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Meditation techniques *v.* relaxation therapies when treating anxiety: a meta-analytic review

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Review Article

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Abstract

To what extent meditation techniques (which incorporate practices to regulate attention, construct individual values, or deconstruct self-related assumptions), are more or less effective than relaxation therapy in the treatment of anxiety, is not clear. The aim of this study was to examine the effectiveness of meditation compared to relaxation in reducing anxiety. A systematic review from PubMed, Embase, PsycInfo and the Cochrane Central was conducted. A meta-analysis of 14 RCTs ($n = 862$ participants suffering from anxiety disorders or high trait anxiety) was performed. Effect sizes (ESs) were determined by Hedges' g. Heterogeneity, risk of publication bias, quality of studies/interventions, and researcher allegiance, were evaluated. Meditation techniques incorporated attentional elements, and five of them also added constructive practices. No studies were found using deconstructive exercises. The overall ES was $g = -0.23$ [95% confidence interval (CI) −0.40 to −0.07], favouring meditation (number needed to treat = 7.74). Heterogeneity was low ($I^2 = 2$; 95% CI 0 to 56). There was no evidence of publication bias, but few studies and interventions were of high quality, and allegiance might be moderating results. Meditation seems to be a bit more effective than relaxation in the treatment of anxiety, and it might also remain more effective at 12-month follow-up. However, more research using the full spectrum of meditation practices to treat different anxiety disorders, including independent studies to avoid researcher allegiance, is needed if we are to have a precise idea of the potential of these techniques compared to relaxation therapy.

Background

Anxiety is a highly prevalent condition, with lifetime rates for its derived mental disorders between 14.5% and 33.7% in Western countries (Alonso and Lepine, 2007; Kessler *et al.*, 2012), and global estimates across countries between 3.8% to 25.0% (Remes *et al.*, 2016). Anxiety can manifest in different ways depending on the underlying disorder subtype, to configure a heterogeneous group of conditions. Nevertheless, all of these conditions are typically characterized by states of hyper-arousal, cognitive beliefs that focus on risk and danger, and excessive fear and worry, all of which are symptoms that allow anxiety to be distinguished from other psychopathologies (Olthuis *et al.*, 2016). Anxiety symptoms have a debilitating impact on wellbeing, quality of life and general functioning, and involve considerable costs to individuals and to society at large (Simpson *et al.*, 2010).

Psychological treatments of anxiety frequently include relaxation therapy, which is considered a behavioural approach that emphasizes the development of a specific response that counteract anxiety (Manzoni *et al.*, 2008). This response – i.e. relaxation response – is characterized by a set of physiological adjustments that are elicited in the absence of tension in the body and mind, and they are often accompanied by reduced neurological arousal together with a decrease in sympathetic activity and a sense of being physically rested (Esch *et al.*, 2003; Klainin *et al.*, 2015). The rationale of relaxation interventions seems to be mainly physiological so that persons suffering from anxiety would have elevated activation of the sympathetic nervous system and relaxation would have a direct impact in its reduction (Taylor *et al.*, 2003; Conrad and Roth, 2007; Chiang *et al.*, 2009). In addition, when people learn to relax, they learn a psychological coping strategy, and a sense of control. Relaxation interventions incorporate several techniques, all of which are particularly focused on changing physiological responses to anxiety with relaxing and stabilizing effects on the autonomic nervous system. They cover different procedures such as abdominal or diaphragmatic breathing, e.g. slow, deep inhalations and exhalations (Chen *et al.*, 2017); autogenic training, e.g. imagination of physical sensations such as heat or heaviness (Schultz and Luthe, 1969); progressive muscle relaxation, e.g. alternate tensing and relaxing of different muscle groups (Bernstein and

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Borkovec, 1973); cue-controlled relaxation, e.g. a combination of deep breathing and repetition of the word 'relax' (Russel and Sipich, 1973); applied relaxation, e.g. making relaxation a portable skill to be used when anxiety is encountered in natural settings (Öst, 1987); and music relaxation, e.g. singing, listening to or playing music to promote relaxation states (Seaword, 2012). Relaxation therapy has been used as an intervention for anxiety with a certain degree of success. In fact, a recent meta-analysis has suggested that there is no evidence that relaxation therapies are less effective than cognitive and behavioural therapy (CBT) for the treatment of generalized anxiety disorder (GAD) and panic disorder, at least considering short-term results (Montero-Marin *et al*., 2018*a*).

Over the last two decades, mindfulness practice has become very popular and has been the object of a growing focus of scientific research. A recent meta-analysis (Goldberg *et al*., 2018) examined the efficacy of mindfulness for clinical populations suffering from psychiatric disorders, concluding that there might have consistent evidence for depression, pain, smoking and addictive disorders. However, mindfulness constitutes a limited part of all the range of meditation practices, which form 'a family of complex attentional and emotional regulatory training regimes developed for various ends, including the cultivation of well-being and emotional balance' (Lutz *et al*., 2008). Meditation is not only the attentional training regimen on which mindfulness is mainly focused (Lutz *et al*., 2015), but also includes constructive practices that try to restructure individual priorities and values, and deconstructive techniques that allow exploration of self-related assumptions (Dahl *et al*., 2015). 'Attentional' practices aim to cultivate the regulation of attention, including the ability to initiate, direct and sustain attentional processes, strengthening the capacity to be aware of the processes of thinking, feeling and perceiving (Dahl *et al*., 2015). 'Constructive' practices aim to strengthen regulatory psychological patterns that foster well-being by targeting maladaptive self-schema, replacing them with more adaptive conceptions of the self (Dahl *et al*., 2015). 'Deconstructive' practices aim to undo maladaptive cognitive patterns by exploring the processes of perception, emotion and cognition, generating insights into one's internal models of the self, others and the world (Dahl *et al*., 2015). Another meta-analysis (Goyal *et al*., 2014) used a definition of meditation that included mindfulness and other techniques based on transcendental and mantra meditation, but again all of them were belonged to the attentional regimen of meditation trainings. This study found that mindfulness had moderate evidence for improving anxiety when the comparator was a non-specific active control – e.g. education or attention control – but insufficient evidence when the comparator was treated with some specific active control – e.g. CBT or progressive muscle relaxation. Nevertheless, the study included not only populations presenting high anxiety scores but also a primary diagnosis of other disorders such as depression, chronic pain, stress, insomnia, diabetes and hypertension, among others.

Based on evidence of parasympathetic activation, meditation was initially considered to be a form of relaxation technique (Benson, 1975). In fact, it has been observed that meditation induces the relaxation response referred above (Deepak, 2019). However, relaxation procedures are thought to differ from meditation techniques in that relaxation has an intentional and main focus to relax, while meditation not only creates a relaxation response but also maximizes the potential of mental ability by enhancing arousal and cognition (Young and Taylor, 1998; Amihai and Kozhevnikov, 2014). This apparent paradox of meditation might be result of altered states of consciousness that facilitate meta-cognitive modes of thinking, making possible cognitive-behavioural benefits such as reducing distractive and ruminative thoughts and behaviours, increasing positive mood states due to its specific focus on cultivating moment-to-moment awareness (Jain *et al*., 2007; Manzoni *et al*., 2008). In summary, relaxation gives the central nervous system the opportunity to adequately process internal sensations and activities while receiving lower amounts of somatosensory inputs and generating lower amount of event outputs, whereas meditation involves additional mechanisms that process the information in a particular way, channelling mental processes, and nullifying wandering thoughts as potential influencers of new thoughts or somato-motor sequences (Deepak, 2019). Notwithstanding whether the cognitive restructuring ability that meditation techniques provide can be considered an advantage in relation to relaxation techniques when treating anxiety is presently unknown and this research gap should be addressed.

In this context, we decided to conduct a systematic review and meta-analysis to examine the comparative effectiveness of meditation techniques considered in a broad sense by the attentional, constructive and deconstructive regimens of practices, compared to relaxation therapies that are specially aimed to change physiological responses to anxiety in order to treat high-anxiety populations.

Method

The Cochrane Collaboration recommendations, as well as the PRISMA guidelines for systematic reviews and meta-analyses (Moher *et al*., 2010; Higgins and Green, 2011), were followed. The protocol was registered with the Centre for Reviews and Dissemination PROSPERO (registration number CRD42018104722).

Identification and selection of studies

We built a database of papers by searching four of the major bibliographical databases in the field (MEDLINE via PubMed, Embase, PsycInfo and the Cochrane Central Register of Controlled Trials – CCRCT). The search strategy had four sets of terms: (1) health condition: anxiety; (2) intervention evaluated: meditation techniques; (3) intervention compared: relaxation therapies; and (4) terms to search for the types of study design to be included. We combined controlled vocabulary, e.g. mesh terms, and a wide range of text words with methodological search filters for retrieving randomized controlled trials (RCTs) and therapy studies (Glanville *et al*., 2008). The online Supplementary Material 1 shows the full electronic search strategy for MEDLINE (via PubMed). We also included additional records identified through other sources, such as the reference lists of earlier reviews and meta-analyses related to the use of meditation and/or relaxation interventions to reduce anxiety (Delmonte, 1985; Eppley *et al*., 1989; Krisanaprakornkit *et al*., 2006; Manzoni *et al*., 2008; Ospina *et al*., 2008; Davis and Kurzban, 2012; Bolognesi *et al*., 2014; Goyal *et al*., 2014; Orme-Johnson and Barnes, 2014; Hilton *et al*., 2017; Cushing and Braun, 2018; Goldberg *et al*., 2018; Niles *et al*., 2018), as well as from the reference list of the included primary studies. The deadline for the search was 13 July 2018.

The inclusion criteria for studies were: (1) RCTs, (2) in which participants met diagnostic criteria for anxiety according to a formal interview or they scored above a specific cut-off point on a self-rating scale, (3) with age ⩾18 years, (4) published in a peer-

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review journal, (5) comparing at least one meditation group with one relaxation group.

Patients, intervention, comparison, and outcome

Anxiety (patients) was defined according to the DSM-IV, and included GAD, panic disorder, social anxiety disorder, specific phobias, OCD and PTSD. Although DSM-V is the most recent prescriptive diagnostic manual for mental disorders, DSM-IV appears to be more appropriate for the retrospective nature of our meta-analytical study because it was the valid prescriptive instrument when the broad literature reviewed took place. Moreover, there seems to be lack of agreement regarding the reliability and comparability of DSM-V in relation to previous epidemiological studies, which could be low due to criteria changes that inflate prevalence rates, or even because DSM-V seems to pose problems concerning treatment and prognosis (Frances and Nardo, 2013; Heimberg *et al.*, 2014; Uher *et al.*, 2014; Crome *et al.*, 2015). Finally, DSM-IV retains PTSD and OCD as anxiety disorders, which offers an important advantage in achieving enough statistical power for the present meta-analysis. Moreover, high trait anxiety was also included when subjects were classified above established cut-off points in rating scales. Comorbidity of mental/somatic disorders was not excluded if anxiety was the primary diagnosis, or in the presence of a dual diagnosis. Meditation techniques (intervention) included attentional, constructive and deconstructive training regimes (Lutz *et al.*, 2008, 2015), but those techniques that included physical activity (e.g. yoga, tai chi, qigong, etc.) were not considered. Relaxation therapy (comparison) included those techniques focused on changing physiological responses to counteract anxiety (Manzoni *et al.*, 2008), but we did not include bio-feedback or neuro-feedback procedures because of their particular characteristics (e.g. the need for specific applications and devices). Anxiety was the main dependent variable (outcome) and it was extracted using self-reported and assessor-reported measures by means of cognitive, physiological, behavioural and mixed domains. Studies that did not report enough data to calculate standardized effect sizes (ESs) were excluded. No language restrictions were applied.

Data extraction and quality assessments

Two independent reviewers screened titles and abstracts, and the full text of potentially relevant studies. Data extraction and quality assessments were also driven by two independent assessors, using a previously established data extraction sheet. In case of lack of agreement, a third assessor was incorporated into the discussion in order to reach a resolution. We coded the year of publication, country, number and characteristics of participants (averaged age and percentage of women), setting for delivery, person who delivered the therapy, follow-ups (post-test, 3–12 months), meditation training (attentional, constructive, deconstructive), type of relaxation therapy (progressive muscle relaxation, applied relaxation, others), format (group, individual), application (audio, therapist), study design (experiment with only one session, intervention with more than one session), target population (anxiety disorder, high trait anxiety), assessment procedure (self-reported, assessor-reported), anxiety outcome domain (mixed, e.g. Hamilton Anxiety Scale; cognitive, e.g. worry; physiological, e.g. heart rate; behavioural, e.g. avoidance), depression outcomes (e.g. Beck Depression Inventory), other outcomes (e.g. quality of life), acceptability (completion rate), and hours of meditation and of relaxation therapy (based on the number of sessions and the length of interventions).

We evaluated the quality of studies using four criteria adapted from the Cochrane Collaboration's tool for assessing risk of bias (Higgins *et al.*, 2011), including: (1) generation of allocation sequence, which refers to selection bias due to inadequate generation of a randomized sequence; (2) concealment of allocation to conditions, which includes selection bias due to inadequate concealment of allocations prior to assignment; (3) prevention of knowledge of the allocated interventions, which refers to detection bias due to knowledge of the allocated interventions by participants, personnel or outcome assessors; and (4) dealing with incomplete outcome data, which considers attrition bias due to amount, nature or handling of incomplete outcomes, and which was considered in a positive way when intention-to-treat analyses were conducted. Quality of interventions was assessed using the following three criteria: (1) using a treatment manual, (2) provision of therapy by specially trained therapists, and (3) verification of treatment integrity (Chambless and Hollon, 1998). We examined researcher allegiance, coding that it was in favour of the meditation techniques, against relaxation therapy, where (Cuijpers *et al.*, 2012): (1) meditation was the only therapy referenced in the title, (2) meditation was explicitly mentioned as the main experimental intervention in the introduction, (3) relaxation therapy was explicitly described as a control condition and it was included to control for the non-specific components of meditation, and (4) there was an explicit hypothesis that meditation was expected to be more effective than relaxation therapy.

Statistical analysis

We calculated Hedges' g as an ES measure for each comparison between a meditation group and a relaxation condition, assuming normal distributions with equal variances. Hedges' g corrects for possible small sample bias, indicating the differences between groups – and the 95% confidence interval (95% CI) – which is usually considered small when $g = 0.20$, moderate when $g = 0.50$, and large when $g \geqslant 0.80$ (Hedges, 1981; Cohen, 1988). If each of the previously specified groups of variables that were the subject of analyses (anxiety outcomes, depression outcomes, other outcomes) included more than one different measure in the same study, they were first pooled within-study before pooling them across-studies (the variables included in the analyses are specified in Table 1). Given that considerable heterogeneity was expected among the studies owing to the different therapeutic techniques included in each of the groups being compared, as well as the different outcome domains used and also the distinct subtypes of anxiety disorders considered, all of which could produce variations in the effects sizes, the random-effects model was used to estimate the pooled ES. In this model, the ESs not only differ because of the random error within studies, but also because of the true variation in ESs from one study to another. We examined the degree of heterogeneity using the I^2 parameter – and its 95% CI by means of the non-central χ^2 approximation (Ioannidis *et al.*, 2007) – as the proportion of the dispersion of ESs that is due to variance in true effects rather than sampling error (Borenstein *et al.*, 2017). Although not in absolute terms, it is considered that if $I^2 = 0$, there is no heterogeneity; if $I^2 = 25$, heterogeneity is low; if $I^2 = 50$, heterogeneity is moderate; and if $I^2 = 75$, there is high heterogeneity (Higgins *et al.*, 2003).

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Table 1. Characteristics of the included studies in the meta-analysis

Study	Population	Age	Female	MBI groups	Relaxation groups	Setting	Who delivered	Waves	CR	Outcomes		St	In	RA
Butow *et al.*, 2017 Australia	Fear (of cancer recurrence)	ACT: Mn: 53.31 s.d.: 10.45 PR: Mn: 52.27 s.d.: 9.63	95.0%	ACT (adapted) (n = 121) • Attention training, metacognitions, acceptance/ mindfulness, screening behaviour, and values-based goals • Therapist • 10 weeks: 1.5 h/week	PR (n = 101) • Muscle relaxation, visualizations, and quick relaxation, • Therapist • 10 weeks: 1.5 h/week	• Unrep. • Individual application	Expert therapists	Post 13 weeks 26 weeks	ACT: 66.9% PR: 70.3%	• Fear of Cancer Recurrence Inventory (FCRI) • Depression, Anxiety, Stress Scale (DAS-21) • Impact of Event Scale (IES) • Metacognitions Questionnaire	• Quality of Life (AQoL-8D) • Survivors Unmet Needs Survey	+ + – –	+ + +	Y Y Y Y
Cludius *et al.*, 2015 Germany	OCD	FA: Mn: 39.88 s.d.: 10.77 PR: Mn: 41.37 s.d.: 12.78	66.7%	FA (n = 49) • Breathing meditation, body scan, informal practices, mindful of needs and positive mindful practices. • Self-applied (online files and audio) • 6 weeks (14.12 Mn days of practice)	PR (n = 38) • Muscle relaxation • Self-applied (online files and audio) • 6 weeks (9.73 Mn days of practice)	• At home • Individual application	Online downloadable materials	Post	MF: 44.9% PR: 52.6%	• Center for Epidemiologic Studies-Depression Scale • Obsessive–Compulsive Inventory-Revised • Symptoms severity • Web Screening Questionnaire		+ + – +	+ ? +	Y Y Y Y
Delgado *et al.*, 2010 Spain	GAD	Rg: 18–24	100%	FA + acceptance + compas. (n = 18) • Attention to the body, body scan, breathing as an anchor, awareness and acceptance of mental and emotional states, labelling experience, empathic compassion • Therapist and self-applied • 5 weeks: 2 h/week	PR (n = 18) • Muscle relaxation, recall relaxation, relaxation of speech and imagination, postpone worry, programming a period to worry • Therapist and self-applied • 5 weeks: 2 h/week	• Unrep. • Group application	Two Post-doctoral Clinical Psychologist with more than 10 years in meditation and relaxation techniques	Post	MF: 83.3% PR: 94.4%	• Penn State Worry Questionnaire • State-Trait Anxiety Inventory • Beck Depression Inventory • Positive and Negative Affect Schedule • Subjective Health Complaints • Trait Meta-Mood Scale	• Daily self-report of worry	+ + – –	+ ? –	Y Y Y Y
Eifert and Heffner, 2003 USA	High anxiety sensitivity	Mn: 19.40 s.d.: 1.84	100%	FA + acceptance (n = 20) • Acceptance experimental context • Therapist • 1 session: 20-min	Other (n = 20) • Diaphragmatic breathing • Therapist • 1 session: 20-min	• University lab • Individual application	Experimenter	Post	MD: 100% Other: 100%	• Unpleasantness rating • Subjective Units of Distress scale (SUDS) • Heart Rate • Skin Conductance	• Catastrophic thoughts • Willing to return • Actual return • Drop-out rate	+ + – –	+ ? –	Y Y Y Y

(*Continued*)

Table 1. (*Continued.*)

Study	Population	Age	Female	MBI groups	Relaxation groups	Setting	Who delivered	Waves	CR	Outcomes		St	In	RA
										• Fear of losing control				
Hayes-Skelton *et al.*, 2013 USA	GAD	ABBT Mn: 33.30 s.d.: 12.42 AR: Mn: 32.56 s.d.: 12.05	65.4%	ABBT ($n = 40$) • Observing breath and painful thoughts, acceptance and commitment based on values, and applying skills • Therapist-applied • 16 weeks: 1.13 h/week	AR ($n = 41$) • Muscle relaxation, cue-controlled, differential, rapid relaxation, diaphragmatic breathing, and applying skills • Therapist-applied • 16 weeks: 1.13 h/week	• Center for Anxiety and Related Disorders • Individual application	Post-doctoral or advanced doctoral students	Post 26 weeks	ABBT: 75.0% AR: 78.1%	• Diagnostic status, responder status, and end-state functioning • Structured Interview guide for the Hamilton Anxiety Scale • Penn State Worry Questionnaire	• State-Trait Anxiety Inventory • Depression Anxiety Stress Scale (stress) • Beck Depression Inventory • Quality of Life Inventory • Number of additional diagnoses	+ + – +	+ + +	Y Y Y Y
Millstein *et al.*, 2015 USA								Post 26 weeks 52 weeks		• Clinician's severity rating • Inventory of Interpersonal Problems Circumplex Scales	• Five Facets Mindfulness Questionnaire			
Eustis *et al.*, 2016 USA								Post		• Acceptance and Action Questionnaire				
Kirkland and Hollandsworth, 1980 USA	Social anxiety	Unrep.	Unrep.	FA ($n = 15$) • Calming the mind using mantra meditation techniques • Therapist-applied • 5 sessions: 1.5 h/session	AR ($n = 15$) • Cue controlled exhalation, progressive, deep muscle relaxation • Therapist-applied • 5 sessions: 1.5 h/session	• Unrep. • Unrep.	Two master's level psychology students	Post	MD: 86.7% AR: 80.0%	• Test-taking skills • Worry scale of the WES • Cognitive scale of the CSAQ • Cognitive Interference Questionnaire • Attentional Interference Scale • Emotionality scale of the WES	• Somatic scale of the CSAQ • Heart rate • Pulse transit time • Otis-Lennon Mental Abilities Test • Anagram test • Grade point average	+ – – –	+ + –	N N N N
Kirsch and Henry, 1979 USA	Social anxiety	Unrep.	Unrep.	FA ($n = 9$)	AR: ($n = 9$)	• At home	Through manual	Post	Unrep.	• Paul's Behavioral Checklist	• Fear thermometer	+ + – –	+ + –	N N N N

				• Transcendental meditation, mantra, passive attitude, comfortable posture, quiet environment • Self-applied • Unrep.	• Muscle relaxation, hierarchy construction, imagery-relaxation pairing, and applying skills • Self-applied • Unrep.	• Individual application				• Personal Report of Confidence as a Speaker	• Heart rate			
Lee and Orsillo, 2014 USA	GAD	MD Mn: 25.93 s.d.: 7.24 RL: Mn: 29.64 s.d.: 12.71	82.1%	FA ($n = 20$) • Focusing attention on the breath, redirect attention back to the breath when noticing it is wandering • Audio-applied • 1 session: 20-min	Other ($n = 18$) • Relaxation while listening to classical music as a mood induction procedure with a verbal suggestion • Audio-applied • 1 session: 20-min	• Unrep. • Individual application	Audio Recording	Post	MF: 95.0% Other: 100%	• State-Trait Anxiety Inventory • Mindful Attention Awareness Scale • Emotional Stroop and modified emotional Stroop switching task		+ – – – + ? –	Y Y Y Y
Lehrer *et al.*, 1983 USA	Trait Anxiety	Unrep.	Unrep.	FA ($n = 23$) • Mantra meditation, mini meditations, facial area awareness and breathing-paced meditation • Therapist-applied • 5 weeks: 1.5 h/week	PR ($n = 19$) • Muscle relaxation • Therapist-applied • 5 weeks: 1.5 h/week	• Unrep. • Group application	Trained graduate students and advance undergraduates	Post 26 weeks	MD: 91.3% PR: 84.2%	• SCL-9OR • IPAT Anxiety Inventory • Lehrer-Woolfolk Trimodal Anxiety • State-Trait Anxiety Inventory		+ – – – + + –	N N N N
Norton *et al.*, 1985 Canada	Trait Anxiety	Mn: 19.90 Rg: 18–28	50.0%	FA ($n = 20$) • Mantra meditation • Audio-applied • 1 session: 10-min	PR ($n = 20$) • Muscle relaxation • Audio- applied • 1 session: 10-min	• Laboratory • Individual application	Audio prepared by an advanced undergraduate student	Post	Unrep.	• Heart Rate		+ + – – + ? –	N N N N
Parker *et al.*, 1978 USA	Trait Anxiety Comorbidity: Alcohol abuse	Mn: 45.1	0.0%	FA ($n = 10$) • Mantra meditation repeating the word 'one' on every exhalation • Therapist and audio-applied • 3 weeks: 1.5 h/week	PR ($n = 10$) • Muscle Relaxation • Therapist and audio-applied • 3 weeks: 1.5 h/week	• Veterans administration hospital • Individually and group applied	Experimenter and Audio-Tape Recording	Post	MD: 100% PR: 90.0%	• Blood Pressure		+ - - – + - ?	N N N N
Twohig *et al.*, 2010 USA	OCD	Mn: 37.00 s.d.: 15.50	61.0%	ACT ($n = 41$) • Present moment awareness, acceptance, life values,	PR ($n = 38$)	• Standard therapy room	Trained advanced graduate students in clinical psychology	Post 13 weeks	ACT: 90.2% PR: 84.2%	• Yale-Brown Obsessive Compulsive Scale • Clinical significance	• Acceptance and Action Questionnaire	+ + + + + + +	N Y Y Y

(*Continued*)

Table 1. (*Continued.*)

Study	Population	Age	Female	MBI groups	Relaxation groups	Setting	Who delivered	Waves	CR	Outcomes		St	In	RA
				commitment and defusion exercises • Therapist-applied • 8 weeks: 1 h/week	• Muscle relaxation and relaxation by recall and counting alone (cueing) • Therapist-applied • 8 weeks:1 h/week	• Individual application				• Beck Depression Inventory-II • Quality of Life Scale • Credibility/ acceptability	• Thought Action Fusion Scale • Thought control questionnaire			
Wahbeh *et al.*, 2016 USA	PTSD	MF_1: Mn: 53.30 s.d.: 12.60 MF_2: Mn: 50.00 s.d.: 12.80 Other: Mn: 52.20 s.d.: 12.50	MF_1: 93.0% MF_2: 96.0% Other: 92.0%	FA_1: ($n = 27$) • Body scan • Therapist and self-applied • 6 weeks (0.33 h/week) FA_2: ($n = 25$) • Mindful breathing • Therapist and self-applied • 6 weeks (0.33 h/week)	Other ($n = 25$) • Slow breathing • Therapist and self-applied • 6 weeks (0.33 h/week)	• Research Centre • Group application	Research assistant	Post	MF: 100% Other: 100%	• PTSD Checklist • Perceived Stress Scale • Beck Depression Inventory • Positive and Negative Affect Schedule • General Perceived Self-Efficacy Scale • Pittsburgh Sleep Quality Index • Global Impression of Change	• Hyperarousal • Heart Rate • Heart Rate Variability • Conflict effect score • Intrusive Thoughts Score • Event related negativity (Cue/ No Cue) • Awakening Cortisol • Respiration Rate	+ + + –	+ + – 	Y Y N N
Colgan *et al.*, 2017 USA								Post		• Reported improvement • Enhanced awareness • Increased non-reactivity • Increased non-judgemental acceptance	• Reduced anger • Reduced hyper-Arousal • Improved sleep • Greater relaxation • Increased coping skills			
Weinstein and Smith, 1992 USA	Trait Anxiety	Mn: 31.00 Rg: 19–54	69.2%	FA ($n = 26$) • Six meditations incorporating different focal stimulus. • Therapist and audio-applied • 1 session: 60-min	PR ($n = 26$) • Isometric Squeeze Muscle relaxation • Therapist and audio-applied • 1 session: 60-min	• Chicago's Roosevelt University • Individual application	Trained psychology graduate students and Audio-Tape Recording	Post	MD: 100% PR: 100%	• Smith Somatic Stress Symptoms Scale-State • The Six-item Cognitive Anxiety Inventory-State • The Focusing Inventory-State		+ + – –	+ + – 	N N N N

GAD: generalized anxiety disorder. PANIC: panic disorder. PHOB: any phobia. PTSD: post-traumatic stress disorder. OCD: obsessive-compulsive disorder. MIXED: mixed disorders. Dashed lines separate the same study analysed by different articles (reporting distinct time measures, outcomes, parameters, etc). CR: completion rate. St: study quality – considered as the opposite of risk of bias (Higgins *et al.*, 2011): low (–)/high (+)/unclear (?), from top to down: adequate generation of allocation sequence, concealment of allocation to conditions, prevention of knowledge of the allocated intervention, and dealing with incomplete outcome data. In: intervention quality (Chambless and Hollon, 1998): low (–)/high (+)/unclear (?), from top to bottom: the study referred to the use of a treatment manual; the therapists who conducted the therapy were trained; treatment integrity was checked during the study. RA: researcher allegiance (Cuijpers *et al.*, 2012): Y (yes)/N (no), from top to bottom: meditation was the only therapy referenced in the title; meditation was explicitly mentioned as the main experimental intervention in the introduction; relaxation therapy was explicitly described as a control condition and it was included to control for the non-specific components; there was an explicit hypothesis that meditation was expected to be more effective than relaxation therapy. Mn: mean. s.d.: standard deviation. Rg: range. MBI: mindfulness-based intervention. PR: progressive relaxation. AP: applied relaxation. Other: other different relaxation technique. Unrep.: unreported data. FA: focused attention. ACT: acceptance and commitment therapy. ABBT: acceptance based behavioural therapy. Acceptance: acceptance contexts of meditation practices. Compas.: compassionate meditation practices.

When two distinct meditation groups were compared with the same relaxation group – including multiple comparisons that were not independent of each other – we used the following sensitivity analysis procedure so as not to artificially affect heterogeneity and the overall ES: (1) we only included the largest ES comparison, (2) we only included the smallest ES comparison, and (3) we calculated the pooled ES for the two comparisons and included that one. Results from non-independent multiple comparisons and the afore-mentioned sensitivity analysis were compared in order to evaluate whether heterogeneity and ES remained similar. We also developed separate analyses that limited the outcomes to each anxiety outcome domain, assessment procedure and time point measurement.

ESs for continuous outcomes were estimated by subtracting the post-test (or follow-up) mean score of the meditation group from the mean score of the relaxation group, dividing by the pooled standard deviation. For dichotomous outcomes, we used the procedures provided by Borenstein *et al.* (2009) to calculate the corresponding Hedges' *g*. We transformed Hedges' *g* into the number needed to treat (NNT) to facilitate clinical interpretability, by using the methods of Kraemer and Kupfer (2006). The NNT is a measure used in communicating the effectiveness of healthcare interventions, and indicates the number of patients that need to be treated in order for one of them to benefit compared to a control condition, so that the higher the NNT, the less effective the treatment (Laupacis *et al.*, 1988). Finally, we defined acceptability as the study drop-out for any reason (Montero-Marin *et al.*, 2018*a*), and thus, we calculated the relative risk (RR) of dropping-out of meditation compared to relaxation. Because we only expected a limited number of studies, we conducted a sensitivity post-hoc power calculation according to the procedures described by Valentine *et al.* (2010).

Publication bias was evaluated by: (1) visually inspecting the funnel plot on anxiety outcomes; (2) Duval and Tweedie's trim and fill procedure, which provided the number of studies probably absent (Duval and Tweedie, 2000); and (3) Begg and Mazumdar's rank correlation, to test whether the adjusted and observed ESs differed from each other (Begg and Mazumdar, 1994); (4) Egger's test of the intercept to contrast the hypothesis of bias absence (Egger *et al.*, 1997). We also calculated Rosenthal's fail-safe *N* test (Rosenthal, 1979) to compute the number of studies needed to be added to the analysis to reach a statistically non-significant total effect, assuming a nil effect in the hidden studies.

We conducted subgroup analyses according to the mixed-effects model, in order to evaluate possible differences in ESs in regard to the meditation regimen, relaxation technique, target population, quality of the study (high quality – e.g. low risk of bias: met 3–4 criteria, and low quality – e.g. high risk of bias: met <4 criteria; Cuijpers *et al.*, 2016; Montero-Marin *et al.*, 2018*a*), quality of intervention (high: met 3 criteria, and low: met <3 criteria; Chambless and Hollon, 1998), and researcher allegiance (no allegiance: met 0 criteria, and allegiance: met any criteria; Cuijpers *et al.*, 2012). This mixed-effects model pools studies within the subgroups according to the random-effects model, and tests for possible significant differences between subgroups using the fixed-effects model (Borenstein *et al.*, 2009). Finally, we conducted two bivariate meta-regression analyses, with anxiety ES as the dependent variable, using the method of moments. As predictors, we entered the continuous variables of averaged age and percent of females. Regression coefficients and their associated *Z*-value and *p*-value were calculated.

All the contrasts were set with a significance level of $\alpha < 0.05$, and they were all two-tailed, except for the bias-related tests, which were one-tailed. Data were analysed by using the R-3.1.1, Stata-12 and Comprehensive Meta-Analysis-3.0 statistical packages.

Results

As can be seen in the flow chart (Fig. 1), 14 studies on anxiety (reported in 17 papers, with 16 possible comparisons between meditation and relaxation using anxiety outcomes) met inclusion criteria for the meta-analysis and were analysed – 1 study (Zargar *et al.*, 2013) met criteria for qualitative synthesis, but was discarded for meta-analysis because it did not provide anxiety outcomes. The characteristics of the 14 included studies are shown in Table 1 and their references are in the online Supplementary Material 2.

Characteristics of included studies

The 14 selected studies included 862 participants, 464 in the meditation groups and 398 in the relaxation groups. The average number of participants per condition was 31. There were 5 studies on high trait anxiety as a target (1 with alcohol abuse dual diagnosis, and 1 on high anxiety sensitivity), 3 on GAD, 2 on OCD, 2 on social anxiety, 1 on fear (of cancer recurrence), and 1 on PTSD. All the meditation procedures incorporated attentional elements, with focused attention the most commonly used (5 studies included mantra recitation; 3 studies included different focal stimulus; 2 studies used the breath as an anchor; and 1 study developed body awareness practices), but the open monitoring attentional technique was also used (2 studies with acceptance and commitment therapy, and 1 study with acceptance-based behavioural therapy, being that 2 studies also used other constructive contexts). A total of 5 studies included ingredients of constructive meditation practices, with a values orientation added to the attentional exercises (hereinafter 'attentional + constructive'). We found no studies using training in deconstructive meditation. There were differences in the sort of relaxation used, with progressive muscle relaxation the most present (8 studies), followed by applied relaxation (with 3 studies), although other techniques were also included (slow breathing with 2 studies, and music relaxation with 1 study). The interventions also differed in terms of treatment format (with 9 studies using an individual format, 3 studies using a group format, 1 study using both formats, and 1 study with unreported data), and application (with 9 studies using therapist application, 3 studies using audio application, and 2 studies using both therapist + audio applications). A total of 10 studies drove the research through a long intervention design, with an average duration of 7.11 weeks and 1.30 h per week (1 study reported no data), while 4 studies used short designs with only one day of exercises. The average number of therapy hours was 6.30, ranging from 0.18 to 18 h. The year of study publication ranged from 1978 to 2017. Of the studies, 11 were conducted in the USA, 1 in Australia, 1 in Canada, 1 in Germany, and 1 in Spain.

The quality of the studies, quality of interventions and researcher allegiance also varied. Only one study (7.2%) met all four study quality criteria; 3 studies (21.4%) met three criteria; and 10 studies (71.4%) met two criteria or fewer. Thus, 4 studies (28.6%) had low risk of bias, and 10 studies (71.4%) presented high risk of bias. All the studies (100%) reported an adequate

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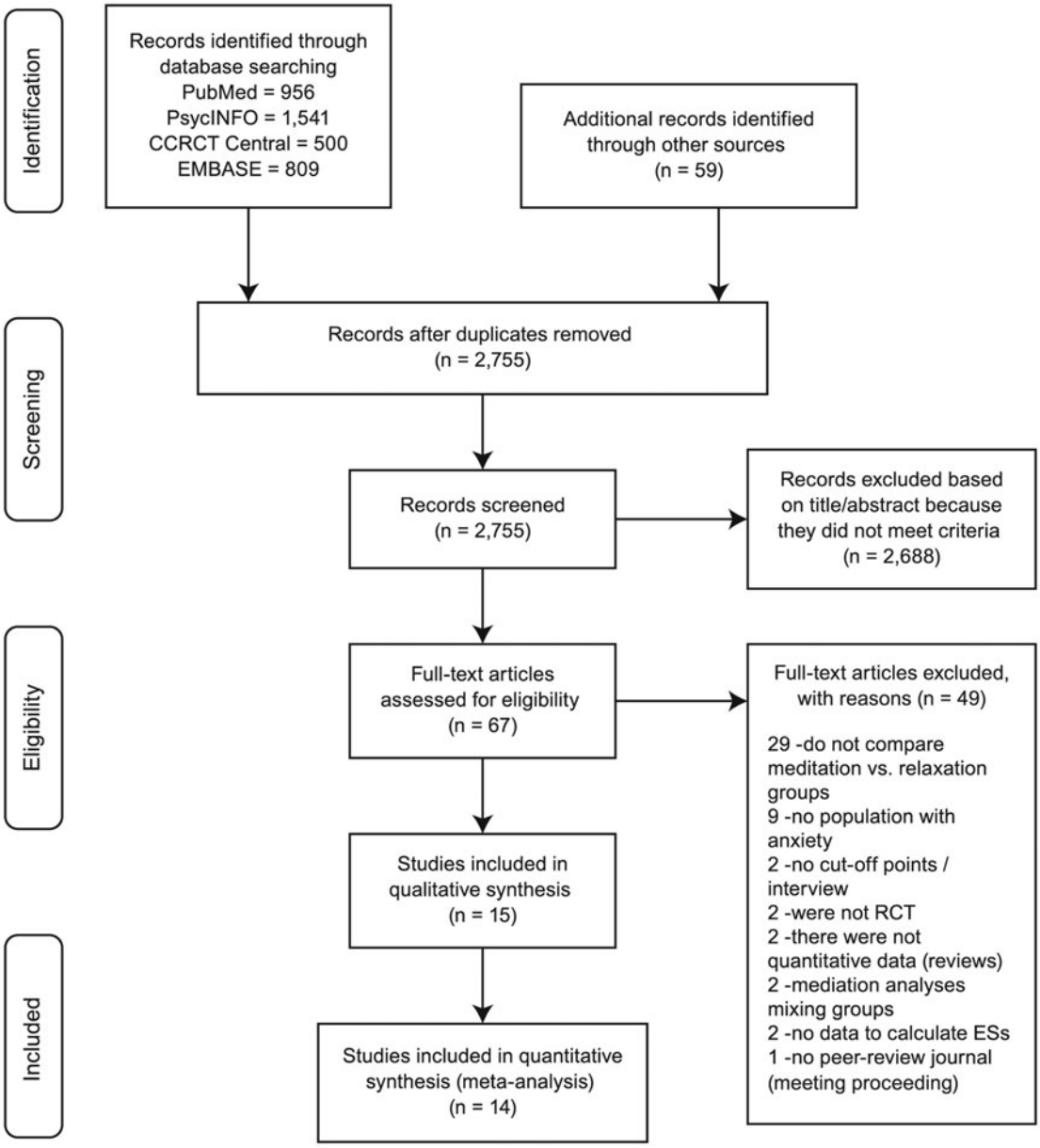

Fig. 1. PRISMA flow diagram.

sequence generation; 10 studies (71.4%) reported concealment of allocation to conditions; 2 studies (14.3%) reported prevention of knowledge of the allocated intervention; and 3 studies (21.4%) dealt correctly with incomplete outcome data. On the other hand, 3 studies (21.4%) met all three quality of intervention criteria; 6 studies (42.9%) met two quality of intervention criteria; and 5 studies (35.7%) met only one criterion (6 studies showed unclear quality of intervention in some criterion). Therefore, 3 studies (21.4%) showed high quality of intervention, and 11 studies (78.6%) were classified as having low quality of intervention. Finally, we found 8 studies (57.1%) with some evidence of researcher allegiance *v.* 6 studies (42.9%) with no evidence.

Overall effects on anxiety outcomes

From the 14 included studies, we compared the effects of meditation with relaxation in 16 possible comparisons (Table 2). The overall ES for anxiety outcomes was $g = -0.23$ (95% CI −0.38 to −0.08), favouring meditation, which corresponded to an NNT of 7.74. Heterogeneity was zero ($I^2 = 0$; 95% CI 0–52). Inspection of the forest plot of the ESs and their 95% CIs (Fig. 2) indicated there were no outliers and that taken one by one, almost all studies were underpowered - results of the power calculation for the meta-analysis are shown in Supplementary Material 2. We calculated the overall ES with the removal of mixed-methods data from one study (Colgan *et al.*, 2017), and the results were very similar (Table 2). We also removed the most weighted study (Butow *et al.*, 2017), which accounted for 21.75% of the overall ES, obtaining a significant $g = -0.20$ (95% CI −0.37 to −0.03), and maintaining no heterogeneity ($I^2 = 0$; 95% CI 0–54). Because one study included multiple meditation groups (Wahbeh *et al.*, 2016) that were included in the same analyses, we conducted an analysis with only one ES in this study (the largest, the smallest, and a combination of all of them). The resulting ESs ranged from $g = -0.24$ to

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Table 2. Effects of relaxation compared to meditation for the treatment of anxiety

	N_{comp}	g	95% CI	I^2	95% CI	NNT[a]
Anxiety						
All studies (overall)	16	−0.23**	−0.38 to −0.08	0	0–52	7.74
Removing mixed-methods data[b]	15	−0.23**	−0.39 to −0.07	0	0–54	7.74
Removing the study with the highest weight[c]	15	−0.20*	−0.37 to −0.03	0	0–54	8.89
One ES per study (lowest)	14	−0.23**	−0.40 to −0.06	4	0–57	7.74
One ES per study (highest)	14	−0.24**	−0.41 to −0.07	2	0–56	7.42
One ES per study (combined)	14	−0.23**	−0.40 to −0.07	2	0–56	7.74
Cognitive outcomes	8	−0.13	−0.37 to 0.10	21	0–63	–
Behavioural outcomes	2	−0.48	−1.44 to 0.48	41	n.c.	–
Physiological outcomes	10	−0.04	−0.27 to 0.18	9	0–66	–
Mixed anxiety domains	12	−0.26**	−0.43 to −0.10	0	0–58	6.85
Self-reported	13	−0.18*	−0.34 to −0.02	0	0–57	9.87
Assessor-reported	10	−0.26**	−0.50 to −0.02	14	0–55	6.86
Post-test	16	−0.23**	−0.39 to −0.07	9	0–46	7.74
Follow-up (3–12 months)	4	−0.28*	−0.54 to −0.02	13	0–87	6.37
Depression	8	−0.25*	−0.50 to −0.01	43	0–75	7.13
Others[d]	12	−0.13	−0.34 to 0.08	36	0–68	–
All outcomes[e]	16	−0.22**	−0.37 to −0.07	0	0–52	8.09

N_{comp}, number of comparisons; g, Hedges' g ES measure; 95% CI, 95% confidence interval; I^2, heterogeneity; NNT, number-needed-to-treat. n.c., not calculated confidence interval because of the absence of enough comparisons. *$p < 0.05$; **$p < 0.01$.

[a]NNT for non-significant results are not reported.

[b]Sensitivity analysis removing the mixed-methods data from Colgan *et al.*, 2017 (pertaining to the study of Wahbeh *et al.*, 2016).

[c]Sensitivity analysis removing the most weighted study (Butow *et al.*, 2017), which implied 21.75% of the overall ES.

[d]Including general functioning, clinical improvement, quality of life, auto-efficacy, distress, perceived stress, sleep quality, interpersonal problems, affectivity, emotional intelligence, mindfulness, attention/interference, cognitive ability and symptoms.

[e]Including anxiety, depression and others.

$g = -0.23$, with a combined ES of $g = -0.23$ (95% CI −0.40 to −0.07), leaving an NNT of 7.74, with very low heterogeneity ($I^2 = 2$; 95% CI 0–56). Only the mixed domain category of anxiety outcomes showed significant results, with a very similar ES to the overall calculation. Both the self-reported and assessor-reported outcomes showed significant ESs, with no or low heterogeneity. Post-test and follow-up (3–12 months) measures presented significant and very similar ESs, with low heterogeneity (Table 2).

Risk of publication bias

We found no indications of publication bias by inspecting the funnel plot. Duval and Tweedie's trim and fill procedure indicated that no studies were missing. Begg and Mazumdar's rank correlation was not significant ($\tau = -0.15$; $p = 0.222$). Egger's regression intercept was also not significant (intercept = −0.12; 95% CI −2.08 to 1.85; $p = 0.449$). The fail-safe N was 13. Therefore, 13 'null' studies would need to be included in order to find a statistically insignificant overall effect. In other words, 0.9 missing studies would be needed for every observed comparison in order for the effect to be nullified.

Overall effects on other outcomes

The overall ES on depression outcomes (Table 2) was significant ($g = -0.25$; 95% CI −0.40 to −0.01; NNT = 7.13), with moderate heterogeneity ($I^2 = 43$; 95% CI 0–75). The ESs for other outcomes (general functioning, clinical improvement, quality of life, auto-efficacy, distress, perceived stress, sleep quality, interpersonal problems, affectivity, emotional intelligence, mindfulness, attention and interference, cognitive ability and symptoms) were not significant ($g = -0.13$; 95% CI −0.34 to 0.08) and showed low to moderate heterogeneity ($I^2 = 36$; 95% CI 0–68). Considering all the outcomes described above (Table 1), differences between meditation and relaxation were small but significant ($g = -0.22$; 95% CI −0.37 to −0.07; NNT = 8.09), with no heterogeneity ($I^2 = 0$; 95% CI 0–52). The overall estimate of acceptability did not show significant differences between interventions (RR = 0.97; 95% CI 0.75–1.26).

Subgroup and meta-regression analyses

Subgroup analyses (Table 3) gave no significant differences in ESs on anxiety outcomes according to the type of meditation, relaxation technique, target population, quality of the study, quality of the intervention, and researcher allegiance. However, significant ESs only remained in the following subgroups: attentional + constructive meditation ($g = -0.39$; 95% CI −0.62 to −0.13), progressive relaxation ($g = -0.30$; 95% CI −0.56 to −0.04), target population ($g = -0.24$; 95% CI −0.41 to −0.07), high study quality, i.e. low risk of bias ($g = -0.28$; 95% CI −0.51 to −0.04), high intervention quality ($g = -0.36$; 95% CI −0.72 to −0.01), and

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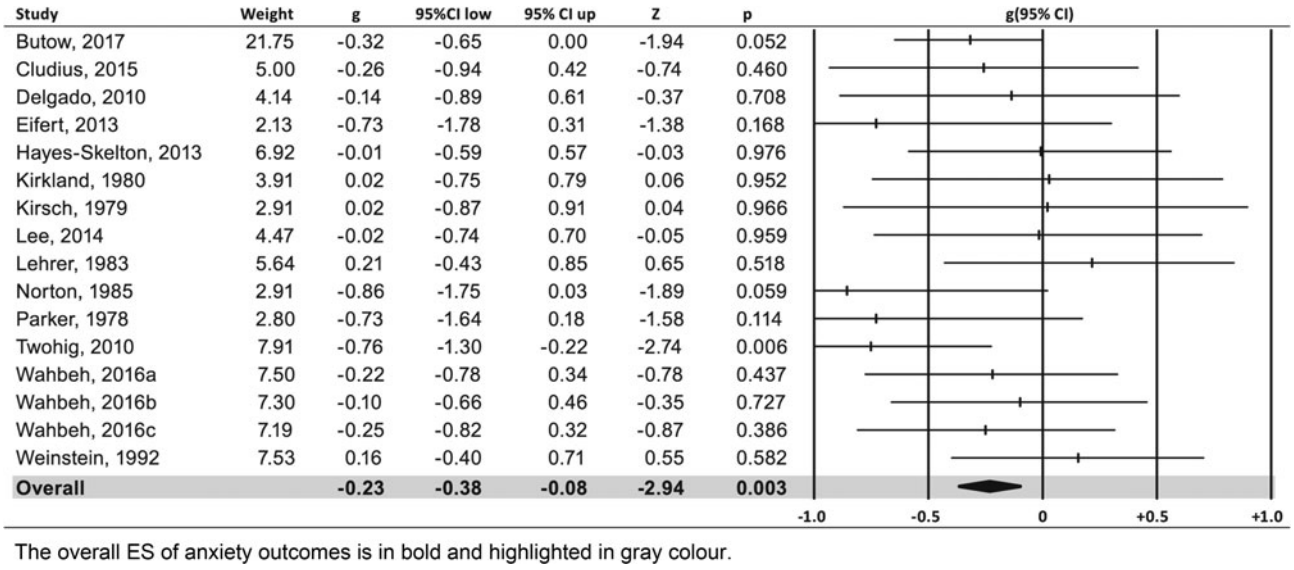

Fig. 2. Forest plot of standardized effect sizes on anxiety outcomes. Weight: study weight in terms of the contribution to the overall ES from the sample size. *g*: Hedges' *g* ES value. 95% CI low: low bond of the 95% confidence interval. 95% CI high: high bond of the 95% confidence interval. *Z*: *Z* statistic associated with the ES contrast. *p*: *p*-value related to the *Z* statistic. Wahbeh, 2016*a* includes the mixed-method results presented in Colgan *et al.* (2017). Wahbeh (2016*b*) includes the body scan comparison presented in Wahbeh *et al.* (2016). Wahbeh (2016*b*) includes the mindful breathing comparison presented in Wahbeh *et al.* (2016). More details are available in Table 1.

Table 3. Effects of relaxation *v.* meditation for the treatment of anxiety: subgroup analyses

	N_{comp}	*g*	95% CI	I^2	95% CI	p^a	NNT[b]
Meditation technique							
Attentional	11	−0.13	−0.33 to 0.07	0	0–60	0.171	–
Attentional + constructive	5	−0.36**	−0.61 to −0.11	8	0–81		4.98
Relaxation technique							
PR	8	−0.30*	−0.56 to −0.04	33	0–70	0.473	5.95
AR	3	0.01	−0.40 to 0.42	0	0–90		–
Others[c]	5	−0.20	−0.49 to 0.08	0	0–79		–
Target population							
High trait anxiety[d]	5	−0.28	−0.76 to 0.20	47	0–81	0.877	–
Anxiety disorder[e]	11	−0.24**	−0.41 to −0.07	0	0–60		7.42
Quality of the study							
High[f]	6	−0.28*	−0.51 to −0.04	0	0–75	0.606	6.37
Low[g]	10	−0.19	−0.39 to 0.01	0	0–62		–
Quality of the intervention							
High[h]	3	−0.36*	−0.72 to −0.01	43	0–83	0.312	4.98
Low	13	−0.15	−0.34 to 0.04	0	0–57		–
Researcher allegiance							
No[i]	6	−0.11	−0.46 to 0.24	23	0–67	0.389	–
Yes	10	−0.28**	−0.46 to −0.10	0	0–62		6.37

N_{comp}, number of comparisons; *g*, Hedges' *g* ES; 95% CI, 95% confidence interval; I^2, heterogeneity; NNT, number-needed-to-treat; PR, progressive relaxation; AP, applied relaxation. *$p < 0.05$; **$p < 0.01$.

[a]*p*-values in this column indicate whether the difference among the ESs in the subgroups is significant.

[b]NNT for non-significant results are not reported.

[c]Including slow breathing and listening to relaxing music.

[d]Including high trait and sensitivity anxiety.

[e]Including GAD, OCD, social anxiety, fear of recurrence, PTSD.

[f]High quality of the study (low risk of bias) includes those studies that meet three or four study quality criteria (Higgins *et al.*, 2011; Cuijpers *et al.*, 2016; Montero-Marin *et al.*, 2018*a*).

[g]Low quality of the study (high risk of bias) includes those studies that meet less than three study quality criteria (Higgins *et al.*, 2011; Cuijpers *et al.*, 2016; Montero-Marin *et al.*, 2018*a*).

[h]Including studies that meet the three intervention quality criteria (Chambless and Hollon, 1998).

[i]Including studies meeting none allegiance criteria (Cuijpers *et al.*, 2012).

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presence of researcher allegiance ($g = -0.28$; 95% CI −0.46 to −0.10). The meta-regression analyses gave no indication that ES was associated with mean age ($B < 0.01$; $Z = 0.03$; $p = 0.975$), and percent of females ($B < 0.01$; $Z = 0.01$; $p = 0.988$).

Discussion

We examined the effects of meditation techniques for the treatment of anxiety compared to relaxation therapy – a specific active condition that has demonstrated moderate efficacy in reducing anxiety symptoms in different types of populations with significant effects (Manzoni *et al*., 2008), and with no evidence of being less effective than CBT for some anxiety disorders (Montero-Marin *et al*., 2018*a*). For this purpose, a meta-analysis of fourteen RCTs was conducted, from which a small but statistically significant overall ES was obtained in favour of meditation that was maintained at 12-month follow up, with very low heterogeneity. Surprisingly, results showed more homogeneous effects than expected. This could mean that despite the different therapeutic techniques and subtypes of anxiety disorders, effects could be quite similar when comparing meditation and relaxation. Nevertheless, not all meditation and relaxation techniques were included in the analysis and no study included patients suffering from panic disorder. Therefore, it cannot be ruled out that if future research is able to include a broader spectrum of techniques and anxiety disorders, higher levels of heterogeneity may be found.

The difference between conditions was consistently observed across self-reported and assessor-reported measures, and it was maintained when only high-quality studies – 28.6% of selected studies (Higgins *et al*., 2011) – and high-quality interventions – 21.4% (Chambless and Hollon, 1998) were considered. However, we found low and non-significant effects when only studies free of researcher allegiance were included – 42.9% (Cuijpers *et al*., 2012). There were also non-significant effects when using cognitive, behavioural and physiological anxiety outcomes separately, and only the mixed domain of anxiety appeared significant. This result was also observed in a previous meta-analysis comparing CBT *v*. relaxation therapy (Montero-Marin *et al*., 2018*a*), noting that the coupling of all the anxiety domains would be where differential effects of treatments can be detected. Although we did not find significant differences in the subgroup analyses, not all the subgroups remained significant. Our results suggest that the constructive regimen of meditation added to attentional practices is the option that would keep significant benefits, perhaps as a result of synergies obtained from meditative components that strengthen the self-regulation of attentional processes, but also allowing cognitive and affective patterns to be cultivated that foster well-being at the same time (Lutz *et al*., 2008, 2015; Dahl *et al*., 2015). It was observed that progressive muscle relaxation was significantly worse than meditation – although differences were small and the risk of bias among this subgroup was considerable – which is easy to understand if we consider that it does not usually include training to cope with real situations, as occurs with other relaxation techniques – e.g. applied relaxation (Öst, 1987). Interestingly, significant effects were maintained when the groups studied were patients specifically diagnosed with anxiety disorders and not only suffering from elevated trait anxiety, which reinforces the use of meditation techniques in clinical settings (Graser and Stangier, 2018). The bivariate meta-regression analyses using the continuous variables of age and percent of females did not show significant effects, but the statistical power to develop this kind of analysis was rather fair owing to the number of studies included.

Although significant, the overall ES observed was small and its clinical relevance could be put in doubt. This result is actually not very surprising if we consider that relaxation itself has been proposed as an active control condition or even as a clear behavioural strategy to reduce anxiety (Hayes-Skelton *et al*., 2013). A previous meta-analysis that included different types of populations concluded that relaxation techniques such as autogenic training, progressive relaxation and others may present moderate effects on anxiety (Manzoni *et al*., 2008). This meta-analysis also showed that mindfulness-based interventions and transcendental meditation might present effects that would be significantly greater than those obtained by the previously described relaxation techniques, which is in line with our results. However, the comparability of this study is limited due to the enormous diversity of populations included, and the scarce types of meditation regimens used. Another meta-analysis (Orme-Johnson and Barnes, 2014) that tested the effects of transcendental meditation on the high trait anxiety suffered by several populations obtained moderate effects compared to controls who received some active treatment, and moderately large effects when using controls with treatment as usual. Goldberg *et al*. (2018) observed low effects on patients suffering from anxiety disorders, favouring meditation when they used active control conditions as comparators, but favouring evidence-based treatments for anxiety when this comparator was used. However, the potential of using meditation practices for the treatment of anxiety was not really clarified with this study, because the analysis was restricted to the reduced field of mindfulness-based interventions (Goldberg *et al*., 2018), and thus, other forms of meditation were discarded (Lutz *et al*., 2008, 2015; Dahl *et al*., 2015). The study of Goyal *et al*. (2014) used a more extensive definition of meditation, including both mindfulness and mantra-based meditations, but it suffered from the same limitation as the previous studies, ruling out programmes that include techniques with a values orientation added to attentional exercises (Lutz *et al*. 2008, 2015; Dahl *et al*. 2015). This study obtained a moderately low ES at post-test, but heterogeneity was very high, perhaps because they included distinct psychiatric and medical conditions, and because the comparators they used comprised specific and non-specific active control conditions – only those comparisons with non-specific controls remained significant, and no evidence was found that meditation programmes were superior to specific active controls, although they observed an effect at follow up that was very close to that obtained in our study.

We observed a small but significant difference in depression outcomes, which was similar to that obtained by Goyal *et al*. (2014), who observed that after separating non-specific and specific active controls, only the first comparison remained significant. However, as mentioned, the comparability of that study is limited. Mindfulness-based interventions compared to no treatment in depressive patients have demonstrated moderately large effects, and these have been moderately low when compared to specific active control conditions (Goldberg *et al*., 2018), which is coherent with our results – in the case of evidence-based treatments for depression no differences were found. We observed no significant differences in other outcomes, e.g. quality of life, nor treatment acceptability. The latter may be due because none of the programmes forced to cope with uncomfortable situations, and thus caused similar attrition rates (Montero-Marin *et al*., 2018*a*). However, we do not know – because no studies using this regimen were found – whether the deconstructive family of mediation practices, e.g. those driven by self-inquiry processes,

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might produce different effects and attrition rates. Self-inquiry should aim to identify the fearful assumptions that underlie anxiety, inquiring into the rationale of beliefs and directly examining the anxious experience, noticing how thoughts, feelings and physical sensations that compose that emotion change and influence each other (Dahl *et al.*, 2015).

In general, we may suppose that the differential effects between meditation and relaxation might respond to distinct mechanisms of action. It has been suggested that decentring could be a potential mechanism of change in meditation practices such as mindfulness trainings (Feldman *et al.*, 2010). Through them, patients may learn to disengage with negative thoughts and emotions, experiencing the temporary and passing nature of mental events, and thus reducing reactivity (Bohlmeijer *et al.*, 2010). This may be accompanied by increases in attentional performance, and reductions in rumination and worry (Jain *et al.*, 2007; Semple, 2010; Gu *et al.*, 2015). On the contrary, relaxation therapies such as progressive muscle relaxation aim to induce physiological relaxation as the opposite of tension, and they have been proposed as logical treatments for the overly anxious person (McCallie *et al.*, 2006). Their aims and rationale could be summarized in the words of their founder: 'an anxious mind cannot exist in a relaxed body' (Jacobson, 1974). However, few studies have explored the specific action mechanisms of relaxation. It appears that some aspects of relaxation therapy might overlap with some meditative practices, in the sense that both incorporate components that train attentional processes (Gao *et al.*, 2018). This is why relaxation seems to lead to improvements in some of the mindfulness skills, but to a lower extent than meditation practices do (Agee *et al.*, 2009; Moritz *et al.*, 2015; Gao *et al.*, 2018). Nevertheless, aside from the common attentional training processes derived from present-moment awareness exercises, there could be other therapeutic action mechanisms that might differentiate meditation (in a broad sense of practices) and relaxation therapies. For instance, psychological flexibility has been proposed as a mediator of changes in the attachment-based compassion therapy (ABCT) of the constructive regimen of meditation (Montero-Marin *et al.*, 2018*b*), and might constitute a candidate that should be specifically investigated in anxious patients.

Limitations

This meta-analysis has the important limitation of not counting on a large enough number of studies with which to analyse the specific effects on the distinct anxiety disorders – e.g. we found no studies with agoraphobia and panic, and there was not a sufficient number of studies on other disorders with which to establish comparisons among them. Nor did we find comparisons integrating deconstructive meditation techniques, and consequently, our intention of using the broadest definition of meditation was not entirely met. A comprehensive search strategy was implemented focused on including a wide range of text words and synonyms. We believe this search strategy had no bearing on the fact that few studies were retrieved, although other strategies may offer different results. However, it is clear that more RCTs including specific anxiety disorders, comparing meditation practices in a broad sense, and relaxation as a specific active control condition, are needed. Some of the deconstructive practices used in other diseases that could be tested are mindfulness-based cognitive therapy (MBCT), vipassana-insights, koan-practices, self-inquiry, etc. Other attentional – e.g. breath counting, mindfulness-based stress reduction (MBSR), dialectical behaviour therapy (DBT), etc. – and constructive – e.g. loving-kindness, compassion practices, well-being therapy, etc. – meditation practices should also be tested *v.* relaxation therapy in the context of anxiety disorders with appropriate RCT designs. We observed that effects were maintained significant until 12-months, but the number of studies with follow-up measures was scarce, and more research is needed in this regard. We also found some evidence that researcher allegiance might be playing a moderating role, because the total absence of this characteristic revealed no significant effects. Therefore, it seems necessary to be more cautious in this regard when developing new research. In addition, although there was no evidence of publication bias, possible bias due to selective outcome reporting was not assessed, and thus we do not know whether statistically non-significant results were selectively withheld from publications, overestimating intervention effects. Finally, we were not able to investigate whether baseline anxiety scores were related to outcomes because of the use of different instruments and anxiety domains.

Implications

Despite the mentioned limitations, we should note that meditation practices have a small but significant advantage compared to relaxation therapy for the treatment of anxiety symptoms. However, we do not possess enough information to specify their effects on each anxiety disorder. In addition, more RCTs using the entire range of meditation techniques from all the regimens that comprise this family of practices seems to be recommended, if we are to have a precise idea of the potential of these techniques in comparison with relaxation therapy. In conclusion, one meditation practice based on attentional and constructive techniques appears to be somewhat more effective than relaxation therapy for the treatment of anxiety, and it seems to remain more effective at 12-month follow-up. Therefore, its use can be recommended. Nevertheless, considering the small effect size obtained, future cost-benefit analyses are needed to clarify to what extent it is worth using meditation or relaxation therapy to treat anxiety disorders.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S0033291719001600

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Ethical standards. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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