


Yoga-based interventions may reduce anxiety symptoms in anxiety disorders and depression symptoms in depressive disorders: a systematic review with meta-analysis and meta-regression

Javier Martínez-Calderon ^{1,2}, María Jesús Casuso-Holgado,^{1,2}
 María Jesús Muñoz-Fernandez,^{2,3} Cristina García-Muñoz ^{2,4},
 Alberto Marcos Heredia-Rizo^{1,2}

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bjsports-2022-106497>).

¹Departamento de Fisioterapia, Facultad de Enfermería, Fisioterapia y Podología, Universidad de Sevilla, Sevilla, Spain

²Uncertainty, Mindfulness, Self, Spirituality (UMSS) Research Group, Sevilla, Spain

³Department of Physiotherapy, University School Francisco Maldonado, Sevilla, Spain

⁴Department of Nursing and Physiotherapy, Faculty of Nursing and Physiotherapy, University of Cadiz, Cadiz, Spain

Correspondence to

Dr Cristina García-Muñoz, Department of Nursing and Physiotherapy, Faculty of Nursing and Physiotherapy, University of Cadiz, Cadiz, CP 11009, Spain; cristina.garciamunoz@uca.es

Accepted 7 June 2023



© Author(s) (or their employer(s)) 2023. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Martínez-Calderon J, Casuso-Holgado MJ, Muñoz-Fernandez MJ, et al. *Br J Sports Med* Epub ahead of print: [please include Day Month Year]. doi:10.1136/bjsports-2022-106497

ABSTRACT

Objective To summarise the effect of mind–body exercises on anxiety and depression symptoms in adults with anxiety or depressive disorders.

Design Systematic review with meta-analysis and meta-regression.

Data sources Five electronic databases were searched from inception to July 2022. Manual searches were conducted to explore clinical trial protocols, secondary analyses of clinical trials and related systematic reviews.

Eligibility criteria Randomised clinical trials evaluating qigong, tai chi or yoga styles with anxiety or depression symptoms as the outcomes were included. No intervention, waitlist or active controls were considered as control groups. The risk of bias and the certainty of the evidence were assessed. Meta-analyses, meta-regressions and sensitivity analyses were performed.

Results 23 studies, comprising 22 different samples (n=1420), were included. Overall, meta-analyses showed yoga interventions were superior to controls in reducing anxiety symptoms in anxiety disorders. Furthermore, yoga-based interventions decreased depression symptoms in depressive disorders after conducting sensitivity analyses. No differences between groups were found in the rest of the comparisons. However, the certainty of the evidence was judged as very low for all outcomes due to concerns of high risk of bias, indirectness of the evidence, inconsistency and imprecision of the results. In addition, there was marked heterogeneity among yoga-based interventions and self-reported tools used to evaluate the outcomes of interest.

Conclusion Although yoga-based interventions may help to improve mental health in adults diagnosed with anxiety or depressive disorders, methodological improvements are needed to advance the quality of clinical trials in this field.

PROSPERO registration number CRD42022347673.

INTRODUCTION

Affective disorders, especially anxiety and depression, are highly prevalent in our society.^{1 2} The global prevalence of depressive disorders has been estimated at 20%,¹ whereas anxiety disorders range from 3.8% to 25%.² These mental illnesses greatly contribute to maintaining chronic symptoms (eg, disability) and increasing mortality rates,^{3–5} which cause important socioeconomic costs.^{6 7} Recent

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Mind–body practices are superior to control interventions in enhancing disease-related outcomes among people with varied affective disorders. However, the certainty of evidence has not been systematically evaluated.

WHAT THIS STUDY ADDS

⇒ Yoga interventions may improve anxiety symptoms in anxiety disorders and depression symptoms in depressive disorders.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Certainty of the evidence was judged to be very low because of the high risk of bias, inconsistency and heterogeneity of the mind–body interventions studied.

systematic reviews have found that different exercise programmes, when used as an adjuvant or alone, are effective in reducing anxiety symptoms and producing antidepressant effects among people with affective disorders.^{8–11} Empirical research in mind–body practices, specifically qigong, tai chi and yoga, has grown exponentially in the field of neuroscience and mental illness in the last decade. Notably, the improvement of brain health after applying tai chi or yoga is supported by recent reviews.^{12 13} Mind–body practices have also been found to be superior to control interventions in enhancing disease-related outcomes among people with schizophrenia,¹⁴ eating disorders,¹⁵ post-traumatic stress disorders¹⁶ or substance use disorders.^{17 18} Although several systematic reviews have investigated the role of mind–body practices in anxiety or depressive disorders,^{19–23} there are still some important gaps in current knowledge, which led us to perform the present systematic review. In the last 3 years, a single review has covered this topic, focusing on perinatal depression.²⁰ In addition, none of the previous systematic reviews^{19–23} have evaluated the certainty of the evidence using a gold standard tool.²⁴ Therefore, our objective was to develop a systematic review with meta-analysis and meta-regression to assess the effectiveness of qigong, tai chi and yoga-based interventions in

modulating anxiety and depression symptoms in adults diagnosed with anxiety or depressive disorders.

METHODS

Protocol and registration

The systematic review protocol was registered in PROSPERO (CRD42022347673). This systematic review followed the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines²⁵ and the PRISMA for abstract checklist.²⁶

Equity, diversity and inclusion statement

This systematic review included all identified randomised clinical trials in anxiety or depressive disorders inclusive of all genders, race/ethnicities, socioeconomic levels and occurrence in a marginalised community. Our author team consisted of three women and two men all physiotherapists, including three authors considered junior researchers. Data collection was similar in all cases, and we did not alter methods based on regional, educational or socioeconomic differences of the community in which the case occurred.

Data sources and search strategy

A reviewer (MJC-H) searched CINAHL (via EBSCOhost), Embase, PubMed, PsycINFO (via ProQuest) and SPORTDiscus (via EBSCOhost) from inception to July 2022. No idioms or restrictions on publication date were imposed. Another reviewer (JM-C) performed manual searches on clinical trial protocols, secondary analyses of clinical trials and systematic map reviews related to the topic to search for potential clinical trials not retrieved from electronic databases. Online supplemental file 1 shows full electronic and manual search strategies.

Eligibility criteria

The PICOS framework (Population, Intervention, Comparator, Outcomes, Study design) was used to guide eligibility criteria.²⁷ We included randomised clinical trials that evaluated the effectiveness of qigong or tai chi styles and yoga-based interventions in adults clinically diagnosed with anxiety or depressive disorders. Diagnoses were based on any version of the Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria or the International Classification of Diseases, 11th revision (ICD-11) for mental, behavioural or neurodevelopmental disorders (<https://icd.who.int/browse11/l-m/en>).^{28–32} Anxiety or depression symptoms measured with self-reported tools were the outcomes of interest. Control groups were no intervention, waitlist and active controls. Those clinical trials where qigong, tai chi or yoga were used as a control group or they were combined with other experimental therapies as part of the treatment intervention (eg, yoga plus cognitive-behavioural therapy) were excluded. Conference abstracts, thesis dissertations and any clinical trial that did not report enough data to be part of our meta-analyses were excluded.

Study selection

Zotero Desktop (V.6.0.13) was used to remove duplicated records. This step was double-checked manually. Subsequently, a reviewer (JM-C) filtered the records by title and abstract, and those abstracts that seemed potentially eligible or those studies where the abstract was unavailable were evaluated by full text. When there was disagreement on study inclusion, two reviewers (JM-C and MJC-H) reached a consensus on 13 occasions during the last screening process.

Risk of bias assessment

Two independent reviewers (CG-M and MJM-F) used the revised Cochrane Risk of Bias tool for randomised trial version 2 (RoB-2) to assess the risk of bias in randomised clinical trials.³³ RoB-2 consists of five domains showing an overall score ranked 'Low', 'Some Concerns' or 'High' risk of bias.

Certainty of the evidence

Two independent reviewers (CG-M and JM-C) applied the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) approach to judge certainty of the evidence based on five domains: risk of bias, imprecision, inconsistency, indirectness and publication bias.³⁴ In randomised controlled trials, certainty of the evidence starts with high evidence and can be downgraded to moderate, low or very low.³⁴

Description of interventions

A reviewer (MJM-F) used the Template for Intervention Description and Replication (TIDieR) checklist, which is based on 12 items (eg, who provided the therapy), to assess whether the interventions were reported in sufficient detail to be replicated.³⁵

Spin in clinical trial abstracts

Two reviewers (AMH-R and MJC-H) independently evaluated the presence of spin of information in the abstracts, using a checklist that consists of seven items (eg, omission of primary outcomes or the failure to report statistically non-significant primary outcomes) that are rated as Yes or No.³⁶ An overall score is obtained after adding up the number of positive answers in each included trial. Subsequently, an overall mean with its SD is provided.

Data synthesis

A reviewer (AMH-R) extracted the following information for each trial, when possible: author(s), year of publication, country, the number of participants, mean age, the type of affective disorder, diagnostic criteria, experimental and control group details, outcomes and qualitative findings. We contacted a corresponding author to request information needed (ie, mean values and SD after intervention) to include this study in our meta-analyses. A reminder was sent 1 week after the first contact. We did not receive any answer and, therefore, this study was excluded.³⁷ Furthermore, two clinical trials shared the same sample^{38 39} and we decided to evaluate the study with a larger number of participants.³⁸ Two reviewers (CG-M and MJC-H) used the R studio software (v. 4.1.1) with the packages of meta (v.5.1–1),⁴⁰ metafor (v.3.0–2)⁴¹ and dmetar (v.0.0.9000)⁴² to perform each meta-analysis. The Microsoft Excel spreadsheet (v. 2007) was used to create a dataset. Meta-analyses were developed according to the type of mind-body exercise, the clinical condition and the outcome of interest (ie, yoga+depressive disorders+depression symptoms). Meta-analyses were also divided by control interventions, when possible. A random-effect model was used assuming the presence of heterogeneity among clinical trials. Data were pooled with an inverse variance weighting method, and standard mean differences (SMDs) were estimated using the Hedge's g method. The sizes of the Hedge's g effect can be classified into small effect (g=0.2), medium effect (g=0.5) or large effect (g=0.8). Heterogeneity among clinical trials was assessed using I² statistics,

and Tau² was also added to the forest plots. Forest plots were designed to report the results of each meta-analysis. Sensitivity analyses were developed to detect outliers or influential cases using influence analysis, leave-one-out methods, the Baujat plot and exploratory analysis of the data. If one study was detected as an outlier or influential case, it was removed from the meta-analysis. The prediction interval was added to the forest plots when the meta-analysis included at least three trials and accounts for the heterogeneity between the trials to assess the probability if true treatment effects can be expected in future settings.⁴³ Publication bias and the possible presence of small-study effects were tested using a funnel plot and Egger's test.⁴⁴ Meta-regressions were performed to explore potential sources of heterogeneity, including covariates at both the person level and the study level.⁴⁵ Covariates were evaluated if they were reported at least in three studies and were not iterative. The following predictors were included: age, control comparator, depression severity, duration of sessions, frequency of sessions, intervention provider, number of female participants, number of male participants, number of sessions, RoB-2, sample size and treatment duration (weeks). In addition, subgroup meta-analyses were performed to explore possible sources of heterogeneity related to the use of different assessment tools and mind-body exercise styles. These

analyses were conducted when at least two studies presented the same category for the mentioned factors.

RESULTS

Study selection

Electronic databases and manual search strategies retrieved 305 eligible records. Of those initially detected, 23 records (comprising 22 different samples) were included (see figure 1). A list of records excluded during the final screening phase (n=68) is listed in online supplemental file 2.

Description of clinical trials

The total number of participants was 1420. Two clinical trials evaluated yoga-based interventions in anxiety disorders.^{46 47} Yoga was compared with drugs or naturopathy and the duration of the interventions ranged from 3 to 12 weeks. The rest of the clinical trials focused on depressive disorders, including diagnoses such as dysthymia, unipolar disorder, mild or moderate depression and pregnancy-related depression.^{38 48–66} The most frequent diagnosis for depression was major depression, as diagnosed using different DSM versions. Yoga was the mind-body exercise most explored (n=16), followed by tai chi (n=4) and qigong (n=2). These interventions were performed alone or together with other approaches such as meditation, education,

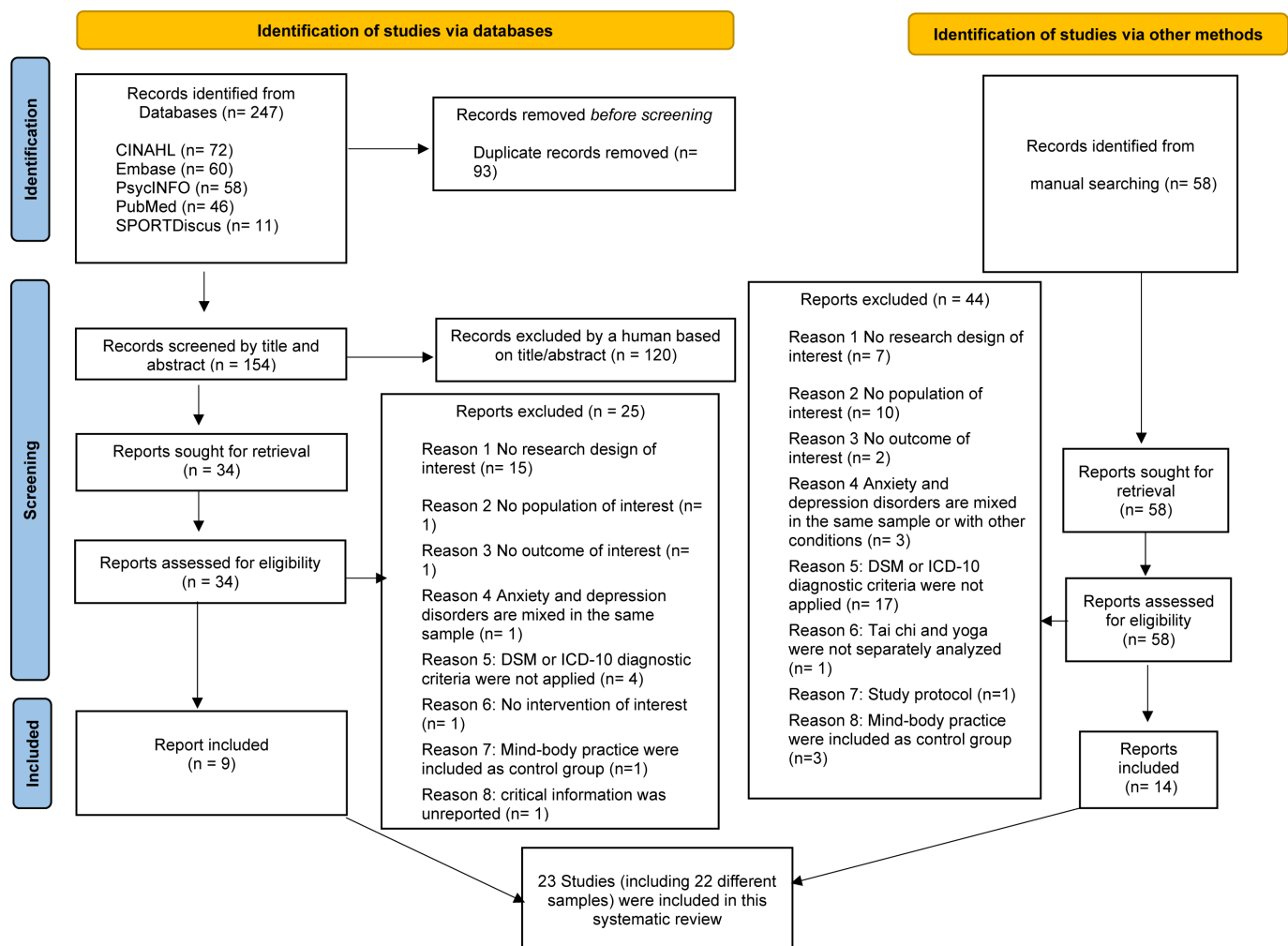


Figure 1 PRISMA flow chart. DSM, Diagnostic and Statistical Manual of Mental Disorders; ICD-10, International Classification of Diseases, 10th revision; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

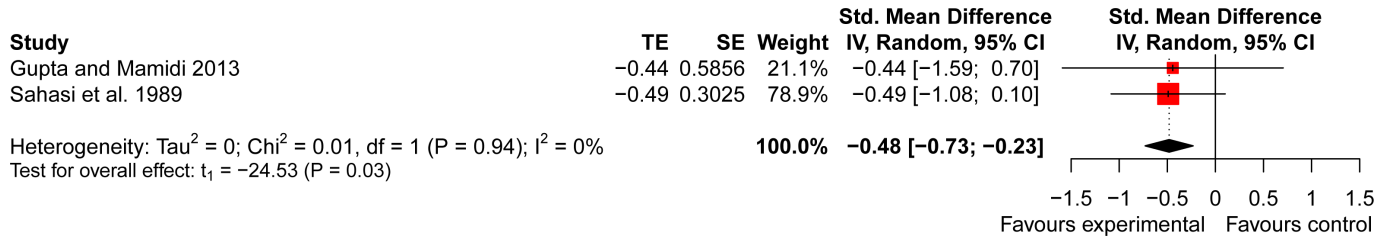


Figure 2 Meta-analysis: the effects of yoga on anxiety symptoms in anxiety disorders. TE, effect size.

diet changes, drug therapy, or usual care. The duration of the interventions ranged from 4 to 12 weeks. Mind–body exercises were compared with usual care, waitlist, education, drug therapy, aerobic exercise or psychological therapy. Online supplemental file 3 shows the characteristics of included studies.

Risk of bias assessment

No clinical trials were judged to have an overall low risk of bias (online supplemental files 4 and 5; inter-rater reliability, 95.45%). Bias due to deviations from intended interventions and bias arising from the randomisation process were the most prevalent.

Spin of information

The total spin-abstract score was 60, with a mean value of 2.8±1.4 points (online supplemental file 6; inter-rater reliability, 83%). All abstracts, except one,¹⁴⁸ showed some form of spin, which may indicate a misrepresentation of the study findings to some extent. The most common types of spin were ‘failure to mention adverse events of interventions’ (n=17) and ‘selective reporting of positive results and omission of negative results of primary outcomes’ (n=11). A study without an abstract section was excluded from this analysis.⁵⁶

Completeness of intervention descriptions

No clinical trials completed all items included in the TIDieR checklist. Item 10 (modifications of the intervention during the study) (n=1, 4.54%), item 9 (tailoring of the intervention) (n=3, 13.63%) and items 11 and 12 (adherence details) (n=5, 22.72%) were scarcely reported (see online supplemental file 7).

Certainty of the evidence (GRADE)

Serious concerns were mainly detected in terms of risk of bias, indirectness of the evidence, inconsistency and imprecision of the results, which caused certainty of the evidence to be judged as very low for all outcomes (see online supplemental files 8 and 9; inter-rater reliability, 84%).

Anxiety disorders: yoga-based interventions on anxiety symptoms (GRADE: very low evidence)

A meta-analysis showed that yoga-based interventions were superior to control interventions in reducing anxiety symptoms (g (95% CI)= -0.48 (-0.73 to -0.23); I²=0%; Tau²=0) (figure 2). Two clinical trials^{46 47} were included in the meta-analysis, evaluating anxiety symptoms with the Hamilton Anxiety Rating Scale or the Institute for Personality and Ability Testing. The outcome assessment points ranged from 3 to 12 weeks. There was no specific yoga style, although both trials shared some approaches such as yoga poses (asanas) and yoga breathing exercises (pranayama). The duration of yoga-based interventions was heterogeneous, ranging from 3 to 12 weeks (see further information, online supplemental file 3). Only two clinical trials were included, and thus, publication bias and meta-regression analysis could not be developed.

Depressive disorders: yoga-based interventions on anxiety symptoms (GRADE: very low evidence)

A meta-analysis found no differences between yoga-based interventions and control interventions to decrease anxiety symptoms (g (95% CI)= -0.02 (-0.67 to 0.63); I²=74%; Tau²=0.28)

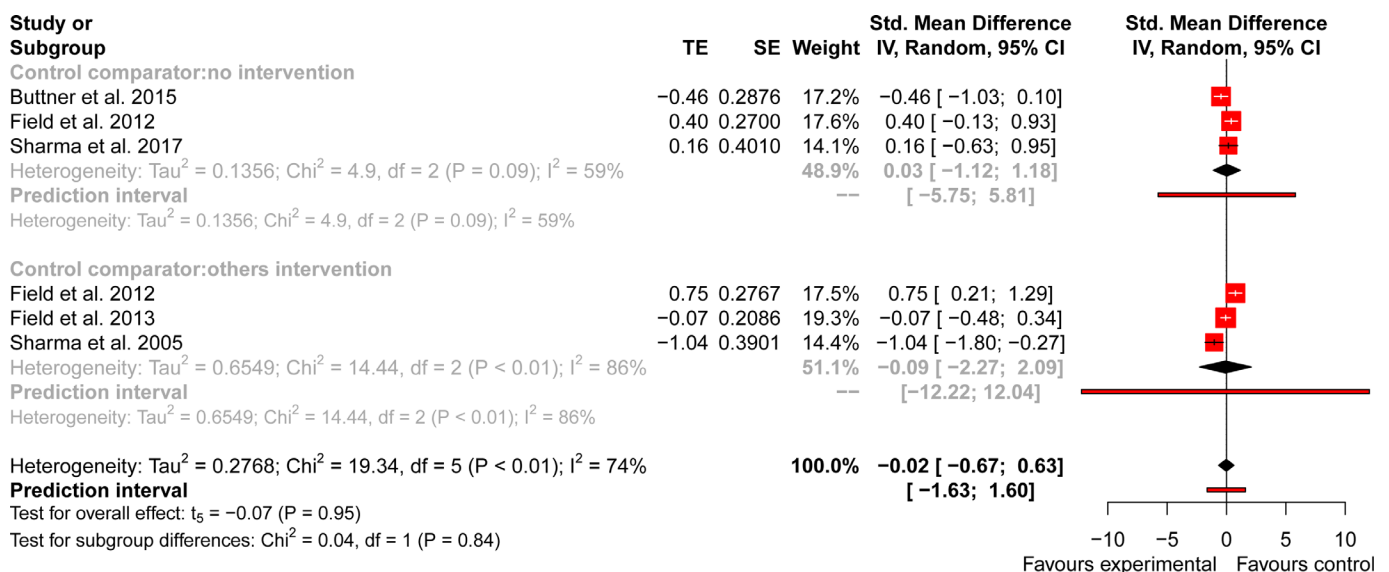


Figure 3 Meta-analysis: the effects of yoga on anxiety symptoms in depressive disorders.

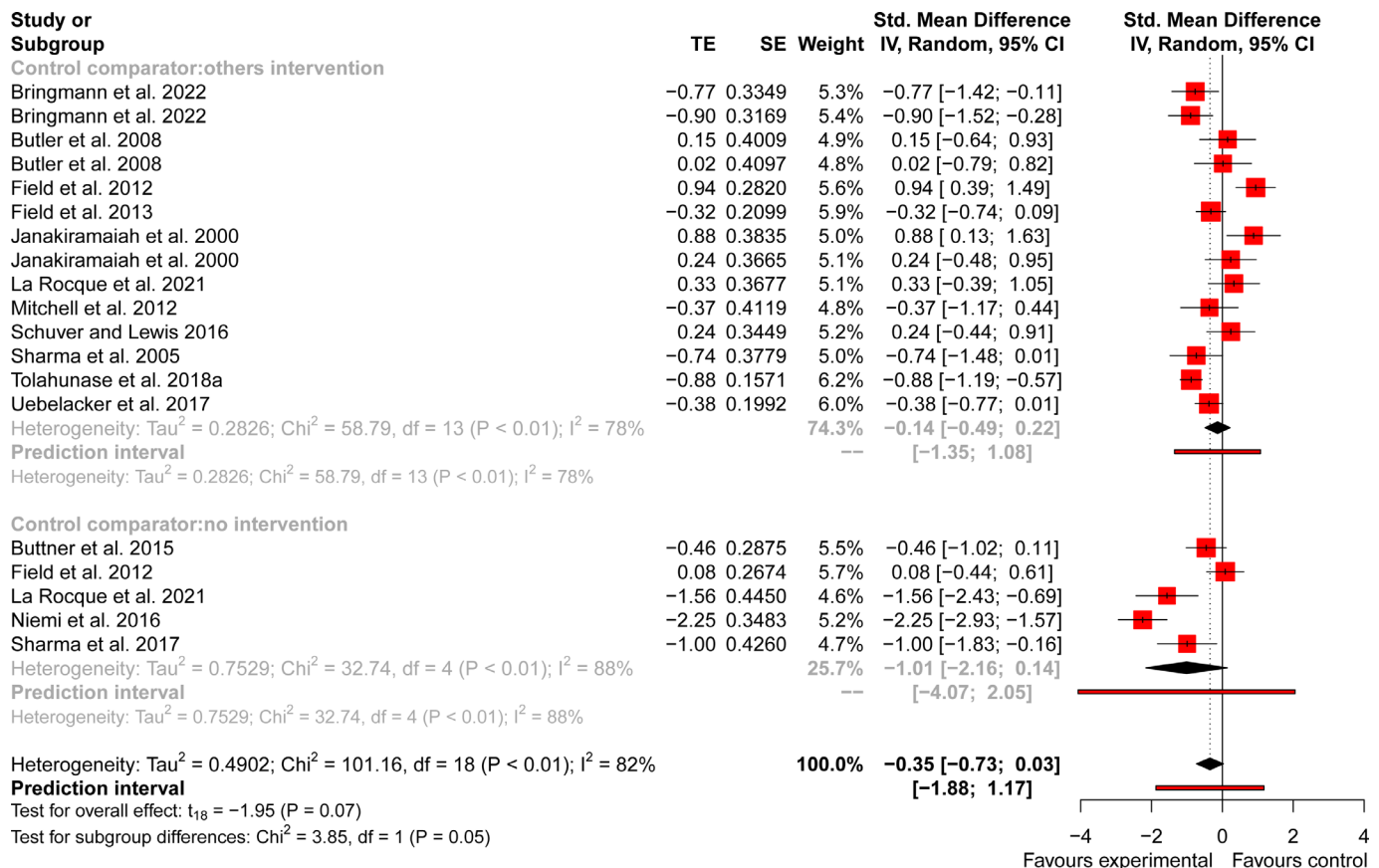


Figure 4 Meta-analysis: the effects of yoga on depressive symptoms in depressive disorders.

(figure 3). Five clinical trials^{48 55 57 64 65} were included in the meta-analysis, assessing anxiety symptoms with the Beck Anxiety Inventory, the Hamilton Anxiety Rating Scale, the Inventory of Depression and Anxiety Symptoms or the State and Trait Anxiety Inventory. Overall, the outcome assessment points ranged from 8 to 12 weeks, although one clinical trial⁶⁵ also evaluated anxiety symptoms at 1–3 weeks postpartum. Yoga-based interventions were heterogeneous. Some clinical trials used specific yoga styles such as Vinyasa Flow Yoga, Sahaj yoga meditation or Sudarshan Kriya yoga, whereas other clinical trials based their interventions on different yoga poses (asanas). The duration of yoga-based interventions was heterogeneous, ranging from 8 to 12 weeks (see further information, online supplemental file 3). Heterogeneity remained high after conducting meta-regression and sensitivity analyses (see online supplemental files 10–13). There was no publication bias observed (Egger's test $p=0.61$; online supplemental file 14).

Depressive disorders: yoga-based interventions on depression symptoms (GRADE: very low evidence)

A meta-analysis showed no differences between yoga-based interventions and control interventions to decrease depression symptoms (g (95% CI) = -0.35 (-0.73 to 0.03); $I^2=82\%$; $Tau^2=0.49$) (figure 4). Fourteen clinical trials^{38 48 52–55 57–60 62 64–66} were included in the meta-analysis. The included trials evaluated depression symptoms with a large list of self-reported tools such as the Beck Depression Inventory (different forms), the Center for Epidemiological Studies Depression Scale, the Edinburg Postnatal Depression Scale, the Hamilton Rating Scale for Depression, the Inventory of Depression and Anxiety Symptoms, the Patient

Health Questionnaire-9, the Profile of Moods State and the Quick Inventory of Depression Symptomatology. Overall, the outcome assessment points ranged from 4 to 36 weeks, although one clinical trial⁶⁵ also evaluated depression symptoms at 1–3 weeks postpartum. Yoga-based interventions were also heterogeneous and included Bikram Yoga, Hatha Yoga, Sudarshan Kriya yoga, Vinyasa Flow Yoga or Yoga Nidra. The duration of yoga-based interventions was also heterogeneous, ranging from 4 to 12 weeks (see further information, online supplemental file 3). Meta-regression (see online supplemental file 10) and sensitivity analyses (see online supplemental files 15–17) were conducted to identify the sources of heterogeneity. In meta-regression, only the type of control group seemed to explain the heterogeneity. The sensitivity analysis showed how heterogeneity decreased and yoga-based interventions were significantly superior to control interventions in decreasing depression symptoms (g (95% CI) = -0.48 (-0.76 to -0.19); $I^2=57\%$) after excluding three outliers.^{53 54 64} Publications bias was not detected (Egger's test $p=0.53$; online supplemental file 18).

Depressive disorders: qigong styles on depression symptoms (GRADE: very low evidence)

A meta-analysis showed no differences between qigong styles and control interventions to reduce depression symptoms (g (95% CI) = -0.49 (-1.59 to 0.61); $I^2=39\%$; $Tau^2=0.08$) (figure 5). Two clinical trials^{49 61} were included in the meta-analysis, evaluating depression symptoms using the Beck Depression Inventory-II, the Geriatric Depression Scale and the Hamilton Rating Scale for Depression. The outcome assessment points ranged from 10 to 12 weeks. Chan-based Dejian mind–body therapy and unspecified qigong styles were

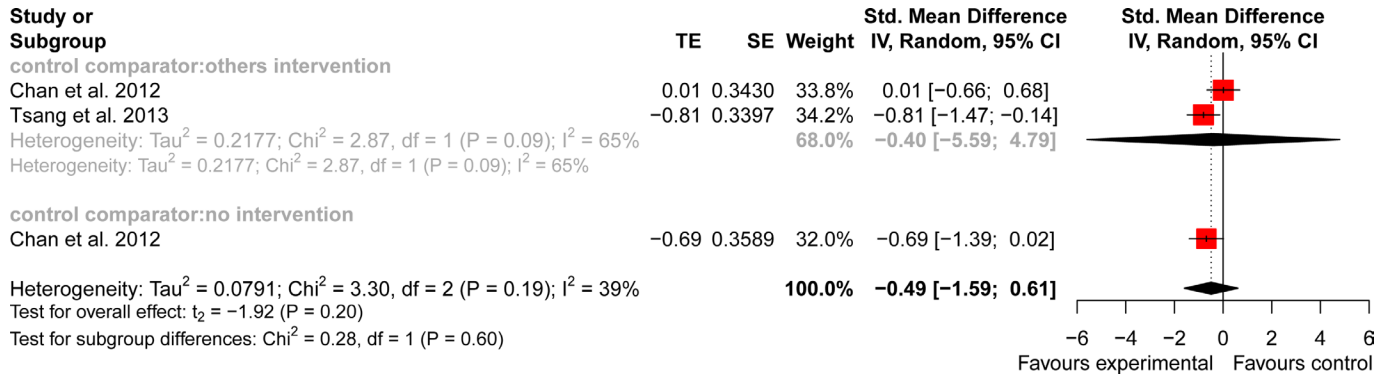


Figure 5 Meta-analysis: the effects of qigong on depressive symptoms in depressive disorders.

combined in the meta-analysis. The duration of the qigong style programmes was heterogeneous, ranging from 10 to 12 weeks (see further information, online supplemental file 3). Meta-regression and subgroup analyses could not be developed, and publication bias was not detected (Egger’s test $p=0.87$; online supplemental file 19).

Depressive disorders: tai chi styles on depression symptoms (GRADE: very low evidence)

A meta-analysis found no differences between tai chi styles and control interventions to decrease depression symptoms (g (95% CI) = -0.60 (-1.67 to 0.47); $I^2=75\%$; $Tau^2=0.47$) (figure 6). Four (4) clinical trials^{50 51 56 63} were included in the meta-analysis, evaluating depression symptoms using the Center for Epidemiological Studies Depression Scale, the Geriatric Depression Scale and the Hamilton Rating Scale for Depression. The outcome assessment points ranged from 12 to 24 weeks. Tai Chi-Chih! Joy Through Movement and Yang style were combined in the meta-analysis. All tai chi style intervention programmes lasted 12 weeks (see further information, online supplemental file 3). Heterogeneity remained high after performing meta-regression (see online supplemental file 10) and sensitivity analyses (see online supplemental files 20–22). Publications bias was undetected (Egger’s test $p=0.45$; online supplemental file 23).

DISCUSSION

The purpose of this systematic review was to evaluate the effectiveness of qigong, tai chi and yoga-based interventions in modulating anxiety and depression symptoms in adults diagnosed with anxiety or depressive disorders. After analysing a total of 23 randomised clinical trials (comprising 22 different samples), we found that yoga-based interventions were superior to control interventions in improving anxiety symptoms in anxiety disorders. Yoga-based interventions were also superior to control interventions in decreasing depression symptoms in depressive disorders after conducting a sensitivity analysis where three clinical trials were considered outliers and discarded.^{53 54 64} No differences between groups were detected in the rest of the comparisons. The findings of recent systematic reviews support our results on the effects that yoga-based interventions may have on anxiety symptoms in anxiety disorders and depression symptoms in depressive disorders. Yoga seems to be a promising mind–body exercise to reduce anxiety symptoms in chronic disorders such as rheumatic diseases,⁶⁷ cancer,⁶⁸ chronic stroke⁶⁹ and HIV/AIDS.⁷⁰ Yoga also seems an interesting approach to reduce the severity of depression symptoms in mental disorders,⁷¹ cancer,⁶⁸ chronic stroke⁶⁹ and rheumatic diseases.⁶⁷ More definitively, systematic reviews have found that yoga may favour the reduction of depression symptoms in major depressive disorders¹⁹ or perinatal depression.²⁰ Altogether, yoga seems a useful approach to help adults to better manage their emotional state

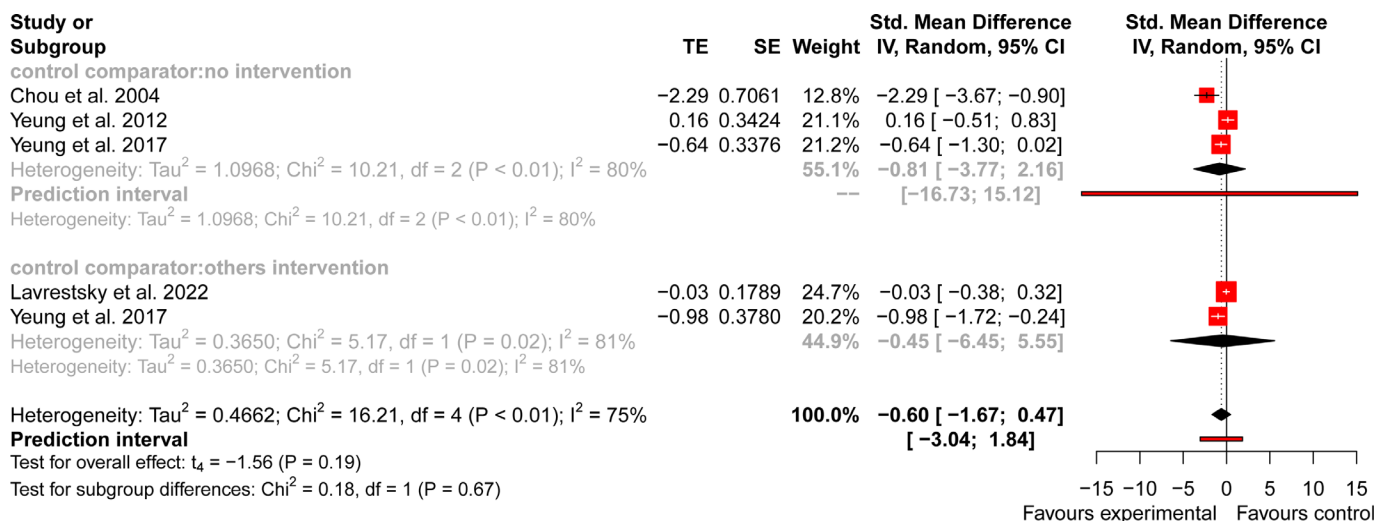


Figure 6 Meta-analysis: the effects of tai chi on depressive symptoms in depressive disorders.

after being diagnosed with medical conditions often characterised by an uncertain and unpredictable course. Interestingly, yoga-based interventions were not superior to control interventions in reducing anxiety symptoms in depressive disorders, contrary to what has been concluded in a systematic review on perinatal depression.²⁰ This previous systematic review meta-analysed clinical trials including participants with and without (eg, Ref. 72) a diagnosis of depressive disorder, which may partly explain this conflicting finding. Additionally, we meta-analysed the potential impact of qigong and tai chi styles on depression symptoms in depressive disorders and found a lack of effect of these mind–body exercises compared with control interventions. In contrast, recent systematic reviews have supported the role that qigong and tai chi play in improving depression symptoms in substance use disorders,^{18 73} chronic heart failure^{74 75} and stroke.⁷⁶ However, the beneficial effects of qigong and tai chi appear to be poor in dementia⁷⁷ or cancer^{76 78} and unclear in those with chronic obstructive pulmonary disease.^{76 79} Taken together, these inconsistencies should encourage researchers to design more robust randomised clinical trials. This would help to elucidate when qigong and tai chi could be helpful in modulating depression symptoms and demonstrate the actual role that yoga-based interventions may play on anxiety symptoms in depressive disorders.

Improving the quality of clinical trials: methodological considerations

A primordial step of a randomised clinical trial should be to provide an accurate estimate of the effectiveness or ineffectiveness of a concrete intervention. The GRADE approach helps researchers and clinicians to have a general picture of certainty of the evidence on a specific outcome. Using this tool, we found this certainty to be very low for all the outcomes of interest, which mainly arose from the presence of serious concerns in risk of bias, inconsistency between clinical trials, indirectness of the evidence and imprecision of the results. Bias due to deviations from intended interventions and bias arising from the randomisation process were very common. Heterogeneity remained high in some meta-analyses even after performing meta-regressions and sensitivity analyses. Qigong, tai chi and yoga-based interventions often used different styles. A large list of self-reported tools was included in each meta-analysis, and outcome assessment points were not homogeneous in the meta-analyses. All these can explain the presence of indirectness of the evidence in the results. Although we are aware of the difficulty that researchers face in recruiting participants, we strongly recommend clinical trials with a larger number of participants. Small samples can lead to overestimating or underestimating the effects of an intervention, which favours the imprecision of the results. Additionally, the TIDieR checklist is a useful tool for showing transparency about how a specific intervention has been designed and conducted. Researchers and, above all, clinicians need to be clearly informed of the details of interventions to be able to replicate them in other settings. Unfortunately, no included clinical trials reported all the items proposed by this checklist. In particular, concerns arose in terms of adherence, tailoring and potential modifications that may have been carried out during the intervention.

Clinical implications

The main clinical finding of this systematic review has been the possible beneficial effect that yoga-based interventions may have on anxiety and depression symptoms in anxiety and depressive disorders, respectively. A large body of evidence supports the

relevance of this mind–body exercise in improving disease-related symptoms in different mental disorders.^{15 71 80 81} Despite the promising findings reported in favour of yoga in the last decade and the exponential growth of this practice in Western countries, yoga is a broad concept. Currently, many yoga styles have appeared (eg, Hatha, Iyengar, Ashtanga or Rocket Yoga), and we still do not have a clear consensus about what yoga style could fit better to the biopsychosocial profile of every person. One of the main goals of clinicians should be to understand the true motivation of their patients to practice regular physical activity, yoga-based interventions in this case. Qualitative research has shown how feeling good during yoga practice and creating one's own yoga programmes appear to enhance adherence.⁸² Despite the interesting clinical findings, we should be cautious before recommending the use of yoga-based interventions to treat anxiety and depressive disorders. The overall certainty of the evidence was judged to be very low, some methodological flaws were noted and a specific yoga style cannot be recommended with the current evidence.

Limitations

We developed a strict database search strategy and followed strict eligibility criteria, thus only randomised clinical trials using current recommendations such as DSM or ICD criteria to diagnose anxiety or depressive disorders were included. Though mind–body exercises are widely used in China and India, clinical studies written in Chinese or Hindi language were not included. Therefore, some potential research of interest could have been missed or not considered. In addition, the limited number of primary studies included in the meta-analysis could have influenced our findings. Despite the wide number of sensitivity analyses, meta-regressions and subgroup analyses performed, the reasons behind the substantial heterogeneity found in our results could not be accurately identified. This issue should be considered when interpreting our meta-analyses.

Future research

An interesting future agenda may include improved and increased numbers of high-quality clinical trials evaluating these mind–body exercises in these mental disorders. In the conduct of this review, we did not find trials assessing qigong or tai chi in anxiety disorders, and the number of yoga trials is currently scarce ($n=2$) for this affective disorder. Addressing the observed methodological concerns may help to clarify the role of these mind–body exercises in anxiety and depression disorders.

CONCLUSIONS

This systematic review aimed to meta-analyse current evidence on the effectiveness of qigong, tai chi and yoga to modulate anxiety and depression symptoms in adults diagnosed with anxiety or depressive disorders. After evaluating 23 randomised clinical trials (comprising 22 different samples) with a total of 1420 participants, we observed that yoga-based interventions may reduce anxiety symptoms in anxiety disorders. Furthermore, we also found that yoga-based interventions may decrease depression symptoms in depressive disorders. However, we cannot make definitive clinical recommendations due to the very low certainty of the evidence, several methodological concerns and the heterogeneity of qigong, tai chi and yoga styles among studies. Therefore, a specific yoga style cannot be recommended with the current evidence. A call for action for improving the quality of research in this field is needed.

Contributors All authors contributed to the development of this manuscript. The guarantor of this study is JMC.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

ORCID iDs

Javier Martínez-Calderon <http://orcid.org/0000-0002-1332-4544>

Cristina Garcia-Muñoz <http://orcid.org/0000-0003-2621-2098>

REFERENCES

- Gutiérrez-Rojas L, Porras-Segovia A, Dunne H, et al. Prevalence and correlates of major depressive disorder: a systematic review. *Rev Bras Psiquiatr Sao Paulo Braz* 1999;42:657–72.
- Remes O, Brayne C, van der Linde R, et al. A systematic review of reviews on the prevalence of anxiety disorders in adult populations. *Brain Behav* 2016;6:e00497.
- James SL, Abate D, Abate KH. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the global burden of disease study 2017. *Lancet* 2018;392:1789–858.
- Otte C, Gold SM, Penninx BW, et al. Major depressive disorder. *Nat Rev Dis Primers* 2016;2:16065.
- Obuobi-Donkor G, Nkire N, Agyapong VIO. Prevalence of major depressive disorder and correlates of thoughts of death, suicidal behaviour, and death by suicide in the geriatric population-A. *Behav Sci (Basel)* 2021;11:142.
- Penninx BW, Pine DS, Holmes EA, et al. Anxiety disorders. *Lancet* 2021;397:914–27.
- König H, König H-H, Konnopka A. The excess costs of depression: a systematic review and meta-analysis. *Epidemiol Psychiatr Sci* 2019;29:e30.
- Morres ID, Hatzigeorgiadis A, Stathi A, et al. Aerobic exercise for adult patients with major depressive disorder in mental health services: a systematic review and meta-analysis. *Depress Anxiety* 2019;36:39–53.
- Marconcin P, Peralta M, Gouveia ER, et al. Effects of exercise during pregnancy on postpartum depression: a systematic review of meta-analyses. *Biology (Basel)* 2021;10:1331.
- Jayakody K, Gunadasa S, Hosker C. Exercise for anxiety disorders: systematic review. *Br J Sports Med* 2014;48:187–96.
- Chong TWH, Kootar S, Wilding H, et al. Exercise interventions to reduce anxiety in mid-life and late-life anxiety disorders and subthreshold anxiety disorder: a systematic review. *Ther Adv Psychopharmacol* 2022;12:20451253221104958.
- Gothe NP, Khan I, Hayes J, et al. Yoga effects on brain health: a systematic review of the current literature. *BPL* 2019;5:105–22.
- Zhang X, Zong B, Zhao W, et al. Effects of mind-body exercise on brain structure and function: a systematic review on MRI studies. *Brain Sci* 2021;11:205.
- Cramer H, Lauche R, Klose P, et al. Yoga for schizophrenia: a systematic review and meta-analysis. *BMC Psychiatry* 2013;13:32.
- Borden A, Cook-Cottone C. Yoga and eating disorder prevention and treatment: a comprehensive review and meta-analysis. *Eat Disord* 2020;28:400–37.
- Gallegos AM, Crean HF, Pigeon WR, et al. Meditation and yoga for posttraumatic stress disorder: a meta-analytic review of randomized controlled trials. *Clin Psychol Rev* 2017;58:115–24.
- Tang Z, Zhu Z, Zhang X, et al. The effects of Tai Chi and Baduanjin activities on physical interventions with substance use disorders: a systematic review and meta-analysis. *Hong Kong J Occup Ther* 2022;35:25–34.
- Zhang P, Li Z, Yang Q, et al. Effects of Taijiquan and Qigong exercises on depression and anxiety levels in patients with substance use disorders: a systematic review and meta-analysis. *Sports Med Health Sci* 2022;4:85–94.
- Seshadri A, Adaji A, Orth SS, et al. Exercise, yoga, and Tai Chi for treatment of major depressive disorder in outpatient settings: a systematic review and meta-analysis. *Prim Care Companion CNS Disord* 2020;23.
- Wang G, Liang C, Sun G. Yoga's therapeutic effect on perinatal depression: a systematic review and meta-analysis. *Psychiatr Danub* 2022;34:195–204.
- Zou L, Yeung A, Li C, et al. Effects of meditative movements on major depressive disorder: a systematic review and meta-analysis of randomized controlled trials. *JCM* 2018;7:195.
- Cramer H, Lauche R, Anheyer D, et al. Yoga for anxiety: a systematic review and meta-analysis of randomized controlled trials. *Depress Anxiety* 2018;35:830–43.
- Vollbehn NK, Bartels-Velthuis AA, Nauta MH, et al. Hatha yoga for acute, chronic and/or treatment-resistant mood and anxiety disorders: a systematic review and meta-analysis. *PLoS ONE* 2018;13:e0204925.
- Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 2008;336:924–6.
- Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:71.
- Beller EM, Glasziou PP, Altman DG, et al. PRISMA for abstracts: reporting systematic reviews in Journal and conference abstracts. *PLoS Med* 2013;10:e1001419.
- Richardson WS, Wilson MC, Nishikawa J, et al. The well-built clinical question: a key to evidence-based decisions. *ACP Journal Club* 1995;123:A12.
- American Psychiatric Association. *Diagnostic and statistical manual of mental disorders, DSM-5*. Washington, DC: American Psychiatric Publishing, 2013.
- American Psychiatric Association. *Diagnostic and statistical manual of mental disorders, DSM-IV-TR, 4th, text revision ed*. Washington, DC: American Psychiatric Association, 2000.
- American Psychiatric Association. *Diagnostic and statistical manual of mental disorders, DSM-I*. Washington, DC: American Psychiatric Publishing, 1952.
- American Psychiatric Association. *Diagnostic and statistical manual of mental disorders, DSM-II, 2nd ed, text rev*. Washington, DC: American Psychiatric Publishing, 1968.
- American Psychiatric Association. *Diagnostic and statistical manual of mental disorders, DSM-III, 3rd ed, revised ed*. Washington, DC, 1987.
- Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019;14898.
- Schünemann H, Brożek J, Guyatt G, eds. *GRADE Handbook for grading quality of evidence and strength of recommendations*. The GRADE Working Group, 2013. Available: guidelinedevelopment.org/handbook
- Hoffmann TC, Glasziou PP, Boutron I, et al. Better reporting of interventions: template for intervention description and replication (Tidier) checklist and guide. *BMJ* 2014;348.
- Yavchitz A, Ravaud P, Altman DG, et al. A new classification of spin in systematic reviews and meta-analyses was developed and ranked according to the severity. *J Clin Epidemiol* 2016;75:56–65.
- Sarubin N, Nothdurfter C, Schüle C, et al. The influence of Hatha yoga as an add-on treatment in major depression on hypothalamic–pituitary–adrenal-axis activity: a randomized trial. *J Psychiatr Res* 2014;53:76–83.
- Tolahunase MR, Sagar R, Dada R. 5-HTTLPR and MTHFR 677C>T polymorphisms and response to yoga-based lifestyle intervention in major depressive disorder: a randomized active-controlled trial. *Indian J Psychiatry* 2018;60:410–26.
- Tolahunase MR, Sagar R, Faiq M, et al. Yoga- and meditation-based lifestyle intervention increases Neuroplasticity and reduces severity of major depressive disorder: a randomized controlled trial. *Restor Neurol Neurosci* 2018;36:423–42.
- Balduzzi S, Rucker G, Schwarzer G. How to perform a meta-analysis with R: a practical Tutorial. *Evid Based Ment Health* 2019;22:153–60.
- Viechtbauer W. Conducting meta-analyses in R with the Metafor package. *J Stat Softw* 2010;36:1–48.
- Harrer M, Cuijpers P, Furukawa T, et al. Companion R package for the guide "doing meta-analysis in R". R package version 0.0.9000. 2019. Available: <http://dmetar.protectlab.org/>
- Int'Hout J, Ioannidis JPA, Rovers MM, et al. Plea for routinely presenting prediction intervals in meta-analysis. *BMJ Open* 2016;6:e010247.
- Lin L, Chu H, Murad MH, et al. Empirical comparison of publication bias tests in meta-analysis. *J Gen Intern Med* 2018;33:1260–7.
- Morton SC, Adams JL, Suttrop MJ, et al. *Meta-regression Approaches: What, Why, When, and How*. Rockville (MD): Agency for Healthcare Research and Quality (US), 2004.
- Gupta K, Prasad M. A pilot study on certain Yogic and Naturopathic procedures in generalized anxiety disorder. *Int J Res Ayurveda Pharm* 2013;4:858–61.
- Sahasi G, Mohan D, Kacker C. Effectiveness of Yogic techniques in the management of anxiety. *J Personal Clin Stud* 1989;5:51–5.
- Sharma A, Barrett MS, Cucchiara AJ, et al. A breathing-based meditation intervention for patients with major depressive disorder following inadequate response to antidepressants: a randomized pilot study. *J Clin Psychiatry* 2017;78:e59–63.
- Chan AS, Wong QY, Sze SL, et al. A Chinese Chan-based mind–body intervention for patients with depression. *J Affect Disord* 2012;142:283–9.
- Yeung AS, Feng R, Kim DJH, et al. A pilot, randomized controlled study of Tai Chi with passive and active controls in the treatment of depressed Chinese Americans. *J Clin Psychiatry* 2017;78:e522–8.
- Lavretsky H, Milillo MM, Kilpatrick L, et al. A randomized controlled trial of Tai Chi Chih or health education for geriatric depression. *Am J Geriatr Psychiatry* 2022;30:392–403.
- Uebelacker LA, Tremont G, Gillette LT, et al. Adjunctive yoga v. health education for persistent major depression: a randomized controlled trial. *Psychol Med* 2017;47:2130–42.

- 53 Janakiramaiah N, Gangadhar BN, Naga Venkatesha Murthy PJ, *et al.* Antidepressant efficacy of Sudarshan Kriya yoga (SKY) in Melancholia: a randomized comparison with electroconvulsive therapy (ECT) and Imipramine. *J Affect Disord* 2000;57:255–9.
- 54 Niemi M, Kiel S, Allebeck P, *et al.* Community-based intervention for depression management at the primary care level in ha Nam province, Vietnam: a cluster-randomised controlled trial. *Trop Med Int Health* 2016;21:654–61.
- 55 Sharma VK, Das S, Mondal S, *et al.* Effect of Sahaj yoga on depressive disorders. *Indian J Physiol Pharmacol* 2005;49:462–8.
- 56 Chou K-L, Lee PWH, Yu ECS, *et al.* Effect of Tai Chi on depressive symptoms amongst Chinese older patients with depressive disorders: a randomized clinical trial. *Int J Geriatr Psychiatry* 2004;19:1105–7.
- 57 Buttner MM, Brock RL, O'Hara MW, *et al.* Efficacy of yoga for depressed postpartum women: a randomized controlled trial. *Complement Ther Clin Pract* 2015;21:94–100.
- 58 Bringmann HC, Bogdanski M, Seifert G, *et al.* Impact of meditation-based lifestyle modification on HRV in outpatients with mild to moderate depression: an exploratory study. *Front Psychiatry* 2022;13:808442.
- 59 Butler LD, Waelde LC, Hastings TA, *et al.* Meditation with yoga, group therapy with hypnosis, and psychoeducation for long-term depressed mood: a randomized pilot trial. *J Clin Psychol* 2008;64:806–20.
- 60 Schuver KJ, Lewis BA. Mindfulness-based yoga intervention for women with depression. *Complement Ther Med* 2016;26:85–91.
- 61 Tsang HWH, Tsang WWN, Jones AYM, *et al.* Psycho-physical and neurophysiological effects of Qigong on depressed Elders with chronic illness. *Aging Ment Health* 2013;17:336–48.
- 62 La Rocque CL, Mazurka R, Stuckless TJR, *et al.* Randomized controlled trial of Bikram yoga and aerobic exercise for depression in women: efficacy and stress-based mechanisms. *J Affect Disord* 2021;280:457–66.
- 63 Yeung A, Lepoutre V, Wayne P, *et al.* Tai Chi treatment for depression in Chinese Americans: a pilot study. *Am J Phys Med Rehabil* 2012;91:863–70.
- 64 Field T, Diego M, Hernandez-Reif M, *et al.* Yoga and massage therapy reduce prenatal depression and prematurity. *J Bodyw Mov Ther* 2012;16:204–9.
- 65 Field T, Diego M, Delgado J, *et al.* Yoga and social support reduce prenatal depression, anxiety and Cortisol. *J Bodyw Mov Ther* 2013;17:397–403.
- 66 Mitchell J, Field T, Diego M, *et al.* Yoga reduces prenatal depression symptoms. *PSYCH* 2012;03:782–6.
- 67 de Orleans Casagrande P, Coimbra DR, de Souza LC, *et al.* Effects of yoga on depressive symptoms, anxiety, sleep quality, and mood in patients with rheumatic diseases: systematic review and meta-analysis. *PM&R* June 20, 2022.
- 68 Gonzalez M, Pascoe MC, Yang G, *et al.* Yoga for depression and anxiety symptoms in people with cancer: a systematic review and meta-analysis. *Psychooncology* 2021;30:1196–208.
- 69 Thayabaranathan T, Andrew NE, Immink MA, *et al.* Determining the potential benefits of yoga in chronic stroke care: a systematic review and meta-analysis. *Top Stroke Rehabil* 2017;24:279–87.
- 70 Dunne EM, Balletto BL, Donahue ML, *et al.* The benefits of yoga for people living with HIV/AIDS: a systematic review and meta-analysis. *Complement Ther Clin Pract* 2019;34:157–64.
- 71 Brinsley J, Schuch F, Lederman O, *et al.* Effects of yoga on depressive symptoms in people with mental disorders: a systematic review and meta-analysis. *Br J Sports Med* 2021;55:992–1000.
- 72 Newham JJ, Wittkowski A, Hurley J, *et al.* Effects of Antenatal yoga on maternal anxiety and depression: a randomized controlled trial. *Depress Anxiety* 2014;31:631–40.
- 73 Cui J, Liu F, Liu X, *et al.* The impact of Qigong and Tai Chi exercise on drug addiction: a systematic review and meta-analysis. *Front Psychiatry* 2022;13:826187.
- 74 Hui J, Wang Y, Zhao J, *et al.* Effects of Tai Chi on health status in adults with chronic heart failure: a systematic review and meta-analysis. *Front Cardiovasc Med* 2022;9:953657.
- 75 Jiang W, Liao S, Chen X, *et al.* Taichi and Qigong for depressive symptoms in patients with chronic heart failure: a systematic review with meta-analysis. *Evid Based Complement Alternat Med* 2021;2021:5585239.
- 76 Cai Q, Cai S-B, Chen J-K, *et al.* Tai Chi for anxiety and depression symptoms in cancer, stroke, heart failure, and chronic obstructive pulmonary disease: a systematic review and meta-analysis. *Complement Ther Clin Pract* 2022;46:101510.
- 77 Liu D-M, Wang L, Huang L-J. Tai Chi improves cognitive function of dementia patients: a systematic review and meta-analysis. *Altern Ther Health Med* 2023;29:90–6.
- 78 Cheung DST, Takemura N, Smith R, *et al.* Effect of Qigong for sleep disturbance-related symptom clusters in cancer: a systematic review and meta-analysis. *Sleep Med* 2021;85:108–22.
- 79 Xu S, Zhang D, He Q, *et al.* Efficacy of Liuzijue Qigong in patients with chronic obstructive pulmonary disease: a systematic review and meta-analysis. *Complement Ther Med* 2022;65:102809.
- 80 Taylor J, McLean L, Korner A, *et al.* Mindfulness and yoga for psychological trauma: systematic review and meta-analysis. *J Trauma Dissociation* 2020;21:536–73.
- 81 Cramer H, Anheyer D, Saha FJ, *et al.* Yoga for posttraumatic stress disorder - a systematic review and meta-analysis. *BMC Psychiatry* 2018;18:72.
- 82 Cheung C, Justice C, Peden-McAlpine C. Yoga adherence in older women six months post-osteoarthritis intervention. *Glob Adv Health Med* 2015;4:16–23.