

SYSTEMATIC REVIEW

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The effectiveness of mindfulness-based cognitive therapy on rumination and related psychological indicators: a systematic review and meta-analysis

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Abstract

Background The effectiveness of Mindfulness-Based Cognitive Therapy (MBCT) on rumination has been reviewed; however, the findings remain inconclusive. The present research will systematically evaluate the effectiveness of MBCT on rumination and related psychological indicators.

Methods We searched the Cochrane Library, EBSCO, Embase, LILACS, PubMed, Web of Science, China Biomedical Literature Database (CBM), China National Knowledge Infrastructure (CNKI), Wanfang Database, and China Science and Technology Journal Database (VIP) for all available records up until December 2024 to include randomized controlled trials (RCTs) examining MBCT on rumination. Rumination scores served as the primary outcome, and the mindfulness, self-compassion, decentering, depression, and anxiety scores served as the secondary outcomes. RevMan and Stata software were applied for data processing.

Results Twenty-nine RCTs comprising 2535 subjects were ultimately selected for analysis. The results revealed that MBCT significantly reduced rumination (SMD = -0.51, 95% CI = [-0.64, -0.39], $z = 8.30$, $P < 0.001$), with sustained effectiveness during the follow-up period (SMD = -0.61, 95% CI = [-0.89, -0.32], $z = 4.21$, $P < 0.001$). Additionally, we also discovered that MBCT had significant effectiveness on mindfulness (SMD = 0.55, 95% CI = [0.46, 0.63], $z = 12.04$, $P < 0.001$), self-compassion (SMD = 0.59, 95% CI = [0.22, 0.96], $z = 3.15$, $P = 0.002$), decentering (SMD = 0.62, 95% CI = [0.45, 0.78], $z = 7.24$, $P < 0.001$), depressive (SMD = -0.57, 95% CI = [-0.79, -0.34], $z = 4.95$, $P < 0.001$) and anxiety symptoms (SMD = -0.37, 95% CI = [-0.56, -0.18], $z = 3.78$, $P < 0.001$). Funnel plot analysis and Egger's statistical test did not reveal any significant publication bias ($t = -1.47$, $P = 0.154$, 95% CI = [-2.20, 0.37]).

Conclusions The present findings confirm the feasibility of MBCT in diminishing rumination and enhancing related psychological indicators. Furthermore, these effects were sustained throughout the follow-up period.

Keywords Mindfulness-based cognitive therapy, Rumination, Randomized controlled trials

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Introduction

Rumination is characterized as an uncontrolled, recurrent cognitive pattern where individuals attempt to alleviate the negative outcomes of life events [1]. However, this process frequently involves an excessive focus on the self, negative emotions, and unresolved issues, rather than on constructive solutions, thereby intensifying and perpetuating adverse effects [2]. As a transdiagnostic symptom, rumination not only manifests across psychiatric conditions but also relates to their development, course, and maintenance [3–7].

Mindfulness-Based Cognitive Therapy (MBCT) emphasizes individuals' relationship with their thoughts, fostering an open and non-judgmental mindset, alongside the capacity to sustain present-moment awareness [8]. Individuals undergoing MBCT can observe and accept their thoughts in a decentered fashion [9]. Moreover, prior studies have shown that MBCT can effectively alleviate the adverse impacts of rumination [10, 11].

The effectiveness of MBCT on rumination has been reviewed; however, the findings remain inconclusive [11–13]. Additionally, existing quantitative syntheses have concentrated on MBCT's effectiveness for particular conditions, such as depression or cancer, or have examined the overall influence of mindfulness-based interventions (MBIs) upon rumination [11–16]. Currently, there is a lack of a focused, systematic analysis in evaluating the specific effectiveness of MBCT on rumination. Moreover, these meta-analyses often include both randomized controlled trials (RCTs) and non-randomized controlled trials (non-RCTs), which could introduce sample bias and diminish the reliability of the results [11, 16]. To sum up, the conclusions drawn from prior meta-analyses may constrain our comprehension of the therapeutic effectiveness of MBCT in addressing rumination.

Prior research has established mindfulness, self-compassion, and decentering as active therapeutic components for reducing rumination in MBCT, while depressive and anxious symptoms are also recognized as critical clinical indicators for MBCT intervention [11, 12, 17–20]. In light of these considerations, this research intends to carry out a comprehensive meta-analysis to assess not only the therapeutic effectiveness of MBCT in mitigating rumination across various psychological and psychiatric conditions but also to examine the psychological indicators associated with MBCT intervention.

Methods

The registration of the study with PROSPERO is under the code CRD42024612750.

Inclusion and exclusion criteria

Following the PRISMA-PICOS standards, the inclusion criteria were: (i) participants (P): individuals of any age or

gender were included. (ii) intervention (I): MBCT intervention. (iii) comparison (C): other intervention methods besides MBCT. (iv) outcomes (O): rumination scores served as the principal outcome, and the mindfulness, self-compassion, decentering, depression, and anxiety scores as the secondary outcomes. (v) study design (S): RCT.

The exclusion criteria were: (i) duplicate publications. (ii) non-empirical studies, reviews, books, etc. (iii) not MBCT intervention. (iv) not rumination scale. (v) not RCT. (vi) not in English or Chinese. (vii) missing or duplicated data. (viii) study protocols.

Search strategy

We performed comprehensive literature searches across multiple databases to identify relevant articles published up to December 2024. For English-language publications, we utilized the Cochrane Library, EBSCO, Embase, LILACS, PubMed, and Web of Science. For Chinese-language publications, we accessed the China Biomedical Literature Database (CBM), China National Knowledge Infrastructure (CNKI), Wanfang Database, and China Science and Technology Journal Database (VIP). The keywords/terms were rumination, cognitive/ cognitive rumination/ rumination/ rumin/ brooding/ pondering/ repetitive thought/repetitive thinking/ ruminative thought/ ruminative thinking/ perseverative thought/ repetitive negative thinking/ mental rumination, and MBCT/ mindfulness-based cognitive therapy/ mindfulness cognitive therapy/ mindfulness-based CBT/ mindfulness-based cognitive behavior therapy/ mindfulness-based cognitive behavioral therapy/ mindfulness-based cognitive behaviour therapy/ mindfulness-based cognitive behavioural therapy/ mindfulness-CBT.

Data extraction

The main author collected data from each of the incorporated studies. This set of information predominantly encompassed the main investigator, publication time, sample size, age, and sex of both the control and experimental groups, as well as the types of interventions and follow-up periods for these groups. Additionally, the outcome indicators, along with the mean (M) and standard deviation (SD) associated with the interventions or follow-ups, were also recorded.

Quality evaluation

Two investigators separately assessed the potential bias risks for all included RCTs, following the Cochrane Handbook recommendations [21]. Seven domains were included in this assessment, and each was rated by the two researchers as either 'high risk of bias', 'low risk of bias', or 'unclear risk of bias'. When disagreements arose, a third researcher was brought in to settle the differences.

All researchers are experienced in evaluations and trained in the use of the Cochrane risk-of-bias tool.

To enhance the reliability and quality of this study, we conducted an inter-rater reliability analysis. The results were presented in terms of the consistency coefficient. Specifically, we assigned scores of 0, 1, and 2 to represent “high”, “unclear”, and “low” risk of bias, respectively, for each item assessed across the seven domains outlined in the Cochrane Handbook. Pearson correlation analysis was employed to calculate the consistency coefficient among researchers. The analysis revealed an inter-rater consistency coefficient of 0.947 ($P < 0.010$), indicating a high level of agreement among the researchers, thereby supporting the reliability of the study findings.

Statistical analysis

The analyses for meta-analysis, subgroup, and sensitivity were conducted with RevMan software, and publication bias was checked using Stata software. A sensitivity analysis was performed using the “leave-one-out” method in RevMan software, whereby each study was sequentially excluded to evaluate its impact on the overall heterogeneity. To assess potential publication bias, funnel plots and Egger’s regression test were conducted using Stata software, with a p -value threshold of less than 0.05 considered indicative of statistically significant bias. The I^2 statistic was applied to quantify inter-study heterogeneity, with $I^2 > 50\%$ indicating significant heterogeneity [22]. According to the heterogeneity assessment, studies meeting the criteria of $I^2 < 50\%$ and $P \geq 0.1$ (indicating homogeneity among studies) were analyzed using a fixed-effects approach, while those with $I^2 \geq 50\%$ or $P < 0.1$ (suggesting heterogeneity among studies) were processed with a random-effects method [23].

When substantial heterogeneity was identified, we conducted sensitivity and subgroup analyses to ascertain the underlying causes of this variation. Subgroup analysis was also executed in the absence of significant heterogeneity to bolster the robustness of the findings. For statistical evaluation, mean difference (MD) was applied to uniform measurement tools and standardized mean difference (SMD) to varied tools. Both were examined using 95% confidence intervals, with p -values under 0.05 indicating significance.

Results

Search results

Altogether, 1,043 articles were retrieved from various databases, with 29 RCTs involving 2,535 participants (1,236 in MBCT groups, 1,299 in control groups) ultimately incorporated into our research [24–52]. The procedure is depicted in Fig. 1.

In the included studies with MBCT intervention, 16 studies focused on individuals with depressive disorder,

2 studies on individuals with sexual dysfunction, and 1 study on individuals with anxiety disorder, bipolar disorder, cancer, migraine, multiple sclerosis, psoriasis, diabetes, perfectionism, neuroticism, D personality, and planned antidepressant discontinuation, respectively. Regarding control interventions, 12 studies were treatment as usual (TAU), 5 studies were waitlist (blank control) (WL) controls, 3 studies were cognitive behavioral therapy (CBT), psychoeducation, and medicine treatments, respectively, 2 studies were self-help interventions, and 1 study was transcranial direct current stimulation (tDCS). On the outcomes, 29 studies were using the rumination scales (14 studies with follow-up data), 21 studies were using mindfulness scales, 10 studies were using self-compassion scales, 5 studies were using decentering scales, 19 studies were using depression scales, and 11 studies were using anxiety scales (Table 1).

Risk of bias

It was at the initial stage that no marked disparities existed between the experimental and control groups regarding rumination, mindfulness, self-compassion, decentering, depression, and anxiety. Twenty-two studies detailed the methodology for random sequence generation, with 10 of these also addressing allocation concealment. Twenty-five studies provided information on participant withdrawals, including the amounts and reasons, while 28 studies reported all predefined outcome measures. Owing to the inherent characteristics of psychological interventions, double-blind designs were infeasible, likely introducing bias risks in all studies. Five studies employed blinding of outcome assessment. Other potential biases were indeterminate. The evaluation of bias risk across 29 RCTs is depicted in Fig. 2.

Meta-analysis results

Effectiveness of MBCT on rumination

All 29 RCTs employed data from measurements taken after treatment. This meta-analysis demonstrated that MBCT had a significant effectiveness in reducing rumination (SMD = -0.51, 95% CI = [-0.64, -0.39], $z = 8.30$, $P < 0.001$). The random-effects model was used due to study heterogeneity ($I^2 = 50\%$, $P = 0.001$), with sensitivity analysis demonstrating reduced heterogeneity ($I^2 = 15\%$, $P = 0.240$) [32, 42]. The therapeutic effectiveness of MBCT remained statistically significant (SMD = -0.46, 95% CI = [-0.55, -0.37], $z = 9.92$, $P < 0.001$). Analyses of subgroups were performed based on the types of interventions in the control group, the modalities and periods of MBCT, rumination scales, participant types, age, and gender (Table 2).

According to subgroup analyses, MBCT was more effectiveness in lowering rumination than medicine

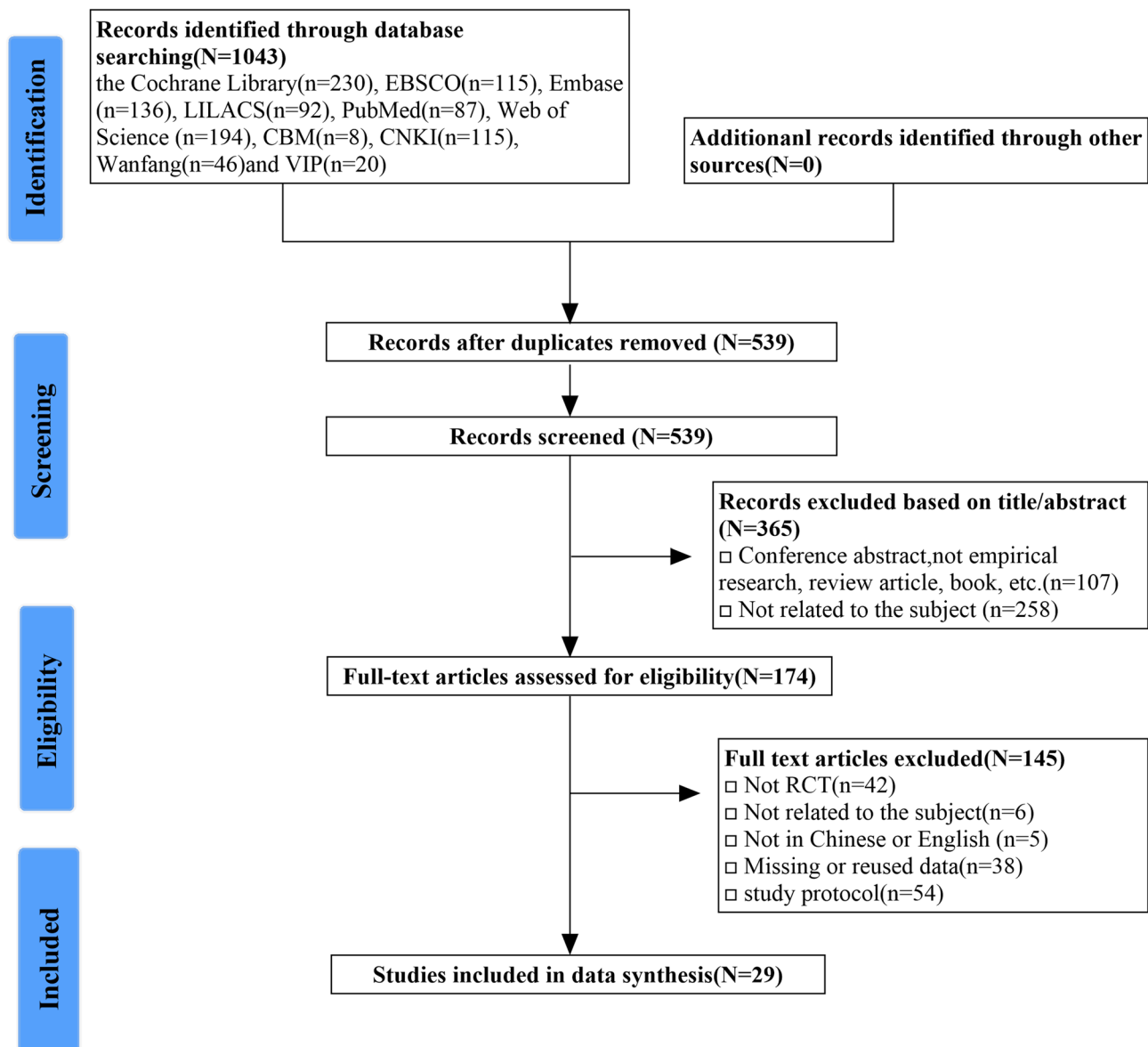


Fig. 1 Flow diagram of the study selection process. Abbreviations: EBSCO, EBSCO information services; Embase, excerpata medica database; LILACS, Latin American and Caribbean health sciences literature; CBM, China biomedical literature database; CNKI, China national knowledge infrastructure; VIP, China science and technology journal database; RCT, randomized controlled trial

(SMD = -0.62, 95% CI = [-0.94, -0.30], $z = 3.81$, $P < 0.001$), self-help intervention (SMD = -0.61, 95% CI = [-1.03, -0.20], $z = 2.88$, $P = 0.004$), WL (SMD = -0.56, 95% CI = [-0.80, -0.32], $z = 4.63$, $P < 0.001$), TAU (SMD = -0.48, 95% CI = [-0.60, -0.36], $z = 7.63$, $P < 0.001$), and CBT (SMD = -0.34, 95% CI = [-0.64, -0.03], $z = 2.18$, $P = 0.030$). Nonetheless, MBCT and psychoeducation did not show a statistical variance (SMD = -0.21, 95% CI = [-0.53, 0.11], $z = 1.26$, $P = 0.210$).

Both hybrid modality and offline modality of MBCT were all significant (SMD = -0.65, 95% CI = [-1.02, -0.28], $z = 3.43$, $P < 0.001$, SMD = -0.45, 95% CI = [-0.55, -0.35], $z = 9.07$, $P < 0.001$), whereas online MBCT showed no

significant effectiveness (SMD = -0.27, 95% CI = [-0.74, 0.19], $z = 1.15$, $P = 0.250$). Subgroup analyses discovered that MBCT significantly improved rumination as measured by the Ruminative Response Scale (RRS) (SMD = -0.52, 95% CI = [-0.67, -0.37], $z = 6.70$, $P < 0.001$), Rumination on Sadness Scale (RSS) (SMD = -0.45, 95% CI = [-0.64, -0.26], $z = 4.61$, $P < 0.001$), and Ruminative Reflection Questionnaire (RRQ) (SMD = -0.34, 95% CI = [-0.50, -0.17], $z = 3.95$, $P < 0.001$). MBCT was significant effectiveness for patients with depression (SMD = -0.55, 95% CI = [-0.66, -0.44], $z = 10.10$, $P < 0.001$), but was not significant effectiveness for patients with sexual dysfunction (SMD = -0.07, 95% CI = [-0.32, 0.18], $z = 0.55$, $P = 0.580$).

Table 1 The features of the involved studies ($n = 29$)

Study	Sample		Gender	Age	Participants	Intervention measures		Inter- vention duration		Follow-up (month(s))	Out- come scales
	Experimental	Control	Female,%	Mean(SD)		Experimental	Control	Week (s)	Min- ute (s)		
Arm- strong 2016 [24]	17	17	94.15	29.40(8.70)	High levels of neuroticism	MBCT	Self-help	8	960	NA	RRQ- Ru, FFMQ, PHQ-9, GAD- 7,SCS, EQ
Bieling 2012 [25]	26	28	50.00	44.80(9.40)	Major depres- sive disorder	MBCT	Medicine	8	1320	NA	EQ-R, TMS-D
Brotto 2021 [26]	70	78	100.00	39.30(13.20)	Sexual arousal disorder	MBCT	Psycho- education	8	1080	6	RRQ
Brotto 2024 [27]	60	56	100.00	49.00(11.00)	Sexual dysfunction	MBCT(online)	Psycho- education	8	960	6	RRQ, FFMQ
Cladder- Micus 2018 [28]	49	57	65.31	46.86(9.53)	Treatment- resistant depression	MBCT	TAU	8	1560	NA	RRS, FFMQ, IDS-SR, SCS
Compen 2018 [29]	77	78	87.01	52.10(11.40)	Cancer	MBCT	TAU	8	1560	NA	RRQ- Ru, FFMQ
Dimidjian 2023 [30]	230	230	74.67	48.30(15.10)	Residual depression	MBCT(online)	TAU	12	NA	12	RRS, FFMQ, EQ
Fork- mann 2014 [31]	64	66	79.69	44.60(9.70)	Residual depression	MBCT	WL	8	1200	NA	RSS, KIMS, HAM-D
Foroughi 2020 [32]	9	9	66.67	NA	Treatment- resistant depression	MBCT+medi- cine	Medicine	8	NA	1	RRS, SMQ, BDI-II, SCS-SF
Hanssen 2023 [33]	72	72	56.94	47.10(12.10)	Bipolar disorder	MBCT	TAU	8	1560	3	RRS-B, FFMQ, IDS-C, STAI, SCS-SF
Hasani 2023 [34]	15	15	NA	NA	Major depres- sive disorder	MBCT	WL	8	NA	NA	RRS
Huijbers 2023 [35]	73	46	63.01	53.30(11.80)	Mental disor- ders planning antidepressant discontinuation	MBCT	TAU	12	1560	6	RRS-B, FFMQ, IDS-C, STAI, SCS-SF
James 2018 [36]	28	32	82.14	NA	Perfectionism	MBCT	Self-help	8	1960	2.5	RRQ, FFMQ, DASS, SCS-SF, EQ
Maddock 2019 [37]	51	50	74.51	43.51(16.96)	Psoriasis	MBCT	TAU	8	960	3	RRQ, SMQ, HADS- D, HADS- A, SCS, EQ

Table 1 (continued)

Study	Sample		Gender	Age	Participants	Intervention measures		Inter- vention duration		Follow-up (month(s))	Out- come scales
	Experimental	Control				Experimental	Control	Week (s)	Min- ute (s)		
Mani- cavasagar 2012 [38]	19	26	64.44	47.00(13.80)	Major depres- sive disorder	MBCT	CBT	8	1080	NA	RRS, MAAS, BDI-II
Monnart 2019 [39]	15	16	66.67	50.00(5.38)	Treatment- resistant depression	MBCT + tDCS	TDCS + re- laxation	8d	960	0.5	SARI, MADRS, STAI
Nauta 2024 [40]	32	35	71.88	46.00(10.20)	Multiple sclerosis	MBCT	TAU	8	1500	6	RRS-B, FFMQ, HADS- A, SCS-SF
Paterniti 2022 [41]	14	13	78.57	48.10(11.36)	Major depres- sive disorder	MBCT	CBT	12	720	2	RRQ, FFMQ, BDI-II
Roodma- jani 2024 [42]	20	20	NA	NA	Cardiac patients with type D personality	MBCT	TAU	8	720	1	RRS
Schanche 2020 [43]	31	33	70.97	40.70(13.19)	Depressive relapse	MBCT	WL	8	1320	NA	RRQ, FFMQ, BDI-II, BAI, SCS
Shahar 2010 [44]	26	19	76.92	46.58(7.77)	Depressive relapse	MBCT	WL	8	1800	NA	RRS-B, MAAS, BDI
Shih 2021 [45]	28	29	89.29	69.69(7.48)	Depressive symptoms	MBCT	Psycho- education	8	1380	NA	RRS, HAMD
Sim- shaeuser 2022 [46]	27	27	92.59	44.40(8.86)	Migraine	MBCT	WL	8	1200	NA	DFS, FMI, HADS- D, HADS- A, SCS
Spin- hoven 2022 [47]	62	74	56.45	39.55(12.61)	Refrac- tory anxiety disorder	MBCT	CBT	8	960	6	RSS, FFMQ, IDS-SR, BAI
van Aalderen 2012 [48]	102	103	69.61	47.30(11.50)	Depressive relapse	MBCT	TAU	8	1560	NA	RSS, KIMS, HAMD
Zhang 2017 [49]	15	13	39.29	38.11(2.19)	Type 2 diabetes	MBCT	TAU	8	600	NA	CERQ
Liu 2024 [50]	63	63	46.03	37.70(6.60)	Depressive disorders	MBCT + medi- cine	Medicine	2	480	NA	RRS, FFMQ, HAMD

Table 1 (continued)

Study	Sample		Gender	Age	Participants	Intervention measures		Inter- vention duration		Follow-up (month(s))	Out- come scales
	Experimental	Control	Female,%	Mean(SD)		Experimental	Control	Week (s)	Min- ute (s)		
Cao 2024 [51]	26	26	61.54	40.81(7.61)	Depressive disorders	MBCT(mixed)	TAU	8	640	NA	RRS, FFMQ, HAMD, HAMA
Li 2024 [52]	64	67	64.06	NA	Major depressive disorder	MBCT(mixed)	TAU	8	640	3	RRS

Abbreviations: Interventions: MBCT = mindfulness-based cognitive therapy; TAU = treatment as usual; WL = waiting list (blank control); CBT = cognitive behavioral therapy. Rumination scales: RRQ = Ruminative Reflection Questionnaire (reflection and rumination); RRQ-Ru = Ruminative Reflection Questionnaire-Rumination Subscale; RRS = Ruminative Response Scale (reflection, brooding, and depression-related characteristics); RRS-B = Ruminative Response Style Questionnaire-Brooding Subscale; RSS = Rumination on Sadness Scale (depressive rumination); EQ-R = Experiences Questionnaire-Rumination scale; SARI = Sadness and Anger Ruminative Inventory; DFS = Questionnaire of Dysfunctional and Functional Self-Consciousness; CERQ = Cognitive Emotion Regulation Questionnaire. Mindfulness scales: FFMQ = Five Facet Mindfulness Questionnaire; FMI = Freiburg Mindfulness Inventory; KIMS = Kentucky Inventory of Mindfulness Skills; MAAS = Mindful Attention Awareness Scale; SMQ = Southampton Mindfulness Questionnaire. Self-compassion scales: SCS = Self-Compassion Scale; SCS-SF = Self-Compassion Scale-Short Form. Decentration scales: EQ = Experiences Questionnaire; TMS-D = Toronto Mindfulness Scale-Decentering. Depression scales: PHQ-9 = Patient Health Questionnaire 9-item; IDS-SR = Inventory of Depressive Symptomatology-Self Report; IDS-C = Inventory of Depressive Symptomatology-Clinician administered; HAMD = Hamilton Depression Rating Scale; BDI-II = Beck Depression Inventory (Second Edition); DASS = Depression Anxiety Stress Scale; HADS-D = Hospital Anxiety and Depression Scale-depression; MADRS = Montgomery-Åsberg Depression Rating Scale. Anxiety scales: GAD-7 = Generalized Anxiety Disorder 7-item; STAI = State-Trait Anxiety Inventory; HADS-A = Hospital Anxiety and Depression Scale-anxiety; BAI = Beck Anxiety Inventory; HAMA = Hamilton Anxiety Rating Scale

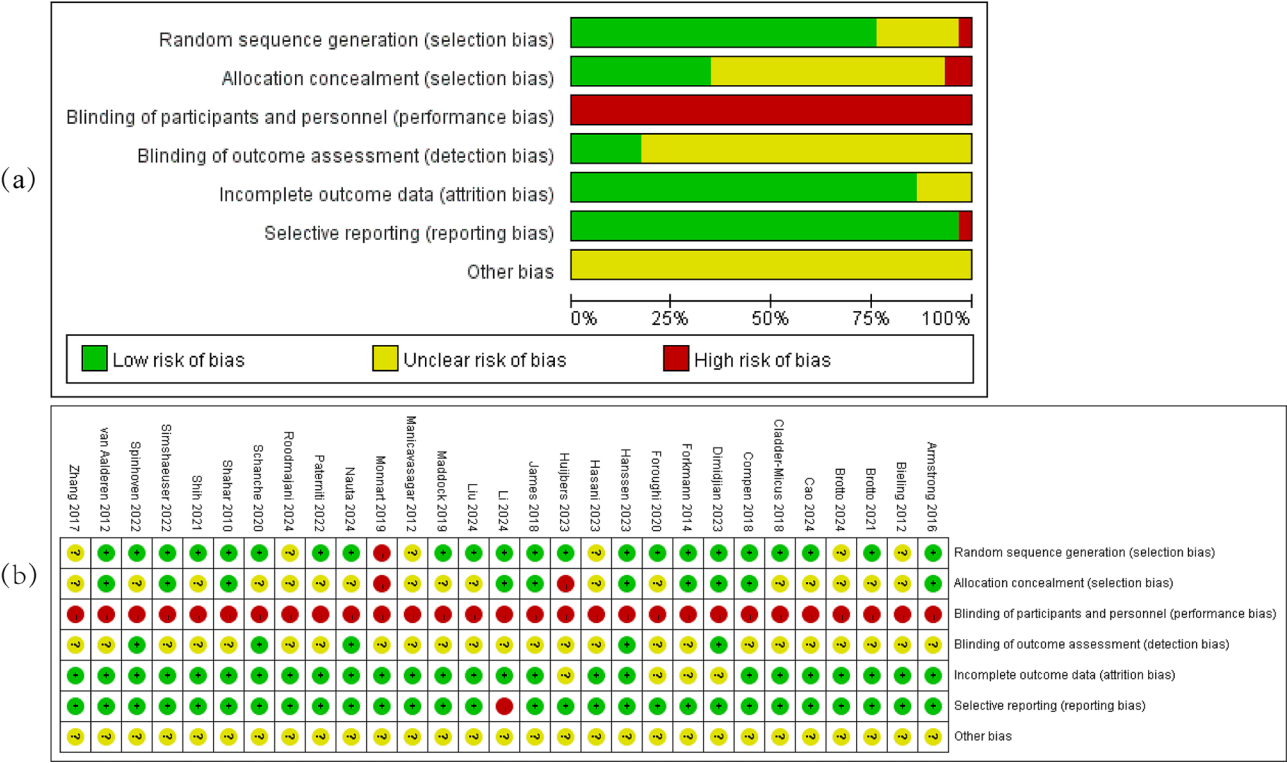


Fig. 2 The evaluation of bias risk across 29 randomized controlled trials (RCTs). Panel (a) illustrates the risk of bias graph, while panel (b) provides a summary of the risk of bias. The color coding is as follows: green denotes a low risk of bias, yellow signifies an unclear risk of bias, and red indicates a high risk of bias

Table 2 Meta-analyses and subgroup analysis of MBCT for rumination

Subgroups	Studies	Participants	Effect Estimate [95%CI]	z	p	Heterogeneity	
						p	I ²
Intervention types	26	2446	-0.46 [-0.55, -0.36]	9.63	<0.001	0.200	18%
MBCT vs. Medicine	2	158	-0.62 [-0.94, -0.30]	3.81	<0.001	0.400	0%
MBCT vs. Self-help	2	94	-0.61 [-1.03, -0.20]	2.88	0.004	0.700	0%
MBCT vs. WL	5	315	-0.56 [-0.80, -0.32]	4.63	<0.001	0.370	6%
MBCT vs. TAU	11	1405	-0.48 [-0.60, -0.36]	7.63	<0.001	0.260	19%
MBCT vs. CBT	3	172	-0.34 [-0.64, -0.03]	2.18	0.030	0.790	0%
MBCT vs. Psychoeducation	3	302	-0.21 [-0.53, 0.11]	1.26	0.210	0.150	47%
Intervention modality	27	2477	-0.46 [-0.55, -0.37]	8.30	<0.001	0.001	50%
Hybrid	3	327	-0.65 [-1.02, -0.28]	3.43	<0.001	0.080	60%
Offline	22	1674	-0.45 [-0.55, -0.35]	9.07	<0.001	0.630	0%
Online	2	476	-0.27 [-0.74, 0.19]	1.15	0.250	0.030	80%
Intervention periods	25	2087	-0.44 [-0.54, -0.35]	9.23	<0.001	0.310	11%
T ≤ 1200 min	14	1104	-0.46 [-0.62, -0.30]	5.69	<0.001	0.080	38%
1200 min < T ≤ 1500 min	4	211	-0.53 [-0.81, -0.26]	3.78	<0.001	0.920	0%
T > 1500 min	7	772	-0.41 [-0.56, -0.27]	5.63	<0.001	0.550	0%
Rumination scales	23	2332	-0.45 [-0.55, -0.35]	8.89	<0.001	<0.150	24%
RRS	12	1242	-0.52 [-0.67, -0.37]	6.70	<0.001	0.110	35%
RSS	3	435	-0.45 [-0.64, -0.26]	4.61	<0.001	0.640	0%
RRQ	8	655	-0.34 [-0.50, -0.17]	3.95	<0.001	0.340	11%
Participant types	17	1662	-0.48 [-0.61, -0.36]	7.46	<0.001	0.110	31%
Depression	15	1417	-0.55 [-0.66, -0.44]	10.10	<0.001	0.670	0%
Sexual dysfunction	2	245	-0.07 [-0.32, 0.18]	0.55	0.580	0.660	0%
Participant age	24	2256	-0.43 [-0.51, -0.34]	9.98	<0.001	0.410	4%
25 < Mean ≤ 40	5	417	-0.45 [-0.64, -0.25]	4.47	<0.001	0.140	42%
40 < Mean ≤ 50	16	1554	-0.43 [-0.54, -0.33]	8.43	<0.001	0.620	0%
Mean > 50	3	285	-0.36 [-0.60, -0.12]	2.98	0.003	0.150	48%
Participant gender	26	2447	-0.45 [-0.53, -0.36]	10.24	<0.001	0.350	8%
Female ≤ 50%	3	186	-0.66 [-0.95, -0.36]	4.34	<0.001	0.600	0%
65% < Female ≤ 80%	9	1021	-0.48 [-0.60, -0.35]	7.52	<0.001	0.990	0%
50% < Female ≤ 65%	7	658	-0.42 [-0.65, -0.20]	3.75	<0.001	0.070	48%
Female > 80%	7	582	-0.39 [-0.61, -0.17]	3.54	<0.001	0.140	38%
Total	27	2477	-0.46 [-0.55, -0.37]	9.92	<0.001	0.240	15%

The effect estimates are expressed as standardized mean differences (SMD) accompanied by 95% confidence intervals (CI). The term “IV” denotes interval variable, while “z” refers to the z-score for the overall effect, and “p” indicates the level of statistical significance. Heterogeneity is evaluated using I² statistics and p-values. All p-values are two-tailed, with a threshold of less than 0.05 deemed statistically significant

Abbreviations: MBCT, mindfulness-based cognitive therapy; WL, waiting list (blank control); TAU, treatment as usual; CBT, cognitive behavioral therapy; RRS, Ruminative Response Scale (reflection, brooding, and depression-related characteristics); RSS, Rumination on Sadness Scale (depressive rumination); RRQ, Ruminative Reflection Questionnaire (reflection and rumination)

In addition, significant effectiveness of MBCT was shown across various intervention periods, participant ages, and genders.

Effectiveness of MBCT on rumination during follow-up

The meta-analysis incorporated data from 14 RCTs encompassing a total of 1,358 participants, focusing on rumination during follow-up. The findings indicated the sustained effectiveness of MBCT in reducing rumination was significantly superior to the control group (SMD = -0.61, 95% CI = [-0.89, -0.32], $z = 4.21$, $P < 0.001$). The application of a random-effects approach ($I^2 = 82\%$, $P < 0.001$) followed by sensitivity testing removed substantially decreased heterogeneity ($I^2 = 60\%$, $P = 0.004$)

[32, 42]. Notably, the therapeutic effectiveness of MBCT remained statistically significant (SMD = -0.41, 95% CI = [-0.59, -0.22], $z = 4.31$, $P < 0.001$).

Subgroup analyses demonstrated that the long-term effectiveness of MBCT exhibited a marked superiority over TAU (SMD = -0.45, 95% CI = [-0.73, -0.16], $z = 3.04$, $P = 0.002$). However, no substantial differences were observed when comparing MBCT with psychoeducation (SMD = -0.31, 95% CI = [-0.79, 0.17], $z = 1.25$, $P = 0.210$) or with CBT (SMD = -0.21, 95% CI = [-0.58, 0.16], $z = 1.10$, $P = 0.270$) (Fig. 3). The effectiveness of MBCT in reducing ruminative thinking remained significant throughout the follow-up periods (SMD = -0.41, 95% CI = [-0.59, -0.22], $z = 4.31$, $P < 0.001$) (Fig. 4).

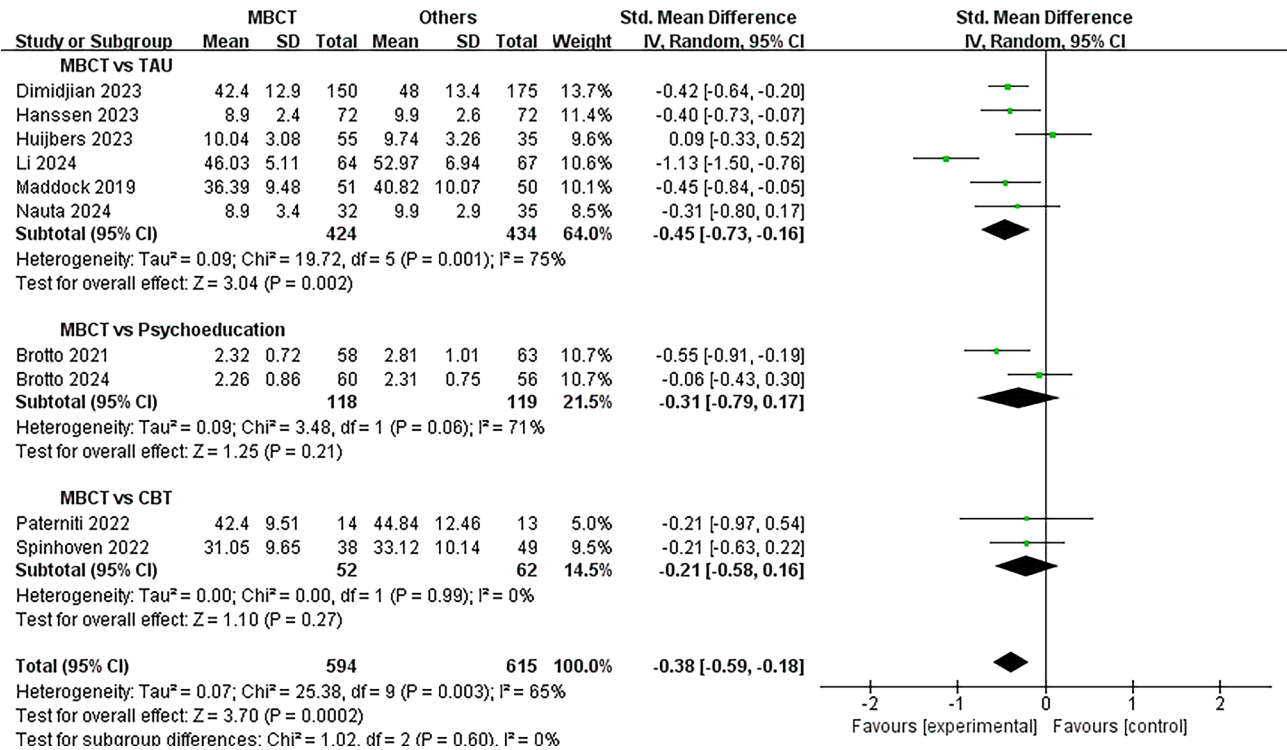


Fig. 3 Effectiveness of MBCT on rumination during follow-up: Subgroup analysis by intervention types. The effect estimates are expressed as standardized mean differences (SMD) accompanied by 95% confidence intervals (CI). The term “IV” denotes interval variable, while “z” refers to the z-score for the overall effect, and “p” indicates the level of statistical significance. Heterogeneity is evaluated using I^2 statistics and p -values. All p -values are two-tailed, with a threshold of less than 0.05 deemed statistically significant. Abbreviations: MBCT, mindfulness-based cognitive therapy; TAU, treatment as usual; CBT, cognitive behavioral therapy

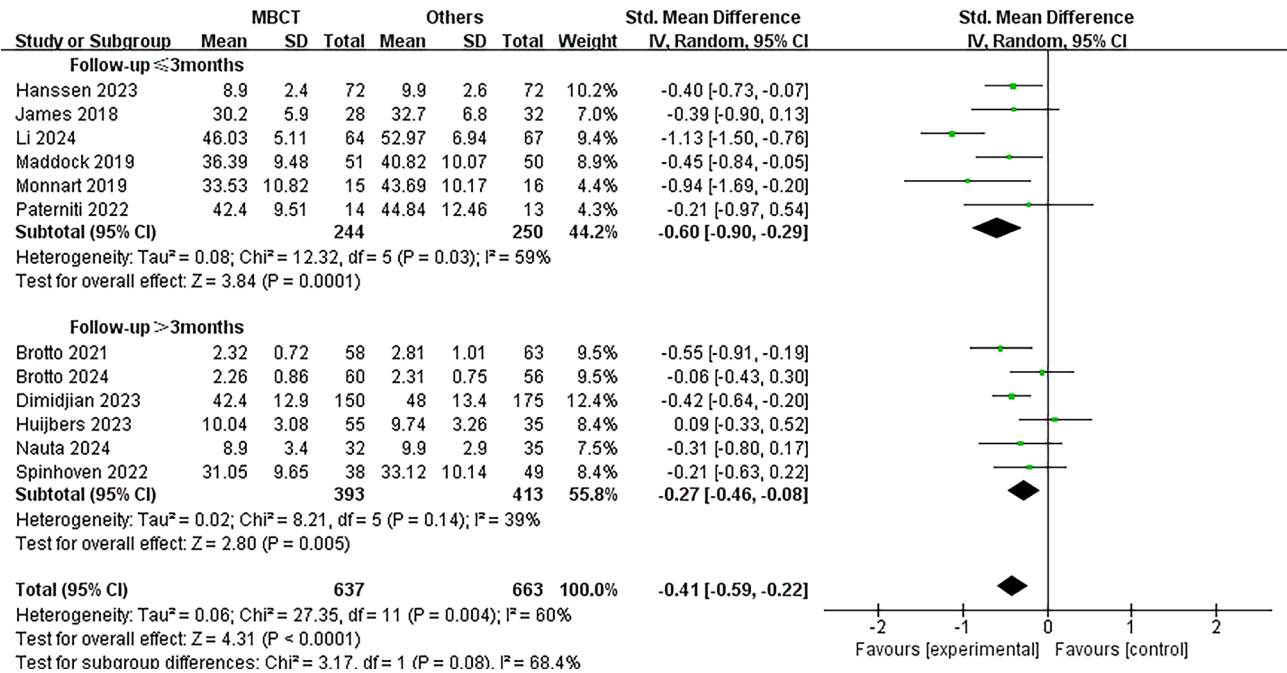


Fig. 4 Effectiveness of MBCT on rumination during follow-up: Subgroup analysis by follow-up period. The effect estimates are expressed as standardized mean differences (SMD) accompanied by 95% confidence intervals (CI). The term “IV” denotes interval variable, while “z” refers to the z-score for the overall effect, and “p” indicates the level of statistical significance. Heterogeneity is evaluated using I^2 statistics and p -values. All p -values are two-tailed, with a threshold of less than 0.05 deemed statistically significant. Abbreviations: MBCT, mindfulness-based cognitive therapy

Effectiveness of MBCT on mindfulness, self-compassion and decentering ability

The analysis of 21 RCTs encompassing a total of 2060 participants provided data on mindfulness. The current meta-analysis identified that MBCT significantly enhanced mindfulness (SMD = 0.55, 95% CI = [0.46, 0.63], $z = 12.04$, $P < 0.001$). The random-effects model was employed ($I^2 = 49\%$, $P = 0.007$), along with a sensitivity analysis, which reduced heterogeneity ($I^2 = 0\%$, $P = 0.520$) [32]. And the therapeutic effectiveness of MBCT remained statistically significant (SMD = -0.54, 95% CI = [-0.45, -0.63], $z = 11.88$, $P < 0.001$). Subgroup analyses demonstrated that the effectiveness of MBCT on enhancing mindfulness was superior to that of WL (SMD = 0.71, 95% CI = [0.47, 0.95], $z = 5.81$, $P < 0.001$), self-help intervention (SMD = 0.57, 95% CI = [0.15, 0.98], $z = 2.69$, $P = 0.007$) and TAU (SMD = 0.53, 95% CI = [0.41, 0.64], $z = 9.11$, $P < 0.001$), but did not differ significantly from CBT (SMD = 0.28, 95% CI = [-0.03, 0.58], $z = 1.79$, $P = 0.070$) (Fig. S1).

Additionally, 10 RCTs involving 716 participants assessed self-compassion levels. The meta-analysis indicated that MBCT significantly improved self-compassion (SMD = 0.59, 95% CI = [0.22, 0.96], $z = 3.15$, $P = 0.002$). The use of a random-effects model ($I^2 = 81\%$, $P < 0.001$) and sensitivity analysis led to a decrease in heterogeneity ($I^2 = 64\%$, $P = 0.005$) [32]. And the therapeutic effectiveness of MBCT remained statistically significant (SMD = 0.47, 95% CI = [0.21, 0.73], $z = 3.58$, $P < 0.001$). Subgroup analyses revealed that MBCT was more effective in enhancing self-compassion compared to WL (SMD = 0.76, 95% CI = [0.27, 1.26], $z = 3.03$, $P = 0.002$) and TAU (SMD = 0.24, 95% CI = [0.04, 0.44], $z = 2.39$, $P = 0.020$), yet showed no significant difference when compared to self-help intervention (SMD = 1.00, 95% CI = [-0.08, 2.08], $z = 1.82$, $P = 0.070$) (Fig. S2).

The decentering ability was assessed in 5 RCTs encompassing 586 participants altogether. The current research identified that the MBCT significantly enhanced individual decentering ability (SMD = 0.62, 95% CI = [0.45, 0.78], $z = 7.24$, $P < 0.001$). Due to the acceptable level of statistical heterogeneity ($I^2 = 16\%$, $P = 0.310$), a fixed-effects model was employed. According to subgroup analyses, MBCT was more effective at enhancing decentering ability compared to self-help intervention (SMD = 0.86, 95% CI = [0.44, 1.29], $z = 3.97$, $P < 0.001$) and TAU (SMD = 0.54, 95% CI = [0.36, 0.73], $z = 5.70$, $P < 0.001$) (Fig. S3).

Effectiveness of MBCT on depressive and anxiety symptoms

The 19 RCTs involving 1,484 participants provided data on depression. The meta-analysis demonstrated that MBCT significantly alleviated depressive symptoms (SMD = -0.57, 95% CI = [-0.79, -0.34], $z = 4.95$, $P < 0.001$).

A random-effects model was used ($I^2 = 76\%$, $P < 0.001$), and subsequent sensitivity analysis reduced heterogeneity ($I^2 = 18\%$, $P = 0.250$) [32, 50]. Besides, the therapeutic effectiveness of MBCT remained statistically significant (SMD = -0.41, 95% CI = [-0.54, -0.29], $z = 6.58$, $P < 0.001$). Subgroup analyses indicated that MBCT was more effective in improving depressive symptoms than WL (SMD = -0.59, 95% CI = [-0.83, -0.35], $z = 4.86$, $P < 0.001$), TAU (SMD = -0.38, 95% CI = [-0.53, -0.23], $z = 4.90$, $P < 0.001$), and CBT (SMD = -0.36, 95% CI = [-0.67, -0.06], $z = 2.35$, $P = 0.020$), although no notable difference was found in comparison with self-help intervention (SMD = -0.16, 95% CI = [-0.57, 0.25], $z = 0.76$, $P = 0.450$) (Fig. S4).

The 11 RCTs involving 795 participants provided the data on anxiety. The meta-analysis revealed that MBCT significantly alleviated anxiety symptoms (SMD = -0.37, 95% CI = [-0.56, -0.18], $z = 3.78$, $P < 0.001$). The analysis was performed with a random-effects model ($I^2 = 42\%$, $P = 0.070$), and subsequent sensitivity analysis reduced heterogeneity ($I^2 = 0\%$, $P = 0.840$) [51]. Moreover, the therapeutic effectiveness of MBCT remained statistically significant (SMD = -0.28, 95% CI [-0.43, -0.14], $z = 3.80$, $P < 0.001$). Analysis of subgroups indicated that the MBCT was superior to TAU (SMD = -0.23, 95% CI = [-0.43, -0.04], $z = 2.31$, $P = 0.020$) in alleviating anxiety symptoms, however, no substantial difference was found in comparison with self-help intervention (SMD = -0.46, 95% CI = [-1.11, 0.19], $z = 1.39$, $P = 0.160$) and WL (SMD = -0.19, 95% CI = [-0.57, 0.18], $z = 1.01$, $P = 0.310$) (Fig. S5).

Publication bias

Publication bias was conducted for the remaining 27 studies after excluding two studies based on the sensitivity analysis [32, 42]. Both the funnel plot and Egger's test revealed a lack of notable publication bias ($t = -1.47$, $P = 0.154$, 95% CI = [-2.20, 0.37]) (Fig. S6).

Discussion

Effectiveness of MBCT on rumination

In alignment with prior meta-analyses, the current research indicates that MBCT exhibits superior effectiveness compared to self-help intervention, WL, and TAU in reducing rumination [11, 13, 16, 53]. This enhanced effectiveness may be attributed to the capacity of MBCT to cultivate awareness and acceptance, which enables individuals to better manage excessive focus on negative thoughts, disrupt inflexible cognitive patterns, and consequently reduce rumination [54, 55].

Furthermore, our study found that the effectiveness of MBCT in reducing rumination was superior to that of both CBT and medicine treatments, which contrasts with findings from previous research [11, 13]. Previous studies only focused on a specific group of people, such as patients with depression [11], however, the populations

studied in our research were a cross-diagnostic group. Moreover, the CBT interventions in the control groups of our study (e.g., standard CBT) differed from those in previous meta-analyses (e.g., behavioral activation and computerized cognitive training) [13]. Furthermore, variations in the definition and assessment of rumination (e.g., RRS, RRQ, RSS, CERQ, DFS) may account for the divergent outcomes observed. Finally, MBCT integrates cognitive strategies of CBT protocols and mindfulness practices, while previous studies often ignored the CBT strategies and merely focused on the efficacy of mindfulness [8, 11, 13, 15]. Consequently, the observed contrasts may be attributed to differences in the populations studied, the specific CBT protocols used in the included RCTs, the measurement of rumination, and the treatment strategies of MBCT. Future research should minimize methodological heterogeneity across studies and systematically compare the efficacy of MBCT with CBT or medication in rumination.

Furthermore, subgroup analyses indicated that the effectiveness of different modalities of MBCT on rumination varied. The results showed that both offline MBCT and hybrid MBCT modalities were significantly effective, whereas online interventions did not exhibit significant effectiveness. Offline intervention is effective, possibly because of the face-to-face interactions facilitated by a psychologist, which not only enhance group dynamics but also offer immediate feedback to effectively guide practice [17, 56]. The hybrid intervention maintains effectiveness while enhancing accessibility by leveraging the strengths of offline modality and incorporating the flexibility of online modality [57]. In contrast, the present study did not observe significant effectiveness in online MBCT. Several factors may contribute to this finding. Firstly, the lack of direct professional feedback and face-to-face interaction with psychologists may diminish the effectiveness of MBCT [58]. Secondly, the absence of mutual communication and encouragement among participants can lead to weakened group dynamics [58]. Furthermore, challenges in delivering complex psychological contents and the issues related to online device usage may impair participants' comprehension and reduce the therapeutic benefits of MBCT [58]. Lastly, participant-related factors such as disease-related physical impairments, difficulties in time management, and interfering factors within the family environment may also decrease treatment adherence and therapeutic outcomes [58–61]. Although there is no consensus on the effectiveness of different MBCT modalities, online MBCT programs hold practical implications for clinicians and developers [14, 62, 63]. Enhancing immediate feedback (e.g., AI-driven biofeedback), fostering group dynamics (e.g., through synchronous videoconferencing or written communication), and improving the usability (e.g., intuitive design)

may be crucial in augmenting the effectiveness of online MBCT.

Subgroup analyses indicated that MBCT significantly reduced rumination across varying intervention periods, offering potential proof of the efficacy of short-term mindfulness programs [64]. Notably, while all intervention periods were effective, several participants expressed a preference for extended training periods, which might imply that a longer intervention period would lead to better therapeutic outcomes [65]. The present study indicates that MBCT significantly reduces rumination among depressive patients, likely due to its capacity to improve emotional state and emotion regulation, thereby more effectively alleviating rumination [66]. However, the effectiveness of MBCT demonstrates no notable advantage over the control group in patients experiencing sexual dysfunction. This may stem from the specific content of rumination, and various intervention methods have all shown considerable effectiveness in addressing sexual dysfunction [27]. Subgroup analyses showed that MBCT significantly reduced rumination across different assessment tools like RRS, RSS, and RRQ, consistent with prior research on the adaptability of these scales [13]. In addition to symptom evaluation, the intervention also proved effective across diverse ages and genders, highlighting its potential for broad clinical application [13, 67]. To date, no study has systematically investigated the variations in the effectiveness of MBIs based on age and gender. Furthermore, due to the few studies available in our analysis, these conclusions should be interpreted with caution.

Effectiveness of MBCT on rumination during follow-up

In long-term follow-up, MBCT proved more effective than TAU and as effective as CBT and psychoeducation, aligning with previous research [13, 53]. Although the intervention mechanisms of MBCT and CBT are different, both can effectively reduce rumination [68, 69]. Specifically, MBCT enhances mindfulness to mitigate rumination, while CBT utilizes cognitive restructuring and behavioral activation strategies to achieve similar effects [38]. The current study demonstrated that, both during the intervention period and during the follow-up period, the effectiveness of MBCT was not more effective than that of psychoeducation. The unique characteristics of the participants and the limited studies included might be related to these results. The subgroup analyses included two studies involving patients with sexual dysfunction, whose rumination primarily focused on sexual performance [26, 27]. Psychoeducation can effectively address the psychological needs of these patients and facilitate modifications in their underlying cognitive patterns [27]. Consequently, psychoeducation also demonstrates significant therapeutic effectiveness in the treatment of sexual dysfunction.

Subgroup analyses further confirmed the sustained effectiveness of MBCT, demonstrating significant effectiveness maintained both within and beyond three months, in alignment with prior research findings [70–72]. This stability may be attributable to the cumulative effects of mindfulness practice, analogous to muscle training, where increased practice yields greater benefits [71–73]. Overall, the current results emphasize the significant role of MBCT in the long-term intervention of rumination. However, due to the limited follow-up data and the inconsistent effectiveness of long-term MBCT, further research is necessary [74].

Effectiveness of MBCT on mindfulness, self-compassion, and decentering ability

Consistent with previous research, our results further confirmed that MBCT significantly enhanced the levels of mindfulness of the participants [15, 75, 76]. This might be due to the dual effects of MBCT, namely, cultivating the participants' non-judgmental attitude and increasing their focus on the present moment [77]. Furthermore, our findings found MBCT and CBT have the same effectiveness in improving the participants' mindfulness levels. This could be due to their shared intervention mechanisms underlying both MBCT and CBT [41].

The current study confirmed the effectiveness of MBCT in augmenting participants' self-compassion, which may be related to the embrace acceptance and avoid judgment of MBCT [18, 78]. It is noted that subgroup analyses indicated MBCT and self-help have the same effectiveness in enhancing self-compassion. It is posited that this equivalence may be attributed to the incorporation of CBT techniques within the self-help program, which potentially augments participants' self-compassion [79, 80]. Moreover, the limited number of studies available in the meta-analysis, coupled with differences in the baseline levels of participants' self-compassion, may contribute to this result [36].

Moreover, this study also confirmed the positive effectiveness of MBCT in enhancing participants' decentering abilities [81]. Decentering, a fundamental aspect of mindfulness, is characterized by individuals' capacity to perceive their present experiences with an open and non-judgmental attitude [19]. While decentering ability is regarded as a significant element in the mechanisms of MBCT, its potential roles associated with MBCT need further investigation [30, 82, 83].

In conclusion, this study found that MBCT may increase the levels of mindfulness and self-compassion among participants, and enhance their decentering ability. According to the metacognitive mode, a higher level of mindfulness enables individuals to consciously redirect their focus, maintain a non-judgmental perspective, interrupt negative cognition patterns, and diminish their

rumination on adverse events, thereby alleviating associated emotional symptoms such as anxiety and depression [8, 84]. Individuals exhibiting higher self-compassion tend to replace self-criticism with kindness, extending care and understanding to themselves in challenging situations, which prevents excessive preoccupation with distressing experiences and consequently reduces rumination [85]. Those possessing a more robust decentering capacity can disengage from negative ruminative thoughts, thereby minimizing the influence of adverse reactions on their well-being and further decreasing rumination [86]. Furthermore, a higher level of mindfulness can enhance an individual's self-compassion and decentering ability, while decentering can also expand one's self-compassion [86]. Therefore, mindfulness, self-compassion, and decentering ability can each reduce rumination through their unique mechanisms. In addition, the three elements can interact with one another to collectively reduce rumination.

Effectiveness of MBCT on depression and anxiety symptoms

Consistent with previous studies, we found that MBCT is effective in alleviating depressive and anxiety symptoms [87, 88]. For depressive symptoms, subgroup analysis showed that MBCT led to greater improvement in depressive symptoms compared to WL, TAU, and CBT, and demonstrated similar effects to self-help interventions. For anxiety symptoms, subgroup analysis showed that MBCT was more effective than TAU and did not differ significantly from self-help and WL. Previous research found that self-help can significantly reduce depressive and anxiety symptoms, and anxiety may decline naturally over time with prolonged exposure [89–92]. Moreover, the characteristics of participants and symptom severity at baseline may contribute to the similar outcomes observed between MBCT and self-help or WL [36].

In this study, anxiety and depression were also considered secondary outcomes due to their significant role in rumination. Rumination, defined as a maladaptive emotion regulation strategy, contributes to the persistence and exacerbation of depression and anxiety symptoms [93]. Previous research has established rumination as a mediating mechanism through which MBCT alleviated symptoms of depression and anxiety [94]. By reducing rumination, MBCT may promote positive emotional experiences, thereby effectively reducing depressive and anxiety symptoms among participants [95, 96].

Publication bias

The funnel plot and Egger's test consistently indicated that this study did not display significant publication bias; thereby, the overall evidence substantiates that our conclusions remain unaffected by publication bias.

Limitations and implications

However, several limitations should be noted. Firstly, although 29 studies were included, the relatively limited number of studies constrains the robustness of the interpretations derived from the subgroup analysis. Notably, the comparison of MBCT with medication for rumination, and the comparison of MBCT with self-help for self-compassion, depression, and anxiety comprised only 2 studies each. Similarly, the comparison of MBCT with CBT for mindfulness involved only 3 studies. Future research should increase sample sizes to enhance the stability of subgroup findings.

Secondly, despite sensitivity analyses, significant heterogeneity also persisted in key outcomes, such as follow-up rumination ($I^2 = 60\%$, $P = 0.004$) and self-compassion ($I^2 = 64\%$, $P = 0.005$), which may affect the stability of results. Heterogeneity may stem from the modality of MBCT intervention, the characteristics of the participants, and the intervention methods of the control group [13, 14, 63, 97]. Future research should employ more homogeneous samples and standardized methodologies to reduce heterogeneity, enhance statistical power, and discover more reliable findings for generalizability and clinical applicability [13, 98].

Furthermore, although our meta-analysis confirmed the effectiveness of MBCT in diminishing rumination and enhancing related psychological indicators, the underlying mechanisms remain insufficiently understood [84–86, 94, 95]. Future research should aim to develop models elucidating the interrelationships among rumination, internal psychological indicators, and external emotional manifestations. Additionally, these studies should investigate the evolution of these models as patients' clinical symptoms improve, employing longitudinal study designs and path analysis. The findings from such research could significantly advance our understanding of the theoretical foundations underpinning the effectiveness of MBCT and facilitate more precise clinical interventions.

Finally, this study also found that MBCT exhibited similar effectiveness to psychoeducation or CBT in long-term follow-up, and to self-help interventions for self-compassion, depression, and anxiety. On one hand, MBCT presents a viable alternative to traditional interventions such as CBT, which might be attributed to its unique mechanism, such as fostering self-compassion or decentering more directly [86]. On the other hand, in cases where other interventions are equally effective, patients' preference, accessibility, or cost-effectiveness might become deciding factors in clinical choice [99–101]. Future research should use homogeneous samples in large-scale RCTs to identify which intervention is suitable for a particular individual and develop personalized treatment plans.

Conclusion

This meta-analysis confirms the feasibility of MBCT in diminishing rumination and enhancing related psychological indicators. Furthermore, these effects were sustained throughout the follow-up period. These findings highlight MBCT's clinical utility and potential as both a primary and alternative intervention across diverse psychological conditions.

Abbreviations

Abbreviations	Full-term
MBCT	Mindfulness-based cognitive therapy
CBM	China biomedical literature database
CNKI	China national knowledge infrastructure
VIP	China science and technology journal database
RCTs	Randomized controlled trials
SMD	Standardized mean difference
CI	Confidence intervals
MBIs	Mindfulness-based interventions
non-RCTs	Non-randomized controlled trials
M	Mean
SD	Standard deviation
MD	Mean difference
SMD	Standardized mean difference
TAU	Treatment as usual
WL	Waitlist (blank control)
CBT	Cognitive behavioral therapy
tDCS	Transcranial direct current stimulation
RRS	Ruminative response scale
RSS	Rumination on sadness scale
RRQ	Ruminative reflection questionnaire

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s40359-025-03348-x>.

Supplementary Material 1

Supplementary Material 2

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Not applicable.

Author contributions

SYW and QWQ performed data extraction. SYW and ZYY conducted data analysis. SYW wrote the main manuscript text. YHC provided guidance throughout the study. PL supervised and guided the manuscript. All authors reviewed and approved the final version.

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Data availability

All data analyzed in this study were extracted from previously published articles included in the systematic review. The extracted datasets used for the meta-analysis are available in the supplementary information files accompanying this manuscript.

Declarations

Ethics approval and consent to participate

This meta-analysis is based solely on previously published studies and did not involve any direct research with human or animal subjects. Therefore, no additional ethical approval was required. The study protocol was pre-registered on PROSPERO (CRD42024612750) to ensure transparency and methodological rigor.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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