

# Meditation-based intervention for obsessive-compulsive disorder

## A PRISMA-compliant systematic review and meta-analysis

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### Abstract

**Background:** The purpose of this study was to investigate the effects of the meditation-based intervention on obsessive-compulsive disorder (OCD).

**Methods:** The following databases were searched up to April 2021: the Cochrane Central Register of Controlled Trials (CENTRAL), EMBASE, Medline (via PubMed), PsycARTICLES, 4 Korean databases (Korean Medical Database [KMedbase], Koreanstudies Information Service System [KISS], National Digital Science Library [NDSL], and Oriental Medicine Advanced Searching Integrated System [OASIS]), and China National Knowledge Infrastructure (CNKI). The search terms related to meditation-based intervention and OCD were used. This systematic review was based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses. The selected articles were evaluated using the Cochrane risk of bias tool. The Review Manager (RevMan) 5.4 was used to perform the meta-analysis.

**Results:** In all, 16 randomized controlled trials were selected. The meta-analysis showed that the group receiving the treatment combining medication and meditation-based intervention for OCD showed a more significant post-treatment improvement in Yale-Brown obsessive compulsive scale than the group receiving medication only. Compared with other non-medication interventions that are known to be effective in treating OCD, the Yale-Brown obsessive compulsive scale showed a significant improvement immediately after the meditation-based intervention. However, no significant difference was found in the follow-up monitoring data across all examined cases.

**Conclusion:** This study was conducted to verify the effects of meditation-based intervention on OCD. The results suggested that combined treatment with medication and meditation-based intervention was more effective in treating OCD than medication alone; the positive effects of meditation-based intervention may be greater than the effects of other non-medication interventions. However, the lack of significant difference in the follow-up indicates that long-term effect of meditation-based interventions is unclear.

**Trial registration number:** PROSPERO CRD42021244408

**Abbreviations:** ACT = acceptance and commitment therapy, CBT = cognitive behavioral therapy, CG = control group, CI = confidence interval, CR = cognitive restructuring, DM = detached mindfulness meditation, EEG = electroencephalography, ERP = exposure and response prevention, FU = follow-up, MBCT = mindfulness-based cognitive therapy, OCD = obsessive-compulsive disorder, PRT = progressive relaxation training, RCT = randomized controlled trial, SMD = standardized mean difference, SMT = stress management training, SSRI = selective serotonin reuptake inhibitors, Y-BOCS = Yale-Brown obsessive compulsive scale.

**Keywords:** meditation, meta-analysis, obsessive-compulsive disorder, systematic review, Yale-Brown obsessive compulsive scale

SML and H-WS contributed equally to this work.

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## 1. Introduction

Obsessive-compulsive disorder (OCD) is a mental disorder characterized by continuous, obsessive thoughts that cause a significant level of anxiety and behaviors that are repeated to reduce the anxiety or prevent related events.<sup>[1]</sup> It is thus one of the mental disorders that induce frailty in patients with high medical cost.<sup>[2]</sup> If left untreated, a chronic condition may develop, resulting in a severely reduced quality of life.<sup>[3]</sup> According to the National Comorbidity Survey Replication, lifetime and 1-year prevalence of OCD were 2.3% and 1.2% in the United States adults, respectively.<sup>[4]</sup> A study reported that an estimated lifetime prevalence of OCD in Canadian adults was 0.93%.<sup>[5]</sup>

For medication treatment, drugs of the class of selective serotonin reuptake inhibitors (SSRIs) are known to be pharmacologically effective, and the effects are reported to be high in combination with the cognitive behavioral therapy.<sup>[6]</sup> Medication treatment is based on the principle that OCD can be caused by a biological or chemical imbalance in the brain, especially inadequate levels of serotonin.

As the discontinuation of medication often leads to reduced quality of life and recurrence of symptoms in patients, a long-term, continuous treatment is required. However, the side effects eventually drive one-third of the patients to discontinue treatment involving SSRIs.<sup>[7]</sup> Approximately 50% of the patients have been reported not to show recovery after the treatment,<sup>[8]</sup> while approximately 25% of the patients drop out of the treatment, mainly because the treatment requires 24.7 hours, on average, of direct and intensive intervention by a therapist. In addition, for a substantial proportion of patients (approximately 30%), the effects of the treatment seem to cease once the severity of the condition reduces by 35% or higher.<sup>[9]</sup>

In the field of psychological treatment, exposure and response prevention (ERP) as a type of cognitive behavioral therapy (CBT) was recommended for OCD in the National Institute of Health and Care Excellence<sup>[10]</sup> and American Psychiatric Association<sup>[11]</sup> guidelines. The essential characteristic of cognitive therapy for OCD is the dysfunctional appraisal of the intrusive thought to change the problematic behavior, followed by the correction of the behavior based on the beliefs related to the symptoms. In general, patients with OCD are known to overestimate a risk, focus excessively on an intrusive thought, show little endurance to uncertainty, feel an excess need to control their thoughts, and have a perfectionist tendency.<sup>[12]</sup> The treatment may include behavioral experiments whereby a patient is exposed to a situation that induces a dysfunctional belief related to a symptom of obsession to eventually experience that the said belief is not reality.<sup>[13]</sup>

In addition, another promising treatment is the meditation-based intervention. The concept of mindfulness, in particular, which is among the key concepts of meditation, is closely associated with the treatment of OCD. An individual with OCD generally tends to pay negative attention on oneself, which leads to a variety of attempts to avoid, control, or suppress a thought or feeling that they have in their mind.<sup>[14]</sup> In this respect, patients with OCD show a specific obsessive behavior to control an inner thought or feeling that has been negatively assessed.<sup>[15]</sup>

The purpose of interventions based on mindfulness is to teach an individual to perceive and accept a present experience with an open mind and without any judgment to facilitate in the treatment of OCD.<sup>[16]</sup> Through the intervention, patients could learn to accept a negative thought rather than run away from it so as to reduce an obsessive thought or behavior.<sup>[17]</sup> Moreover, as mindfulness training is a multidimensional approach, the method not only helps treat OCD but also enhances the patient's quality of life with improvements in general mental functions. Mindfulness interventions have in fact shown similar effects to other evidence-based methods in reducing the symptoms related to anxiety and depression.<sup>[18]</sup>

Other metacognitive models view OCD as an obsessive thought generating and maintaining a metacognitive belief that

an inner negative thought or feeling of anxiety could actually affect the reality. In this respect, the therapeutic effects of meditation may come from the state of being aware of the separation between the self and the event.<sup>[19]</sup>

Hence, studies on meditation-based interventions have been conducted in many fields. Nevertheless, no study has yet performed a systematic review or meta-analysis of the effects of meditation-based intervention in patients with OCD. Thus, the present aimed to determine the actual effectiveness of meditation-based interventions in improving OCD and to examine how the method differs from other treatments.

## 2. Methods

This protocol will be conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 statement.<sup>[20]</sup> This research was registered on PROSPERO (CRD42021244408).

### 2.1. Inclusion criteria for study selection

**2.1.1. Types of participants.** All patients currently or previously diagnosed with OCD or treated in relation to the diagnosis. All disorders within the scope of OCD based on Diagnostic and Statistical Manual of Mental Disorders-III, IV, or V, with the exception of those caused by drugs or medical conditions and related disorders such as trichotillomania.

**2.1.2. Types of interventions.** All additional or single treatments involving meditation-based interventions, with the exception of dynamic meditation or relaxation methods such as yoga, tai chi, and progressive muscle re-laxation or autonomic training, while including solely the pure, static meditation (the meditation methods accompanied with static posture and yoga such as the Kundalini, was included).

**2.1.3. Types of comparators.** All studies involving a control group (CG) with active control, placebo, and wait list groups.

**2.1.4. Types of outcome measures.** Yale-Brown obsessive-compulsive scale (Y-BOCS), regarded as the standard assessment of the severity of OCD, and related scales (e.g., self-reported Y-BOCS, child or adolescent Y-BOCS, and etc).

**2.1.5. Types of studies.** The systematic review targeted randomized controlled trials (RCTs) on the treatment effects of meditation-based interventions in patients with OCD. Uncontrolled trials such as non-RCTs and case series as well as qualitative studies were excluded.

### 2.2. Search methods for identification of studies

The literature search was performed on April 14, 2021, using 9 databases: the Cochrane Central Register of Controlled Trials (CENTRAL), EMBASE, Medline (via PubMed), PsycARTICLES, 4 Korean databases (Korean Medical Database [KMedbase], Koreanstudies Information Service System [KISS], National Digital Science Library [NDSL], and Oriental Medicine Advanced Searching Integrated System [OASIS]), and China National Knowledge Infrastructure (CNKI), without linguistic restriction. Grey literature was excluded. The search strategies are presented in Supplementary Table 1, <http://links.lww.com/MD2/A969>.

### 2.3. Data collection and analysis

**2.3.1. Selection of studies.** Two independent researchers (SML and HYK) checked the title and abstract of each article before analyzing the entire text to ensure they satisfied the predetermined Population, Intervention, Comparison, Outcome

criteria. The full-text was then examined to determine whether the article should be included in the review. In the case of disagreement, a discussion was held and, if necessary, opinions were obtained from another researcher, to decide on the suitability of the article.

**3.2.3. Data extraction and management.** Two independent researchers (SML and HYK) analyzed the entire text of each selected article to extract the data of the first author, publication year, title, name of journal, type of study, number/mean age/sex of participants, the number of analyzed subjects, subject selection criteria, intervention method, treatment method for control or comparison groups, intervention duration, monitoring period, outcome measures, statistical methods, and category of result values, in compliance with the criteria. In the case of disagreement, a discussion was held and if necessary, opinions were obtained from another researcher, for the final decision.

#### 3.2.4. Quality assessment

Two independent researchers (SML and HYK) assessed the risk of bias using the Cochrane risk of bias tool 1.0.<sup>[21]</sup> The following 6 items were assessed as low risk (L), high risk (H), or uncertain risk (U): random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, and selective reporting. In the case of disagreement, a discussion was held and, if necessary, opinions were obtained from another researcher for the final decision.

#### 3.2.5. Data synthesis

**3.2.5.1. Measures of treatment effect.** For continuous data, the mean difference was used, while the standardized mean difference (SMD) was used if 2 different scales or tools had been used for obtaining an identical outcome measure, whereby the treatment effect was evaluated at 95% confidence interval (CI).

**3.2.5.2. Assessment of heterogeneity.** Using the Chi-square ( $\chi^2$ ) test of the forest plot, any heterogeneity that may arise among various studies was assessed. Inconsistency was assessed by calculating the  $I^2$  statistics of Higgins;  $0\% \leq I^2 \leq 40\%$  may indicate insignificant heterogeneity,  $30\% \leq I^2 \leq 60\%$ , potential moderate heterogeneity,  $50\% \leq I^2 \leq 90\%$ , actual moderate heterogeneity, and  $75\% \leq I^2 \leq 100\%$ , significant heterogeneity.<sup>[22]</sup> For articles showing a high level of heterogeneity, a sensitivity analysis was performed.

**3.2.5.3. Data synthesis.** Review Manager (RevMan) 5.4 (version 5.4.1 for Mac OS; The Cochrane Collaboration, 2020) was used to perform the meta-analysis of the articles that allowed quantitative analysis of the final reported outcome measures. The treatment effect size for the synthesized data was estimated using a random effects model under 95% CI.

**3.2.5.4. Ethical considerations.** This review collected and analyzed the data of published articles, and did not collect personally identifiable information from the participants. Therefore, this study did not require institutional review board approval.

### 3. Results

#### 3.1. Study selection

The database search retrieved 969 references, and no additional records were identified. After duplicates were removed, 673

references remained, among which 626 references were excluded by screening the titles and abstracts. The remaining 47 references were reviewed for eligibility assessment. Finally, 16 studies<sup>[23–38]</sup> were included in this review and 11 studies<sup>[23,27–31,34–38]</sup> were synthesized quantitatively (Fig. 1).

#### 3.2. Characteristics of the included studies

In the systematic review, 16 articles were included.<sup>[23–38]</sup> The details of the included studies are presented in Table 1.

**3.2.1. Study design.** All finally included studies were RCTs, 2 of which contained a no-treatment CG (Key et al<sup>[26]</sup>; Hawley et al<sup>[25]</sup>) and 14 contained an active CG. One article (Cludius et al<sup>[24]</sup>) reported the result of 12-month follow-up (FU) monitoring of the participants in another article (Külz et al<sup>[27]</sup>) included in the review.

**3.2.2. Sample size.** The sample size of the finally selected articles varied in the range between 21 and 125. The total number of all subjects across the 16 RCTs (with the number of participants in Cludius et al<sup>[24]</sup> and Külz et al<sup>[27]</sup> counted only once as they were identical), was 882.

**3.2.3. Subjects.** The subjects were patients currently or previously diagnosed with OCD and treated for the same. The cases within the scope of OCD based on Diagnostic and Statistical Manual of Mental Disorders-III, IV or V, were included in the review. The details of the selection criteria for each study are presented in Table 1.

**3.2.4. Interventions.** Five articles applied mindfulness-based cognitive therapy (MBCT) (2 of which targeted the same patients), 2 articles applied Kundalini yoga meditation, 3 articles applied combined treatment of acceptance and commitment therapy (ACT) and SSRI-based medication, and the remaining 6 separately applied detached mindfulness meditation (DM), ACT only, combination of ACT and ERP, combination of mindfulness-based ERP, combination of mindfulness group training and medication, and technology supported mindfulness using an electroencephalogram (EEG)-based biofeedback device known as the “Muse.”

Two articles had a no-treatment CG while the others contained an active CG; 2 articles used ERP monotherapy, 2 used combined treatment of relaxation response and meditation, 3 used an OCD psychoeducational group program (2 of which targeted the same patients), 4 used SSRI medication, and the remaining 5 separately used progressive relaxation training (PRT), cognitive restructuring (CR), conventional medication (details unknown), ERP in combination with CBT and SSRI medication, and stress management training (SMT). In the study of Rupp et al,<sup>[30]</sup> the participants were initially divided into the non-waitlist and waitlist groups; the former was sub-divided into the DM and CR groups for primary comparison with the waitlist group, and the subsequent results were presented separately for the DM and CR groups. In that study, the results of the DM group in the non-waitlist group comparison were missing, and as the authors did not respond to the contact, the results were excluded from the review in this study. In the study by Hawley et al,<sup>[25]</sup> the mean and standard deviation of Y-BOCS for the non-treatment CG were missing, and as the authors did not respond to the contact, the results were excluded from the review.

**3.2.5. Outcome measurement.** The outcome measurement in this study was Y-BOCS taken as the standard indicator of the severity of OCD. The total scores ranged between 0 and 40, with 10 sub-categories for the checklist of symptoms and severity measurement, each on a scale of 0 to 4 and broadly divided into the Obsessions and Compulsions groups.<sup>[39–42]</sup> Among the studies, Strauss et al<sup>[34]</sup> used the Y-BOCS second edition, which differs from the first edition as it contains 10 sub-categories of 0 to 5

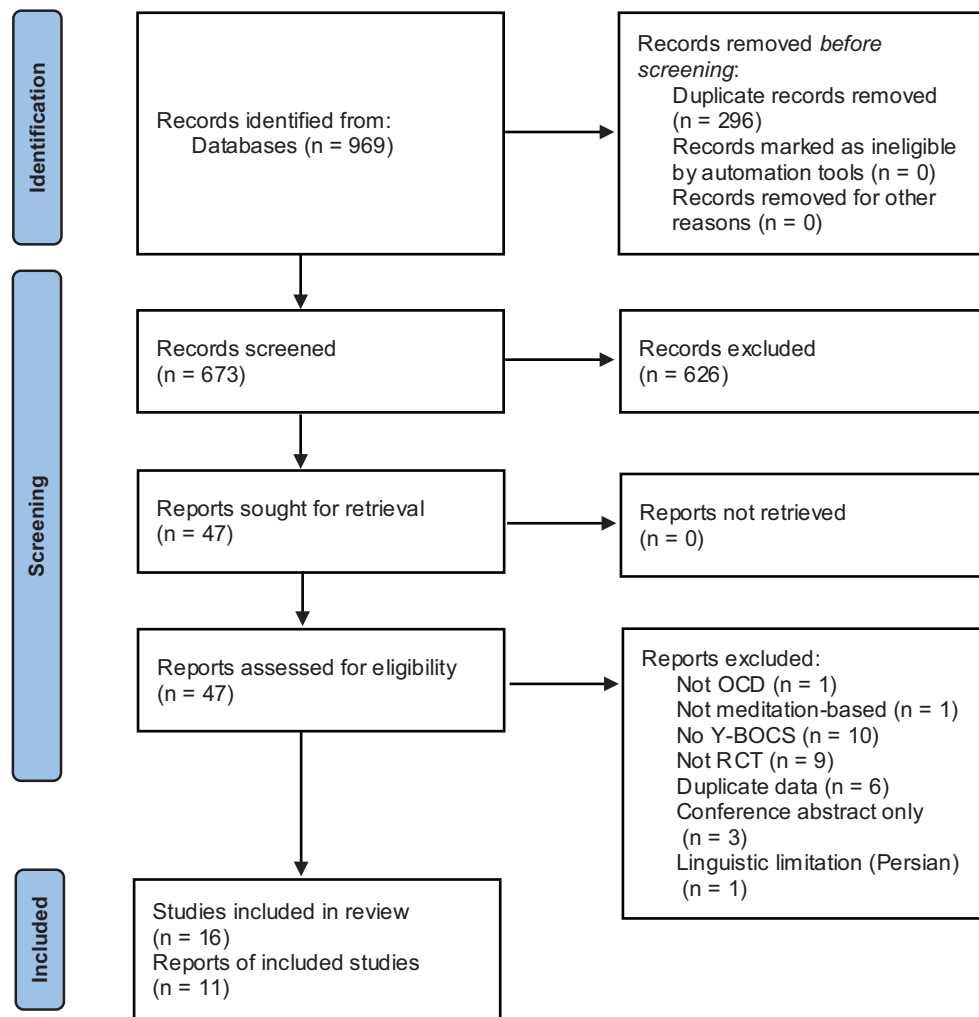


Figure 1. PRISMA flow chart. PRISMA=Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

scales so that the maximum total score is 50. As with the Y-BOCS, the validity and reliability scores of the Yale-Brown Obsessive Compulsive scale second edition are high.<sup>[43,44]</sup> Rohani et al,<sup>[29]</sup> Key et al,<sup>[26]</sup> and Hawley et al<sup>[25]</sup> used the Y-BOCS self-report, whose checklist of symptoms contains the same core items and severity measurement with similar contents as the Y-BOCS. The 2 scales showed a moderate level of agreement.<sup>[45]</sup>

Shabani et al<sup>[31]</sup> used the Children's Yale-Brown obsessive compulsive scale. The total score ranged between 0 and 40 as in Y-BOCS, with a notably high level of internal consistency for the measurement of the severity of OCD in children and adolescents ( $\alpha$ s=0.87–0.90, 0.80, and 0.82).<sup>[46]</sup>

### 3.3. Risk of bias

The overall risk of bias across the articles reviewed in this study is presented in Figs. 2 and 3.

### 3.4. Effectiveness of meditation-based intervention

Eleven studies were eligible for meta-analysis.<sup>[23,27–31,34–38]</sup> We conducted meta-analyses using the endpoint values and result reported after several months after treatment. The type of intervention in each study was analyzed and categorized, and meta-analysis could be performed for 2 or more similar studies that could be synthesized.

#### 3.4.1. Meditation-based intervention plus medication versus medication.

Four RCTs investigated add-on effect of meditation-based intervention on the medication monotherapy.<sup>[23,29,31,37]</sup> The duration of the treatments ranged 4 to 16 weeks. Among 4 studies, 3 compared ACT+SSRI with SSRI.<sup>[29,31,37]</sup> The other used mindfulness group training, details of which were unreported, as adjunctive therapy to usual medication.<sup>[29]</sup> The meta-analysis applying the random effect model to the 4 RCTs that assessed the severity of OCD was conducted. The pooled results indicated that the combined treatment of medication and the meditation-based intervention significantly reduced the OCD severity compared with medication at endpoint (SMD, -1.49; 95% CI, -2.33 to -0.65; 4RCTs, n=137,  $I^2=76\%$ ) (Fig. 4). The sensitivity analysis showed that heterogeneity was substantially affected by the study of Vakili et al.<sup>[37]</sup>

Three RCTs reported moderate-term effects, where periods of FU were 2 to 3 months after endpoint.<sup>[23,29,31]</sup> The meta-analysis applying the random effect model to the 3 RCTs was conducted. The pooled results showed no significant difference, possibly due to the results in Madani et al,<sup>[23]</sup> where the post-treatment values indicated markedly reduced severity of OCD, whereas the Y-BOCS scores were lower in the medication-only CG in the FU monitoring (SMD, -1.08; 95% CI, -2.65 to -0.49; 3RCTs, n=95,  $P=91\%$ ) (Fig. 5). The sensitivity analysis showed that the heterogeneity was substantially affected by the study of Madani et al.<sup>[23]</sup>



**Table 1**  
**Characteristics of included studies.**

Study ID	Study type	Sample size (included (TG:CG)?)	Mean age (SD, range)	Sex (male: female)	Population	Treatment intervention	Control intervention	Duration of treatment	Length of F/U	Primary outcome of the review	Results mean (SD)		
											Baseline	Endpoint	Follow-up
Madani 2013 [23]	RCT	30 (15:15)? 24 (12:12)? 24 (12:12)	Unclear	Only women (due to the cultural characteristics in Iran)	Adult females diagnosed with OCD based on DSM-IV (in Iran)	Mindfulness group training (8 sessions, 2 h per session, twice a week) + medication as usual	Medication as usual	4 w	2 m	Y-BOCS	TG: 12.83 (5.07) CG: 12.33 (6.30)	TG: 7.41 (3.36) CG: 13.83(4.98)	TG: 14.41 (4.74) CG: 12.25(2.89)
Cludius 2020 [24]	RCT	125 (61:64)? 112 (55:57)? 103 (50:53)? 100 (48:52)	38.62 (SD = 12.0)	39%:61% in Iran	Men and women aged between 18 and 70, with symptoms of OCD based on DSM-V (i.e., a Y-BOCS global score > 12 or subscore of =8 in either obsessions or compulsions) Individuals who participated in at least 20 sessions of CBT in the past 3 years (regardless of whether an improvement was shown within 6 months) (in Germany)	MBCT: 2-h group session, once a week, for 8 weeks (by MBCT or MBSR therapists)	OCD psychoeducation: 2-h group session, once a week, for 8 weeks (by clinical psychologists)	8 w	6 m, 12 m	Y-BOCS	TG: 20.8 (6.5) CG: 23.1 (5.8)	Not reported	TG: 14.35 (7.80) CG: 17.2 (7.9)
Hawley 2021 [25]	RCT	71 (36:35)? 69 (35:34)	26(4:61)	Not reported (chi-squared test showed no difference between TG and CG)	OCD based on DSM-V (SCID-5) (in Canada)	TSM by "Muse" (EEG-based biofeedback device) + biofeedback about "Mind Wandering" 20 min per session every day for 8 weeks	Wait-list	8 w	-	Y-BOCS-SR	TG: 28.16 (5.73) CG: 24.98 (6.12)	Not reported	-
Key 2017 [26]	RCT	36 (18:18)? 36 (18:18)	TG:40.53 (12.42) CG:46.06 (15.25)	TG(9:9)/CG (10:8)	Individuals diagnosed with OCD based on DSM-IV, who showed symptoms even after the CBT+ERP treatment, with Y-BOCS-SR =14 (and no change in medication within at least 3 months) (in Canada)	MBCT once a week, 2 h per session, and 8 assignments (by psychologists)	wait-list	8 w	-	Y-BOCS-SR	TG: 24.18 (7.10) CG: 25.35 (7.12)	TG: 21.69 (7.45) CG: 26.76 (7.12)	-

(Continued)

**Table 1**  
**(Continued)**

Study ID	Study type	Sample size (included (TG:CG)? analyzed (TG:CG))	Mean age (SD, range)	Sex (male: female)	Population	Treatment intervention	Control intervention	Duration of treatment	Length of F/U	Primary outcome of the review	Results mean (SD)		
											Baseline	Endpoint	Follow-up
Kılız 2019 [27]	RCT	125 (61:64)?	TG:37.61 (10.62)	TG (21:40)	Men and women aged between 18 and 70, with symptoms of OCD based on DSM-V (i.e., a Y-BOCS global score > 12 or subscore of =8 in either obsessions or compulsions) Individuals who participated in at least 20 sessions of CBT in the past 3 years (regardless of whether an improvement was shown within 6 months) (in Germany)	MBCT: 2 h group session, once a week, for 8 weeks by MBCT or MBSR therapists	OCD	8 w	6 m	Y-BOCS	TG:20.8 (6.5)	TG: 17.1 (7.4)	TG: 15.8 (7.8)
		112 (55:57)?	CG:39.59 (13.11)	CG (27:37)							CG:23.1 (5.8)	CG: 20.1 (7.7)	CG: 18.6 (7.4)
Mathur 2021 [28]	RCT	60 (30:30)?	TG:27.57 (4.82)	TG (20:10)	Adults aged 18–50 years, diagnosed with OCD based on DSM-IV and with Y-BOCS =20, who received at least 10 years of regular education (in India)	MBCT12 sessions, 35 – 40 min per session, once a week, by a clinical psychologist	SMT12 sessions, 25–30 min per session, once a week, by a clinical psychologist	12 w	-	Y-BOCS	TG: 26.24 (1.2)	TG: 13.73 (1.23)	-
		60 (30:30)	CG:28.93 (7.07)	CG (20:10)							CG: 26.46 (1.03)	CG: 17.51 (1.2)	-
Rohani 2018 [29]	RCT	46 (23:23)?	TG:29.13 (7.48)	Only women (men and women cannot engage in the same training or discussion due to the cultural characteristics in Iran)	Adult females aged >17 years with minimum high school education, diagnosed with OCD based on DSM-IV (SSRI at low doses [Fluoxetine 20 mg, Fluvoxamine 50 mg, Citalopram 10 mg, and Sertraline 50 mg] and increasing every 3 or 4 days until maximum results with least side-effects (No change in dose within 4 weeks prior to the experiment) (in Iran)	ACT + SSRI Three subgroups, 8 sessions of group ACT, assignments and various trainings with Iranian cultural background and discussions in between sessions (by ACT-trained therapists)	SSRI (No change in dose during the study period)	16 w	2 m	YBOCS-SR	TG: 22.62 (3.07)	TG: 13.50 (5.53)	TG: 6.50 (4.31)
		40 (21:19)?	CG:22.26 (14.27)	CG (16:16)							CG: 21.25 (4.18)	CG: 17.56 (4.33)	CG: 14.62 (4.08)
Rupp 2019 [30]	RCT	43 (21:22)?	TG:30.81(9.48)	TG (6:15)	Adults aged = 18 years, with IQ = 80 and ability to communicate in German; Y-BOCS score was 16 or higher based on DSM-V (SCID-1) (in Germany)	DM: 4 sessions (100 min per session, twice a week, assignments) by master level psychologists	CR: 4 sessions (100 min per session, twice a week, assignments) by master level psychologists	2 w	4 w	Y-BOCS	TG: 24.30 (4.00)	TG: 19.05 (6.30)	TG: 17.05 (7.92)
		40 (20:20)?	CG:31.23 (10.96)	CG (12:10)							CG: 25.05 (2.69)	CG: 19.40 (5.38)	CG: 16.35 (9.11)
		40 (20:20)											

(Continued)

**Table 1**  
**(Continued)**

Study ID	Study type	Sample size (included (TG:CG)? analyzed (TG:CG))	Mean age (SD, range)	Sex (male: female)	Population	Treatment intervention	Control intervention	Duration of treatment	Length of F/U	Primary outcome of the review	Results mean (SD)		
											Baseline	Endpoint	Follow-up
Shabbani 2019 [31]	RCT	69 (22:22:25)?	TG:14.95 (1.43)	TG (12:10)CG-1	Adolescent males and females aged 12–18 years, diagnosed with OCD based on DSM-V and total score of CYBOCS = 16, who were on the following medication for 3 months or more: clomipramine (Anafranil), fluoxetine (Prozac), fluvoxamine (Luvox), and sertraline (Zoloft) (in Iran)	ACT + SSRI10 sessions, 1 h per session, once a week (by clinical psychologists)	CG-1: CBT + SSRI12 sessions, 1 h per session, once a week (by clinical psychologists) CG-2: SSRI	12 w	3 m	CY-BOCS	TG: 23.86 (4.06)	TG: 16.85 (3.91)	TG: 13.18 (2.86)
		64 (20:19:25)?	CG-1: 14.95 (1.78)	(12:10)CG-2							CG-1: 24.68 (4.57)	CG-1: 16.47 (2.04)	CG-1: 13.56 (3.24)
		55 (17:16:22)	CG-2: 14.96 (1.24)	(14:11)							CG-2: 24.44 (20.72)	CG-2: 20.72 (3.71)	CG-2: 18.77 (2.98)
Shannahoff-Khalisa 1999 [32]	RCT	21 (11:10)?	TG: 38.55 (22–62)	TG (4:7)CG (4:6)	Males and females aged = 14 years, diagnosed with OCD based on DSM-III (Y-BOCS = 15 and no change in drug dose for at least 3 months prior to the experiment) (in the USA)	KY: 1 h (30 min each) of 2 h meeting every Wednesday (by expert in KY, the first author)	RR: 1 h (30 min each) of 2 h meeting every Wednesday, plus mindfulness meditation technique (by licensed therapist, the second author)	3 m	3,6,9,12,15 m	Y-BOCS	TG: 24.57 (4.68)	TG: 15.14 (6.20)	Not reported
		14 (7:7)	CG: 40 (21–67)								CG: 20.57 (3.36)	CG: 17.71 (2.98)	
Shannahoff-Khalisa 2019 [33]	RCT	52 (26:26)?	TG: 43.29 (13.97)	TG (6:18)	Individuals diagnosed with OCD based on DSM-IV, while the condition has persisted for 6 months or more (Y-BOCS = 16) (in Brazil)	KY: 11 sessions (2 h per session, once a week, meditation practice as assignments; 65 min, 10–11 times) (by physician certified as a KY teacher)	RR: 11 sessions (2 h per session, once a week, meditation practice as assignments; 60 min, 10–11 times) (by psychologist and RR practitioner)	11 w	4.5, 8.5, 12.5, 16.5 m	Y-BOCS	TG: 26.25 (4.74)	TG: 15.19 (5.86)	Not reported
		48 (24:24)?	CG: 40.04 (11.80)	CG (11:13)							CG: 27.55 (4.20)	CG: 22.45 (4.34)	
		27 (16:11)?											
		17 (8:9)?											
Strauss 2018 [34]	RCT	37 (19:18)?	TG: 33 (21–49)	TG (4:15)CG (9:9)	Men aged = 18 years, diagnosed with OCD based on DSM-IV and no history of psychological treatment or change in drugs in the past 3 months (in England)	Mindfulness-based ERP (30 min mindfulness & 90 min ERP), 10 sessions, 2 h per session, assignments related to mindfulness (by clinical psychologists)	ERP, 10 sessions, 2 h per session, assignments related to ERP (by clinical psychologists)	10 w	6 m	YBOCS II	TG: 29.11 (6.02)	TG: 22.93 (8.15)	TG: 17.27 (13.57)
		32 (15:17)?	CG: 27 (18–51)								CG: 29.83 (7.59)	CG: 21.12 (9.78)	CG: 18.17 (11.82)
		4 (12:12)											

(Continued)

**Table 1**  
**(Continued)**

Study ID	Study type	Sample size (included (TG:CG)? analyzed (TG:CG))	Mean age (SD, range)	Sex (male: female)	Population	Treatment intervention	Control intervention	Duration of treatment	Length of F/U	Primary outcome of the review	Results mean (SD)		
											Baseline	Endpoint	Follow-up
Twohig 2010 [39]	RCT	79 (41:38)? 79 (41:38)	37 years(SD 15.5;range: 18–67)	Female 61%	Men and women aged =18 years and diagnosed with SCID (based on DSM-IV) OCD. The type or dose of medication did not vary within 1 month, while no other psychological therapy was added (in the USA)	ACT: 11 sessions (1 hour per session, once a week) (by graduate students in clinical psychology)	PRT: 11 sessions (1 hour per session, once a week) (by graduate students in clinical psychology)	11 w	3 m	Y-BOCS	TG: 24.22 (4.80) CG: 25.40 (5.26)	TG: 12.76 (8.35) CG: 18.67 (5.68)	TG: 11.79 (8.97) CG: 16.23 (7.46)
Twohig 2018 [38]	RCT	58 (30:28)? 49 (25:24)? 47 (24:23)	TG:27.21 (9.62) CG:27.29 (6.93)	TG (9:19) CG (9:19)	Adults diagnosed with OCD based on DSM-IV (in US)	ACT+ERP: 16 sessions (120 min per session, twice a week) (by master level clinical psychology doctoral students)	ERP: 16 sessions (120 min per session, twice a week) (by master level clinical psychology doctoral students)	8 w	6 m	Y-BOCS	TG: 24.57 (4.45) CG: 25.29 (4.1)	TG: 11.20 (4.3) CG: 11.38 (5.5)	TG: 11.83 (6.9) CG: 10.91 (6.8)
Vakilii 2015 [37]	RCT	32 (10:11:11)?27 (9:10:8)	TG-1:25.89 (5.58) TG-2:27.80 (9.46) CG:27.13 (4.48)	TG-1 (5:4) (6:4)CG (4:4)	Adult men and women aged 18–50 years, diagnosed with OCD based on DSM-IV and showing persisting symptoms for 1 year or more (in Iran)	TG-1:ACTTG-2:ACT+SSR(sertraline = 50–200 mg/d; fluoxetine = 20–80 mg/d)by clinical psychologists	SSR(sertraline = 50–200 mg/d; fluoxetine = 20–80 mg/d)	10 w	-	Y-BOCS	TG-1: 23.86 (2.57) TG-2: 24.10 (3.69) CG: 25.63 (2.44)	TG-1: 14.00 (4.55)TG-2: 13.80 (3.85) CG: 19.88 (3.68)	-
Zhang 2019 [36]	RCT	123 (42:41:40)? 93 (30:30:33)	TG:29.77 ± 7.279 CG-1: 27.29 ± 7.329 CG-2: 29.32 ± 6.852	TG (22:9) (28:13) CG-2 (22:12)	Men and women diagnosed with OCD based on DSM-IV, not caused by other medical conditions or materials but not satisfying other axis-1 mental disorders (in China)	TG:MBCT	CG-1: SSRICG-2: OCD psychoeducation	10 w	14,22,34 w	Y-BOCS	TG: 21.43 (2.932) CG-1: 21.00 (3.586) CG-2: 20.12 (3.629)	TG: 13.53 (5.877)CG-1: 12.48 (7.049) CG-2: 16.00 (4.802)	-

ACT = acceptance and commitment therapy, CBT = cognitive behavioral therapy, CG = control group, CR = cognitive restructuring, CY-BOCS = Children's Yale-Brown obsessive compulsive scale, DM = detached mindfulness meditation, DSM = diagnostic and statistical manual of mental disorders, EEG = electroencephalography, ERP = exposure and response prevention, FU = follow-up, KY = Kundalini yoga meditation, MBCT = mindfulness-based cognitive therapy, OCD = obsessive-compulsive disorder, PRT = progressive relaxation training, RCT = randomized controlled trial, RR = relaxation response, SCID = structured clinical interview for DSM disorders, SD = standard deviation, SMT = stress management training, SSR = selective serotonin reuptake inhibitors, TG = Treatment group, TSM = technology supported mindfulness, Y-BOCS II = Yale-Brown obsessive compulsive scale second edition, Y-BOCS-SR = Yale-Brown obsessive compulsive scale self-report.



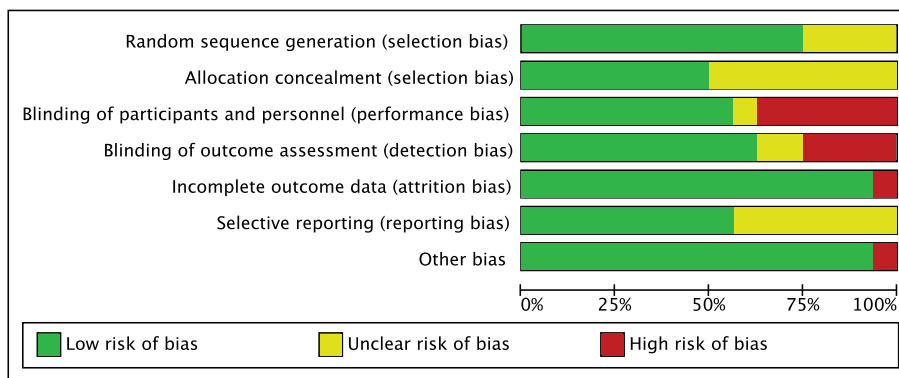


Figure 2. Risk of bias graph: reviewers' judgements about each risk of bias item presented as percentages across all included studies.

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Alsadat Musavi Madani 2013	?	?	-	?	+	?	+
Cludius 2020	+	+	+	+	+	?	+
Hawley 2021	+	+	-	-	+	?	+
Key 2017	?	?	-	-	+	?	+
Külz 2019	+	+	+	+	+	?	+
Mathur 2021	+	+	-	+	+	+	+
Rohani 2018	+	?	-	-	+	+	+
Rupp 2019	+	?	+	+	+	+	+
Shabani 2019	+	?	+	+	+	+	+
Shannahoff-Khalsa 1999	+	+	+	+	-	?	+
Shannahoff-Khalsa 2019	+	?	-	-	+	+	-
Strauss 2018	+	+	+	+	+	+	+
Twohig 2010	+	+	+	+	+	+	+
Twohig 2018	?	?	+	+	+	?	+
Vakili 2015	?	?	?	?	+	+	+
Zhang 2019	+	+	+	+	+	+	+

Figure 3. Risk of bias summary: reviewers' judgements about each risk of bias item for each included study.

**3.4.2. Meditation-based intervention versus non-pharmacological active control.** Seven RCTs compared meditation-based intervention with other non-pharmacological interventions.<sup>[27,28,30,34-36,38]</sup> Among 7 studies, MBCT was used in 3 studies,<sup>[27,28,38]</sup> meditation-based ERP (i.e., mindfulness-based ERP and ACT+ERP) in 2 studies,<sup>[34,36]</sup> ACT in 1 study,<sup>[35]</sup> DM in 1 study,<sup>[30]</sup> Comparators were PRT in 1 study,<sup>[35]</sup> CR in 1 study,<sup>[30]</sup> SMT in 1 study,<sup>[28]</sup> ERP in 2 studies,<sup>[34,36]</sup> and OCD psychoeducation in 2 studies.<sup>[27,38]</sup>

The meta-analysis applying the random effect model to the 7 RCTs was conducted. The pooled results indicated the meditation-based interventions significantly reduced OCD severity at endpoint compared with other active controls at endpoint (SMD, -0.64; 95% CI, -1.24 to -0.03; 7 RCTs, n=451,  $I^2=89%$ ) (Fig. 6). The sensitivity analysis showed that the heterogeneity was substantially affected by the study of Mathur et al.<sup>[28]</sup>

Three RCTs reported the results of the FU monitoring.<sup>[27,34,36]</sup> The monitoring period was 6months in all 3 studies. The meta-analysis applying the random effect model to the 3 RCTs was conducted. The pooled results showed no significant difference (SMD, -0.18; 95% CI, -0.49 to -0.13; 3RCTs, n=174,  $I^2=4%$ ) (Fig. 7).

#### 4. Discussion

This study investigated the effects of meditation-based intervention on OCD through a systematic review of previous RCTs, with an aim to provide clinical evidence. The meta-analysis showed that the combined treatment of medication and meditation-based intervention led to a significantly higher improvement in post-treatment OCD severity than medication monotherapy. However, the 2 to 3months of FU monitoring showed no significant difference. Nevertheless, the observed trend of higher effectiveness with the addition of meditation-based intervention implied the need for further studies on this intervention. The result indicated that for OCD, combined treatment with meditation is likely to be more effective than medication monotherapy.

In studies comparing meditation-based interventions with other non-medication interventions for OCD, post-treatment OCD severity was found to have significantly improved with the addition of meditation-based intervention. The FU monitoring, however, showed no significant difference. Most interventions used in the CG in the analyzed studies have been reported to show a positive effect on OCD. PRT was successfully applied for reducing the OCD severity in a previous study,<sup>[47,48]</sup> while CR is an effective method treatment, as proven through several studies using meta-analysis.<sup>[49,50]</sup> The ERP, as described in the Introduction section, is an intervention suggested in numerous OCD guidelines. The OCD psychoeducation used as the control intervention by Külz et al<sup>[27]</sup> provides an education

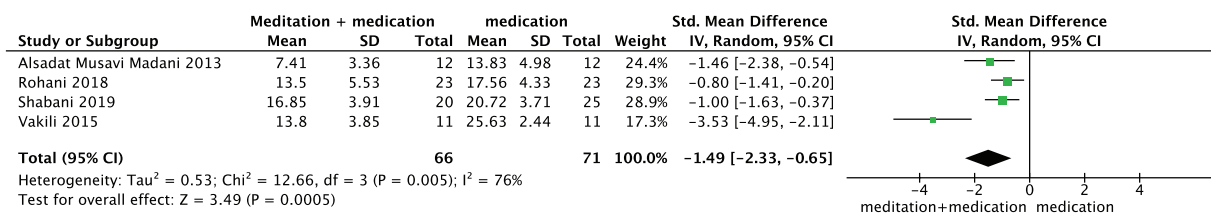


Figure 4. Forest plot of comparison: meditation based therapy + medication versus medication; outcome: Y-BOCS, post-treatment. Y-BOCS=Yale-Brown obsessive compulsive scale.

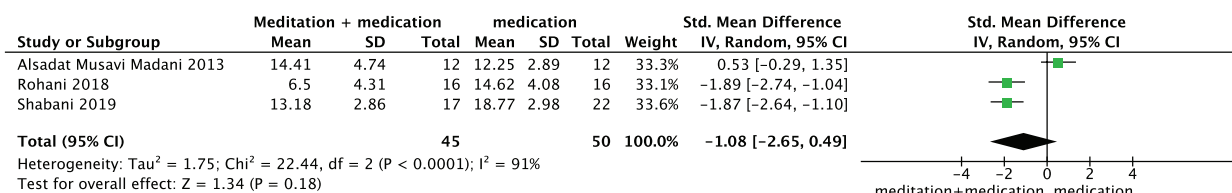


Figure 5. Forest plot of comparison: meditation-based therapy + medication versus medication; outcome: Y-BOCS, follow-up. Y-BOCS=Yale-Brown obsessive compulsive scale.

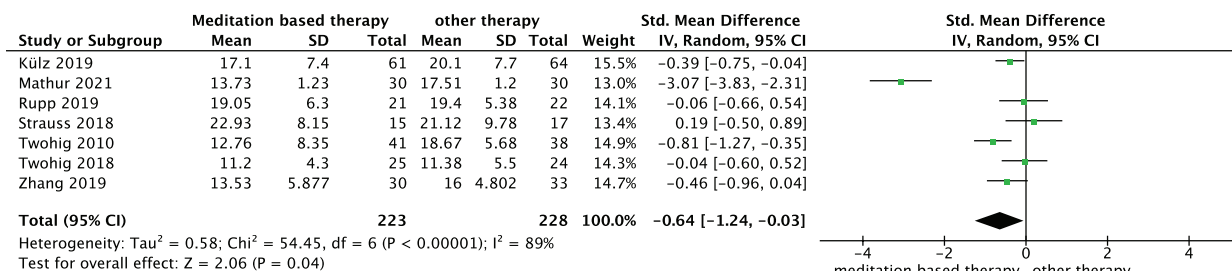


Figure 6. Forest plot of comparison: meditation-based therapy versus other non-pharmacological therapy; outcome: Y-BOCS, post-treatment. Y-BOCS=Yale-Brown obsessive compulsive scale.

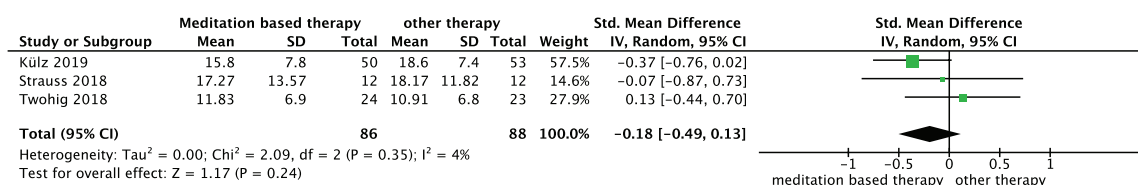


Figure 7. Forest plot of comparison: meditation based therapy versus other non-pharmacological therapy, outcome: Y-BOCS, follow-up. Y-BOCS=Yale-Brown obsessive compulsive scale.

of the pathology, mechanism, and dysfunctional factors of OCD in the metacognitive and neurobiological perspectives. The intervention also encourages communication and discussions among the patients with respect to the information provided on the medication treatment, psychological therapy, and preventions measures, so that patients can explore effective therapeutic strategies by themselves. SMT applies various techniques related to stress management, including progressive muscle relaxation, creative and positive visualization, problem solving skills, assertiveness skills, and goal setting, as well as the factors incorporated in CR and ERP. In light of this, the effects of meditation-based intervention may be interpreted as higher than other non-medication interventions with proven effects.

Among the studies excluded from the meta-analysis in this study, the studies of Shannahoff-Khalsa in 2019 and 1999 determined the effectiveness of the Kundalini yoga meditation compared with other techniques. Key's study (2017) may be viewed as a study designed to prove the effects of

meditation-based intervention in patients with OCD, whose symptoms did not improve after conventional CBT. Cludius et al<sup>[24]</sup> reported the results of 12-month FU monitoring for the OCD patients reported in the studies of Külz et al<sup>[27]</sup> and Key et al<sup>[26]</sup>; the OCD symptoms in these patients did not improve after CBT, and the study thus pointed out the limitations of conventional treatments in the OCD guidelines and implicated the potential utility of meditation-based interventions. MBCT used in this study did not lead to a significant difference compared with the control, which is likely because MBCT was originally developed to prevent major depressive symptoms. Nonetheless, despite the lack of significant differences after OCD psychoeducation in the control, MBCT was found to have had a positive effect on OCD severity after CBT. Further studies should thus develop and investigate the meditation-based interventions focused intensively on OCD. In the study of Hawley et al,<sup>[25]</sup> a machine-based meditation technique was investigated, which is anticipated to enable the patients to conduct the meditation by themselves under

specific conditions. The machine-led biofeedback may suggest a future integrative use of meditation and EEG device in combination. The “Mind Wandering” on the EEG and “Non Reactivity” on the FFMQ presented a statistical viewpoint of OCD treatment. Further studies should investigate the statistical correlations as well as the potential integrative applications. Shabani et al<sup>[31]</sup> compared ACT+SSRI and CBT+SSRI and found that both produced similarly effective results. In other words, the same effects of the standard treatment based on CBT+SSRI may be obtained through meditation-based intervention. The study of Vakili et al<sup>[37]</sup> may be viewed as a study outlining the notable effects of meditation-based intervention, especially ACT, on the severity of OCD. As a third-wave behavioral therapy, ACT aims to reduce experiential avoidance, while ensuring that the patient performs practical behaviors towards the personally chosen life values as well as promoting psychological flexibility. The results are not just a simple improvement of symptoms but the induction of a drive to accept the inner negative experiences by performing valuable activities.<sup>[51]</sup> Such interventions are presumed to allow OCD patients to be better able to let go of and accept the anxiety and negative emotions as they are encouraged to perform practical behaviors and participate in the intervention than other meditation-based interventions.

The limitation of this study is the insufficient sample size to draw definite conclusions. Further studies should thus continue to investigate the effects of meditation-based intervention on OCD patients through RCTs. In addition, only the severity of OCD was used as an indicator in this study. However, as various comorbidities are exhibited by OCD patients, further studies should comprehensively analyze various indicators. Furthermore, as OCD is characterized by chronic progression, continuous FU monitoring should be conducted as part of RCTs, while a novel meditation-based intervention should be developed so as to maintain significant effects in the follow-up monitoring.

**Author contributions**

All authors discussed the concept of this systematic review. A search strategy was developed, and a search will be conducted by Si Myeong Lee and Hui-Yong Kwak. The protocol was drafted by Si Myeong Lee. Hyo-Weon Suh revised the manuscript and submitted the manuscript for publication. All authors approved the publication of the final manuscript.

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