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Effects of mindfulness-based stress reduction on quality of life of breast cancer patient: A meta-analysis --Manuscript Draft--

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Corresponding Author:	Tongxia Zhan Weifang Medical University Weifang, CHINA
Keywords:	Mindfulness-based stress reduction; breast cancer; MBSR; quality of life; Negative Emotions; Usual Care.
Abstract:	<p>Abstract: Background: Breast cancer is the most common malignancy that occurs in women, due to the pain caused by disease itself and the adverse reactions in the treatment process, breast cancer patients are prone to anxiety, depression, fear of recurrence and other negative emotions, which seriously affect the quality of life. As a systematic stress reduction method, mindfulness-based stress reduction (MBSR) is widely applied to the treatment of breast cancer patients and has been found by a growing number of studies to relieve stress, regulate mood and improve state. However, due to the absence of recent researches and uniform outcome measures, previous studies have failed to fully explain the role of mindfulness-based stress reduction in improving quality of life in breast cancer patients.</p> <p>Objective: We conducted a systematic review and meta-analysis to evaluate and compare the effects of mindfulness-based stress reduction therapy (MBSR) and usual care on quality of life and psychological status in breast cancer patients. Methods: We searched PubMed, Web of Science, Embase, China's National Knowledge Infrastructure, and the Cochrane Central Registry of Controlled Trials up to July 2023 to identify candidate randomized clinical trials, which addressing the values of MBSR in breast cancer patients. The endpoint was to assess the improvement on quality of life in breast cancer patients treated with MBSR using a meta-analysis and to compare them with usual care. Result: A total of 1644 patients participated in 11 randomized controlled trials. The results of meta-analysis showed that mindfulness-based stress reduction therapy can be significant reduce the negative emotions such as PSS (MD = -1.46 , 95%CI = -2.53 to -0.38 , p = 0.03), depression (MD = -1.84 , 95%CI = -3.99 to -0.30 , p = 0.0004), anxiety (MD = -2.81 , 95%CI = -5.31 to -0.32 , p = 0.002) and fear of recurrence (MD = -1.27, 95%CI = -3.44 to 0.90 , p = 0.0004). Mindfulness-based stress reduction therapy also has certain advantages in improving the coping ability (MD = 1.26, 95%CI = -3.23 to 5.76, p = 0.03) and the emotional state (MD = -7.73, 95%CI = -27.34 to 11.88, p = 0.0007) of patients with breast cancer.</p> <p>Conclusion: Our analyses support that compared with usual care, mindfulness-based stress reduction therapy can significantly improve patients' coping ability, reduce adverse emotions such as depression, anxiety, perceived stress and fear of recurrence, and improve patients' emotional state. These results have to be confirmed in a larger cohort. Nevertheless, our study might help policymakers and stakeholders evaluate the clinical and social impact of the MBSR in breast cancer patients.</p>
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1 **Effects of mindfulness-based stress reduction on**
2 **quality of life of breast cancer patient: A systematic**
3 **review and meta-analysis**

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21

22

23 **Abstract**

24 **Background:** Breast cancer is the most common malignancy that occurs in
25 women. Due to the pain caused by the disease itself and the adverse reactions in the
26 treatment process, breast cancer patients are prone to anxiety, depression, fear of
27 recurrence, and other negative emotions, which seriously affect the quality of life. As
28 a systematic stress reduction therapy, mindfulness-based stress reduction is widely
29 applied to the treatment of breast cancer patients and has been found by a growing
30 number of studies to relieve stress, regulate mood, and improve the state. However,
31 due to the absence of recent research and uniform outcome measures, previous studies
32 have failed to fully explain the role of mindfulness-based stress reduction in
33 improving the quality of life in breast cancer patients.

34 **Objective:** We conducted a systematic review and meta-analysis to evaluate and
35 compare the effects of mindfulness-based stress reduction therapy and usual care on
36 the quality of life and psychological status of breast cancer patients.

37 **Methods:** We searched PubMed, Web of Science, Embase, China's National
38 Knowledge Infrastructure and the Cochrane Central Registry of Controlled Trials up
39 to July 2023 to identify candidate randomized clinical trials addressing the values of
40 mindfulness-based stress reduction in breast cancer patients.

41 **Results:** A total of 1644 patients participated in 11 randomized controlled trials. The
42 results of the meta-analysis showed that mindfulness-based stress reduction therapy
43 can significantly reduce negative emotions such as perceived stress (MD = -1.46,
44 95%CI = -2.53 to -0.38, $p = 0.03$), depression (MD = -1.84, 95%CI = -3.99 to -0.30, p

45 = 0.0004), anxiety (MD = -2.81, 95%CI = -5.31 to -0.32, $p = 0.002$), and fear of
46 recurrence (MD = -1.27, 95%CI = -3.44 to 0.90, $p = 0.0004$). Mindfulness-based
47 stress reduction therapy also has certain advantages in improving the coping ability
48 (MD = 1.26, 95%CI = -3.23 to 5.76, $p = 0.03$) and the emotional state (MD = -7.73,
49 95%CI = -27.34 to 11.88, $p = 0.0007$) of patients with breast cancer.

50 **Conclusion:** Our analyses support that, compared with usual care, mindfulness-
51 based stress reduction therapy can significantly improve patients' coping ability,
52 reduce adverse emotions and improve patients' emotional states.




53 **Keywords:** Mindfulness-based stress reduction; Breast cancer; MBSR; Quality of
54 life; Negative Emotions; Usual Care.

55

56 **1. Introduction**

57 Breast cancer is the most commonly diagnosed cancer type, with approximately
58 2.1 million new cases every year, making it the leading cause of death in women
59 worldwide[1]. Early-stage breast cancer is considered curable[2]. At present, the most
60 common treatment for breast cancer is surgical treatment, including breast-conserving
61 surgery and sentinel lymph node biopsy. In addition to surgery, the main treatment
62 methods for breast cancer include neoadjuvant chemotherapy, targeted therapy,
63 endocrine therapy, and radiotherapy. Side effects can occur to varying degrees during
64 treatment, such as the direct toxic effect of breast cancer treatment on the heart[3].
65 Other effects include changes in body and body image, arm diseases (lymphedema,
66 axillary syndrome), and functional changes[4]. These adverse reactions can lead to a

67 range of psychological problems in breast cancer patients, including pain, fatigue,
68 sleep disturbances, anxiety, depression, perceived stress (PSS), cognitive dysfunction,
69 and fear of recurrence (FOR), greatly affecting their quality of life. The evidence
70 indicates that anxiety and depression are significantly correlated with a decreased
71 quality of life in breast cancer patients [5].

72 Malignant tumors have a significant psychological impact on patients, and
73 women are often more delicate and sensitive than men hus, female patients
74 experience enormous mental pressure either upon learning of their malignant tumors
75 or during the follow-up treatment[6]. Emotions are contagious, and the emotional
76 state of cancer patients profoundly impacts the family around them and their daily
77 activities. Negative and depressed emotions not only cast a shadow on the entire
78 family[7] but also make it difficult for patients to cooperate with doctors with a
79 positive attitude, seriously reducing their quality of life. As the most common
80 malignant tumor with the highest incidence among women[8], ~~the harm of~~ breast
81 cancer to female patients cannot be ignored. Therefore, improving the psychological
82 status of breast cancer patients is of great significance.

83 As a psychologically focused therapy, mindfulness-based stress reduction
84 (MBSR) can positively affect stress management ~~in the brain through mindfulness~~
85 ~~meditation~~. Patients can better manage their emotions, ~~awaken~~ **improve** their inner focus, ~~and~~
86 regulate their mental state with MBSR, alleviating negative emotions such as
and
87 loneliness, anxiety, and depression. MBSR is a widely used mindfulness-based
88 intervention with main components such as ~~scan~~ **awareness**, breathing meditation, walking

89 meditation, mindful movement, and psychoeducation designed to relieve pain or
90 reduce stress[9, 10]. ~~It is an eight-week group-based therapy that teaches mindfulness~~
91 **An eight week** skills through various practices, including mindfulness of breath, thoughts, bodily
92 sensations, sounds, and everyday activities, with weekly 2.5-hour sessions and one
93 full retreat day. Participants are given a CD containing instructions for home practice
94 for 45 minutes per day, six days a week[11]. A growing body of robust evidence from
95 several studies has demonstrated that MBSR has a significant effect on improving
96 mental health[12, 13] and is beneficial for psychological states[14-19], anxiety[20],
97 stress[21], depression[22], and pain[23, 24], particularly in high-risk pregnant
98 women[13].

99 Although the latest meta-analysis suggests a slight improvement in the quality of
100 life through MBSR[25], it is based on data up to April 2018, omitting several relevant
101 randomized controlled trials (RCTs)[15, 26-28] and lacking information on fatigue
102 and sleep quality. Thus, our systematic review and meta-analysis aim to
103 comprehensively evaluate the impact of mindfulness-based stress reduction therapy
104 on the quality of life and psychological well-being of breast cancer patients. Utilizing
105 recent RCTs, this study seeks to provide ~~up-to-date~~ evidence for the clinical
106 **recent** application of MBSR.

107 **2. Materials and Methods**

108 This systematic review and meta-analysis followed the criteria recommended by
109 the Cochrane Collaboration and adhered to the Preferred Reporting Items for
110 Systematic Review and Meta-Analysis (PRISMA) guidelines for reporting the

111 results[29]. Since this study relied on published data, obtaining consent from
112 participants was not applicable. The meta-analysis is registered with the PROSPERO
113 database under registration number CRD42023459075.

114 **2.1 Literature search strategy**

115 The population, intervention, control, and outcomes (PICO) criteria in this study
116 were determined by the coauthors as follows: assessing the quality of life in breast
117 cancer patients treated with MBSR compared to those receiving ~~usual~~ **standard** care. We
118 conducted an analysis of both short-term and long-term quality of life in breast cancer
119 patients. ~~To~~ **In order to** identify relevant studies addressing the impact of MBSR in breast cancer
120 patients, we conducted an integrated search of databases, including Web of Science
121 (from 1946 to July 2023), PubMed (from 1966 to July 2023), Embase (from 1974 to
122 July 2023), China's National Knowledge Infrastructure (from 1976 to July 2023), and
123 the Central Cochrane Registry of Controlled Trials (from 1997 to July 2023). The
124 search terms used were combined to capture relevant studies: ("Mindfulness"[Mesh])
125 OR (((("mindfulness training") OR ("Mindfulness-based Cognitive Therapy")) OR
126 ("mindfulness-based stress reduction")) AND ((((((breast cancer [Title/Abstract]))
127 OR ("breast tumor")) OR ("mammary tumor")) OR ("mammary neoplasms ") OR
128 ("breast neoplasms")). The ~~endpoint~~ **aim** of our study was to evaluate the improvement in
129 the quality of life in breast cancer patients treated with MBSR using a meta-analysis
130 and to compare with those of patients receiving usual care.

131 **2.2 Inclusion and exclusion criteria**

132 We assessed the quality of life using 11 outcome measures for comparison.

133 Studies were deemed eligible if they included one of the following outcome measures:
134 perceived pressure (PSS), depression, anxiety, fear of relapse (FOR), coping capacity,
135 quality of life (QOL), sleep quality, post-traumatic growth (PTG), fatigue, pain, and
136 emotional state. In the included studies, mindfulness-based stress reduction was
137 implemented in the experimental group, while usual care was provided in the control
138 group. We excluded meeting notes and abstracts lacking complete RCTs, as well as
139 studies with incomplete data. In cases of replicated published studies, we selected
140 articles with available data and the most recent results. To ensure a comprehensive
141 search for data, we also reviewed the references of the included studies.

142 **2.3 Data Extraction**

143 In this study, two researchers independently screened the literature and
144 completed data extraction. The extracted information included the first author's name,
145 year of publication, country, sample size, intervention details, treatment duration, age,
146 key elements of bias risk assessment, and outcome indicator data. The extracted
147 results were then cross-checked. Any disagreements during data extraction were
148 resolved through discussion and adjudicated by a third senior investigator. For
149 literature lacking original data, we attempted to contact the authors to obtain the raw
150 data; otherwise, the studies were excluded.

151 **2.4 Quality and risk of bias assessment**

152 All included studies underwent quality assessment using the JADAD scale,
153 which evaluates four aspects: random sequence generation, random hiding, blinding,
154 and exit. The tool assigns ratings on a scale of 1 to 7, with scores of 1 to 3 considered

155 low-quality literature and scores of 4 to 7 considered high-quality literature. To assess
156 the risk of bias, we utilized the Cochrane Bias tool for RCTs, which includes seven
157 assessments: sequence generation, assignment hiding, subject blindness, outcome
158 evaluators, exit and loss of follow-up, incomplete outcome data, and selective
159 outcome reporting. The included literature was categorized as low risk, high risk, or
160 unclear. Two independent reviewers conducted the assessment, and any discrepancies
161 were resolved through negotiation with a third researcher.

162 **2.5 Outcomes**

163 A meta-analysis of 11 outcome indicators was performed through literature
164 integration. Primary outcome measures included perceived stress (PSS), depression,
165 anxiety, fear of relapse (FOR), and coping ability. Secondary outcome measures
166 included quality of life, sleep quality, post-traumatic growth (PTG), fatigue, pain, and
167 emotional state.

168 **2.6 Statistical Analysis**

169 Data were analyzed using Revman 5.3 software. Results for continuous data are
170 presented as mean difference (MD) and 95% confidence interval (CI). Heterogeneity
171 among studies was assessed using the χ^2 and I^2 tests. A P value for the Q statistic of <
172 0.10 and $I^2 > 50\%$ indicated significant heterogeneity, prompting the use of a random-
173 effects model. Subgroup analysis was conducted to explore the effects of publication
174 date, number of participants, and duration of treatment. In cases where the data from
175 11 articles were expressed as a median, the algorithm of Hozo et al. [31] was
176 employed to estimate the weighted mean and standard deviation. The test for overall

177 effects determined statistical significance by the magnitude of the p-value,
178 considering data as statistically significant when $p < 0.05$. Publication bias was
179 assessed using funnel plots.

180 **3. Results**

181 **3.1 Results of the search**

182 The RCTs screening process for meta-analysis is illustrated in Figure 1. Initially,
183 a systematic search yielded 1599 articles, which was reduced to 1138 after removing
184 duplicates. Subsequently, a title and abstract filter excluded 205 non-RCTs, 16
185 conference abstracts, 80 meta-analysis papers, 194 irrelevant documents, 1 animal
186 study, and 167 articles involving non-breast cancer patients. An additional 282 papers
187 not using mindfulness-based stress reduction as an intervention were excluded.
188 Screening the full text of the remaining 193 papers led to the exclusion of 152
189 duplicate references, 28 papers lacking the required outcome indicators, and 2 papers
190 with incomplete data. Finally, 11 papers were included in this study.

191 **3.2 Characteristics of Included Studies**

192 A total of 11 randomized controlled trials met our inclusion criteria, and detailed
193 features of the included literature are presented in Table 1. The papers were published
194 between 2009[30] and 2022[28]. Seven studies were conducted in North America
195 countries[26, 27, 30-34], two in ~~the~~ China[28, 35] and two ~~in~~ European ~~countries~~
196 37]. A total of 1644 patients were included in our study, among which the study by
197 Lengacher et al. [33] included 322 patients (the highest number of cases), while
198 Zhang et al.[35] included 60 patients (the lowest number of cases). Four articles[30,

199 32-34] used mindfulness-based stress reduction therapy ~~to intervene~~ for 6 weeks,
200 while the remaining seven articles[26-28, 31, 35-37] for 8 weeks. Five articles[26, 32-
201 34, 36] reported on patients with stage 0-III breast cancer, three [28, 30, 37] reported
202 on patients with breast cancer during chemotherapy, one [27] reported on neuropathic
203 pain in breast cancer patients, and the remaining two articles focused on stage I-II[31]
204 and stage I-III [35] breast cancer patients, respectively.

Table 1. Characteristics of the included studies.

First Author	Country	Participants	Intervention methods		Number of patients (Intervention/control)	Treatment duration	Age Ratio		Follow-up time	JADAD	Outcomes
			Observation group	Control group			Observation group	Control group			
Henderson2012	USA	Stage I-II breast cancer	①For 8 weeks, 7 sessions per week of 2.5 to 3.5 hours of therapy and the 6th session of 7.5 hours of intensive silent retreat therapy.② After completing the MBSR, participants are offered three 2-hour sessions per month.	Usual care	53/58	8 weeks	49.8±8.4	49.8 ± 8.4	24 months	4	Coping Capacity
		Patients with stage 0-III breast cancer who have completed treatment for 2 months to 2 years	①Courses lasting 8 weeks, 2 hours per week (the first and last courses are 2.25 hours).②Week 6 plus a 6-hour mindfulness session. Do home exercises for 40 to 45 minutes six or seven days a week.	Usual care	114/115	8 weeks	49.0±9.3	50.1±9.1	3 months	6	Emotional States
Janusek2019	USA	Breast cancer	①For 8 weeks (2.5 hours per week).② 6 hour meditation retreat after the fifth week.	ACC Group: Group education lasting 8 weeks, 2.5 hours per week	63/61	8 weeks	55.0 ± 10.1	55.2 ± 10.1	6 months	7	Sleep Quality, PSS, Depression, Fatigue
Lengacher2009	USA	Stage 0-III	①Two hour sessions six times a week	Routine care,	41/43	6 weeks	56.1±9.1	58.0±1	6 weeks	4	FOR、

		breast cancer patients receiving radiotherapy or chemotherapy after surgery	for six weeks.②Practice meditation techniques for 15-45 minutes a day.	providing mindfulness-based stress reduction after the intervention.				0.2			Anxiety
Lengacher2015	USA	Stage 0 to III breast cancer patients	①Two hour sessions six times a week for six weeks.②Practice meditation techniques for 15-45 minutes a day.	Routine care, providing mindfulness-based stress reduction after the intervention.	38/41	6 weeks	56.1±9.1	58.0±10.2	3 months	5	Sleep Quality
Lengacher2016	USA	Stage 0 to III breast cancer patients	①For 6 weeks, attend a 2-hour course once a week.②Practice 15 to 45 minutes a day.	Routine care, providing mindfulness-based stress reduction after the intervention.	155/167	6 weeks	56.5±10.2	57.6±9.2	3 months	6	Pain, Fatigue, Depression, Anxiety, PSS, FOR
Reich2017	USA	Stage 0 to III breast cancer patients	①A two-week course in formal meditation techniques.②Practice 15-45 minutes a day.	Usual care	167/155	6 weeks	56.6	56.6	3 months	4	Depression, Anxiety, Sleep Quality, Anxiety

											、 QOL、 Fatigue、 Pain、 FOR QOL、 PTG、 Coping Capacity PSS、 Pain、 Emotional States PSS、 Anxiety 、 PTG
Sarenmalm2017	Sweden	Breast cancer patients during chemotherapy	①Self-directed mindfulness-based stress reduction course lasting 8 weeks. ②Teachers and weekly group meetings.	Usual care	62/52	8 weeks	57.2±10.2	57.2±10.2	3 months	7	
Shergill2022	Canada	Breast cancer survivors with nerve pain	①Courses lasting 8 weeks, 2.5 hours per week.②One day (about 6 hours) of retreat a week.	Usual care	49/49	8 weeks	51.3±11.4	55.1±9.6	3 months	7	
Zhang2017	China	Stage I-III breast cancer patients	①For 8 weeks, 2 hours of treatment per week.②40-45 minutes of homework 6 or 7 days a week.	Usual care	30/30	8 weeks	48.67 ± 8.49	46.00 ± 5.12	3 months	6	
Zhu2022	China	Breast cancer patients who have completed their first chemotherapy after surgery	Mindfulness training was performed six days a week (at least 30 minutes) for eight weeks.	Usual care	50/51	8 weeks	47.96 ± 8.51	49.78 ± 7.48	/	6	PTG

3.2.1 Participants and Interventions

The details are given in Table 1.

3.2.2 Conflicts of Interest

For all studies included, the authors indicated no potential conflicts of interest.

3.2 Primary Outcomes

3.2.1 Perceived Stress

The perceived stress (PSS) is a 10-item scale that assesses the degree to which life experiences are appraised as uncontrollable[38]. Four studies[26, 30, 34, 35] reported the PSS (Figure 2). A meta-analysis showed that MBSR therapy significantly reduced PSS in breast cancer patients compared to usual care (MD = -1.46 , 95%CI = -2.53 to -0.38 , $p = 0.03$), showed high heterogeneity ($I^2 = 67%$, $p < 0.00001$).

We performed a subgroup analysis based on publication date and number of participants. Subgroup analysis (Table 2) showed that MBSR had a significant advantage over usual care in reducing PSS in breast cancer patients. Three articles [34, 39, 40] reported stress in patients with breast cancer after 3-6 months of follow-up (Figure 3), after 3-6 months of follow-up, MBSR showed no difference in improving PSS in breast cancer patients compared to usual care (MD = -1.62 , 95%CI = -3.48 to 0.23 , $p = 0.08$), showed high heterogeneity ($I^2 = 60%$, $p = 0.010$).

Figure 2: The forest plots of primary outcomes. (A) HQOL (B) Depression (C) Anxiety (D) Perceived Pressure (E) Personal Growth (F) Fear of relapse.

Figure 3: The forest plot of primary outcomes after follow-up. (A)HQOL(B) Depression (C) Anxiety (D) Perceived Pressure.

3.2.2 Depression

Depressive symptoms were measured by the 20-item Center for Epidemiological Studies Depression Scale[41]. Three studies[26, 30, 33] reported the depression (Figure 2). A meta-analysis showed that MBSR therapy significantly reduced depression in breast cancer patients compared to usual care (MD = -1.84,

95%CI = -3.99 to -0.30, $p = 0.0004$), showed high heterogeneity ($I^2 = 87\%$, $p < 0.00001$). Subsequently, we performed a subgroup analysis based on publication date and number of participants. Subgroup analysis (Table 3) showed that MBSR was more effective than usual care in reducing depression in breast cancer patients. Two articles [33, 39] reported depression in patients with breast cancer after 3-6 months of follow-up (Figure 3), after 3-6 months of follow-up, MBSR showed no difference in improving depression in breast cancer patients compared to the usual care (MD = -0.26, 95%CI = -1.62 to 1.09, $p = 0.93$), showed low heterogeneity ($I^2 = 0\%$, $p = 0.70$).

Table 2. Subgroup analysis of PSS.

Subgroups	PSS						
	Studies, n	Participants, n	<i>I</i> ²	Q-test	Mean difference	95% CI	<i>P</i>
Publication date							
>2017 or = 2017	2	444	56	0.13	-0.75	-2.63,1.12	0.43
<2017	2	140	0	0.48	-1.82	-2.12,-1.52	<0.00001
Treatment duration							
<7 weeks	2	389	88	0.004	-1.69	-1.98,-1.39	<0.00001
>7 weeks	2	195	0	0.74	-2.30	-3.78,-0.81	0.002

3.2.3 Anxiety

Anxiety measured by the State-Trait Anxiety Inventory, higher scores are indicative of more anxiety. Three studies[30, 33, 35] reported the anxiety (Figure 2). A meta-analysis showed that MBSR therapy significantly reduced anxiety in breast cancer patients compared to usual care (MD = -2.81, 95%CI = -5.31 to -0.32, $p = 0.002$), showed high heterogeneity ($I^2 = 84%$, $p < 0.00001$). We performed a subgroup analysis on the number of participants. Subgroup analysis (Table 3) showed that MBSR was more effective than ~~usual care~~ ^{standard} in reducing anxiety in breast cancer patients. Two articles [33, 40] reported anxiety in patients with breast cancer after 3 months of follow-up (Figure 3), after 3 months of follow-up, MBSR showed no difference in improving anxiety in breast cancer patients compared to usual care (MD = -2.40, 95%CI = -3.98 to -0.83, $p = 0.32$), showed low heterogeneity ($I^2 = 1%$, $p = 0.003$).

3.2.4 Fear of Relapse

Fear of relapse (FOR) measured by the 30-item Concerns about Recurrence Scale[42]. Two studies[30, 33] reported the FOR (Figure 2). The results of the meta-analysis showed that MBSR therapy ~~was~~ ^{were} significantly better than ~~usual care~~ ^{standard} in reducing FOR in breast cancer patients (MD = -1.27, 95%CI = -3.44 to 0.90, $p = 0.0004$), showed high heterogeneity ($I^2 = 92%$, $p < 0.00001$).

3.2.5 Coping Capacity

Coping capacity was evaluated using the Sense of Coherence scale (SOC)[43]. Two studies[31, 37] reported the coping capacity (Figure 2). The results of the meta-analysis showed that MBSR therapy was significantly better than usual care in improving the coping capacity in breast cancer patients (MD = 1.26, 95%CI = -3.23 to 5.76, $p = 0.03$), showed high heterogeneity ($I^2 = 78%$, $p < 0.00001$).

3.3 The Secondary Outcome

3.3.1 Quality of Life

Quality of Life (QOL) was measured by the Medical Outcomes Studies Short-form General Health Survey[44]. Four studies[30, 33, 34, 37] reported the QOL (Figure 4), and a meta-analysis showed that MBSR therapy did not make a significant difference in improving QOL compared to usual care (MD =

1.81, 95%CI = -0.46 to 4.08, $p = 0.22$), showed low heterogeneity ($I^2 = 33%$, $p < 0.00001$). Subsequently, we performed a subgroup analysis based on publication date and number of participants. A subgroup analysis (Table 4) showed that MBSR was no less effective than usual care in improving QOL for breast cancer patients. Two articles[33, 34] reported QOL after 3 months of follow-up (Figure 5), after three months of follow-up, MBSR did not differ in improving QOL compared to usual care (MD = -0.30, 95%CI = -4.04 to 3.44, $p = 0.46$), showed low heterogeneity ($I^2 = 0%$, $p = 0.88$).

Figure 4: The forest plots of secondary outcomes. (A) Sleep Quality (B) Fatigue (C) Pain (D) Coping Capacity (E) Emotional State.

Table 3. Subgroup analysis of depression and anxiety.

Subgroups	Depression							Anxiety						
	Studies, n	Participants, n	<i>I</i> ²	Q-test	Mean difference	95% CI	<i>P</i>	Studi es, n	Participants, n	<i>I</i> ²	Q-test	Mean difference	95% CI	<i>P</i>
Publication date														
>2017 or = 2017	2	437	0	0.88	-0.74	-1.95,0.47	0.23							
<2017	2	382	93	0.0002	-2.08	-4.62,0.47	< 0.00001							
Number of participants														
<100	2	219	50	0.16	-2.7	-4.70,-0.69	0.008	2	140	88	0.004	-1.00	-2.74,0.73	0.26
>100	2	606	0	1	-0.70	-1.62,0.22	0.14	2	622	0	0.74	-2.30	-3.78,-0.81	0.002

Table 4. Subgroup analysis of QOL.

Subgroups	Studies, n	Participants, n	<i>I</i> ²	Q-test	Mean difference	95% CI	<i>P</i>
Publication date							
>2017 or = 2017	2	411	0	0.97	-0.41	-4.88,4.07	0.86
<2017	2	379	53	0.14	2.21	2.41,3.81	0.16
Number of participants							
<100	2	196	0	0.33	3.16	2.45,3.86	<0.00001
>100	2	594	0	0.97	-0.40	-4.05,3.24	0.83

3.3.2 Sleep Quality

Sleep quality was measured by the Pittsburgh Sleep Quality Index[45]. Three studies[26, 32, 34] reported the sleep quality (Figure 4). Meta-analysis showed that there was no significant difference between MBSR therapy and usual care in improving the sleep quality of breast cancer patients (MD = -0.43, 95%CI = -0.67 to -0.19, $p = 0.69$), showed low heterogeneity ($I^2 = 0\%$, $p = 0.0004$). Three articles [32, 34, 39] reported sleep quality in patients with breast cancer after 3-6 months of follow-up (Figure 5), after 3-6 months of follow-up, MBSR showed no difference in improving sleep quality in breast cancer patients compared to usual care (MD = -0.45, 95%CI = -0.68 to -0.22, $p = 0.39$), showed low heterogeneity ($I^2 = 0\%$, $p = 0.0001$).

Figure 5: The forest plots of secondary outcomes after follow-up. (A) Sleep Quality (B) Fatigue.

3.3.3 Post-traumatic Growth

Post-traumatic growth (PTG) was evaluated using the Posttraumatic Growth Inventory (PTGI)[46]. Three studies[28, 35, 37] reported PTG (Figure 4), and meta-analysis results showed that no significant difference could be observed between MBSR therapy and usual care in PTG in breast cancer patients (MD = 7.59, 95%CI = 4.23 to 10.96, $p = 0.18$) and the heterogeneity was low ($I^2 = 41\%$, $p < 0.00001$).

3.3.4 Fatigue

Fatigue was measured using the Fatigue Symptom Inventory[47]. Two studies[26, 33] reported fatigue (Figure 4), and meta-analysis results showed that no significant difference could be observed between MBSR therapy and usual care in reducing fatigue in breast cancer patients (MD = -1.01, 95%CI = -2.79 to 0.76, $p = 0.87$). Showed low heterogeneity ($I^2 = 0\%$, $p = 0.26$). Two articles [33, 39] reported fatigue in patients with breast cancer after 3-6 months of follow-up (Figure 5), after 3-6 months of follow-up, MBSR showed no difference in improving fatigue in breast cancer patients compared to usual care (MD = -1.12, 95%CI = -3.03 to 0.79, $p = 0.83$), showed low heterogeneity ($I^2 = 0\%$, $p = 0.25$).

3.3.5 Pain

Pain was measured by the Brief Pain Inventory, which examines pain intensity and interference[48].

Two studies[27, 33] reported the ache (Figure 4), and meta-analysis results showed that no significant difference could be observed between MBSR therapy and ~~usual~~ care in reducing pain in breast cancer patients (MD = 0.32, 95%CI = -0.93 to 1.58, $p = 0.21$), showed low heterogeneity ($I^2 = 36%$, $p = 0.70$).

3.3.6 Emotional States

Emotional states measured by using the Profile of Mood State (POMS). Two studies[27, 36] reported the emotional states (Figure 4). The results of the meta-analysis showed that MBSR therapy was significantly better than ~~usual~~ care in improving the emotional states in breast cancer patients (MD = -7.73, 95%CI = -27.34 to 11.88, $p = 0.0007$), showed high heterogeneity ($I^2 = 91%$, $p = 0.11$).

3.4 Assessment of Risk of Bias

The purpose of funnel plots is to illustrate whether the included studies exhibit significant publication bias (S1 Fig). One article[36] did not provide a specific description of the double-blind method, so its type was categorized as high-risk. Four articles[30-32, 34] did not describe the method of concealment of allocation, but the remaining articles used characteristics such as hidden opaque envelopes or bottles for allocation. Four papers[30, 31, 34, 35] did not detail the randomization method and were assessed as unclear. Additionally, one article[35] reported incomplete outcome data and was rated as high risk.

4. Discussion

4.1 Main results and connection with other studies

A meta-analysis of 11 outcome measures, including stress, depression, anxiety, coping ability and fear of relapse, quality of life, sleep quality, post-traumatic growth, fatigue, pain, and emotional state, was conducted through literature integration.

The results of this study revealed that MBSR therapy showed no significant difference in both short- and long-term QOL for breast cancer patients compared to usual care. This aligns with the findings of a meta-analysis by Zhang et al. [49]. In the meta-analysis of Haller et al. [50], MBSR therapy demonstrated a short-term positive effect on improving the QOL of breast cancer patients. The divergence in results could be attributed to the inclusion of a broader range of quality of life scoring tools in the Haller et al. study,

while our study used a single assessment tool with eight dimensions. Not every dimension may necessarily be meaningful, contributing to the observed heterogeneity. Sarenmalm et al. [37] discovered that MBSR can enhance the short-term QOL of breast cancer patients. This difference may be attributed to the intervention duration in the study, which was 8 weeks, compared to the 6-week duration of MBSR in Lengacher et al. [30] and Reich et al. [51]. It suggests that only long-term MBSR therapy may have a positive impact on the short-term QOL of breast cancer patients.

An increasing number of doctors and nurses are turning to mindfulness-based stress reduction therapy to alleviate the negative emotions of breast cancer patients. The findings suggest that MBSR therapy effectively improves anxiety, depression, and emotional state in breast cancer patients after intervention, aligning with the findings of Hoffman et al.[52]. This positive impact on emotions is attributed to the core element of MBSR intervention, which involves meditation—a mind-based practice designed to achieve a balanced mental state[53]. ~~This positive impact on emotions is attributed to the core element of MBSR~~
Furthermore, this intervention, which involves meditation—a mind-based practice designed to achieve a balanced mental state[50]. This implies that while MBSR therapy can offer short-term relief for negative emotions in breast cancer patients, its long-term efficacy is less apparent. ~~The potential explanation is that the initial~~
A improvement in the status of breast cancer patients after MBSR intervention diminishes over time, overshadowed by the gradual increase in adverse reactions during treatment. Regarding promoting ~~Post-~~
p traumatic growth in breast cancer patients, MBSR shows no significant difference compared to ~~usual~~ care, but there is a trend toward improvement. The analysis suggests that the limited number of included studies and insufficient sample size may contribute to this observed difference. The results indicate that MBSR does not significantly enhance short- and long-term sleep quality or reduce distress in breast cancer patients compared to ~~usual~~ care, consistent with the meta-analysis results by Zhang et al.[49]. The study of Janusek et al. [26] found that MBSR intervention could improve the sleep quality of breast cancer patients in the short term after 8 weeks, whereas interventions of 6 weeks by Lengacher et al. [54] and Reich et al. [51] showed less significant effects. This suggests that insufficient intervention time might impact the improvement of sleep quality in breast cancer patients. Furthermore, the study results indicate no significant

difference in reducing fatigue and pain in breast cancer patients with MBSR compared to usual care, potentially influenced by different disease stages. During chemotherapy, breast cancer patients may experience aggravated tumor-related symptoms, new symptoms, and an increased likelihood of psychiatric symptoms. On a positive note, the study demonstrates that MBSR significantly enhances coping skills in breast cancer patients, measured through the Sense of Coherence (SOC). SOC reflects an individual's general perception and feeling of the outside world, representing a stable and lasting self-confidence. Higher SOC correlates with an improved ability to utilize resources and cope with pressure. Patients with higher SOC reported fewer mental symptoms, such as anxiety and depression, with a significant reduction in the prevalence of depression. The analysis attributes this improvement to MBSR techniques, such as meditation and yoga, which enhance concentration and coping skills, redirecting patients toward a healthier self-awareness and self-relationship.

MBSR demonstrated a significant reduction in negative emotions, including anxiety, depression, stress, and fear of relapse in breast cancer patients. However, there were no significant differences compared to usual care in terms of improving quality of life, sleep quality, post-traumatic growth, pain, and fatigue. All outcome indicators in this study were measured using a uniform tool, contributing to a limited number of included studies. Moving forward, it is essential to conduct large-sample randomized controlled trials, establishing a standardized evaluation method for outcome indicators. This will contribute to evidence-based insights and a clearer understanding of the impact of MBSR on breast cancer patients.

4.2 Clinical Implications

~~As an adjunctive treatment, mindfulness-based stress reduction (MBSR) proves effective in~~
Previous studies point to MBSR significantly reducing
~~significantly reducing~~ negative emotions such as anxiety, depression, stress, and fear in breast cancer patients. It enhances patients' coping abilities and positively influences their emotional states. Moreover, Also, MBSR MBSR is characterized by its low threshold for use, simplicity in implementation, and low economic cost, making it suitable for post-disease psychological intervention. Its application can contribute to a more comprehensive and improved treatment system for breast cancer patients.
Applying MBSR

4.3 Limitations

There are limitations to our paper. The main limitation was the heterogeneity of patient populations in terms of inclusion criteria and clinical features. Breast cancer patients may be at different stages of their illness, which could be an important confounder. Different conditions and prior therapies could also influence the results. For some patients in the early stage of the disease, surgical treatment can resolve the disease, while patients in the advanced stage of the disease may be followed by targeted therapy or immunotherapy. No study was precise enough to assess whether treatment measures affect the effectiveness of MBSR at different stages of treatment. In addition, the number of outcome indicators is inconsistent between different studies, and some studies lack sufficient indicators. This variability could lead to incomplete data interpretation. As there was measurable significant heterogeneity across the studies, our conclusions should still be interpreted with caution.

5. Conclusion

In conclusion, ~~Mindfulness-Based Stress Reduction (MBSR)~~ emerges as an effective intervention in significantly reducing negative emotions, including anxiety, depression, stress, and fear of relapse in breast cancer patients. ~~It also~~ demonstrates positive effects on enhancing patients' coping skills and emotional well-being. Our study also However, to strengthen the evidence base, further trials with extended follow-up periods and more tightly controlled conditions are warranted.

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Author Contributions

Drafted the article, X.W. (Xiaohui Wang) and X.Z. (Xinying Zhu); methodology, x.w. and Z.D. (Zhicheng Dai) and Y.L. (Yu Li) and T.Z. (Tongxia Zhan); data curation, X.W., Y.L., X.C. (Xinghui Cui) and L.M. (Limin Ma); writing—review and editing, T.Z., X.C. and L.M.; All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

Data will be provided upon request.

Conflicts of Interest

The authors declare no conflict of interest.

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Figure legends

Figure 1: Flow chart of study selection.

Figure 2: The forest plots of primary outcomes. (A) HQOL (B) Depression (C) Anxiety (D) Perceived Pressure (E) Personal Growth (F) Fear of relapse.

Figure 3: The forest plot of primary outcomes after follow-up. (A)HQOL(B) Depression (C) Anxiety (D) Perceived Pressure.

Figure 4: The forest plots of secondary outcomes. (A) Sleep Quality (B) Fatigue (C) Pain (D) Coping Capacity (E) Emotional State.

Figure 5: The forest plots of secondary outcomes after follow-up. (A) Sleep Quality (B) Fatigue.

Table legends

Table 1: Characteristics of the included studies.

Table 2: Subgroup analysis of HQOL and Depression.

Table 3: Subgroup analysis of Anxiety.

Table 4: Subgroup analysis of PSS.

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Supporting Information

S1 Fig: RCT risk of bias summary for included Randomized Controlled Trial.

S2 Fig: The funnel plots of primary outcomes. (A) HQOL(B) Depression (C) Anxiety (D) Perceived

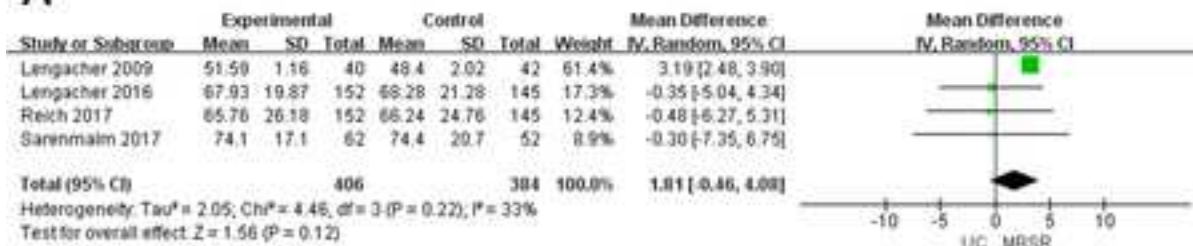
Pressure (E) Personal Growth (F) Fear of relapse.

S3 Fig: The funnel plot of primary outcomes after follow-up. (A)HQOL(B) Depression (C) Anxiety (D) Perceived Pressure.

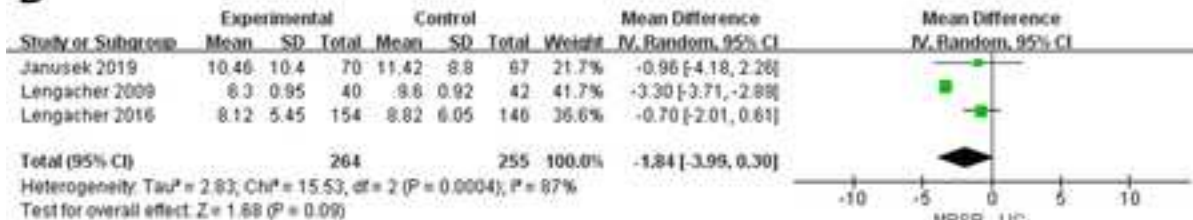
S4 Fig: The funnel plots of secondary outcomes. (A) Sleep Quality (B) Fatigue (C) Pain (D) Coping Capacity (E) Emotional State.

S5 Fig: The funnel plots of secondary outcomes after follow-up. (A) Sleep Quality (B) Fatigue.

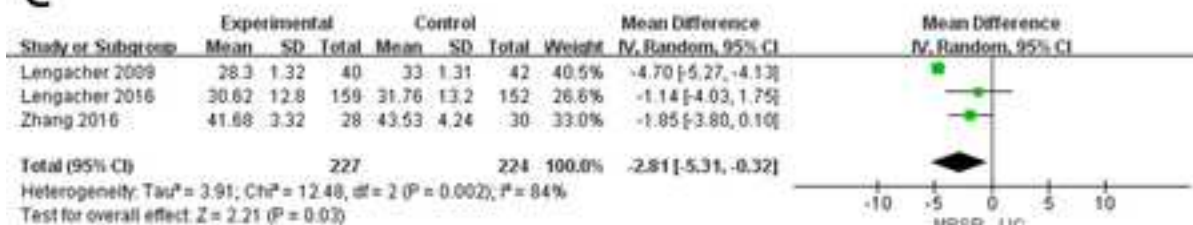
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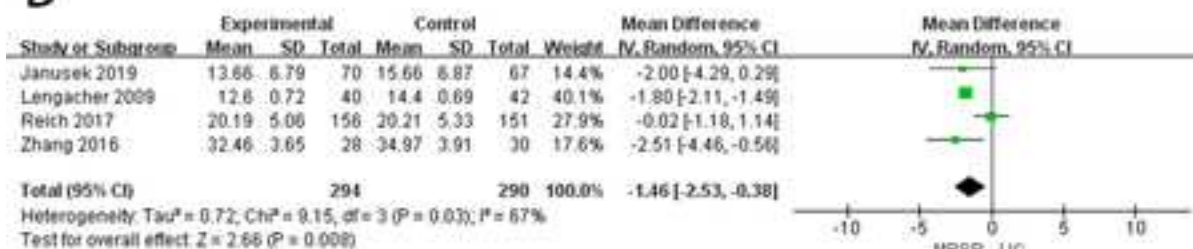
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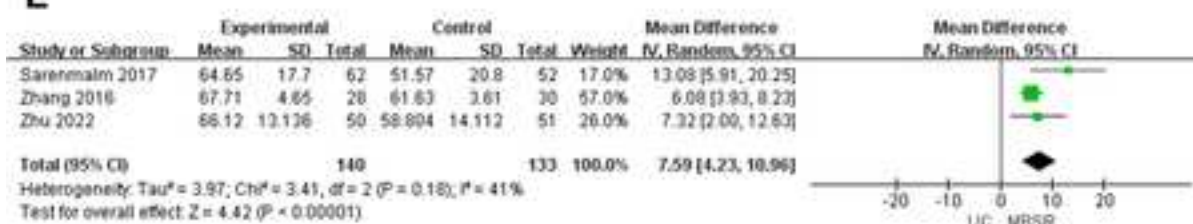
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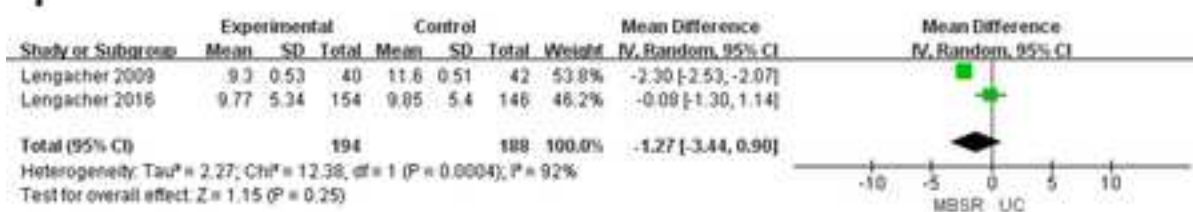
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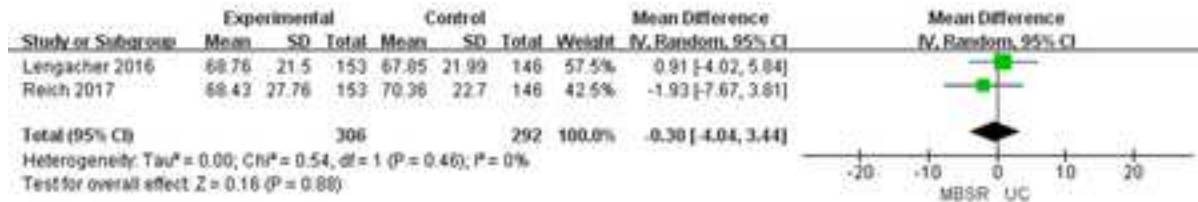
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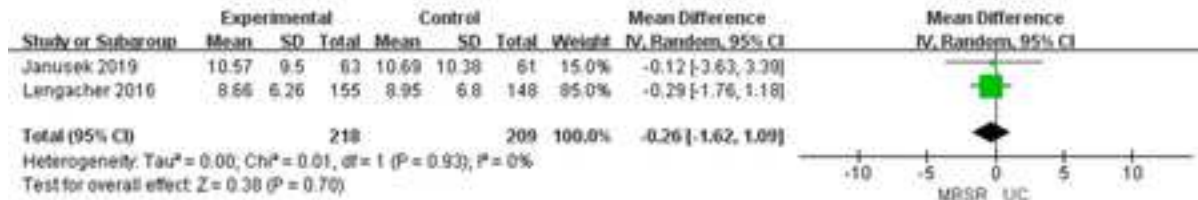
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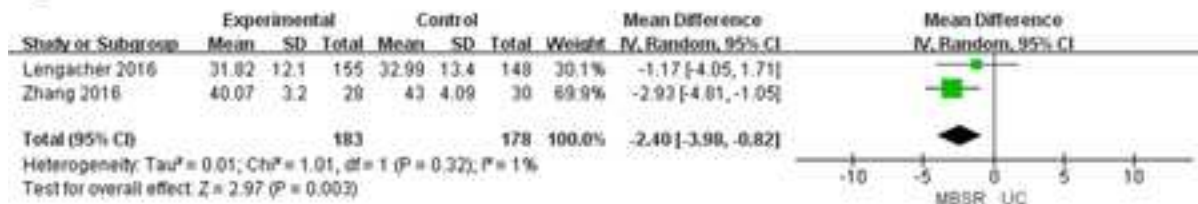
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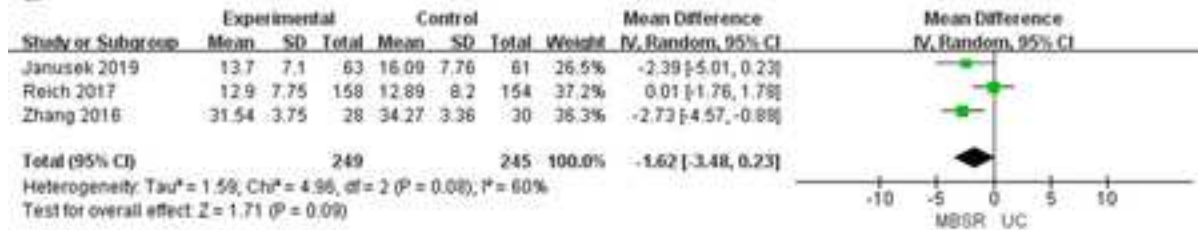
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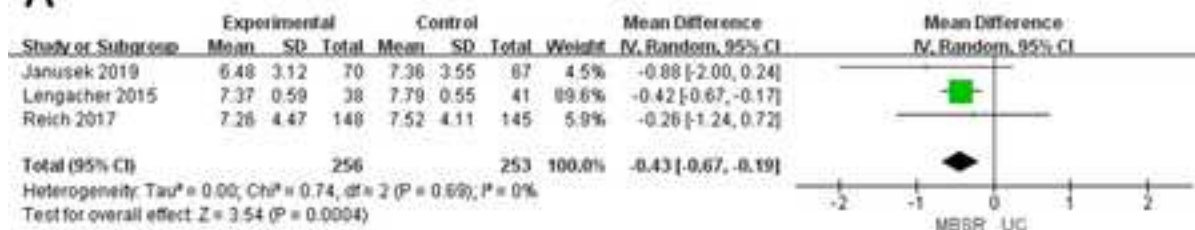
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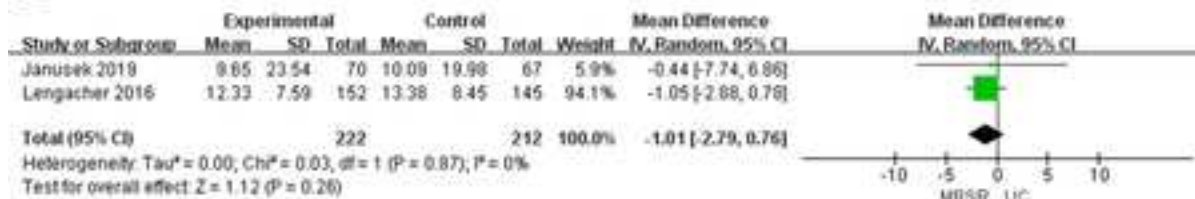
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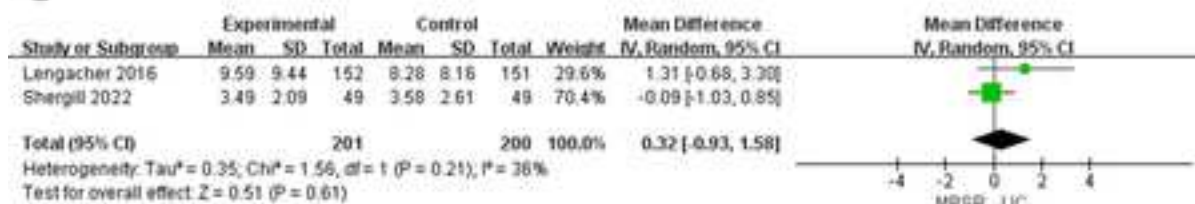
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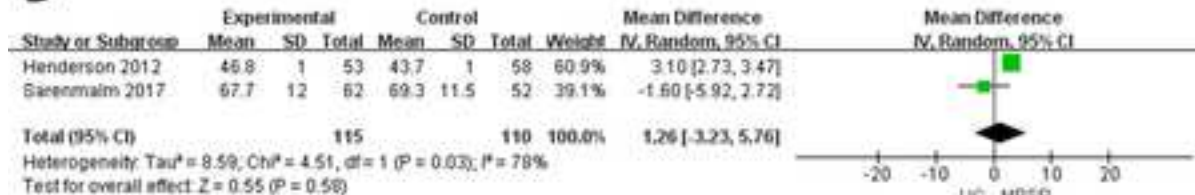
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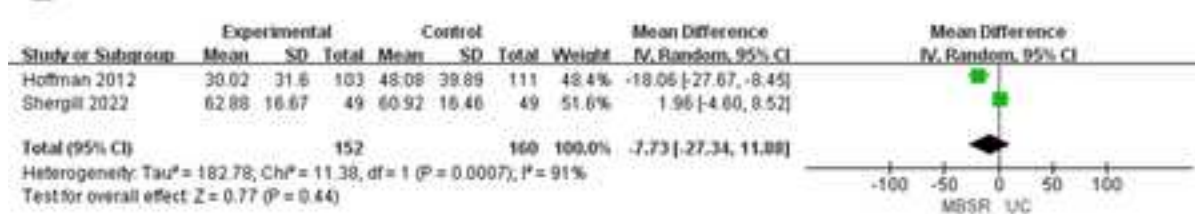
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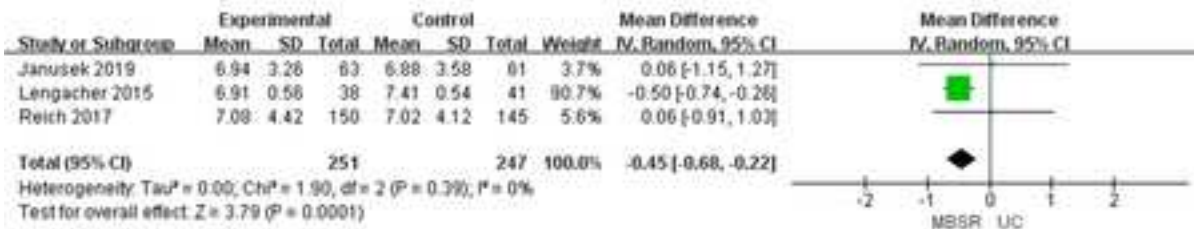
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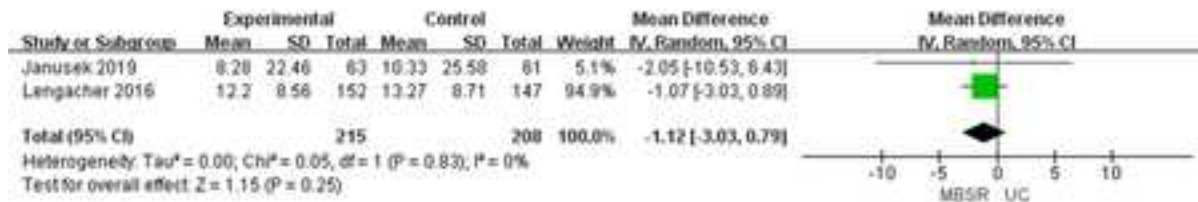
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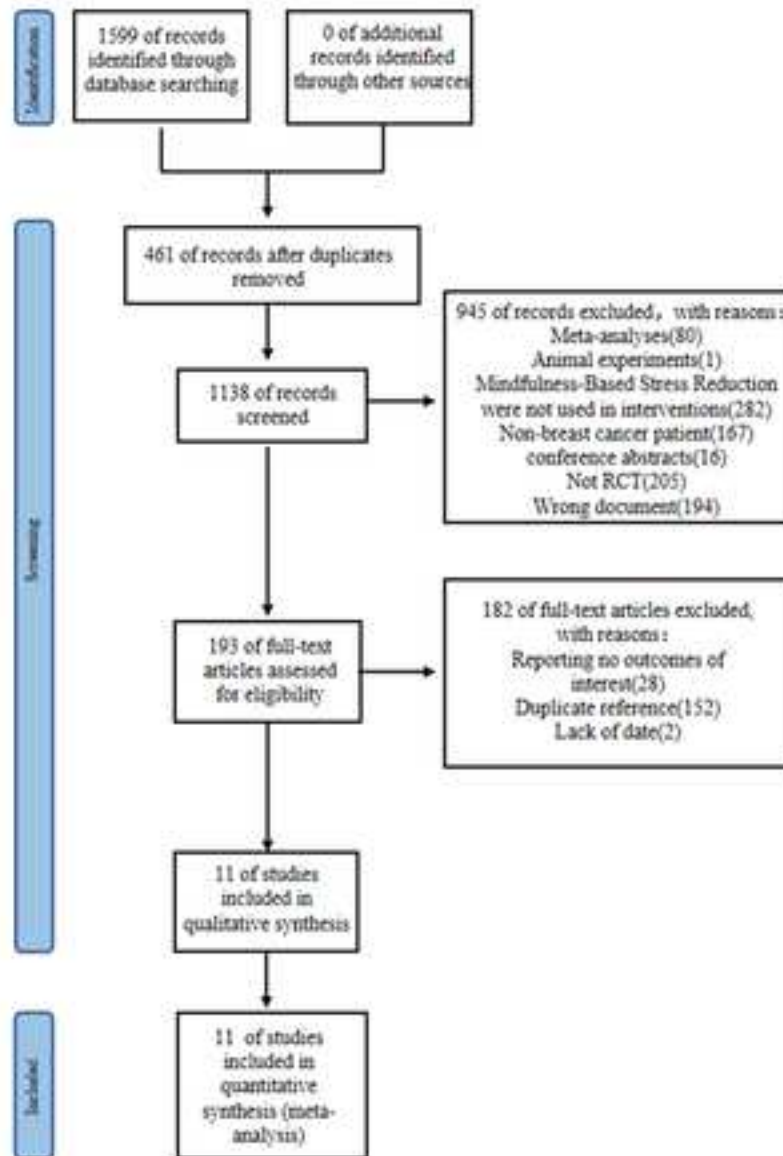


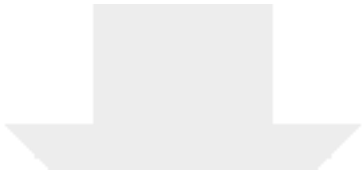
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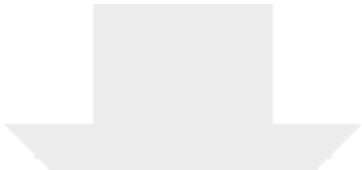




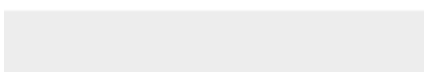
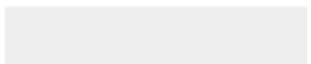


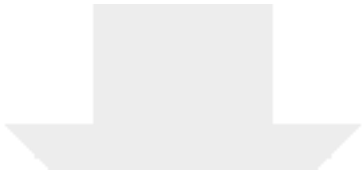
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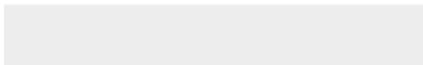
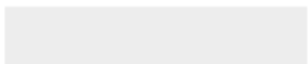


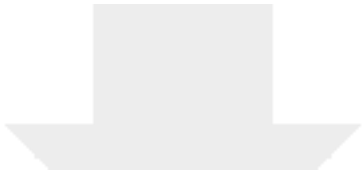
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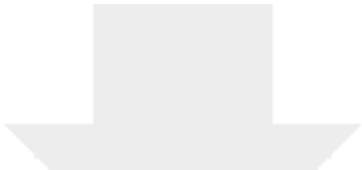
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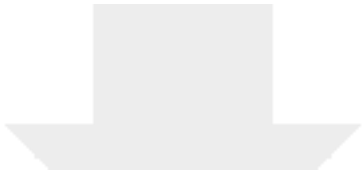
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