institute, 2017.
- 300 25. Higgins JPT, Li T and Deeks JJ (eds.). Chapter 6: Choosing effect measures and computing  
301 estimates of effect. In: Higgins JPT, Thomas J, Chandler J, et al., (eds.). *Cochrane Handbook for*  
302 *Systematic Reviews of Interventions version 6.0 (updated July 2019)*. Cochrane, 2019.



- 303 26. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. Florence, United Kingdom:  
304 Routledge, 1988.
- 305 27. Sutton A, Abrams KR, Jones DR, et al. *Methods for Meta-Analysis in Medical Research*.  
306 2000, p.3-317.
- 307 28. Higgins JPT, Thompson SG, Deeks JJ, et al. Measuring inconsistency in meta-analyses. *BMJ*  
308 2003; 327: 557-560. DOI: 10.1136/bmj.327.7414.557.
- 309 29. Deeks JJ, Higgins JPT and Altman DG (eds.). Chapter 10: Analysing data and undertaking  
310 meta-analyses. In: Higgins JPT, Thomas J, Chandler J, et al., (eds.). *Cochrane Handbook for*  
311 *Systematic Reviews of Interventions version 6.0 (updated July 2019)*. Cochrane, 2019.
- 312 30. Sterne JAC, Sutton AJ, Ioannidis JPA, et al. Recommendations for examining and interpreting  
313 funnel plot asymmetry in meta-analyses of randomised controlled trials. *BMJ* 2011; 343: d4002. DOI:  
314 10.1136/bmj.d4002.
- 315 31. das Nair R, Kontou E, Smale K, et al. Comparing individual and group intervention for  
316 psychological adjustment in people with multiple sclerosis: a feasibility randomised controlled trial.  
317 *Clinical Rehabilitation* 2016; 30: 1156-1164. DOI: 10.1177/0269215515616446.
- 318 32. Forman A and Lincoln N. Evaluation of an adjustment group for people with multiple sclerosis:  
319 A pilot randomized controlled trial. *Clinical Rehabilitation* 2010; 24: 211-221. DOI:  
320 10.1177/0269215509343492.
- 321 33. Nordin L and Rorsman I. Cognitive behavioural therapy in multiple sclerosis: a randomized  
322 controlled pilot study of acceptance and commitment therapy. *Journal of Rehabilitation Medicine*  
323 2012; 44: 87-90. DOI: 10.2340/16501977-0898.
- 324 34. Khayeri F, Rabiei L, Shamsalinia A, et al. Effect of Fordyce Happiness Model on depression,  
325 stress, anxiety, and fatigue in patients with multiple sclerosis. *Complementary Therapies in Clinical*  
326 *Practice* 2016; 25: 130-135. DOI: 10.1016/j.ctcp.2016.09.009.
- 327 35. Rigby S, Thornton E and Young C. A randomized group intervention trial to enhance mood  
328 and self-efficacy in people with multiple sclerosis. *British Journal of Health Psychology* 2008; 13: 619-  
329 631. DOI: 10.1348/135910707X241505.
- 330 36. Haji-Adineh S, Farzanfar A, Salehi-Morekani S, et al. The effectiveness of Mindfulness-Based  
331 Cognitive Therapy on life expectancy and depression in patients with multiple sclerosis. *International*  
332 *Journal of Body, Mind, and Culture* 2019; 6: 79-89. DOI: 10.22122/ijbmc.v6i2.160.
- 333 37. Schwartz CE. Teaching coping skills enhances quality of life more than peer support: results  
334 of a randomized trial with multiple sclerosis patients. *Health Psychology* 1999; 18: 211-220.
- 335 38. Amiri M, Rabiei M and Donyavi V. Effectiveness of mindfulness training in enhancing  
336 executive function and decreasing symptoms of depression and anxiety in patients with multiple  
337 sclerosis (MS). *Journal of Behavioral and Brain Science* 2016; 06: 329-336. DOI:  
338 10.4236/jbbs.2016.68032.
- 339 39. Moher D, Liberati A, Tetzlaff J, et al. Preferred Reporting Items for Systematic Reviews and  
340 Meta-Analyses: The PRISMA Statement. *PLoS Medicine* 2009; 6: e1000097. DOI:  
341 10.1371/journal.pmed.1000097.

- 342 40. Calandri E, Graziano F, Borghi M, et al. Improving the quality of life and psychological well-  
343 being of recently diagnosed multiple sclerosis patients: preliminary evaluation of a group-based  
344 cognitive behavioral intervention. *Disability & Rehabilitation* 2017; 39: 1474-1481. DOI:  
345 10.1080/09638288.2016.1198430.
- 346 41. Crescentini C, Matiz A, Cimenti M, et al. Effect of mindfulness meditation on personality and  
347 psychological well-being in patients with multiple sclerosis. *International Journal of MS Care* 2018; 20:  
348 101-108. DOI: 10.7224/1537-2073.2016-093.
- 349 42. Hoogerwerf AEW, Bol Y, Lobbestael J, et al. Mindfulness-based cognitive therapy for  
350 severely fatigued multiple sclerosis patients: A waiting list controlled study. *Journal of Rehabilitation*  
351 *Medicine* 2017; 49: 497-504. DOI: 10.2340/16501977-2237.
- 352 43. Tesar N, Baumhackl U, Kopp M, et al. Effects of psychological group therapy in patients with  
353 multiple sclerosis. *Acta Neurologica Scandinavica* 2003; 107: 394-399. DOI: 10.1034/j.1600-  
354 0404.2003.00077.x.
- 355 44. Alschuler KN, Arewasikporn A, Nelson IK, et al. Promoting resilience in individuals aging with  
356 multiple sclerosis: Results from a pilot randomized controlled trial. *Rehabilitation Psychology* 2018;  
357 63: 338-348. DOI: 10.1037/rep0000223.
- 358 45. Bahrani S, Zargar F, Yousefipour G, et al. The Effectiveness of Mindfulness-Integrated  
359 Cognitive Behavior Therapy on Depression, Anxiety, and Stress in Females with Multiple Sclerosis: A  
360 Single Blind Randomized Controlled Trial. *Iranian Red Crescent Medical Journal* 2017; 19: e44566.  
361 DOI: 10.5812/ircmj.44566.
- 362 46. Barlow J, Turner A, Edwards R, et al. A randomised controlled trial of lay-led self-  
363 management for people with multiple sclerosis. *Patient Education & Counseling* 2009; 77: 81-89. DOI:  
364 10.1016/j.pec.2009.02.009.
- 365 47. Bogosian A, Chadwick P, Windgassen S, et al. Distress improves after mindfulness training  
366 for progressive MS: A pilot randomised trial. *Multiple Sclerosis* 2015; 21: 1184-1194. DOI:  
367 10.1177/1352458515576261.
- 368 48. Ehde DM, Elzea JL, Verrall AM, et al. Efficacy of a telephone-delivered self-management  
369 intervention for persons with multiple sclerosis: a randomized controlled trial with a one-year follow-  
370 up. *Archives of Physical Medicine & Rehabilitation* 2015; 96: 1945-1958. DOI:  
371 10.1016/j.apmr.2015.07.015.
- 372 49. Ennis M, Thain J, Boggild M, et al. A randomized controlled trial of a health promotion  
373 education programme for people with multiple sclerosis. *Clinical Rehabilitation* 2006; 20: 783-792.  
374 DOI: 10.1177/0269215506070805.
- 375 50. Grossman P, Kappos L, Gensicke H, et al. MS quality of life, depression, and fatigue improve  
376 after mindfulness training: a randomized trial. *Neurology* 2010; 75: 1141-1149. DOI:  
377 10.1212/WNL.0b013e3181f4d80d.
- 378 51. Graziano F, Calandri E, Borghi M, et al. The effects of a group-based cognitive behavioral  
379 therapy on people with multiple sclerosis: a randomized controlled trial. *Clinical Rehabilitation* 2014;  
380 28: 264-274.

- 381 52. Kolahkaj B and Zargar F. Effect of Mindfulness-Based Stress Reduction on anxiety,  
382 depression and stress in women with multiple sclerosis. *Nursing and midwifery studies* 2015; 4:  
383 e29655-e29655. DOI: 10.17795/nmsjournal29655.
- 384 53. Lincoln NB, Yuill F, Holmes J, et al. Evaluation of an adjustment group for people with multiple  
385 sclerosis and low mood: a randomized controlled trial. *Multiple Sclerosis Journal* 2011; 17: 1250-1257.  
386 DOI: 10.1177/1352458511408753.
- 387 54. Sanaeinasab H, Saffari M, Hashempour M, et al. Effect of a transactional model education  
388 program on coping effectiveness in women with multiple sclerosis. *Brain and behavior* 2017; 7:  
389 e00810. DOI: 10.1002/brb3.810.
- 390 55. Senders A, Hanes D, Bourdette D, et al. Impact of mindfulness-based stress reduction for  
391 people with multiple sclerosis at 8 weeks and 12 months: a randomized clinical trial. *Multiple sclerosis*  
392 *journal* 2018. DOI: 10.1177/1352458518786650.
- 393 56. Shahdadi H, Dahmardeh H, Salari S, et al. The effect of a self-care instructional program  
394 based on Orem's model on the stress of multiple sclerosis patients. *Indian journal of public health*  
395 *research and development* 2017; 8: 280-285. DOI: 10.5958/0976-5506.2017.00056.0.
- 396 57. Stuijbergen AK, Becker H, Blozis S, et al. A randomized clinical trial of a wellness intervention  
397 for women with multiple sclerosis. *Archives of Physical Medicine and Rehabilitation* 2003; 84: 467-  
398 476. DOI: 10.1053/apmr.2003.50028.
- 399 58. Duval S and Tweedie R. Trim and Fill: A Simple Funnel-Plot-Based Method of Testing and  
400 Adjusting for Publication Bias in Meta-Analysis. *Biometrics* 2000; 56: 455-463. DOI: 10.1111/j.0006-  
401 341X.2000.00455.x.
- 402 59. Kayes NM, McPherson KM, Taylor D, et al. Facilitators and barriers to engagement in  
403 physical activity for people with multiple sclerosis: A qualitative investigation. *Disability and*  
404 *Rehabilitation* 2011; 33: 625-642. DOI: 10.3109/09638288.2010.505992.
- 405 60. Dobson R and Giovannoni G. Multiple Sclerosis – a review. *European Journal of Neurology*  
406 2018; 26: 27-40. DOI: 10.1111/ene.13819.
- 407 61. Sesel A-L, Sharpe L and Naismith Sharon I. Efficacy of Psychosocial Interventions for People  
408 with Multiple Sclerosis: A Meta-Analysis of Specific Treatment Effects. *Psychotherapy and*  
409 *Psychosomatics* 2018; 87: 105-111. DOI: 10.1159/000486806.
- 410 62. Simpson R, Simpson S, Ramparsad N, et al. Mindfulness-based interventions for mental well-  
411 being among people with multiple sclerosis: a systematic review and meta-analysis of randomised  
412 controlled trials. *Journal of Neurology, Neurosurgery & Psychiatry* 2019; 90: 1051. DOI: 10.1136/jnnp-  
413 2018-320165.
- 414 63. Casey B, Coote S, Hayes S, et al. Changing physical activity behavior in people with multiple  
415 sclerosis: a systematic review and meta-analysis. *Archives of Physical Medicine and Rehabilitation*  
416 2018; 99: 2059-2075. DOI: <https://doi.org/10.1016/j.apmr.2017.12.013>.
- 417 64. Castro O, Ng K, Novoradovskaya E, et al. A scoping review on interventions to promote  
418 physical activity among adults with disabilities. *Disability and Health Journal* 2018; 11: 174-183. DOI:  
419 <https://doi.org/10.1016/j.dhjo.2017.10.013>.

- 420 65. Evangelidis N, Craig J, Bauman A, et al. Lifestyle behaviour change for preventing the  
421 progression of chronic kidney disease: a systematic review. *BMJ Open* 2019; 9: e031625. DOI:  
422 10.1136/bmjopen-2019-031625.
- 423 66. Coulter EH, Bond S, Dalgas U, et al. The effectiveness of interventions targeting physical  
424 activity and/or sedentary behaviour in people with Multiple Sclerosis: a systematic review. *Disability  
425 and Rehabilitation* 2018: 1-19. DOI: 10.1080/09638288.2018.1503737.
- 426 67. Huedo-Medina TB, Sánchez-Meca J, Marín-Martínez F, et al. Assessing heterogeneity in  
427 meta-analysis: Q statistic or I2 Index? *Psychological Methods* 2006; 11: 193-206. DOI: 10.1037/1082-  
428 989X.11.2.193.

1 **Review article: Multiple Sclerosis and Related Disorders**

2

3 The effectiveness of emotional wellness programs on mental health outcomes for  
4 adults with multiple sclerosis: a systematic review and meta-analysis

5

6 Supplementary files

7 **Appendix A** Search strategy for MEDLINE (Ovid) and CINAHL

MEDLINE (Ovid)	
Search number	Search terms
1	Exp Multiple Sclerosis or multiple sclerosis.mp.
2	demyelinating disease.mp.
3	optic neuritis.mp.
4	demyelinating disorder.mp.
5	1 OR 2 OR 3 OR 4
6	exp Health Education/ or health education.mp.
7	exp Patient Participation or patient participation.mp.
8	education*.mp.
9	exp Health Promotion/ or health promotion.mp.
10	patient information.mp.
11	client information.mp.
12	Intervention.ab,ti.
13	Program*.ab,ti.
14	6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13
15	exp Health Status/ or health status.mp.
16	well-being.mp. or wellbeing.mp.
17	exp "Quality of Life"/
18	exp Mindfulness/ or mindfulness.mp.
19	Mindfulness-based.mp.
20	exp Stress, Psychological/ or stress.mp.
21	exp Self Care/
22	(self care or self-care).mp.
23	cognitive health.mp.
24	wellness.mp.
25	exp Depression/ or depression.mp.
26	exp Anxiety/ or exp Anxiety Disorders/ or anxiety.mp.
27	coping.mp.
28	Resilienc*.mp/ or exp Resilience, Psychological/
29	Meditat*.mp. Or exp Meditation/
30	Cognitive training.mp.
31	Self-efficacy.mp. Or exp Self Efficacy/
32	15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21 OR 22 OR 23 OR 24 OR 25 OR 26 OR 27 OR 28 OR 29 OR 30 OR 31
33	5 AND 14 AND 32
34	limit 33 (English language and humans)

CINAHL	
Search number	Search terms
S1	(MH "Multiple Sclerosis+") OR "multiple sclerosis"
S2	"demyelinating disease"
S3	"optic neuritis"
S4	"demyelinating disorder"
S5	S1 or S2 or S3 or S4
S6	(MH "Health Education+") OR "health education"
S7	(MH "Consumer Participation") OR "patient participation"
S8	(MH "Health Promotion+") OR "health promotion"
S9	"patient information"
S10	"client information"
S11	TI intervention* OR AB intervention*
S12	AB program* OR TI program*
S13	TI education OR AB education
S14	S6 or S7 or S8 or S9 or S10 or S11 or S12 or S13
S15	(MH "Health Status+") OR "health status"
S16	(MH "Psychological Well-Being") OR "well-being"
S17	"wellbeing"
S18	(MH "Quality of Life+")
S19	"mindfulness-based"
S20	(MH "Mindfulness") OR "mindfulness"
S21	(MH "Stress+") OR "stress" OR (MH "Stress, Psychological+")
S22	(MH "Self Care+") OR "self care" OR "self-care"
S23	"cognitive health"
S24	(MH "Wellness") OR "wellness"
S25	(MH "Depression+") OR "depression"
S26	(MH "Anxiety") OR "anxiety"
S27	(MH "Coping+") OR "coping"
S28	(MH "Hardiness:")
S29	"resilienc*"
S30	"meditat*" OR (MH "Meditation")
S31	"cognitive training"
S32	(MH "Self-Efficacy") OR "self-efficacy" OR "self efficacy"
S33	S15 or S16 or S17 or S18 or S19 or S20 or S21 or S22 or S23 or S24 or S25 or S26 or S27 or S28 or S29 or S30 or S31 or S32
S34	S5 and S12 and S31 (limiters - English Language)

15 **Appendix B** Tools used to measure depression, anxiety, quality of life, and stress

Outcome	Tool	Score range
Depression	Arthritis Impact Measurement Scales (AIMS) <sup>1</sup>	0 - 10
	Beck Depression Inventory (BDI) <sup>1</sup>	0 - 63
	BDI-II <sup>1</sup>	0 - 63
	Center for Epidemiologic Studies Depression Scale (CES-D) <sup>1</sup>	0 - 60
	Depression, Anxiety and Stress Scales (DASS-21) <sup>1</sup>	0 - 21
	Hospital Anxiety and Depression Scale (HADS) <sup>1</sup>	0 - 21
	Mental Health Inventory (MHI-18) <sup>2</sup>	0 - 100
	Patient Health Questionnaire (PHQ-9) <sup>1</sup>	0 - 27
	Patient-Reported Outcomes Measurement Information System (PROMIS) <sup>1</sup>	35.2 - 82.4
Anxiety	AIMS <sup>1</sup>	0 - 10
	DASS-2 <sup>1</sup>	0 - 21
	HADS <sup>1</sup>	0 - 21
	MHI-18 <sup>2</sup>	0 - 100
	PROMIS <sup>1</sup>	35.2 - 82.4
	State-Trait Anxiety Inventory (STAI) <sup>1</sup>	20 - 80
Quality of life	EuroQol (EQ-5D) <sup>1</sup>	0 - 1
	Hamburg Quality of Life Questionnaire in Multiple Sclerosis (HAQUAMS) <sup>1</sup>	1 - 5
	Life Satisfaction Questionnaire (LiSat-9) <sup>1</sup>	9 - 54
	Multiple Sclerosis Quality of Life-54 (MSQOL-54) <sup>1</sup>	0 - 24
	Profile of Health-Related Quality of Life in Chronic Disorders (PQOLC) <sup>1</sup>	0 - 24
	Medical Outcomes Study 8-Item Short-Form Health Survey (SF-8) <sup>1</sup>	0 - 100
	Medical Outcomes Study 12-Item Short-Form Health Survey (SF-12) <sup>1</sup>	0 - 100
	Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) <sup>1</sup>	0 - 100
	Stress	DASS-21 <sup>1</sup>
Perceived Stress Scale (PSS) <sup>1</sup>		0 - 40

16 <sup>1</sup>Higher score indicates greater severity of outcome

17 <sup>2</sup>Higher score indicates lower severity of outcome

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29 **Appendix C** Studies ineligible following review of full text ( $n=69$ )

- 30 Agland, S., Shaw, S., Lea, R., Mortimer-Jones, S., & Lechner-Scott, J. (2017). Does  
31 mindfulness, meditation and progressive muscle relaxation reduce stress in people with  
32 multiple sclerosis? *Multiple Sclerosis Journal*, 23(3), 963-964.  
33 <https://doi.org/10.1177/1352458517731285>  
34 *Reason for exclusion:* Abstract or poster
- 35 Bermudez, M., Olivares, T., Moises, B., Hernandez, M. A., & Villar Van Weigaert, C. (2015).  
36 Cognitive behavioural therapy in multiple sclerosis: effectiveness in reducing depressive  
37 symptoms and cognitive impairments. *Multiple Sclerosis*, 21(11 SUPPL. 1), 230.  
38 <https://doi.org/10.1177/1352458515602642>  
39 *Reason for exclusion:* Abstract or poster
- 40 Fischer, A., Schroder, J., Pottgen, J., Lau, S., Heesen, C., Moritz, S., & Gold, S. M. (2013).  
41 Effectiveness of an internet-based treatment programme for depression in multiple sclerosis:  
42 a randomized controlled trial. *Multiple Sclerosis Journal*, 19(11), 350-351.  
43 *Reason for exclusion:* Abstract or poster
- 44 Franco, M., Barone, D., Barone, K., Foley, F., Pfohl, D. C., Rosenberg, J., . . . Treadaway, K.  
45 (2008). Patient education: using relaxation and guided imagery to lower anxiety associated  
46 with multiple sclerosis and injections. *International Journal of MS Care*, 10, 44-45.  
47 *Reason for exclusion:* Abstract or poster
- 48 Goldoust, F., Ebadifard Azar, F., Solhi, M., & Ghorchiany, F. (2012). Planning and  
49 Evaluation of Stress Management Educational Program to Improve Behavior in Multiple  
50 Sclerosis Patients Based on Basnef Model. *Journal of Urmia Nursing & Midwifery Faculty*,  
51 10(3), 1-9.  
52 *Reason for exclusion:* Abstract or poster
- 53 Gonzalez-Suarez, I., Munoz-San Jose, A., Cebolla Lorenzo, S., Carrillo Notario, L., Lopez  
54 De Velasco, V., Orviz Garcia, A., . . . Oreja-Guevara, C. (2016). Benefits of a mindfulness-  
55 based intervention compared to psychoeducation among multiple sclerosis patients. *Multiple*  
56 *Sclerosis*, 22, 694-. <https://doi.org/10.1177/1352458516663086>  
57 *Reason for exclusion:* Abstract or poster
- 58 Granmayeh, S. H., Besharat, M., Nabavi, S. M., Sadeghi, S., & Imani, A. (2012). The effects  
59 of Mindfulness-based Stress Reduction programme on physical symptoms, quality of life,  
60 and mental health in patients with multiple sclerosis. *Journal of Neurology*, 259, S154-S154.  
61 *Reason for exclusion:* Abstract or poster
- 62 Kalina, J. (2016). Effects of a Program Designed to Improve Self-Efficacy and Subsequent  
63 Effects on Decreasing Loneliness and Depression Among People with Multiple Sclerosis.  
64 *Neurology*, 86.  
65 *Reason for exclusion:* Abstract or poster
- 66 Landtblom, A. M., Guala, D., Hau, S., Jansson, L., Martin, C., & Fredrikson, S. (2017).  
67 RebiQoL: a telemedicine patient support program on health related quality of life and  
68 adherence in MS patients treated with Rebif. *Multiple Sclerosis Journal*, 23(3), 425-.  
69 <https://doi.org/10.1177/1352458517731404>  
70 *Reason for exclusion:* Abstract or poster
- 71 Munoz San Jose, A., Cebolla Lorenzo, S., Carrillo, L., Gonzalez-Suarez, I., Sanz Velasco,  
72 N., Soto Lopez, T., . . . Oreja-Guevara, C. (2015). Mindfulness in multiple sclerosis patients.  
73 *European Journal of Neurology*, 22, 826. <https://doi.org/10.1111/ene.12808>



- 74 *Reason for exclusion:* Abstract or poster
- 75 Saeed, R., Evangelou, N., & Turner, A. (2014). A service evaluation of the Multiple Sclerosis  
76 Mindfulness Programme. *Multiple Sclerosis Journal*, 20(7), 991-991.  
77 *Reason for exclusion:* Abstract or poster
- 78 Bombardier, C. H., Cunniffe, M., Wadhvani, R., Gibbons, L. E., Blake, K. D., & Kraft, G. H.  
79 (2008). The efficacy of telephone counseling for health promotion in people with multiple  
80 sclerosis: a randomized controlled trial. *Archives of Physical Medicine & Rehabilitation*,  
81 89(10), 1849-1856  
82 *Reason for exclusion:* Cannot extract emotional wellness program component
- 83 Burschka, J. M., Keune, P. M., van Oy, U. H., Oschmann, P., & Kuhn, P. (2014).  
84 Mindfulness-based interventions in multiple sclerosis: Beneficial effects of Tai Chi on  
85 balance, coordination, fatigue and depression. *BMC Neurology*, 14  
86 *Reason for exclusion:* Cannot extract emotional wellness program component
- 87 Gilbertson, R. M., & Klatt, M. D. (2017). Mindfulness in Motion for People with Multiple  
88 Sclerosis: A Feasibility Study. *International Journal of MS Care*, 19(5), 225-231.  
89 <https://doi.org/10.7224/1537-2073.2015-095>  
90 *Reason for exclusion:* Cannot extract emotional wellness program component
- 91 Hadgkiss, E. J., Jelinek, G. A., Taylor, K. L., Marck, C. H., van der Meer, D. M., Pereira, N.  
92 G., & Weiland, T. J. (2015). Engagement in a program promoting lifestyle modification is  
93 associated with better patient-reported outcomes for people with MS. *Neurological Sciences*,  
94 36(6), 845-852.  
95 *Reason for exclusion:* Cannot extract emotional wellness program component
- 96 Hart, D. L., Memoli, R. I., Mason, B., & Werneke, M. W. (2011). Developing a Wellness  
97 Program for People with Multiple Sclerosis. *International Journal of MS Care*, 13(4), 154-  
98 162.  
99 *Reason for exclusion:* Cannot extract emotional wellness program component
- 100 Li, M. P., Jelinek, G. A., Weiland, T. J., Mackinlay, C. A., Dye, S., & Gawler, I. (2010). Effect  
101 of a residential retreat promoting lifestyle modifications on health-related quality of life in  
102 people with multiple sclerosis. *Quality in Primary Care*, 18(6), 379-389  
103 *Reason for exclusion:* Cannot extract emotional wellness program component
- 104 Malec, C. A. (2002). The effect of a healthy lifestyle intervention on quality of life in the  
105 chronically ill: A Randomized Control Trial Ph.D. University of Calgary (Canada).  
106 *Reason for exclusion:* Cannot extract emotional wellness program component
- 107 Marck, C. H., De Livera, A. M., Brown, C. R., Neate, S. L., Taylor, K. L., Weiland, T. J., . . .  
108 Jelinek, G. A. (2018). Health outcomes and adherence to a healthy lifestyle after a  
109 multimodal intervention in people with multiple sclerosis: Three year follow-up. *PLoS ONE*,  
110 13(5), e0197759.  
111 *Reason for exclusion:* Cannot extract emotional wellness program component
- 112 Ng, A., Kennedy, P., Hutchinson, B., Ingram, A., Vondrell, S., Goodman, T., & Miller, D.  
113 (2013). Self-efficacy and health status improve after a wellness program in persons with  
114 multiple sclerosis. *Disability & Rehabilitation*, 35(12), 1039-1044.  
115 *Reason for exclusion:* Cannot extract emotional wellness program component
- 116 Plow, M. A. H. (2006). Comparing the effectiveness of a wellness intervention to  
117 prehabilitation in individuals with multiple sclerosis Ph.D. University of Minnesota.

118 *Reason for exclusion:* Cannot extract emotional wellness program component

119 Seifi, K., & Moghaddam, H. E. (2018). The Effectiveness of Self-care Program on the Life  
120 Quality of Patients with Multiple Sclerosis in 2015. *Journal of the National Medical*  
121 *Association*, 110(1), 65-72. <https://doi.org/10.1016/j.jnma.2017.01.010>  
122 *Reason for exclusion:* Cannot extract emotional wellness program component

123 Tietjen, K. M., & Breitenstein, S. (2017). A Nurse-Led Telehealth Program to Improve  
124 Emotional Health in Individuals With Multiple Sclerosis. *Journal of Psychosocial Nursing and*  
125 *Mental Health Services*, 55(3), 31-37. <https://doi.org/10.3928/02793695-20170301-04>  
126 *Reason for exclusion:* Cannot extract emotional wellness program component

127 Burleson Sullivan, A., Scheman, J., LoPresti, A., & Prayor-Patterson, H. (2012).  
128 Interdisciplinary Treatment of Patients with Multiple Sclerosis and Chronic Pain. *International*  
129 *Journal of MS Care*, 14(4), 216-220. <https://doi.org/10.7224/1537-2073-14.4.216>  
130 *Reason for exclusion:* Disease or symptom focus

131 Feicke, J., Spörhase, U., Köhler, J., Busch, C., & Wirtz, M. (2014). A multicenter,  
132 prospective, quasi-experimental evaluation study of a patient education program to foster  
133 multiple sclerosis self-management competencies. *Patient Education and Counseling*, 97(3),  
134 361-369. <https://doi.org/10.1016/j.pec.2014.09.005>  
135 *Reason for exclusion:* Disease or symptom focus

136 Köpke, S., Kern, S., Ziemssen, T., Berghoff, M., Kleiter, I., Marziniak, M., . . . Heesen, C.  
137 (2014). Evidence-based patient information programme in early multiple sclerosis: a  
138 randomised controlled trial. *Journal of Neurology, Neurosurgery & Psychiatry*, 85(4), 411-  
139 418. <https://doi.org/10.1136/jnnp-2013-306441>  
140 *Reason for exclusion:* Disease or symptom focus

141 Kos, D., Duportail, M., Meirte, J., Meeus, M., D'Hooghe, M. B., Nagels, G., . . . Nijs, J.  
142 (2016). The effectiveness of a self-management occupational therapy intervention on activity  
143 performance in individuals with multiple sclerosis-related fatigue: a randomized-controlled  
144 trial. *International Journal of Rehabilitation Research*, 39(3), 255-262.  
145 <https://doi.org/10.1097/MRR.0000000000000178>  
146 *Reason for exclusion:* Disease or symptom focus

147 Thomas, S., Thomas, P. W., Kersten, P., Jones, R., Green, C., Nock, A., . . . et al. (2013). A  
148 pragmatic parallel arm multi-centre randomised controlled trial to assess the effectiveness  
149 and cost-effectiveness of a group-based fatigue management programme (FACETS) for  
150 people with multiple sclerosis. *Journal of Neurology, Neurosurgery, and Psychiatry*, 84(10),  
151 1092-1099. <https://doi.org/10.1136/jnnp-2012-303816>  
152 *Reason for exclusion:* Disease or symptom focus

153 Bogosian, A., Hughes, A., Norton, S., Silber, E., & Moss-Morris, R. (2016). Potential  
154 treatment mechanisms in a mindfulness-based intervention for people with progressive  
155 multiple sclerosis. *British Journal of Health Psychology*, 21(4), 859-880.  
156 <https://doi.org/10.1111/bjhp.12201>  
157 *Reason for exclusion:* Duplicate studies

158 Kalina, J. (2016). Effects of an educational socialization program designed to improve self-  
159 efficacy and subsequent effects on decreasing loneliness and depression among people  
160 with multiple sclerosis. *Dissertation Abstracts International: Section B: The Sciences and*  
161 *Engineering*, 77(3-B(E)).  
162 *Reason for exclusion:* Duplicate studies

- 163 Cosio, D., Jin, L., Siddique, J., Mohr, D. C., Cosio, D., Jin, L., . . . Mohr, D. C. (2011). The  
164 effect of telephone-administered cognitive-behavioral therapy on quality of life among  
165 patients with multiple sclerosis. *Annals of Behavioral Medicine*, 41(2), 227-234.  
166 <https://doi.org/10.1007/s12160-010-9236-y>  
167 *Reason for exclusion:* Individualised cognitive therapy
- 168 Fischer, A., Schroder, J., Vettorazzi, E., Wolf, O. T., Pottgen, J., Lau, S., . . . Gold, S. M.  
169 (2015). An online programme to reduce depression in patients with multiple sclerosis: a  
170 randomised controlled trial. *Lancet Psychiatry*, 2(3), 217-223. [https://doi.org/10.1016/s2215-](https://doi.org/10.1016/s2215-0366(14)00049-2)  
171 [0366\(14\)00049-2](https://doi.org/10.1016/s2215-0366(14)00049-2)  
172 *Reason for exclusion:* Individualised cognitive therapy
- 173 Kiropoulos, L. A., Kilpatrick, T., Holmes, A., & Threader, J. (2016). A pilot randomized  
174 controlled trial of a tailored cognitive behavioural therapy based intervention for depressive  
175 symptoms in those newly diagnosed with multiple sclerosis. *BMC Psychiatry*, 16(1), 435.  
176 *Reason for exclusion:* Individualised cognitive therapy
- 177 Mohr, D. C., Hart, S., & Vella, L. (2007). Reduction in disability in a randomized controlled  
178 trial of telephone-administered cognitive-behavioral therapy. *Health Psychology*, 26(5), 554-  
179 563.  
180 *Reason for exclusion:* Individualised cognitive therapy
- 181 Anderson, J. K., Turner, A., & Clyne, W. (2017). Development and feasibility of the Help to  
182 Overcome Problems Effectively (HOPE) self-management intervention for people living with  
183 multiple sclerosis. *Disability & Rehabilitation*, 39(11), 1114-1121  
184 *Reason for exclusion:* No comparator group
- 185 Becker, H., Stuifbergen, A. K., Schnyer, R. N., Morrison, J. D., & Henneghan, A. (2017).  
186 Integrating Acupuncture Within a Wellness Intervention for Women With Multiple Sclerosis.  
187 *Journal of Holistic Nursing*, 35(1), 86-96.  
188 *Reason for exclusion:* No comparator group
- 189 Blankespoor, R. J., Schellekens, M. P., Vos, S. H., Speckens, A. E., & Jong, B. A. (2017).  
190 The effectiveness of mindfulness-based stress reduction on psychological distress and  
191 cognitive functioning in patients with multiple sclerosis: A pilot study. *Mindfulness*, 8(5),  
192 1251-1258.  
193 *Reason for exclusion:* No comparator group
- 194 Brittle, N., Brown, M., Mant, J., McManus, R., Riddoch, J., & Sackley, C. (2008). Short-term  
195 effects on mobility, activities of daily living and health-related quality of life of a Conductive  
196 Education programme for adults with multiple sclerosis. *Clinical Rehabilitation*, 22(4), 329-  
197 337.  
198 *Reason for exclusion:* No comparator group
- 199 Calandri, E., Graziano, F., Borghi, M., & Bonino, S. (2017). Improving the quality of life and  
200 psychological well-being of recently diagnosed multiple sclerosis patients: preliminary  
201 evaluation of a group-based cognitive behavioral intervention. *Disability & Rehabilitation*,  
202 39(15), 1474-1481  
203 *Reason for exclusion:* No comparator group
- 204 Chruzander, C., Gottberg, K., Ytterberg, C., Backenroth, G., Fredrikson, S., Widén  
205 Holmqvist, L., & Johansson, S. (2016). A single-group pilot feasibility study of cognitive  
206 behavioural therapy in people with multiple sclerosis with depressive symptoms. *Disability &*  
207 *Rehabilitation*, 38(24), 2383-2391.

208 *Reason for exclusion:* No comparator group

209 Crawford, J. D., & McIvor, G. P. (1987). Stress management for multiple sclerosis patients.  
210 Psychological Reports, 61(2), 423-429.  
211 *Reason for exclusion:* No comparator group

212 Hankin, V. M. (2010). Mindfulness based stress reduction in couples facing multiple  
213 sclerosis: Impact on self reported anxiety and uncertainty. Dissertation Abstracts  
214 International: Section B: The Sciences and Engineering, 70(10-B), 6551.  
215 *Reason for exclusion:* No comparator group

216 Pakenham, K. I., Mawdsley, M., Brown, F. L., & Burton, N. W. (2018). Pilot evaluation of a  
217 resilience training program for people with multiple sclerosis. Rehabilitation Psychology,  
218 63(1), 29-42.  
219 *Reason for exclusion:* No comparator group

220 Pritchard, M., Elison-Bowers, P., & Birdsall, B. (2010). Impact of integrative restoration  
221 (iRest) meditation on perceived stress levels in multiple sclerosis and cancer outpatients.  
222 Journal of the International Society for the Investigation of Stress, 26(3), 233-237.  
223 <https://doi.org/10.1002/smi.1290>  
224 *Reason for exclusion:* No comparator group

225 Sheppard, S. C., Forsyth, J. P., Hickling, E. J., & Bianchi, J. (2010). A novel application of  
226 acceptance and commitment therapy for psychosocial problems associated with multiple  
227 sclerosis: results from a half-day workshop intervention. International Journal of MS Care,  
228 12(4), 200-206.  
229 *Reason for exclusion:* No comparator group

230 Sinclair, V. G., & Scroggie, J. (2005). Effects of a cognitive-behavioral program for women  
231 with multiple sclerosis. Journal of Neuroscience Nursing, 37(5), 249-257, 276.  
232 *Reason for exclusion:* No comparator group

233 Spitzer, E., & Pakenham, K. I. (2018). Evaluation of a brief community-based mindfulness  
234 intervention for people with multiple sclerosis: A pilot study. Clinical Psychologist, 22(2), 182-  
235 191. <https://doi.org/10.1111/cp.12108>  
236 *Reason for exclusion:* No comparator group

237 Visschedijk, M. A., Collette, E. H., Pfennings, L. E., Polman, C. H., & Van Der Ploeg, H. M.  
238 (2004). Development of a Cognitive Behavioral Group Intervention Programme For Patients  
239 with Multiple Sclerosis: An Exploratory Study. Psychological Reports, 95(3,Part1), 735-746.  
240 *Reason for exclusion:* No comparator group

241 Wingerson, N. W., & Wineman, N. (2000). The mental health, self-efficacy, and satisfaction  
242 outcomes of a community counseling demonstration project for multiple sclerosis patients.  
243 Journal of Applied Rehabilitation Counseling, 31(2), 11-17.  
244 *Reason for exclusion:* No comparator group

245 Artemiadis, A. K., Vervainioti, A. A., Alexopoulos, E. C., Rombos, A., Anagnostouli, M. C., &  
246 Darviri, C. (2012). Stress management and multiple sclerosis: a randomized controlled trial.  
247 Archives of Clinical Neuropsychology, 27(4), 406-416.  
248 *Reason for exclusion:* No education component

249 Beatus, J., O'Neill, J. K., Townsend, T., & Robrecht, K. (2002). The effect of a one-week  
250 retreat on self-esteem, quality of life, and functional ability for persons with multiple sclerosis.  
251 Neurology Report, 26(3), 154-159.

- 252 *Reason for exclusion:* No education component
- 253 Khan, F., Amatya, B., Elmalik, A., Lowe, M., Ng, L., Reid, I., & Galea, M. P. (2016). An  
254 Enriched Environmental Programme During Inpatient Neuro-Rehabilitation: A Randomized  
255 Controlled Trial. *Journal of Rehabilitation Medicine*, 48(5), 417-425.  
256 <https://doi.org/10.2340/16501977-2081>  
257 *Reason for exclusion:* No education component
- 258 Lincoln, N., Dent, A., Harding, J., Weyman, N., Nicholl, C., Blumhardt, L., & Playford, E.  
259 (2002). Evaluation of cognitive assessment and cognitive intervention for people with  
260 multiple sclerosis. *Journal of Neurology, Neurosurgery & Psychiatry*, 72(1), 93-98  
261 *Reason for exclusion:* No education component
- 262 Block, P., Vanner, E. A., Keys, C. B., Rimmer, J. H., & Skeels, S. E. (2010). Project Shake-  
263 It-Up: using health promotion, capacity building and a disability studies framework to  
264 increase self efficacy. *Disability & Rehabilitation*, 32(9), 741-754.  
265 *Reason for exclusion:* No outcomes of interest
- 266 Kalina, J., Hinojosa, J., Strober, L., Bacon, J., Donnelly, S., & Goverover, Y. (2018).  
267 Randomized controlled trial to improve self-efficacy in people with multiple sclerosis: The  
268 Community Reintegration for Socially Isolated Patients (CRISP) program. *American Journal*  
269 *of Occupational Therapy*, 72(5), 1-8.  
270 *Reason for exclusion:* No outcomes of interest
- 271 Liu, Y. J. (2017). A Hope-Based Group Therapy Program to Women with Multiple Sclerosis:  
272 Quality of Life. *Neuroquantology*, 15(4), 127-132.  
273 <https://doi.org/10.14704/nq.2017.15.4.1135>  
274 *Reason for exclusion:* No outcomes of interest
- 275 Shevil, E. (2008). Developing and pilot testing a cognitive intervention program for persons  
276 with multiple sclerosis. *Dissertation Abstracts International: Section B: The Sciences and*  
277 *Engineering*, 69(5-B), 2954.  
278 *Reason for exclusion:* No outcomes of interest
- 279 Shevil, E., & Finlayson, M. (2010). Pilot study of a cognitive intervention program for persons  
280 with multiple sclerosis. *Health Education Research*, 25(1), 41-53.  
281 *Reason for exclusion:* No outcomes of interest
- 282 Stuifbergen, A., Becker, H., Rogers, S., Timmerman, G., & Kullberg, V. (1999). Promoting  
283 wellness for women with multiple sclerosis. *Journal of Neuroscience Nursing*, 31(2), 73-79.  
284 *Reason for exclusion:* No outcomes of interest
- 285 Stuifbergen, A. K., Becker, H., Timmerman, G. M., & Kullberg, V. (2003). The use of  
286 individualized goal setting to facilitate behavior change in women with multiple sclerosis.  
287 *Journal of Neuroscience Nursing*, 35(2), 94-99, 106.  
288 *Reason for exclusion:* No outcomes of interest
- 289 Dehghani, A., Kermanshahi, S., & Memarian, R. (2012). The effect of peer group educational  
290 program on multiple sclerosis patients ' level of stress.  
291 *Reason for exclusion:* Not in English language
- 292 Boosman, H., Visser-Meily, J. M., Meijer, J.-W. G., Elsinga, A., & Post, M. W. (2011).  
293 Evaluation of change in fatigue, self-efficacy and health-related quality of life, after a group  
294 educational intervention programme for persons with neuromuscular diseases or multiple

295 sclerosis: A pilot study. Disability and Rehabilitation: An International, Multidisciplinary  
296 Journal, 33(8), 690-696.  
297 *Reason for exclusion:* Not exclusively MS participants (can't extract MS data)

298 Canade, R. F. (2014). Be here now: evaluating an adapted mindfulness-based intervention  
299 in a mixed population with acquired brain injury (ABI) and neurological conditions Ph.D.  
300 University of Hertfordshire (United Kingdom).  
301 *Reason for exclusion:* Not exclusively MS participants (can't extract MS data)

302 Hughes, R. B., Robinson-Whelen, S., Taylor, H. B., & Hall, J. W. (2006). Stress self-  
303 management: an intervention for women with physical disabilities. Womens Health Issues,  
304 16(6), 389-399.  
305 *Reason for exclusion:* Not exclusively MS participants (can't extract MS data)

306 Mandel, A. R., & Keller, S. M. (1986). Stress management in rehabilitation. Archives of  
307 Physical Medicine & Rehabilitation, 67(6), 375-379  
308 *Reason for exclusion:* Not exclusively MS participants (can't extract MS data)

309 Muller, R., Gertz, K. J., Molton, I. R., Terrill, A. L., Bombardier, C. H., Ehde, D. M., & Jensen,  
310 M. P. (2016). Effects of a Tailored Positive Psychology Intervention on Well-Being and Pain  
311 in Individuals With Chronic Pain and a Physical Disability: A Feasibility Trial. Clinical Journal  
312 of Pain, 32(1), 32-44.  
313 *Reason for exclusion:* Not exclusively MS participants (can't extract MS data)

314 Classen, S. (2002). The long-term effectiveness of two occupational therapy interventions on  
315 the lives of people with MS: a randomized controlled trial Ph.D. Nova Southeastern  
316 University.  
317 *Reason for exclusion:* Rehabilitation-focus

318 Egner, A., Phillips, V., Vora, R., & Wiggers, E. (2003). Depression, fatigue, and health-  
319 related quality of life among people with advanced multiple sclerosis: Results from an  
320 exploratory telerehabilitation study. NeuroRehabilitation, 18(2), 125-133.  
321 *Reason for exclusion:* Rehabilitation-focus

322 Hanssen, K., Beiske, A., Landro, N., Hofoss, D., & Hessen, E. (2016). Cognitive  
323 rehabilitation in multiple sclerosis: A randomized controlled trial. Acta Neurologica  
324 Scandinavica, 133(1), 30-40.  
325 *Reason for exclusion:* Rehabilitation-focus

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335 **Appendix D** Studies excluded for scoring less than 50% on assessment of methodological  
336 quality

337 Haji-Adineh S, Farzanfar A, Salehi-Morekani S, et al. (2019). The Effectiveness of  
338 Mindfulness-Based Cognitive Therapy on Life Expectancy and Depression in Patients with  
339 Multiple Sclerosis. *International Journal of Body, Mind, and Culture*, 6, 79-89.  
340 <https://doi.org/10.22122/ijbmc.v6i2.160>.

341 Khayeri F, Rabiei L, Shamsalinia A, et al. (2016). Effect of Fordyce Happiness Model on  
342 depression, stress, anxiety, and fatigue in patients with multiple sclerosis. *Complementary  
343 Therapies in Clinical Practice*, 25, 130-135.

344 Rigby S, Thornton E and Young C. (2008). A randomized group intervention trial to enhance  
345 mood and self-efficacy in people with multiple sclerosis. *British Journal of Health  
346 Psychology*, 13, 619-631.

## Appendix E Table of characteristics of included studies

Author, country, study design	MS type	Sample size (n)	Age y; mean (SD), Female (%)	Disease duration y; mean (SD)	Intervention description; delivery method	Intervention duration; frequency	Comparator	Primary outcomes of the study	Emotional wellness outcome (tool): main findings between IG and CG	Behaviour change theory used
Alschuler <i>et al.</i> , 2018. USA, RCT	All	IG: 12 CG: 16	59.8 (7.7), 83% 59.8 (6.5), 100%	18.6 (16.3) 21.0 (12.2)	“Everyday Matters”; aging-focussed resilience; group, tele-conference	90 min; 6 sessions over 6 weeks	Waitlist control	Resilience	Depression (PROMIS): no significant difference ( $P = 0.09$ ) Anxiety (PROMIS): no significant difference ( $P > 0.05$ )	NR
Amiri <i>et al.</i> , 2016. Iran, RCT	NR	IG: 20 CG: 20	25.2 (4.5), 48%	NR	Mindfulness; group, in-person	2 hr; 8 sessions over 8 weeks	Usual care	Anxiety Depression Executive Function	Depression (BDI-II): significant improvement in IG ( $P < 0.01$ ) Anxiety (STAI): significant improvement in IG ( $P < 0.01$ )	NR
Bahrani <i>et al.</i> , 2017. Iran, RCT	NR	IG: 23 CG: 24	36.8 (6.1), 100% 36.0 (7.1), 100%	7.3 (3.5) 6.7 (3.2)	Mindfulness-integrated cognitive behaviour therapy; group, in-person	2 hr; 8 sessions over 8 weeks	Usual care	Anxiety Depression Stress	Depression (DASS-21): significant improvement in IG ( $P < 0.001$ ) Anxiety (DASS-21): significant improvement in IG ( $P < 0.001$ ) Stress (DASS-21): significant improvement in IG ( $P < 0.001$ )	NR
Barlow J, <i>et al.</i> , 2009. UK, RCT	NR	IG: 78 CG: 64	48.2 (10.1), 73% 50.7 (11.7), 69%	9.6 (8.3) 12.1 (7.4)	Chronic Disease Self-Management Course; group, in-person	2 hr; 6 sessions over 6 weeks	Waitlist control	Depression Self-efficacy	Depression (HADS): IG trend towards improvement ( $P = 0.051$ ) Anxiety (HADS): no significant difference ( $P > 0.05$ )	Self-efficacy theory
Bogosian <i>et al.</i> , 2015. UK, RCT	Progressive	IG: 19 CG: 21	53.4 (8.3), 47% 50.9 (9.9), 62%	16.2 (10.1) 12.6 (8.6)	Mindfulness; group, videoconference	1 hr; 8 sessions over 8 weeks	Waitlist control	Distress	Depression (HADS): significant improvement in IG ( $P = 0.017$ ) Anxiety (HADS): no significant difference at post ( $P = 0.099$ )	NR



									QoL (EQ-5D): no significant difference ( $P > 0.05$ )	
Calandri <i>et al.</i> , 2016. Italy, Quasi-controlled trial	All	IG: 54	38.0 (12.5), 61%	1.5 (0.7)	Cognitive behavioural program; group, in-person	2 hr; 5 sessions over 8 weeks, and 1 session at 6 month follow-up	Waitlist control	Depression Optimism Psychological well-being Quality of life	Depression (CES-D): no significant difference ( $P = 0.258$ )	NR
		CG: 31	34.8 (11.9), 55%	1.8 (0.8)					QoL (SF-12): significant improvement in IG ( $P = 0.036$ )	
Cavalera <i>et al.</i> , 2019. Italy, RCT	RR and SP	IG: 69	42.3 (8.4), 67%	11.2 (8.0)	Mindfulness; group, online	2 hr; 8 sessions over 8 weeks	Online psychoeducational group	Quality of life	Depression (HADS): significant improvement in IG ( $P = 0.020$ )	NR
		CG: 70	43.2 (9.0), 62%	12.2 (7.3)					Anxiety (HADS): significant improvement in IG ( $P = 0.049$ )	
Crescentini <i>et al.</i> , 2018. Italy, Quasi-controlled trial	All	IG: 15	47.8 (9.3), 80%	13.1 (10.7)	Mindfulness-oriented meditation; group, in-person	2 hr; 8 sessions over 8 weeks	Usual care	Temperament and character	Depression (BDI): no significance difference ( $P < 0.05$ )	NR
		CG: 13	49.1 (10.6), 77%	14.5 (7.7)					Anxiety (STAI-trait): significant improvement in IG ( $P = 0.04$ ) Anxiety (STAI-state): no significant difference ( $P > 0.08$ )	
das Nair <i>et al.</i> , 2016. UK, RCT	All	IG: 11	48.9 (10.4), 73%	9.3 (6.8)	Modified group program for adjustment to MS, based on cognitive and psycho-educational framework; individual, in-person	1 hr; 6 sessions over 12 weeks	Group adjustment program	Feasibility Mood	Depression (BDI-II and HADS): no significant difference (HADS $P = 0.13$ , BDI-II $P = 0.57$ )	NR
		CG: 10	48.0 (11.2), 70%	8.9 (6.4)					Anxiety (HADS): no significant difference ( $P = 0.16$ )	
Ehde <i>et al.</i> , 2015. USA, RCT	RR and Progressive	IG: 75	51.0 (10.1), 89.3%	<5 y 28%; 5-9 y 3%; 10-19 y 39%; 20+ y 11%	Self-management intervention (skill-building) for chronic conditions; individual, telephone-delivered	45-60 min; 6 sessions over 6 weeks	Education program; individual, telephone-delivered	Fatigue impact Pain interference Depression	Depression (PHQ-9): no significant difference ( $P > 0.05$ )	NR
									QoL (SF-8): no significant difference ( $P > 0.05$ )	

		CG: 88	53.2 (10), 85.2%	<5 y 24%; 5-9 y 28%; 10-19 y 30%; 20+ y 18%						
Ennis <i>et al.</i> , 2006. UK, RCT	All	IG: 32  CG: 30	45.0 (9), 63%  46.0 (8), 63%	7.0 (5)  8.0 (6)	'OPTIMSE' health promotion education intervention; group, in-person	3 hr; 8 sessions over 8 weeks	Waitlist	Health Promoting Lifestyle Profile	QoL (SF-36, mental health): significant improvement in IG ( $P < 0.01$ )	NR
Forman & Lincoln, 2010. UK, RCT	All	IG: 20  CG: 20	47.3 (10.3), 80%  47.7 (9.8), 80%	7.3 (5.4)  12.4 (11.4)	Adjustment to MS program; group, in-person	2 hr; 6 sessions over 12 weeks	Waitlist	Mood	Depression (HADS): significant improvement in IG (area under curve $P = 0.02$ ; includes 6 month follow-up)  Anxiety (HADS): no significant difference (area under curve $P = 0.89$ ; includes 6 month follow-up)  QoL (SF-36, psychological): no significant difference (area under curve $P = 0.90$ , includes 6 month follow-up)	Cognitive behavioral therapy principles
Graziano <i>et al.</i> , 2014. Italy, RCT	All	IG: 41  CG: 41	42.3 (5.2), 66%  38.3 (10.1), 60%	8.6 (5.2)  7.2 (5.3)	Cognitive behavioural program; group, in-person	2 hr; 4 sessions over 8 weeks, and 1 session at 6 month follow-up	Information sessions; group, in-person	Depression Psychological wellbeing QoL	Depression (CES-D): no significant difference ( $P = 0.224$ )  QoL (MSQOL-54): no significant difference ( $P > 0.05$ )	NR
Grossman <i>et al.</i> , 2010. Switzerland, RCT	RR and SP	IG: 76  CG: 74	45.9 (10.0), 78%  48.7 (10.6), 81%	7.7 (0.9)  9.7 (0.9)	Mindfulness-based intervention (MBI), based on mindfulness-based stress reduction; group, in-person	2.5 hr; 8 sessions over 8 weeks, and one 7-hr session at week 6	Usual care	Depression Fatigue Quality of Life	Depression (CES-D): significant improvement in IG ( $P < 0.001$ )  Anxiety (STAI): significant improvement in IG ( $P < 0.001$ )  QoL (HAQUAMS and PQOLC): significant improvement in IG (HAQUAMS $P < 0.001$ ; PQOLC $P < 0.001$ )	NR
Haji-Adineh <i>et al.</i>	NR	IG: 15	33.1 (9.1), 53%	Minimum 1 y <sup>1</sup>		90 min; 8 sessions	Usual care	Depression	Depression (BDI): significant improvement in IG ( $P < 0.001$ )	NR

<i>al.</i> , 2019. Iran, RCT		CG: 15	31.5 (12.5), 53%		Mindfulness-based cognitive therapy; group, in-person	over 8 weeks		Life expectancy		
Hoogerw erf <i>et al.</i> , 2017. Netherla nds, Quasi- controlle d trial	RR and SP	IG: 55  CG: 59	48.0 (8.5), 83% <sup>1</sup>	11.0 (8.2) <sup>1</sup>	Modified mindfulness-based cognitive therapy; group, in-person	2.5 hr; 8 sessions over 10 weeks	Waitlist control <sup>2</sup>	Fatigue	Depression (HADS): significant improvement in IG ( $P < 0.001$ )  Anxiety (HADS): significant improvement in IG ( $P < 0.001$ )  QoL (LiSat-9): no significant difference ( $P$ = 0.220)	NR
Khayeri <i>et al.</i> , 2016. Iran, RCT	NR	IG: 70  CG: 70	49.3 (6.8), 57.6% <sup>1</sup>	NR	Fordyce Happiness Model; group, in- person	1.5-2 hr; 8 sessions over 4 weeks	Usual care	Anxiety Depression Stress	Depression (DASS-21): significant improvement in IG ( $P = 0.04$ )  Anxiety (DASS-21): no significant difference ( $P = 0.07$ )  Stress (DASS-21): no significant difference ( $P = 0.09$ )	NR
Kolahkaj & Zargar, 2015. Iran, RCT	NR	IG: 24  CG: 24	5.8 (25.7), 100%  2.4 (24.8), 100%	NR	Mindfulness-based stress reduction; group, in-person	2 hr; 8 sessions over 8 weeks	Usual care	Anxiety Depression Stress	Depression (DASS-21): significant improvement in IG ( $P < 0.001$ )  Anxiety (DASS-21): significant improvement in IG ( $P < 0.001$ )  Stress (DASS-21): significant improvement in IG ( $P < 0.001$ )	NR
Lincoln, 2011. UK, RCT	All	IG: 72  CG: 79	44.5 (11.1), NR  47.5 (10.5), NR	9.2 (7.8)  10.5 (8.0)	Adjustment to MS program; group, in- person	2 hr; 6 sessions over 12 weeks	Waitlist	Mood	Depression (BDI-II and HADS): significant improvement in IG (BDI-II $P =$ 0.001; HADS $P = 0.008$ )  Anxiety (HADS): significant improvement in IG ( $P = 0.028$ )  QoL (EQ-5D): significant improvement in IG ( $P = 0.041$ )	Cognitive behavioral therapy principles

Nordin & Rorsman, 2012. Sweden, RCT	RR and SP	IG: 11 CG: 10	43.0 (9) <sup>3</sup> , 73% 48.5 (7) <sup>3</sup> , 80%	5 (10) <sup>3</sup> 9 (16) <sup>3</sup>	Acceptance and commitment therapy; group, in-person	NR; 5 sessions over 15 weeks	Relaxation training	Anxiety Depression	Depression (BDI and HADS): significant improvement in CG for HADS ( $P < 0.05$ ). No significant difference for BDI ( $P > 0.05$ )  Anxiety (HADS): no significant difference ( $P > 0.05$ )	NR
Pahlavan zadeh <i>et al.</i> , 2017. Iran, RCT	NR	IG: 35 CG: 35	NR, 100% <sup>1</sup>	NR	Cognitive behavioural therapy; group, in-person	90 min; 8 sessions over 8 weeks	Usual care	Anxiety Depression Stress	Depression (DASS-21): significant improvement in IG ( $P < 0.001$ )  Anxiety (DASS-21): significant improvement in IG ( $P < 0.001$ )  Stress (DASS-21): significant improvement in IG ( $P < 0.001$ )	NR
Rigby <i>et al.</i> , 2008. UK, RCT	NR	IG: 44 CG1: 42 CG2: 52	44 (9.6), 63% <sup>1</sup>	9 (7.5) <sup>1</sup>	Brief psychosocial intervention plus information booklet; group, in-person	90 min; 3 sessions over 3 weeks	CG1: Social discussion group plus information booklet CG2: Information booklet only	Mood Self-efficacy	Depression (HADS): no significant difference (area under curve $P = 0.153$ , includes 12 month follow-up)  Anxiety (HADS): No significant difference between IG and CG1 ( $P < 0.05$ ). Significant improvement in IG compared to CG2 (area under curve $P < 0.01$ , includes 12 month follow-up)	NR
Sanaeina sab <i>et al.</i> , 2017. Iran, RCT	NR	IG: 40 CG: 40	29.4 (7.5), 100% 32.0 (5.9), 100%	4.8 (3.5) <sup>1</sup>	Lazaraus and Folkman's transactional model of stress and coping program; group, in-person	1 hr; 6 sessions over 6 weeks	Usual care	Coping Stress	Stress (PSS): significant improvement in IG ( $P < 0.001$ )	NR
Schwartz, 1999. USA, RCT	RR and Progressive	IG: 64 CG: 68	43.0 (9.0), 73% <sup>1</sup>	7.3 (6.8) 8.6 (6.4)	Coping skills group plus monthly peer phone-calls; group, in-person	2 hr; 8 sessions over 8 weeks, plus monthly phone-calls for 10 additional months	Peer telephone support, monthly for 12 months (15 min duration)	Coping skills	Depression (AIMS): no significant difference ( $P > 0.05$ )  Anxiety (AIMS): no significant difference ( $P > 0.05$ )	NR

Senders <i>et al.</i> , 2018. USA, RCT	All	IG: 33	53.2 (10.7), 85%	14.6 (10.1)	Mindfulness-based stress reduction; group, in-person	2 hr; 8 sessions over 8 weeks, plus a 6-hr retreat at week 6	MS Education program; 2-hr classes over 8 weeks, plus a 6-hr retreat at week 6	Feasibility	Depression (PROMIS): no significant difference ( $P = 0.18$ )	NR
		CG: 29	52.6 (12.3), 69%	17.9 (11.2)					Anxiety (PROMIS): no significant difference ( $P = 0.13$ )	
Shahdadi <i>et al.</i> , 2017. Iran, RCT	NR	IG: 39	34.1 (8.2), 79%	4.9 (5.7)	Self-care program based on Orem's self-care model; NR	45 min; 9 sessions over 2 weeks	Usual care	Stress	Stress (DASS-21): significant improvement in IG ( $P < 0.001$ )	NR
		CG: 39	35.6 (8.4), 67%	3.6 (4.8)					Stress (PSS): significant improvement in IG ( $P < 0.001$ )	
Simpson <i>et al.</i> , 2017. UK, RCT	All	IG: 25	43.6 (10.7), 92%	8.9 (8.5)	Mindfulness-based stress reduction; group, in-person	2.5 hr; 8 sessions over 8 weeks	Waitlist control	Feasibility Stress QoL	Depression (MHI): significant improvement in IG ( $P < 0.05$ )	NR
			CG: 25	46.3 (11.1), 88%					9.6 (9.4)	
Stuifbergen <i>et al.</i> , 2003. USA, RCT	All	IG: 56	45.8 (10.1), 100% <sup>1</sup>	10.8 (6.9) <sup>1</sup>	Wellness program; group, in-person	1.5 hr; 8 sessions over 8 weeks, or, 3 hr; 4 sessions over 8 weeks. Plus bimonthly phone-call	Waitlist control	Self-efficacy for health behaviours Health promotion behaviours QoL	QoL (SF-36, mental health): significant improvements in IG points (combined 8 month follow-up, $P < 0.05$ )	Health belief model, Pedner model of health promotion, and self-efficacy theory
		CG: 57								
Tesar <i>et al.</i> , 2003.	NR	IG: 14	38.2 (3.2), 86%	5.1 (3.2)		90 min.; 7 sessions	Usual care	Anxiety Coping	Depression (BDI): no significant difference ( $P < 0.05$ )	NR

Austria, Quasi- controlle d trial	CG: 15	35.7 (9.9), 87%	4.2 (3.2)	Psychological therapy program; group, in-person	over 7 weeks	Depression on body image	Anxiety (STAI): no significant difference ( <i>P</i> < 0.05)
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<sup>1</sup>total study sample data reported (intervention and control not reported separately)

<sup>2</sup>control group enrolled into intervention after serving a waiting period

<sup>3</sup>median (interquartile range)

AIMS, Arthritis Impact Measurement Scales; BDI, Beck Depression Inventory; BDI-II, Beck Depression Inventory II; CES-D, Center for Epidemiologic Studies Depression Scale; CG, comparator group; DASS-21, Depression, Anxiety and Stress Scales; EQ-5D, EuroQol; HADS, Hospital Anxiety and Depression Scale; HAQUAMS, Hamburg Quality of Life Questionnaire in Multiple Sclerosis; HPLP-II, Health-Promoting Lifestyle Profile-II; IG, intervention group; LiSat-9, Life Satisfaction Questionnaire; MHI-18, Mental Health Inventory; MS, multiple sclerosis; MSQOL-54, Multiple Sclerosis Quality of Life-54; NR, none reported; PHQ-9, Patient Health Questionnaire; PQOLC, Profile of Health-Related Quality of Life in Chronic Disorders; PROMIS, Patient-Reported Outcomes Measurement Information System; PSS, Perceived Stress Scale; QoL, Quality of life; RCT, randomized controlled trial; RR, relapsing-remitting; SD, standard deviation; SF-8, Medical Outcomes Study 8-Item Short-Form Health Survey; SF-12, Medical Outcomes Study 12-Item Short-Form Health Survey; SF-36, Medical Outcomes Study 36-Item Short-Form Health Survey; SP, secondary progressive; STAI, State-Trait Anxiety Inventory.