Mindfulness-based therapy versus cognitive behavioral therapy for people with anxiety symptoms: a systematic review and meta-analysis of random controlled trials

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Background: Mindfulness-based interventions (MBIs) and cognitive behavioral therapy (CBT) have both been shown to be effective treatment approaches for anxiety. The purpose of this paper was to directly investigate the ability of MBIs and CBT to improve anxiety symptoms (primary outcome), as well as depression symptoms and sleep quality (second outcome).

Methods: We searched the following electronic databases from 1st December, 2019 to 14th January 2021: English databases including PubMed, PsycINFO, Web of Science, the Cochrane Library, Elsevier, Springer Link, Wiley Online Library, ClinicalTrails, and Embase, and Chinese database including CNKI, WANFANG, and CQVIP. The eligibility criteria included the following: (I) patients with anxiety disorders or symptoms of anxiety; and those with physical or mental disorders with comorbid anxiety symptoms; (II) randomized controlled trial (RCT) design; (III) the treatment group received MBIs; (IV) the control group received CBT; and (V) the treatment outcomes were anxiety, depression, and sleep quality.

Results: In total, 4,095 abstracts were reviewed. Of these, the full-texts of 45 articles were read in detail; and 11 RCTs were finally included in the analysis. Upon completion of MBIs and CBT group sessions, the study outcomes (mean anxiety, depression, and sleep quality scores) revealed no difference between MBIs and CBT with regards to anxiety, depression, and sleep quality post-intervention. Subgroup analysis was also performed, and the results indicated that MBIs may provide a small advantage for people with anxiety symptoms compared to CBT [standard mean difference (SMD): –0.36, 95% confidence interval (CI): –0.66 to –0.06], while the CBT group demonstrated a small comparative advantage for anxiety in the Liebowitz Social Anxiety Scale (LSAS) and Social Phobia Inventory (SPIN) scales, as well as mindfulness-based stress reduction (MBSR) in the types of MBIs (LSAS: SMD: 0.35, 95% CI: 0.08 to 0.63; SPIN: SMD: 0.51, 95% CI: 0.11 to 0.92; MBSR: SMD: 0.41, 95% CI: 0.07 to 0.74).

Discussion: There was no significant difference between MBIs and CBT in terms of the treatment outcomes of anxiety, depression, and sleep quality. MBIs could be used as an alternative intervention to CBT for anxiety symptoms.

Trial registration: This meta-analysis was conducted in line with the PRISMA guideline and was registered at PROSPERO https://www.crd.york.ac.uk/PROSPERO/ (CRD42021219822).

Keywords: Mindfulness; cognitive behavioral therapy (CBT); anxiety; depression; meta-analysis

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Introduction

Anxiety encompasses numerous different mental conditions, and is commonly characterized by an excessive feeling of fear and worry (1), leading to a poorer quality of life among anxiety disorder patients (2). The causes of anxiety are complex interactions between biological factors, environmental influences and psychological mechanisms (3). It is significantly associated with increased work efficiency, higher dependency on medical assistance, age, gender, marital and insurance status, income level, smoking, alcohol consumption, level of exercise, and the burden of comorbidities (such as depression and insomnia) (4,5). Insomnia can in turn increase levels of depression and anxiety (6). The current estimates regarding the prevalence of anxiety disorders range between 0.9% and 28.3% (7). A U.S. study showed that anxiety or depression increased from 4.7% in 2007 to 5.3% in 2011–2012, highlighting the significant increase in the prevalence of anxiety in society (8).

Statistical

Different types of interventions, including mental, physical, and pharmacological interventions, could considerably alleviate anxiety symptoms. Some reviews have argued that cognitive behavior therapy (CBT) alone should be considered the best initial treatment for social anxiety disorder (9). Interventions based on mindfulness have also been shown to be especially effective for reducing anxiety (10-13). In approximately half of the studies reviewed, musical interventions were found to exert positive effects on reducing anxiety (14). Furthermore, the evidence for positive effects of exercise and exercise training on anxiety is growing (15). The anxiolytic action of repetitive transcranial magnetic stimulation (rTMS) has also been demonstrated as effective in both preclinical trials and human subject research (16). Moreover, a previous meta-analysis reported that the overall effect size (ES) for pharmacotherapy was not statistically different to that of CBT for measures of the severity of anxiety (17).

CBT emphasizes increasing the flexibility in the thinking process and behaviors to better cope with challenges. CBT has been applied to treat numerous disorders; it exerts the most potent effect on anxiety disorders (18), and has a moderate effect on anxiety in insomniacs with or without comorbid anxiety (19). Furthermore, it has a long-lasting impact in the treatment of anxiety (20).

Mindfulness-based interventions (MBIs), which is traditionally rooted in Eastern cultures, can be somehow considered as non-judgmental attention; that is, focusing on purpose and being in the present moment (21). MBIs mainly consist of mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT) (22). It is worth noting that Acceptance Commitment Therapy (ACT) and the Dialectical Behavior Therapy (DBT) do not contain the active ingredient of meditation (sitting meditation) (23,24); therefore, they have not been included in this review. Therapies based on mindfulness are effective for the treatment of many psychological disorders (12) and especially for reducing anxiety and depression (9,10,12). However, some reviews have indicated that there is not a strong correlation between practicing mindfulness and changes in anxiety (25,26).

Both interventions (MBIs and CBT) appear to have a good effect on anxiety. Moreover, group-based interventions based on mindfulness offer a low-cost treatment for healthy living and more health benefits (23,27,28). By comparing the differences between these two interventions, we suggest that MBIs may offer another potentially useful intervention and could be a viable alternative for anxiety, especially if the effects of MBIs and CBT are not significantly different in the treatment of anxiety symptoms.

There have been several systematic reviews and meta-analyses on the impact of CBT (19,29) and MBIs (11,30) for anxiety. However, a comparative meta-analysis of MBIs and CBT has rarely been performed. One systematic review and meta-analysis (31) evaluated group-based MBSR and CBT for managing and treating chronic pain; however, no meta-analysis has compared MBIs and CBT for anxiety symptoms.

Therefore, this meta-analysis aims to compare the short- and long-term effects of MBIs and CBT on anxiety, depression symptoms, and sleep quality. This paper will also endeavor to elucidate factors responsible for the interventional effect by subgrouping.

We present the following article in accordance with the PRISMA reporting checklist (available at https://dx.doi.org/10.21037/apm-21-1212).

Methods

Data sources and study selection

We performed structured searches of electronic English and Chinese databases to identify potentially eligible studies. The English databases included PubMed, PsycINFO, Web

of Science, the Cochrane Library, Elsevier, Springer Link, Wiley Online Library, ClinicalTrails, and Embase, and the Chinese databases included CNKI, WANFANG, and CQVIP. We employed a comprehensive search strategy to select randomized controlled trials (RCTs) comparing MBIs to CBT interventions in people with anxiety disorder or anxiety symptoms. The strategy involved using free-text terms and controlled vocabulary to identify potentially relevant studies. Searches were executed 1st December, 2019 and updated on 14th January 2021. Two authors independently reviewed the abstracts using Endnote (Clarivate, https://www.endnote.com). If the information of abstracts were insufficient, the authors scanned the full articles. Different opinions between the authors were resolved through discussion and consensus. In addition, advanced searches in Google were utilized to look for unpublished abstracts, briefs, reports, and preliminary papers. Grey literature searches were not performed (see Appendix 1 for search terms).

Inclusion criteria

The following criteria were used to select relevant studies for inclusion in the meta-analyses: (I) studies that included the following health conditions: people with anxiety disorders or symptoms; and patients physical or mental disorders with comorbid anxiety symptoms; (II) RCT design; (III) the treatment group received MBIs, including MBSR, MBCT, and other types of MBIs; (IV) the control group received CBT, or treatment as usual (TAU), but including the ingredients of CBT; (V) the treatment outcomes (anxiety, depression, sleep quality) were assessed with a validated instrument; (VI) studies written in English or Chinese; and (VII) studies with complete data, results clearly listed, and the multi-measurement results also included.

The exclusion criteria were as follows: (I) non-RCT studies, such as controlled clinical trials, quasi-experimental design, and case studies; (II) the original literature is a review instead of a comparative study of mindfulness therapy and CBT; (III) a study of the low or non-active ingredients of mindfulness, such as ACT, DBT, or transcendental meditation; (IV) repeated studies; and (V) animal experiments.

Methodological quality and risk of bias assessment

Methodological quality assessment of included independent studies was performed by two evaluators using the risk of bias assessment tool provided by Cochrane Handbook for Systematic Review of Interventions 5.1.0. The following six domains were assessed: allocation concealment; sequence generation; blinding (of participants, personnel, and outcome assessors); selective outcome reporting; incomplete outcome data; and other sources of bias. The two researchers discussed the reasons for evaluation results upon completion of the evaluation. In cases of disagreement, an experienced tutor in psychotherapy was consulted for advice.

Data extraction, coding, and processing

Data from the included studies were extracted using a standardized data extraction form of these studies by Microsoft Excel, which contained the details of population characteristics, type of study design, type of intervention, and all primary and secondary outcomes. If the same study was included in multiple reports, data from these reports were directly inputted into a single data extraction form. Two researchers independently extracted the data of the included studies according to the inclusion and exclusion criteria. If an abstract was potentially relevant, or it was unclear whether it was relevant or not, the full text of the paper was read carefully to decide whether the study satisfied the inclusion criteria. Cross-checking between the two researchers was then carried out, and any disagreements were settled through discussion or arbitration by a third researcher.

Statistical analysis

The RevMan 5.3 software provided by the international Cochrane collaboration group was used for this meta-analysis.

We investigated the comparative data for each endpoint. Standard mean difference (SMD) values with 95% confidence intervals (CIs) were used as the measure of ES for the counting data when studies used different scales. Thus, the synthesis of data measuring the same outcomes using different scales was possible. The present analysis focused on comparing MBIs and CBT. The included studies used different data reporting approaches; any post-intervention, and comparisons made using follow-up were both included. The mean difference between the two treatment arms was calculated by a pooled within-study standard deviation (SD) for standardization. For the sake of
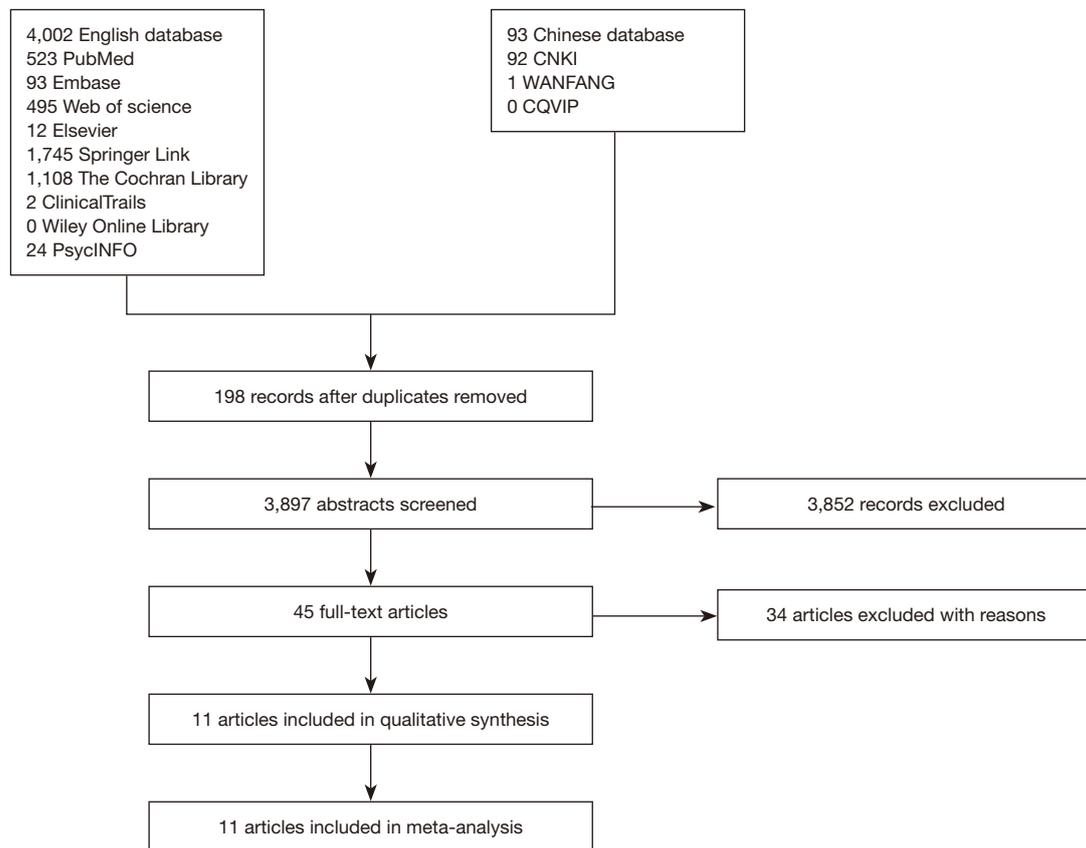
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┌─────────────────────────────┐        ┌─────────────────────────────┐
│ 4,002 English database      │        │ 93 Chinese database         │
│ 523 PubMed                  │        │ 92 CNKI                     │
│ 93 Embase                   │        │ 1 WANFANG                   │
│ 495 Web of science          │        │ 0 CQVIP                     │
│ 12 Elsevier                 │        └─────────────────────────────┘
│ 1,745 Springer Link         │
│ 1,108 The Cochran Library   │
│ 2 ClinicalTrails            │
│ 0 Wiley Online Library      │
│ 24 PsycINFO                 │
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198 records after duplicates removed

3,897 abstracts screened → 3,852 records excluded

45 full-text articles → 34 articles excluded with reasons

11 articles included in qualitative synthesis

11 articles included in meta-analysis

Figure 1 Study flow diagram.

explanation, we considered that SMDs of 0.2–0.5, 0.5–0.8, and >0.8 represent small, medium, and large effect values, respectively (32).

The random-effects model was utilized to evaluate the effect quantity. This model assumes that each independent effector is based on the convergence of multiple real effectors, so there is a certain degree of difference between the independent effectors. Using the random-effects model analysis, the results can obtain a wider CI, reduce the risk of making the first type of error, and give greater weight to small sample studies (33). Heterogeneity analysis was evaluated using the I^2 statistic, and the statistical heterogeneity was examined by observing the forest plots to detect any overlapping CI, and by the P value of 0.05 used in the χ^2 tests to determine statistical significance. Quantification of the heterogeneity was performed using I^2 statistics, which describe the percentage of the estimated change in effect, and standard classification statistics for heterogeneity interpretation were applied. Values between 0% and 25% indicated low heterogeneity; those between 26% and 50% suggested moderate heterogeneity, and those greater than 50% indicated considerable heterogeneity (34).

Through examining the subgroup analysis, we discussed the possible causes of statistical heterogeneity, such as the different methods of MBIs and the different populations measured by the results. For missing data, we contacted authors of studies for relevant explanation and clarification.

Results

Search results and study characteristics

In total, 4,095 studies were identified through database searches. Of these, 4,050 irrelevant and duplicate studies were excluded by inspection of the titles and abstracts. The full-texts of 45 articles were read in detail, and another 34 studies were further rejected. Finally, a total of 11 published studies were included in the review. The selection process is shown in the flow diagram in *Figure 1*.

Overview of participant characteristics

As shown in *Table 1*, the total amount of participants was 819. Of these, 422 were in the MBIs group and 407 were in the CBT group. The feature encoding results showed that the study of Western countries by meta-analysis accounted for 90.9%. The ethnicity of participants (35-38) were accounted for 45.5%, which Caucasians were still the majority, the educational level of the participants was measured in three articles (39-41).

The sample size of each study was between 26 and 148. The majority of participants were females (61.3% females in 90.9% of the included studies) (35-40,42-45). Individuals with anxiety disorders (38-40,42,43,45) accounted for 48.7%, while people with anxiety symptoms were 51.3%.

Of the 11 included studies, eight used two treatment arms (MBIs and CBT), one was a three-arm study comparing MBIs, CBT, and control (44), and one compared internet-delivered cognitive behavioral therapy (iCBT), mindfulness-enhanced iCBT (MEiCBT), and internet-delivered mindfulness training (iMT) compared with TAU study (40). Since each arm is independent in the three- and four-arm studies, and no unit risk bias needed to be considered, only two of the intervention groups were selected for comparison. The courses of intervention of the five studies (35,41-44) were 8 weeks, whereas for other studies (37,39), it was 10–18 weeks per arm. Only one of the studies included anxiety, depression, and sleep quality outcomes (35), seven studies reported both anxiety and depression outcome measures (37,38,40,42-44), while two reported anxiety and sleep quality outcomes (41,45). One of the studies could only extract the anxiety outcome (39). Six studies had an additional follow-up (35,36,38-40,42), but only four sets of data could be extracted, and they ranged from 10 weeks to 6 months post-intervention (35,36,38,40). Of the nine studies that reported dropout rates, four (37,39,42,45) were below 20% (46), while five (35,36,38,40,44) were over 20%. 81.8% of the included studies (35-40,42-44) used intention-to-treat (ITT) for data analysis.

Risk of bias of included studies

Figure 2A,B display a summary of the risk of bias assessments. Only randomized trials were included in this review. However, it is important to note that works of Tovote *et al.* [2014] (44), Van Gordon *et al.* [2017] (35), Koszycki *et al.* [2021] (38), and Kladnitski *et al.* [2020] (40) contained sufficient details of the methodologies for them to be considered as low risk of selection bias. Studies carried out by Goldin *et al.* [2016] (39) and Wright *et al.* [2019] (37) were deemed as high risk for selection bias because they involved a non-randomized method of selection. Three trials (35,38,40) described blinding using envelopes, while two studies (37,44) were allocated at the choice of parents or the experimenter. The risk of selection bias remains unclear for all of the other included trials.

Seven trials were at low risk of performance bias as the authors of the other included trials did not describe blinding in depth. One study (42) stated that it did not use the blinding method, and another study (39) was at unclear risk of detection bias. Other studies that described the methods used were considered to be low risk of detection bias.

Four studies (35,36,38,40) reported high levels of dropout rates over the study period (>20%) and they were considered to be at high risk of attrition bias. The risk of attrition bias was at low risk for the remaining trials. Only one trial (41) did not contain information regarding the protocol or hypothesis of outcome, no evidence of selective reporting was found, consequently, it was at high risk of reporting bias and other included studies were considered to have a low risk of reporting bias.

Effects of interventions

Anxiety scores
A reduction in the mean anxiety scores at the end of each group session was generally detected in the included studies. Comparing MBIs and CBT, no difference was observed in the ES for anxiety at the end of each group session (SMD: –0.01, 95% CI: –0.26 to 0.24; *Figure 3*) as well as at the 10-week to 6-month follow-up after randomization (SMD: 0.05, 95% CI: –0.61 to 0.72).

This study was further sub-grouped based on patients' age, and no significant difference was found (SMD: 0.06, 95% CI: –0.21 to 0.33; *Figure 4*). Studies proposed by Kladnitski *et al.* [2020] (40) and Wang *et al.* [2018] (41) both contained samples with large age ranges, however, it was not possible to place their data into any subgroup, thus they were not included.

When examining the interventions by population, people with anxiety symptoms seemed to have a small gain from MBIs compared to CBT (SMD: –0.36, 95% CI: –0.66 to –0.06), while no significant difference in anxiety disorders was observed between the two intervention groups (SMD: 0.21, 95% CI: –0.04 to 0.47; *Figure 5*).

Table 1 Characteristics of included studies and results

Author	Region	N (men/women)	Age	Population	Intervention (I)/control (C)	Forms of intervention	Anxiety measure	Depression measure	Sleep quality measure	The longest follow-up	Attrition (%)	Data analysis
Koszycki et al. [2007]	Canada	I, 26 (10/16); C, 27 (15/12)	I, 38.9±15.7; C, 37.6±11.1	Social anxiety disorder	I, MBSR; C, CBGT	I, 8-weekly 2.5 h group sessions and an all-day meditation retreat; C, 12 weekly 2.5 h group sessions	LSAS	BDI-II	–	No	23.10	ITT
Piet et al. [2010]	Denmark	I, 14 (3/11); C, 12 (5/7)	I, 21.6±2.84; C, 22.1±2.54	Young adults with social phobia	I, MBCT; C, GCBT	I, 8 weekly 2-hour sessions, daily practices of mindfulness; C, 12 2-hour sessions	LSAS; SCL-90-R; BAI	BDI-II	–	12-month	11.50	ITT
Tovote et al. [2014]	Netherlands	I, 31 (17/14); C, 32 (16/16)	I, 49.8±13.3; C, 54.6±11.3	Diabetes and comorbid depressive symptoms	I, MBCT; C, CBT	I and C, 8 sessions 45–60 min in 3 months and 30 min home practice everyday	GAD-7	DBI-II; HAM-D7	–	No	No data	ITT
Goldin et al. [2016]	The United States	I, 36 (16/20); C, 36 (16/20)	I, 29.9±7.6; C, 34.1±8.0	Generalized social anxiety disorder	I, MBSR; C, CBGT	I and C, 12 weekly 2.5-hour sessions	LSAS	–	–	1-year	4.20	ITT
Van Gordon et al. [2017]	UK	I, 74 (13/61); C, 74 (12/62)	I, 46.41±9.06; C, 47.34±9.83	FMS	I, SG-MBI; C, CBTG	I and C, 8 weekly workshops (each lasting 2 hrs) and daily self-practice	DASS	DASS	PSQI	6-month	28.40	ITT
James and Rimes. [2018]	UK	I, 28 (5/23); C, 32 (6/26)	18–39	University students with perfectionism	I, MBCT; C, pure CBT self-help	I, 8-week intervention (2 hours) and 10-week post-intervention (2 hours); C, 50-page self-help booklet	DASS	DASS	–	10-week	28.00	ITT
Wang et al. [2018]	China	I, 30; C, 30	18–70	Chronic insomnia	I, MG; C, CG	I, 8 weeks 20 min; C, not mention	GAD-7	PHQ-9	PSQI; ISI	No	No data	?
Wright et al. [2019]	Australia	I, 45 (21/24); C, 44 (24/20)	I, 10.6±1.1; C, 10.6±1.1	Children	I, MCBT-C; C, CBT	I, 10 sessions 90 min, 9–10 weeks; C, FRIENDS activity books	RCADS	RCADS	–	No	4.50	ITT
Horenstin et al. [2019]	USA	I, 36 (16/20); C, 36 (16/20)	32.70±7.99	SAD	I, MBSR; C, CGBT	I and C, 12-weekly 2.5 h sessions	LSAS-SR	–	PSQI	12-month	10.80	Listwise deletion

Table 1 (*continued*)

7602

Li et al. Mindfulness-based therapy versus CBT for anxiety

Table 1 (*continued*)

Author	Region	N (men/women)	Age	Population	Intervention (I)/control (C)	Forms of intervention	Anxiety measure	Depression measure	Sleep quality measure	The longest follow-up	Attrition (%)	Data analysis
Koszycki et al. [2021]	Canada	I, 52 (14/38); C, 45 (22/23)	I, 41.52±11.36; C, 40.09±13.9	SAD	I, MBI-SAD; C, CBGT	I and C, 12-weekly 2 h group sessions	LSAS; SPIN	BDI-II	–	6-month	29.70	ITT
Kladnitski et al. [2020]	Australia	I, 40 (4/36); C, 39 (6/33)	I, 41.38±11.30; C, 36.69±11.53	Depressive or/ and anxiety disorder	I, MEiCBT; C, iCBT	I and C, 6 lessons in 14 weeks	GAD-7	PHQ-9	–	3-month	33.70	ITT

I, intervention group; C, control group; SAD, social anxiety disorder; MBSR, mindfulness-based stress reduction; CBGT, cognitive behavior group therapy; MBCT, mindfulness-based cognitive therapy; CBT, cognitive behavior therapy; CBT-P, cognitive-behavioral therapy for pain; M, mindful awareness and acceptance treatment; MBAT, mindfulness-based addiction treatment; SG-MBI, second-generation mindfulness-based intervention; MGT, mindfulness-based group therapy; MG, mindfulness therapy group; CG, cognitive behavior therapy group; MCBT-C, mindfulness-based cognitive therapy for children; MBI-SAD, mindfulness-based intervention for social anxiety disorder; MEiCBT, mindfulness-enhanced internet-delivered cognitive behavioural therapy; iCBT, internet-delivered cognitive behavioural therapy; LSAS, The Liebowitz Social Anxiety Scale; SCL-90-R, The Symptom Checklist-90-Revised; BAI, The Beck Anxiety Inventory; GAD-7, Generalized Anxiety Disorder 7; DASS, the 21-item Depression Anxiety Stress Scale; RCADS, The Revised Child Anxiety and Depression Scale; LSAS-SR, Liebowitz Social Anxiety Scale-Self Report; SPIN, Social Phobia Inventory; BDI-II, Beck Depression Inventory; HAM-D7, Toronto Hamilton Depression Rating Scale; PHQ-9:Patient Health Questionnaire; PSQI, Pittsburgh sleep quality index; ISI, insomnia severity index; ITT, intention-to-treat; FMS, fibromyalgia syndrome.

Over the study period of these trials, the Liebowitz Social Anxiety Scale (LSAS) and Social Phobia Inventory (SPIN) portrait highlighted benefits in the CBT group (LSAS: SMD: 0.35, 95% CI: 0.08 to 0.63; SPIN: SMD: 0.51, 95% CI: 0.11 to 0.92), while no significant difference between the interventions was reported in other studies (*Figure 6*). Additional subgrouping based on the type of MBI used was also performed (*Figure 7*). Three trials that employed MBSR showed a small change in the ES that was in favor of the CBT group (SMD: 0.41, 95% CI: 0.07 to 0.74), while eight trials that used MBCT and other MBIs compared to CBT had the consistent comparative effects on anxiety (MBCT: SMD: –0.19, 95% CI: –0.43 to 0.06; other MBIs: SMD: –0.12, 95% CI: –0.64 to 0.41).

Depression scores

Eight trials assessed the scale of depression. Overall, there were no effect differences apparent at the end of the sessions (SMD: –0.18, 95% CI: –0.36 to 0.00), or during the 10-week to 6-month post-intervention follow-up (SMD: –0.26, 95% CI: –0.72 to 0.21; *Figure 8*).

Most trials used different depression scales, however, they all reported no significant differences between the two intervention groups (*Figure 9*).

Sleep quality scores

Only three trials assessed the aspect of sleep quality, and no significant discrepancies were observed post-intervention (SMD: 0.01, 95% CI: –0.43 to 0.44). However, one study described a more positive effect of MBIs compared to CBT at the 6-month post-intervention follow-up after (SMD: –0.79, 95% CI: –1.24 to –0.35; *Figure 10*).

The three trials all used Pittsburgh sleep quality index (PSQI), while one of them additionally used the insomnia severity index (ISI), however they all reported no significant discrepancies between the two intervention groups (*Figure 11*).

Discussion

The present study is the first meta-analysis that compares the ES between MBIs and CBT for the treatment of anxiety. MBIs and CBT both yield promising results in alleviating anxiety, depression, and improving sleep quality. Overall, there was no significant difference between the two intervention groups in either arm at the end of each group session, as well as in post-intervention follow-up sessions.

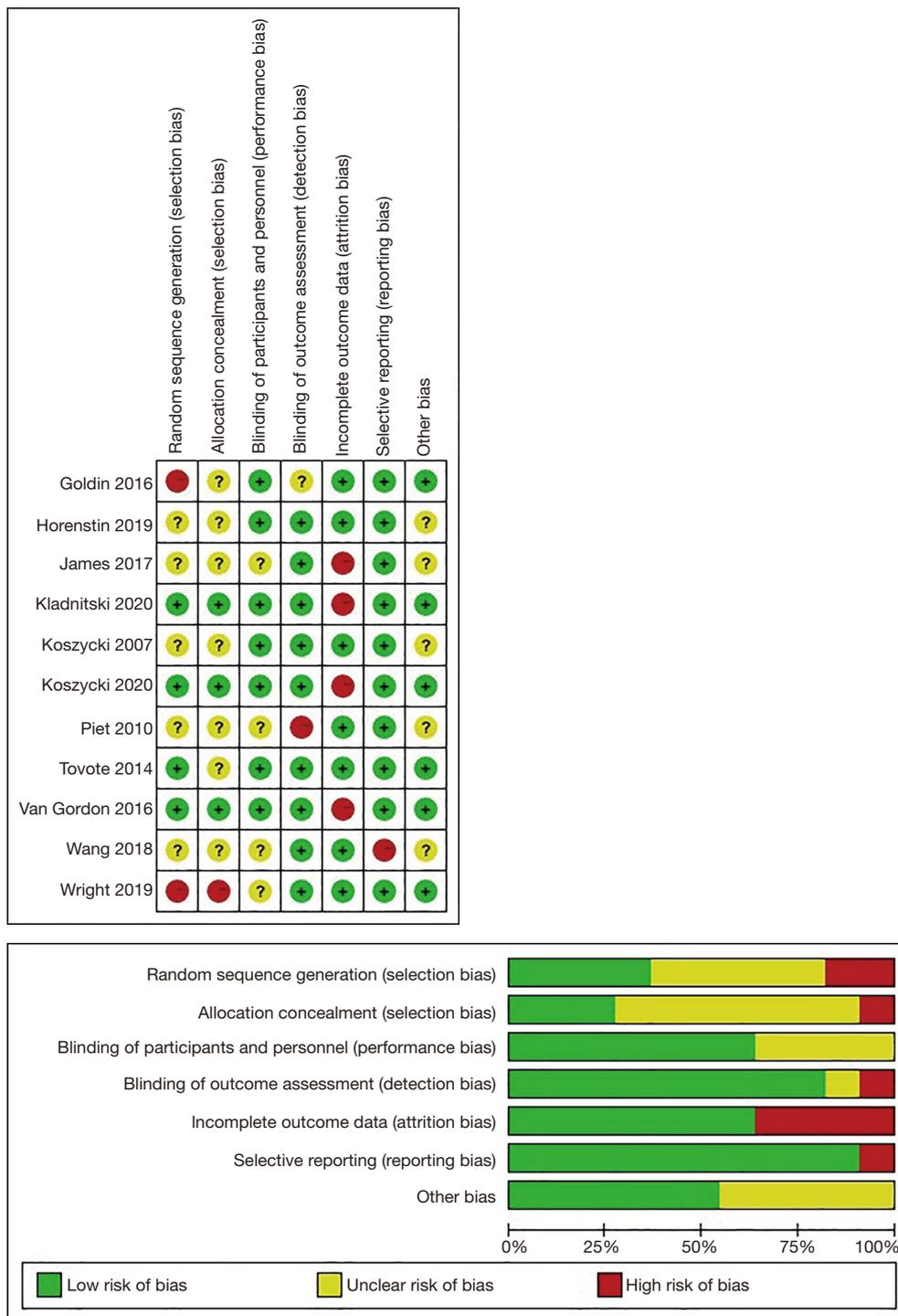Of the included studies, only 5 (45.5%) had an extra

Figure 2 Risk of bias. (A) Risk of bias summary: review of the authors' judgements about the risk of bias item for each included trial; (B) risk of bias graph: review of the authors' judgements about each risk of bias item presented as percentages across all included trials.
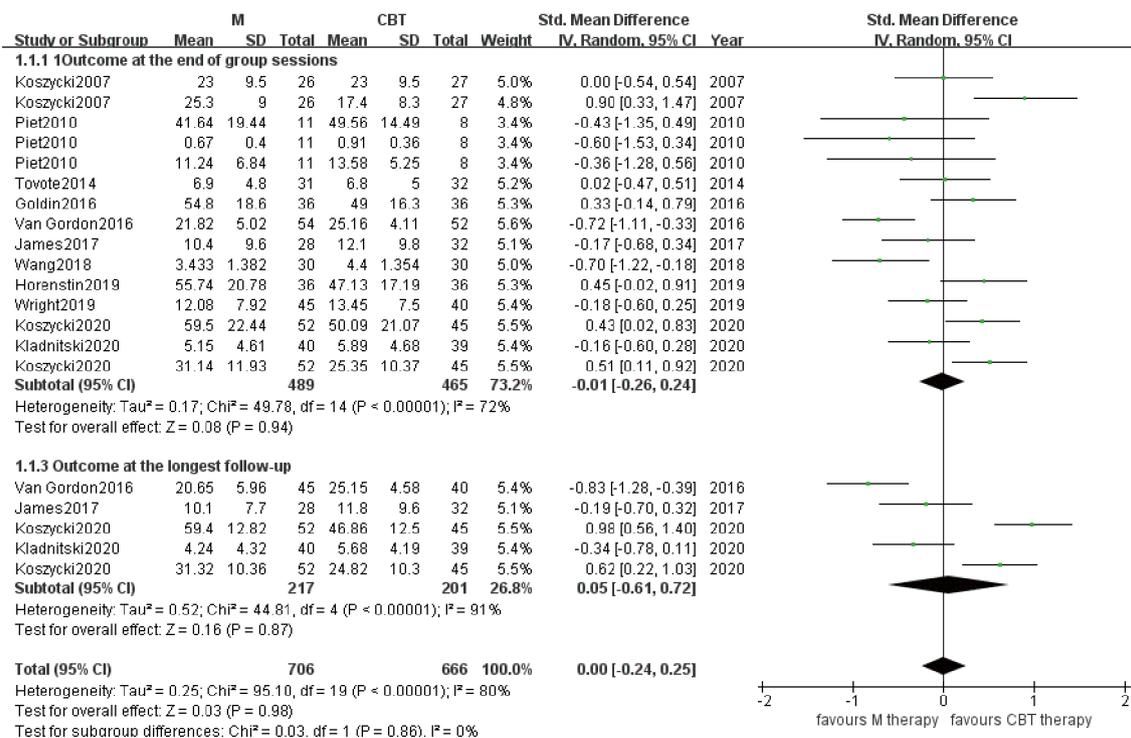
Study or Subgroup	M Mean	SD	Total	CBT Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI	Year	Std. Mean Difference IV, Random, 95% CI
1.1.1 1Outcome at the end of group sessions										
Koszycki2007	23	9.5	26	23	9.5	27	5.0%	0.00 [-0.54, 0.54]	2007	
Koszycki2007	25.3	9	26	17.4	8.3	27	4.8%	0.90 [0.33, 1.47]	2007	
Piet2010	41.64	19.44	11	49.56	14.49	8	3.4%	-0.43 [-1.35, 0.49]	2010	
Piet2010	0.67	0.4	11	0.91	0.36	8	3.4%	-0.60 [-1.53, 0.34]	2010	
Piet2010	11.24	6.84	11	13.58	5.25	8	3.4%	-0.36 [-1.28, 0.56]	2010	
Tovote2014	6.9	4.8	31	6.8	5	32	5.2%	0.02 [-0.47, 0.51]	2014	
Goldin2016	54.8	18.6	36	49	16.3	36	5.3%	0.33 [-0.14, 0.79]	2016	
Van Gordon2016	21.82	5.02	54	25.16	4.11	52	5.6%	-0.72 [-1.11, -0.33]	2016	
James2017	10.4	9.6	28	12.1	9.8	32	5.1%	-0.17 [-0.68, 0.34]	2017	
Wang2018	3.433	1.382	30	4.4	1.354	30	5.0%	-0.70 [-1.22, -0.18]	2018	
Horenstin2019	55.74	20.78	36	47.13	17.19	36	5.3%	0.45 [-0.02, 0.91]	2019	
Wright2019	12.08	7.92	45	13.45	7.5	40	5.4%	-0.18 [-0.60, 0.25]	2019	
Koszycki2020	59.5	22.44	52	50.09	21.07	45	5.5%	0.43 [0.02, 0.83]	2020	
Kladnitski2020	5.15	4.61	40	5.89	4.68	39	5.4%	-0.16 [-0.60, 0.28]	2020	
Koszycki2020	31.14	11.93	52	25.35	10.37	45	5.5%	0.51 [0.11, 0.92]	2020	
Subtotal (95% CI)			**489**			**465**	**73.2%**	**-0.01 [-0.26, 0.24]**		
Heterogeneity: Tau² = 0.17; Chi² = 49.78, df = 14 (P < 0.00001); I² = 72%										
Test for overall effect: Z = 0.08 (P = 0.94)										
1.1.3 Outcome at the longest follow-up										
Van Gordon2016	20.65	5.96	45	25.15	4.58	40	5.4%	-0.83 [-1.28, -0.39]	2016	
James2017	10.1	7.7	28	11.8	9.6	32	5.1%	-0.19 [-0.70, 0.32]	2017	
Koszycki2020	59.4	12.82	52	46.86	12.5	45	5.5%	0.98 [0.56, 1.40]	2020	
Kladnitski2020	4.24	4.32	40	5.68	4.19	39	5.4%	-0.34 [-0.78, 0.11]	2020	
Koszycki2020	31.32	10.36	52	24.82	10.3	45	5.5%	0.62 [0.22, 1.03]	2020	
Subtotal (95% CI)			**217**			**201**	**26.8%**	**0.05 [-0.61, 0.72]**		
Heterogeneity: Tau² = 0.52; Chi² = 44.81, df = 4 (P < 0.00001); I² = 91%										
Test for overall effect: Z = 0.16 (P = 0.87)										
Total (95% CI)			**706**			**666**	**100.0%**	**0.00 [-0.24, 0.25]**		
Heterogeneity: Tau² = 0.25; Chi² = 95.10, df = 19 (P < 0.00001); I² = 80%										
Test for overall effect: Z = 0.03 (P = 0.98)										
Test for subgroup differences: Chi² = 0.03, df = 1 (P = 0.86), I² = 0%										

-2   -1   0   1   2
favours M therapy   favours CBT therapy

Figure 3 Comparison 1: MBIs versus CBT. Outcome 1: anxiety scores at the end of group session and the longest follow-up (compared to baseline). MBIs, mindfulness-based interventions; CBT, cognitive behavioral therapy; SD, standard deviation; CI, confidence interval.
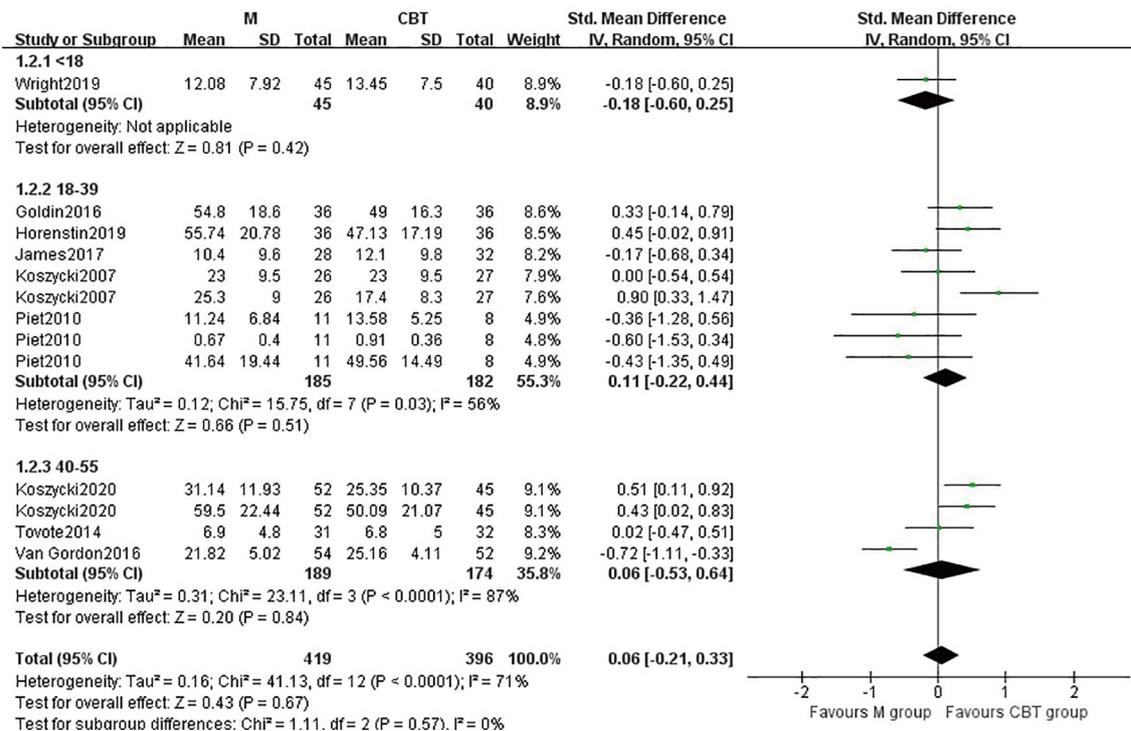
Study or Subgroup	M Mean	SD	Total	CBT Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI	Std. Mean Difference IV, Random, 95% CI
1.2.1 <18									
Wright2019	12.08	7.92	45	13.45	7.5	40	8.9%	-0.18 [-0.60, 0.25]	
Subtotal (95% CI)			**45**			**40**	**8.9%**	**-0.18 [-0.60, 0.25]**	
Heterogeneity: Not applicable									
Test for overall effect: Z = 0.81 (P = 0.42)									
1.2.2 18-39									
Goldin2016	54.8	18.6	36	49	16.3	36	8.6%	0.33 [-0.14, 0.79]	
Horenstin2019	55.74	20.78	36	47.13	17.19	36	8.5%	0.45 [-0.02, 0.91]	
James2017	10.4	9.6	28	12.1	9.8	32	8.2%	-0.17 [-0.68, 0.34]	
Koszycki2007	23	9.5	26	23	9.5	27	7.9%	0.00 [-0.54, 0.54]	
Koszycki2007	25.3	9	26	17.4	8.3	27	7.6%	0.90 [0.33, 1.47]	
Piet2010	11.24	6.84	11	13.58	5.25	8	4.9%	-0.36 [-1.28, 0.56]	
Piet2010	0.67	0.4	11	0.91	0.36	8	4.8%	-0.60 [-1.53, 0.34]	
Piet2010	41.64	19.44	11	49.56	14.49	8	4.9%	-0.43 [-1.35, 0.49]	
Subtotal (95% CI)			**185**			**182**	**55.3%**	**0.11 [-0.22, 0.44]**	
Heterogeneity: Tau² = 0.12; Chi² = 15.75, df = 7 (P = 0.03); I² = 56%									
Test for overall effect: Z = 0.66 (P = 0.51)									
1.2.3 40-55									
Koszycki2020	31.14	11.93	52	25.35	10.37	45	9.1%	0.51 [0.11, 0.92]	
Koszycki2020	59.5	22.44	52	50.09	21.07	45	9.1%	0.43 [0.02, 0.83]	
Tovote2014	6.9	4.8	31	6.8	5	32	8.3%	0.02 [-0.47, 0.51]	
Van Gordon2016	21.82	5.02	54	25.16	4.11	52	9.2%	-0.72 [-1.11, -0.33]	
Subtotal (95% CI)			**189**			**174**	**35.8%**	**0.06 [-0.53, 0.64]**	
Heterogeneity: Tau² = 0.31; Chi² = 23.11, df = 3 (P < 0.0001); I² = 87%									
Test for overall effect: Z = 0.20 (P = 0.84)									
Total (95% CI)			**419**			**396**	**100.0%**	**0.06 [-0.21, 0.33]**	
Heterogeneity: Tau² = 0.16; Chi² = 41.13, df = 12 (P < 0.0001); I² = 71%									
Test for overall effect: Z = 0.43 (P = 0.67)									
Test for subgroup differences: Chi² = 1.11, df = 2 (P = 0.57), I² = 0%									

-2   -1   0   1   2
Favours M group   Favours CBT group

Figure 4 Comparison 1: MBIs versus CBT. Outcome 2: anxiety scores (subgrouped by age). MBIs, mindfulness-based interventions; CBT, cognitive behavioral therapy; SD, standard deviation; CI, confidence interval.
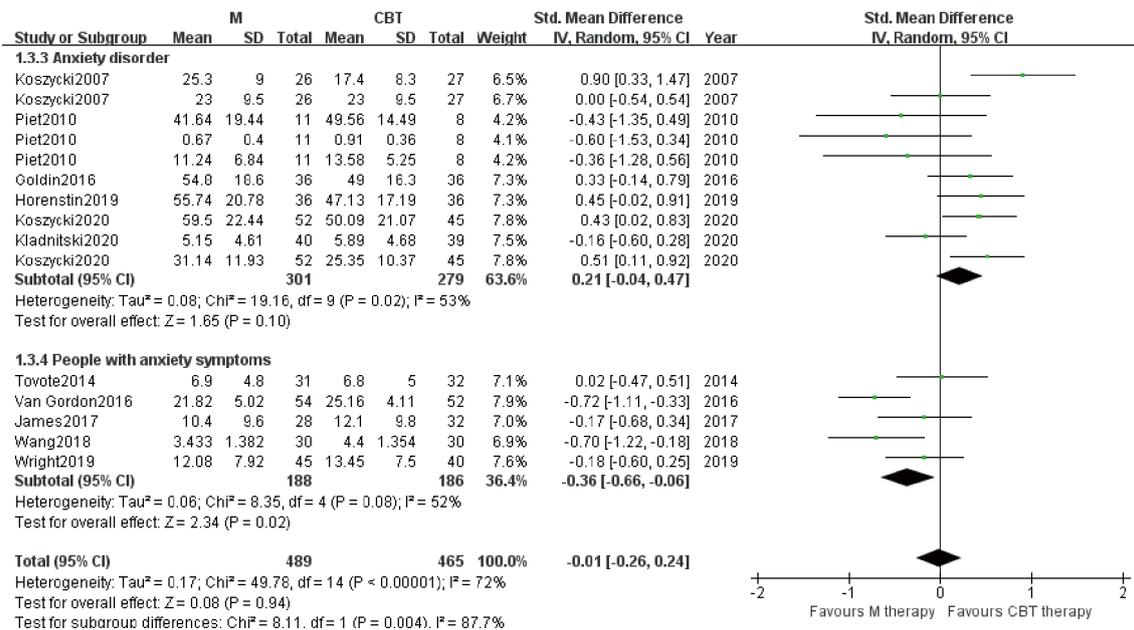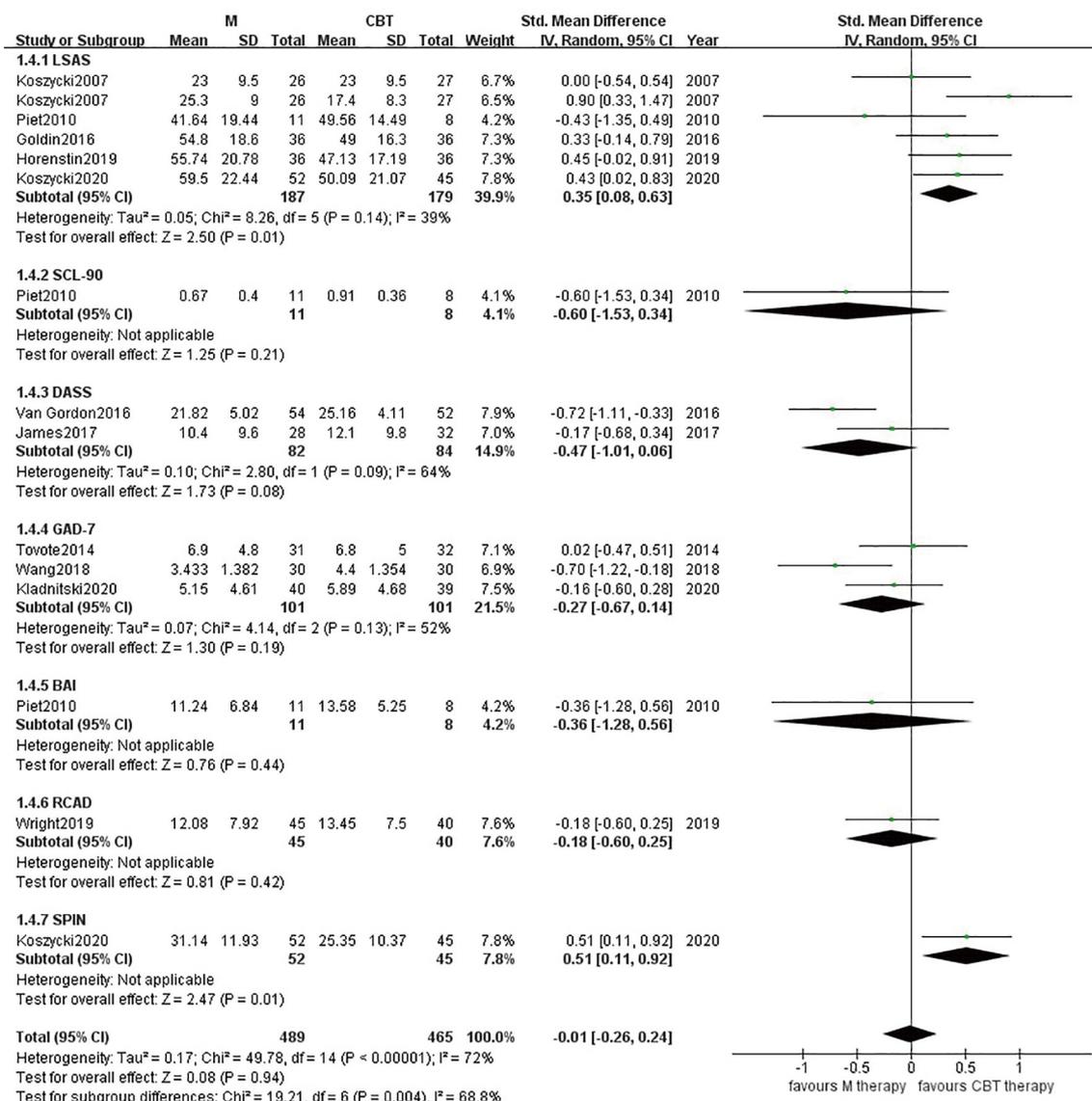

Figure 5 Comparison 1: MBIs versus CBT. Outcome 3: anxiety scores (subgrouped by population). MBIs, mindfulness-based interventions; CBT, cognitive behavioral therapy; SD, standard deviation; CI, confidence interval.

follow-up, which ranged from 10 weeks to 1 year. The results of the quality assessment in this review indicate that more attention needs to be paid when designing the experiment to improve the quality of future research, including the use of standardized measurements and follow-up time points (e.g., 12 months). Future studies should increase the follow-up period and record the corresponding data. We suggest a unified follow-up time to ensure that the continuous effect of intervention can be evaluated within a consistent period of time.

For patients who were experiencing symptoms of anxiety but were below the threshold of the diagnostic criteria, MBIs were favored over CBT; while no difference between the two groups was observed for anxiety disorder. It seems reasonable to conclude that growth in mental strength provided by meditation has a significant mechanistic role in enhancing primary and secondary outcomes (35). Further benefits of mindfulness included reductions in negative emotions, decentering, and improvements in self-compassion and mindfulness. Furthermore, mindfulness exercises are receiving considerable popularity worldwide. Mindfulness and meditation groups have become accessible to the general public in many places, which greatly benefit those in need of ongoing mindfulness practice. The widespread availability of mindfulness could be helpful in

maintaining treatment outcomes (36). Just as it was shown in this meta-analysis that the effect of MBIs for anxiety symptoms were better than those of CBT, perhaps MBIs could also be used to prevent the recurrence of anxiety.

Two types of measurement scales favored CBT over MBIs. The study of Goldin *et al.* [2016] (39) discussed the reasons for the difference, proposing that the greater differential improvement reduced the occurrence of subtle avoidance behaviors after interventions. CBTs explicitly elucidate why avoidance occurs, and train patients to overcome avoidance and escape behaviors by engaging in, and even learning from the situations they are running away from. The frequency of safety behaviors has been shown to decrease more following CBTs compared with the control (47). Also, some studies demonstrated that CBTs had greater post-test improvement and that participants made further gains over the follow-up phase of the study (48-50). However, other studies reported no differences between the two groups.

In the subgroup of mindfulness intervention used, the group of MBSR showed a small change in the ES for anxiety that was in favor of the CBT group. Maybe as the short-term effect of MBSR was not as obvious as long-term effect. Miller *et al.* [1995] (51) showed that a time-limited yet intensive group MBSR can provide long-term beneficial influences in treating patients with anxiety disorders. It
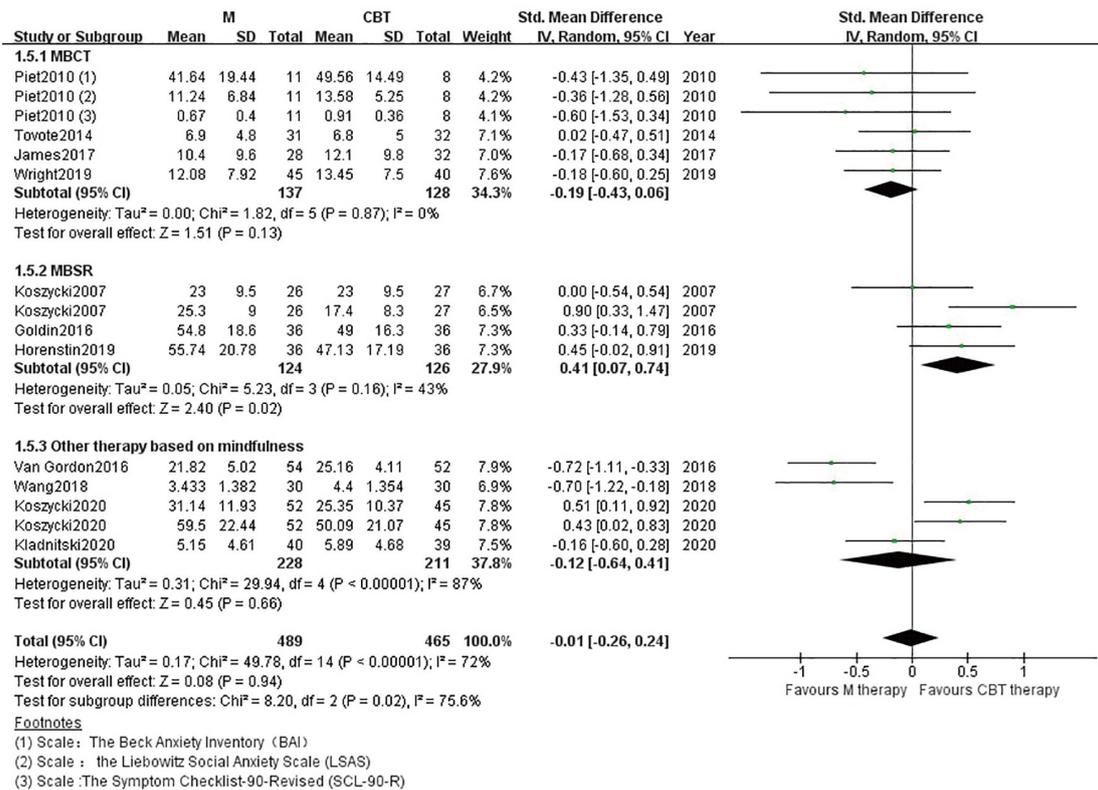
Figure 6 Comparison 1: MBIs versus CBT. Outcome 4: anxiety scores (subgrouped by scales). MBIs, mindfulness-based interventions; CBT, cognitive behavioral therapy; SD, standard deviation; CI, confidence interval; LSAS, the Liebowitz Social Anxiety Scale; SCL-90, The Symptom Checklist-90; DASS, Depression, Anxiety, and Stress Scale; GAD-7, Generalized Anxiety Disorder 7; BAI, The Beck Anxiety Inventory; RCAD, The Revised Child Anxiety and Depression Scale; WSWS, The Wisconsin Smoking Withdrawal Scale; PANAS, The Positive and Negative Affect Scale-Expanded Form.

might have different small ESs on sleep quality 6 months after the intervention, which favored the MBIs group over the CBT group. However, as there was only one study assessing the ES of sleep quality, the evidence supporting its effectiveness is weak.

Most experimental interventions were carried out in similar ways (similar forms and similar sessions).

Most studies were conducted in developed and wealthy environments (Canada, US, Denmark, Netherlands, UK, and Australia) and only one was conducted in a developing country (China). Furthermore, no trial was carried out in under-developed environments. Females accounted for a higher proportion of available demographic gender data, however we could not use subgroup analysis to explore

Figure 7 Comparison 1: MBIs versus CBT. Outcome 5: anxiety scores (subgrouped by types of MBIs). MBIs, mindfulness-based interventions; CBT, cognitive behavioral therapy; SD, standard deviation; CI, confidence interval; MBCT, mindfulness-based cognitive therapy; MBSR, mindfulness-based stress reduction.
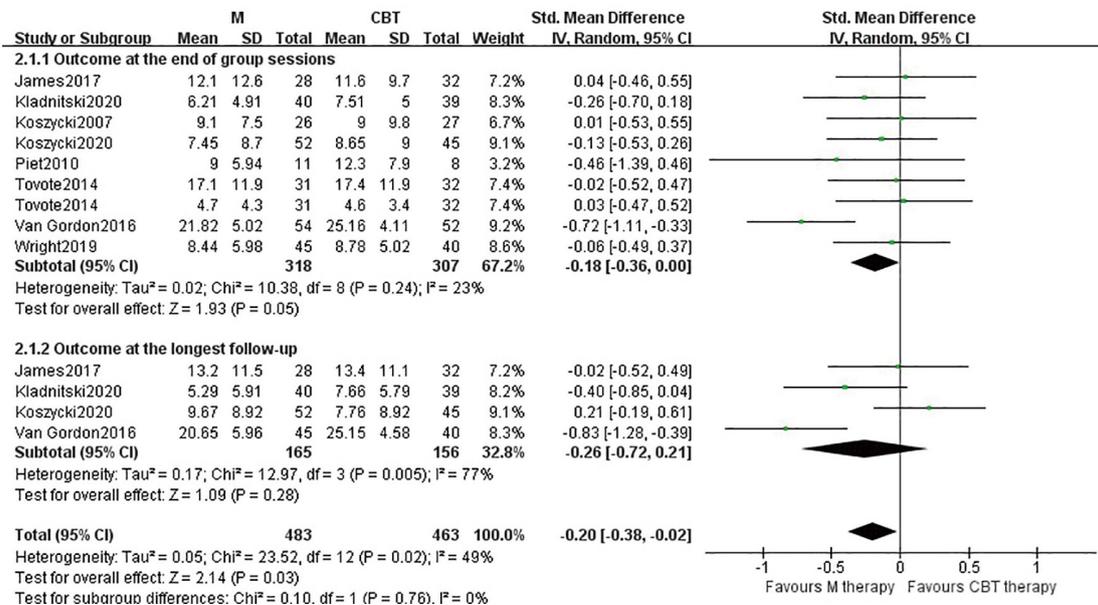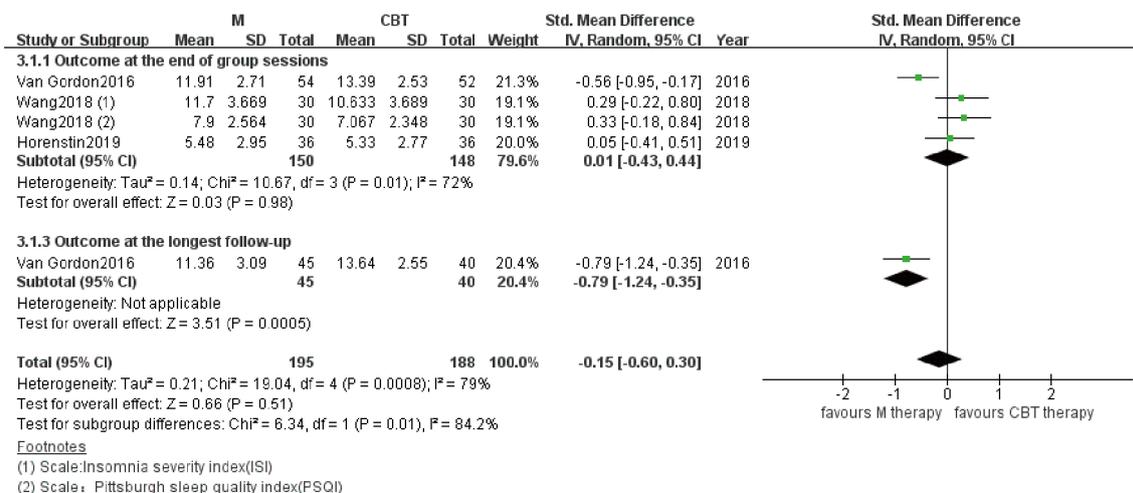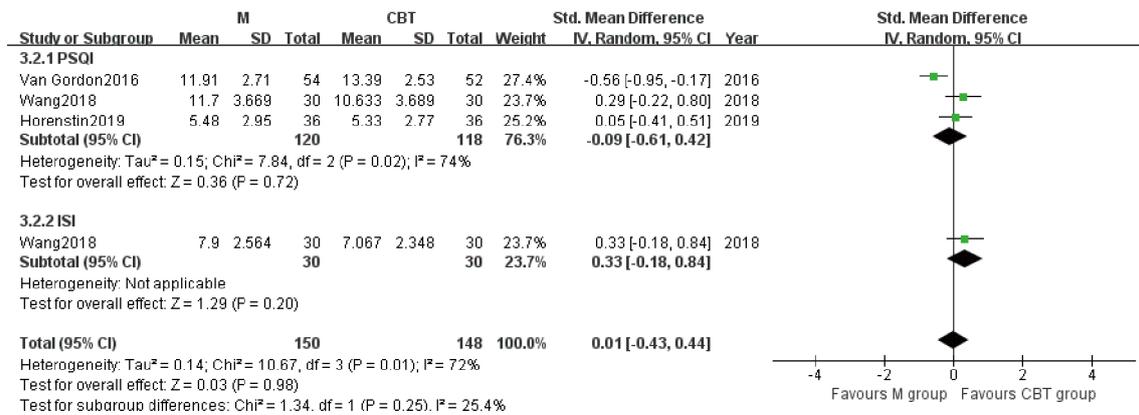

Figure 8 Comparison 2: MBIs versus CBT. Outcome 1: depression scores at the end of group sessions and the longest follow-up (compared to baseline). MBIs, mindfulness-based interventions; CBT, cognitive behavioral therapy; SD, standard deviation; CI, confidence interval.

Ann Palliat Med 2021;10(7):7596-7612 | https://dx.doi.org/10.21037/apm-21-1212
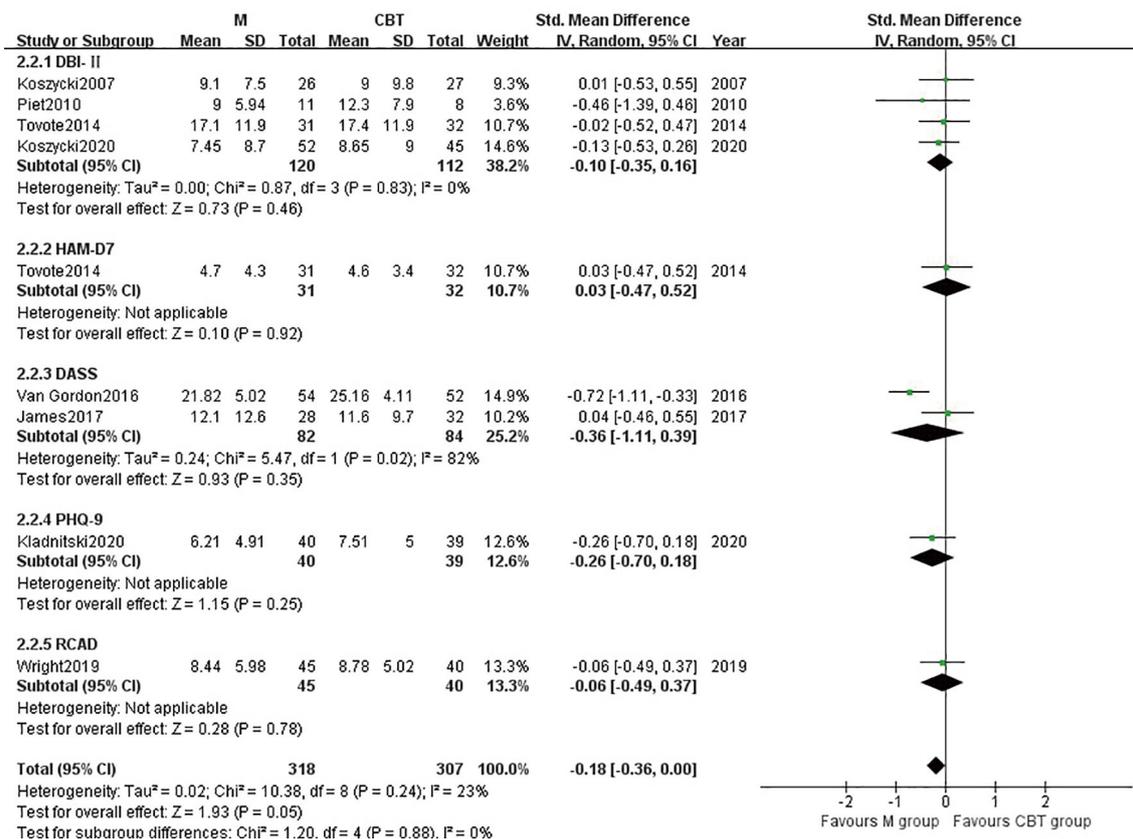
Figure 9 Comparison 2: MBIs versus CBT. Outcome 2: depression scores (subgrouped by scales). MBIs, mindfulness-based interventions; CBT, cognitive behavioral therapy; SD, standard deviation; CI, confidence interval; BDI-II, Beck Depression Inventory-II; HAM-D7, Toronto Hamilton Depression Rating Scale; DASS, Depression, Anxiety, and Stress Scale; SCL-90, The Symptom Checklist-90; RCAD, The Revised Child Anxiety and Depression Scale.

Figure 10 Comparison 3: MBIs versus CBT. Outcome 1: sleep quality scores at the end of group sessions and the longest follow-up (compared to baseline). MBIs, mindfulness-based interventions; CBT, cognitive behavioral therapy; SD, standard deviation; CI, confidence interval.

Figure 11 Comparison 3: MBIs versus CBT. Outcome 2: sleep quality scores (subgrouped by scales). MBIs, mindfulness-based interventions; CBT, cognitive behavioral therapy; SD, standard deviation; CI, confidence interval; PSQI, Pittsburgh sleep quality index; ISI, insomnia severity index.

whether participants with different gender exhibited different responses, as there have were no studies that only included female or male participants. The subgroup analyses for patients' education and national traditional culture were facing the same problems. Certain population characteristics (such as sex, ethnicity, education level), which predict responses to CBT or MBIs, are important for guiding clinical practice.

Numerous studies did not distinguish the degree of anxiety according to the results of the scale, which may be due to the fact that anxiety was not considered as the main outcome in many studies. Therefore, the level of anxiety that generated such analysis results was unknown. This represents a risk of unclear selection bias and methodological bias due to the difficulty of generalizing the findings to other environments and populations. We believe this could have an impact on anxiety, depression, and sleep quality outcomes.

Five studies (45.5%) had high rates of dropouts (>20%), and they all used ITT for data analysis. Therefore, the success of treatments in reduced sessions remains unclear. Moreover, the training of therapists and treatment adherence could not be examined, which could also impact on the results. This is an important aspect that future research needs to take into account to enhance the quality of treatment delivery.

We rate the certainty of the evidence as having a little effect on the outcome. The small sample size, especially participants with anxiety disorders (356 participants, six trials), may limit the reliability of the results. The inclusion criteria of the Cochrane review may increase the level of bias

due to subjective factors, including study and population inclusion, and may not be reproduced. We included all studies that measured anxiety. However, to minimize this potential bias, only RCTs were included.

Conclusions

In summary, there were no significant differences between MBIs and CBT regarding treatment outcomes for anxiety, depression, and sleep quality. However, there were differences in population, types of MBIs, and types of scales used in the subgroup analysis of anxiety symptoms. MBIs may be used as an alternative to CBT for reducing anxiety symptoms. However, more rigorous studies are needed to compare MBIs and CBT, including more information on patient demographics, follow-up results, process evaluation, and treatment compliance, so as to draw clearer conclusions and provide valuable information for clinical guidance.

Acknowledgments

Footnote

7610

Li et al. Mindfulness-based therapy versus CBT for anxiety

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://dx.doi.org/10.21037/apm-21-1212). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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7612

Li et al. Mindfulness-based therapy versus CBT for anxiety

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(English Language Editor: A. Kassem)

Methods

Search strategy used in the current systematic review and meta-analysis.

PubMed

1. Mindfulness-based cognitive therapy [MeSH]
2. Mindful* based cognitive therapy [MeSH]
3. MBCT [MeSH]
4. OR/1–3
5. Anxi* [MeSH]
6. Mood [MeSH]
7. Worr* [MeSH]
8. OR/5–7
9. Randomized Controlled Trial [MeSH Terms]
10. Controlled Clinical Trial [MeSH Terms]
11. randomized controlled trial [publication type]
12. controlled clinical trial [publication type]
13. random* [Ti/Ab] AND control
14. OR/9–13
15. 4 AND 8 AND 14

Embase (OVID)

- "mindfulness-based therapy OR mindfulness-based intervention OR mindfulness-based program OR MBCT OR MBSR OR MBI OR MB OR mindful* based OR mindful"
- AND "cognitive behavioral therapy OR cognitive behavioural therapy OR CBT OR cognitive OR behav* OR tau OR treatment as usual OR usual care OR standard care"
- AND "anxi* OR mood OR worr*"
- AND "random* OR rct OR randomized controlled trial"

Web of Science

- TS = (mindfulness-based therapy OR mindfulness-based intervention OR mindfulness-based program OR MBCT OR MBSR OR MBI OR MB OR mindful* based OR mindful*)
- AND TS = (cognitive behavioral therapy OR cognitive behavioural therapy OR CBT OR cognitive OR behav* OR tau OR treatment as usual OR usual care OR standard care)
- AND TS = (anxi* OR mood OR worr*)
- AND TS = (random* OR rct OR randomized controlled trial)