Lifestyle Interventions for Depression: An Umbrella Review of Systematic Reviews and Meta-Analyses

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Abstract

Background: Depression is a prevalent and disabling mental health disorder that significantly affects quality of life and remains a leading global contributor to disability. Although pharmacological and psychological interventions are effective, many patients fail to achieve complete remission of depressive symptoms. Current evidence suggests that lifestyle-related interventions may offer a promising strategy as an adjuvant treatment for depression.

Objective: To evaluate the effectiveness of lifestyle-based interventions in reducing depressive symptoms in adults.

Methods: An umbrella review of systematic reviews and meta-analyses of randomized controlled trials (RCTs) evaluating lifestyle-based interventions for adults with depression was conducted. The literature search was conducted in Medline/PubMed, PsycINFO, Web of Science, Cochrane Library, and Scopus from inception to March 2025. The review followed the PRISMA 2020 guidelines and was prospectively registered in PROSPERO (CRD42024420246). Two reviewers independently screened titles and abstracts, reviewed full texts for eligibility, extracted data and evaluate the methodological quality of included reviews using AMSTAR-2. Discrepancies were resolved through discussion with a third author. A narrative synthesis of findings was conducted.

Results: A total of 46 systematic reviews were included, of which 32 incorporated meta-analysis. Aerobic and resistance exercise showed moderate-to-large effects, particularly when delivered in supervised settings. Mind-body therapies achieved similar benefits and were associated with high adherence rates. Multicomponent interventions showed small-to-moderate effect, although their effectiveness was limited by heterogeneity and follow-up decline.

Conclusions: Lifestyle-based interventions are safe, scalable, and effective adjuvant treatments for depression. However, further high-quality, standardized trials are needed to optimize intervention protocols and confirm their long-term benefits. Clinical Trial: The protocol for this umbrella review was prospectively registered in the PROSPERO database (International Prospective Register of Systematic Reviews, under registration number CRD42024420246.

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Introduction

Depressive disorders are among the most prevalent mental health conditions worldwide, affecting an estimated 3.8% of the global population, including approximately 5% of adults, and constitute a leading cause of disability [1]. Despite advances in pharmacological and psychological treatments, approximately 20-30% of individuals experience treatment-resistant forms of depression [2]. This persistent challenge underscores the need to identify complementary and adjuvant strategies that may enhance treatment efficacy and address the complex, multifactorial nature of depressive disorders [2, 3].

Growing evidence highlights the significant role of lifestyle-related factors, such as lack of exercise, poor dietary habits, disrupted sleep patterns, or chronic stress [4], in contributing to the development and persistence of depressive disorders [4, 5]. These lifestyle factors influence physiological mechanisms including inflammation, oxidative stress, and neuroendocrine regulation [6]. Exercise has been associated with metabolic imbalances of serotonin and other neurotransmitters involved in mood regulation, whereas diets high in processed foods and low in essential nutrients may increase systemic inflammation [7, 8].

The bidirectional relationship between depression and lifestyle factors is complex. Depression is often associated with unhealthy behaviours, including poor diet, physical inactivity, and sleep disturbances, which contribute to worsening the condition. [9-12]. This reciprocal influence underscores the importance of an integrated treatment approach that addresses both psychological and behavioural determinants of depression [9].

Background

Lifestyle medicine (LM) is an emerging and increasingly accepted discipline that addresses mental health conditions related to behavioural and environmental factors [13, 14]. LM integrates multiple evidence-based interventions, including nutrition, exercise, and sleep hygiene, which are relevant for managing depressive disorders, as it addresses the diverse and interacting contributors to the condition while promoting sustainable improvements in overall well-being [13, 15]. A recent meta-analysis assessed the preventive potential of lifestyle-based interventions in reducing depressive symptoms, finding a small but statistically significant effect ([Standardized Mean Difference (SMD)] = -0.29; 95% CI: -0.40 to -0.18). The study synthesized data from 27 randomized controlled trials, many of which included interventions focused on exercise, diet, sleep quality, and stress reduction. These findings underscore the clinical relevance of lifestyle interventions as a feasible strategy for the management of depression [16].

In this context, lifestyle interventions represent a promising adjuvant approach to managing depression, as they target modifiable behavioural risk factors that contribute to its development and maintenance, rather than focusing solely on symptom control [17]. In addition to their preventive role, emerging evidence highlights the innovative potential of lifestyle-based interventions, including diet, physical activity, sleep hygiene, and stress regulation, to significantly improve depressive symptoms even after the disorder has been diagnosed [7, 18]. Among these interventions, exercise stands out, as a meta-analysis has demonstrated its consistent ability to reduce depressive symptoms across diverse populations and clinical contexts, with a moderate but reliable effect size [19]. Its applicability across diverse populations and settings supports its integration into the comprehensive management of depression [16]. Likewise, dietary modifications, particularly those aligned with whole-food-based patterns like the Mediterranean diet, may improve both mental and physical health through anti-inflammatory and antioxidant mechanisms [15, 20].

The present review examines the effectiveness of various lifestyle-based interventions in the management of depression. Considering the multifactorial nature of depression and its strong association with modifiable lifestyle factors, an integrative approach that incorporates lifestyle modifications may be important; however, the specific characteristics and components of effective interventions remain insufficiently defined [16].
Despite this promising evidence, the existing literature shows substantial variability in intervention components, target populations, and methodological quality. Most interventions have been examined in isolation, with relatively few studies implementing or evaluating comprehensive multicomponent approaches. This heterogeneity highlights the need for a systematic synthesis of the evidence to identify which combinations of lifestyle interventions are most effective, and under what conditions.

Therefore, the aim of this study is to summarise the most current and robust evidence on the comparative effectiveness of various lifestyle interventions in the treatment of depression. To this end, we synthesise findings from systematic reviews and meta-analyses to support shared decision-making and to develop an evidence map that highlights current knowledge and guides future research directions.

Methods

We conducted an umbrella review of systematic reviews and metanalysis of Randomized Controlled Trials (RCT) to synthesise the current evidence on the effectiveness of lifestyle-based interventions for the treatment of depression.
This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020 Statement) [21], including the PRISMA harms checklist [22] for the identification of adverse outcomes, and adhered to the Measurement Tool to Assess Systematic Reviews (AMSTAR-2) guidelines [23] for assessing methodological quality. The protocol for this umbrella review was prospectively registered in the PROSPERO database (International Prospective Register of Systematic Reviews, under registration number CRD42024420246.

Search strategy

An initial search was conducted by two researchers (XG-G and AGR) between 1st February and 15th May 2023. A second search was performed in March 2025 to identify studies published from 15th May 2023 to March 2025. This update was conducted by three researchers (XG-G, PG-P, and AGR). The search strategy included the following terms: “depressive disorder”, “depressive disorder, major”, “depressive disorder, treatment resistant”, “motor activity”, “diet mediterranean”, and “lifestyle”, combined with the terms “systematic review” or “meta-analysis” in the title. Searches were conducted in the following databases: Medline/PubMed, PsycINFO, Web of Science, Cochrane Library, and Scopus. Language filters were applied to include studies published in English, Spanish, or Portuguese, with no date restrictions. Additionally, the reference lists of selected reviews were manually screened to identify further eligible studies. The complete search strategy is provided in the Supplementary Material.

Eligibility criteria

The PICOS framework (Population, Intervention, Comparison, Outcome and Study design) was used to define eligibility criteria:
Population: Adults aged 18 and older with a diagnosis of depression or depressive symptoms, assessed using a standardized diagnostic tool or validated scale. Reviews focusing on populations with clinical conditions that could significantly influence the results (e.g., pregnancy, cancer, neurodegenerative disease, or psychotic disorders) were excluded.
Interventions: Reviews assessing one or more healthy lifestyle interventions (e.g., Mediterranean diet, exercise, sun exposure, sleep habits, or stress management), compared to a control group.
Comparators: Acceptable comparators included care as usual (CAU), no intervention, placebo,

waitlist, attention controls, or other active interventions.
Outcomes: Only reviews reporting depressive symptoms as the primary outcome were included.
Study design: We included only systematic reviews and meta-analysis of RCTs. Other designs were excluded.

Data extraction and management

The study selection process was conducted in three phases: 1) removal of duplicates, 2) screening of titles and abstracts, and 3) full-text review of selected articles.
Two reviewers (AGR and XG-G) independently screened and selected studies using the Covidence platform. Disagreements were resolved by consensus with a third reviewer (MB-V).
The following information was independently extracted from each included review: first author, year of publication, country, study design, number of included trials, type of lifestyle intervention, comparator(s), sample size and population characteristics (e.g., age, gender), outcome measures, risk of bias assessment tool used, presence of GRADE assessment, and main findings with reported effect sizes (including confidence intervals and p-values, when it was described). A PRISMA flow diagram was developed to illustrate the study selection process (Fig. 1).

Risk of bias assessment

The methodological quality and risk of bias of the included systematic reviews were assessed using the AMSTAR-2 tool, which is specifically designed for systematic reviews of randomized and non-randomized healthcare interventions [23]. The updated version (2017) includes 16 items focusing on critical domains such as protocol registration, inclusion criteria, comprehensive search strategies, duplicate study selection and data extraction, and justification for excluded studies [23]. Unlike the original version, AMSTAR-2 does not generate an overall score but instead identifies critical methodological weaknesses that may affect the validity of the findings. Each included review was independently assessed by two reviewers.

Results

Study selection

A total of 2672 records was retrieved through the database search. After removing duplicates, 2533 titles and abstracts were screened, resulting in 118 full-text articles assessed for eligibility. Ultimately, 46 systematic reviews evaluating lifestyle interventions for depression met the inclusion criteria and were included in this umbrella review (1.76% inclusion rate). Figure 1 illustrates the flowchart of the study selection process across both databases. A list of the 72 excluded systematic reviews, along with reasons for exclusion, is provided in Supplementary Material.

[Insert Figure 1]

Figure 1. Diagram Selection Flowchart (PRISMA). Source: Covidence.

Study Characteristics

The characteristics of the included studies are summarized in Tables 1 and 2. Table 1 presents reviews involving participants with a clinical diagnosis of depressive disorder, while Table 2 presents reviews including participants with depressive symptoms at baseline.

The evidence included in this synthesis, representing contributions from 18 different countries [11, 16, 19, 24-66]. The country with the highest number of publications was China**,** with 14 reviews, reflecting its strong research engagement in non-pharmacological interventions for depression [16, 25, 33, 37, 43, 51, 53, 54, 57, 58, 60-63]. Several other countries also made substantial contributions**:** Australia**,** Spain**,** the United Kingdom**,** Germany**,** Brazil**,** the United States**,** Sweden**,** Denmark**,** Iran**,** and Canada**.** Additional single-country contributions came from the Netherlands**,** Norway**,** Greece**,** South Korea**,** Italy**,** Finland**,** and Colombia, highlighting the global interest in evaluating the

effectiveness of lifestyle-based and mind-body interventions in the management of depressive symptoms, with particularly active participation from East Asia, Western Europe, and America [11, 19, 24, 26-32, 34-36, 38-42, 44-50, 52, 55, 56, 59, 64, 65].

Of the 46 systematic reviews included, 32 incorporated meta-analyses, several of which employed advanced analytical techniques such as subgroup analyses and, in some cases, meta-regression. Table 1 summarizes 38 reviews including participants with a clinical diagnosis of depressive disorder, while Table 2 presents 10 reviews that focused on individuals reporting depressive symptoms. The methodological quality of the included studies was generally high, with most employing validated tools such as the Cochrane Collaboration's Risk of Bias tool and the AMSTAR 2 checklist [23]. Moreover, several reviews assessed the certainty of evidence using the GRADE framework, which further strengthened the reliability of their findings [67].

The number of primary studies included in each review ranged significantly, from as few as five to as many as eighty randomized controlled trials. Reviews with the largest scopes, such as that by Tian et al., synthesized data from more than 70 RCTs [62]. The interventions examined in the reviews were classified into three main categories: physical exercise interventions, multicomponent lifestyle interventions, and mind-body therapies. Additionally, two reviews specifically focused on dietary interventions. Among the thirty reviews focused on exercise, eight also incorporated mind-body components such as yoga or qigong [24, 45, 46, 50, 56, 58, 61, 62]. Four reviews examined multicomponent lifestyle programs [16, 26, 42, 49], while ten reviews exclusively evaluated mind-body therapies [25, 27, 28, 33, 43, 51, 53, 57, 60, 66]. Two further reviews addressed diet-based interventions alone [55, 59].

Across the included reviews, exercise interventions involved a wide range of modalities, with aerobic training (e.g., walking, running, cycling, dancing) being the most frequently studied and consistently effective across age groups, supported by robust evidence demonstrating moderate-to-large reductions in depressive symptoms in people with some depressive disorder or with depressive symptoms [48, 58, 60, 68]. Resistance training, such as strength or neuromuscular exercises, also demonstrated moderate to large antidepressant effects, particularly among older adults [45, 54, 68]. Several reviews additionally examined mixed exercise programs combining aerobic and resistance components, as well as high-intensity interval training (HIIT) and neuromotor activities, both of which showed emerging efficacy, however, no consistent evidence suggested a clear superiority of combined modalities over single-modality interventions [63, 64].

Exercise interventions were typically delivered three times per week, with individual studies ranging from 2 to 5 sessions weekly [38, 52]. Session duration varied from 30 to 60 minutes, and programs often spanned between 4 and 16 weeks, with longer durations (≥8 weeks) associated with more robust outcomes [58]. Several studies reported a nonlinear dose-response relationship, with optimal effects found within the range of 390–1000 MET-minutes per week [58, 60]. Interventions conducted at moderate intensity, especially under structured supervision or in group-based formats, tended to produce the most consistent benefits [48, 50]. Notably, professionally supervised programs not only enhanced adherence but also resulted in greater symptom reduction and higher completion rates compared to unsupervised interventions [30, 38, 45].

Lifestyle-based multicomponent interventions, although less frequently studied, demonstrated small to moderate short-term improvements in depressive symptoms, with SMDs ranging from −0.20 to −0.45 [16, 26, 42, 49]. These programs combined exercise with complementary strategies such as mindfulness training, nutritional counselling, sleep hygiene, or psychoeducation (face-to-face, telephone or online formats) [16, 26, 56]. While short-term results were promising, several reviews reported that improvements tended to decline with longer follow-up [16]. However, there was

substantial heterogeneity in both the structure and duration of the interventions, which complicates direct comparisons across studies. This variability, arising from the inclusion of different lifestyle components, limits the ability to precisely assess their overall efficacy.

Mind-body therapies, including yoga, tai chi, and qigong, showed moderate to large effects on depressive symptoms, with reported SMDs ranging from −0.45 to −1.21 [27, 43, 57, 60]. Yoga emerged as the most frequently studied intervention and demonstrated consistent efficacy with depressed population [27, 28, 51]. Tai chi was especially effective among older adults, particularly in interventions that lasted over 24 weeks and used structured routines such as the 24-style format [57]. Qigong, although less frequently investigated, yielded moderate benefits, particularly when delivered in dynamic or movement-based formats [43].

Regarding control conditions, CAU was the most frequently employed comparator [27, 29, 31, 32, 34, 50, 68], followed by the wait-list control [11, 24, 40, 41, 69]. Several reviews also included active control conditions, such as health education, light stretching, or relaxation exercises, designed to account for nonspecific therapeutic effects while avoiding structured moderate--intensity exercise [29, 39, 45]. Placebo interventions, such as pills or treatments, were less commonly used [33, 44]. Other noteworthy comparators included pharmacotherapy and structured psychotherapy, which were less frequent but clinically relevant. These comparisons often showed that lifestyle-based-interventions, particularly exercise, produced improvements in depressive symptoms that were comparable to, or even greater than, those observed with conventional treatments [25, 36, 37, 48].

Another remarkable finding was that five reviews assessed lifestyle-based interventions as a first-line treatment, specifically in populations presenting with depressive symptoms at baseline. These reviews explicitly excluded studies involving pharmacological interventions, whereas the remaining forty-one reviews either did not specify this aspect or considered lifestyle interventions primarily as adjuvant treatments (Dong et al., 2023; Pérez-Bedoya et al., 2023; Swainson et al., 2023; Heissel et al., 2023 [48, 58, 60, 68]

Sample sizes across the reviews varied substantially, ranging from 277 to over 20000 participants. Reviews focusing on multicomponent and mind-body interventions tended to encompass larger cumulative samples. The instruments most commonly used for determining the included population were the Beck Depression Inventory (BDI), the Centre for Epidemiologic Studies Depression Scale (CES-D), the Hamilton Depression Rating Scale (HAM-D), the Geriatric Depression Scale (GDS), and the Patient Health Questionnaire-9 (PHQ-9). Women comprised most participants across studies, with proportions frequently exceeding 60% [53].

Risk of bias was systematically assessed in most included reviews. Most used the AMSTAR 2 tool or the Cochrane Risk of Bias instrument [23, 70] while several applied the GRADE framework to evaluate the strength and consistency of the evidence [67]. A minority of older reviews lacked explicit descriptions of bias assessment methodology.

Risk of bias

The methodological quality of the included reviews, as assessed by the AMSTAR-2 tool [23], showed considerable variability. Of the 46 reviews, 6 were rated as high quality, 4 as moderate quality, 7 as low quality, and 27 as critically low quality. While several high-quality reviews demonstrated rigorous methodology, particularly those employing comprehensive literature searches, duplicate study selection and data extraction, and appropriate risk of bias assessment [51, 52, 54]; a substantial proportion was rated as having low or critically low confidence due to methodological limitations. These limitations included the absence of prior protocol registration, insufficient reporting of excluded studies with justification, and lack of detailed consideration of funding sources for included trials. Additionally, although many reviews employed suitable statistical methods for meta-analyses, fewer adequately assessed publication bias or accounted for the impact of study-level

risk of bias on pooled results. Overall, only a minority of reviews achieved a high confidence rating, while most were classified as low or critically low, underscoring the need for more robust methodological standards in future systematic reviews and meta-analyses on lifestyle interventions for depression. Table 3 and 4 present a visual summary of the methodological quality and risk of bias across the reviews included.

Table 1. Summary of findings of included studies with diagnosed of depressive disorders' population.

Main author, Year of publication and Country	Design	Number of articles included in the reviews	Main intervention	Control groups	Size sample sociodemographic characteristics	Outcome measures	Risk of bias (YES/NO) If is YES described which tool	GRADE (YES/ NO)	Main findings
Miller, 2020 **Australia**	Multivariate random-effects meta-analysis	16 (Included in the qualitative synthesis) /15 (Included in the quantitative synthesis)	Exercise intervention (aerobic such as walking or dancing, resistance or mind-body such as Tai Chi or Qigong)	Wait-list, usual care or attention-control (people receive other interventions such as educational groups)	596 (321 intervention and 275 controls) in elderly people (>65y) clinically depressed	BDI CES-D GDS GDS HRSD	YES (Cochrane Collaboration's Tool for Assessing Risk of Bias)	YES	Aerobic exercise showed a small to moderate effect (**SMD = -0.31; 95% CI: -0.45 to -0.17; p < 0.01**), resistance training had a slightly smaller effect (**SMD = -0.24; 95% CI: -0.39 to -0.10; p = 0.002**), and mind-body exercises such as tai chi and qigong demonstrated the largest effect (**SMD = -0.36; 95% CI: -0.52 to -0.20; p < 0.001**). Mind-body interventions with more duration were more effective.
Tsang, 2008 **China**	Systematic review	13	Mindful intervention (Taichi, Qigong y yoga) and non-mindful intervention (pram walking, jogging, and other supervised physical exercise)	Drug medication or placebo or partial yoga programme.	N=631adults clinically depressed	HRSD GDS BDI-II EPDS	YES	NO	11 studies reported positive results and only one study non-mindful with exercise intervention don´t. The positive long-term effects were reported in 3 studies. Due to the limited number of well-conducted studies in this field, meta-analysis based on the direct comparison of effect size of different studies cannot be conducted at this stage.
Cramer, 2013 **Germany**	Systematic review and meta-analysis	12/9	Complex yoga interventions including physical exercise and at least one of the following: breath control, meditation, and/or lifestyle advice (based on yoga theory and/or traditional yoga practices).	CAU or active control	N=619/452 Adults with depression (>18y)	BDI HRSD GDS CDRS CES-D SDS EPDS	YES (Cochrane Back Review Group)	NO	Yoga over CAU for reducing depression severity (**SMD = −0.69; 95% CI −0.99 to −0.39; p < .001; I^2 = 86%).** Comparisons with relaxation (**SMD = −0.62; 95% CI −1.03 to −0.22; p = .003; I^2 = 0%)** and aerobic exercise (**SMD = −0.59; 95% CI −0.99 to −0.18; p = .004; I^2 = 68%**) also showed medium-sized effects.

			Exercise-based yoga interventions (based on yoga theory and/or traditional yoga practices) without breath control, meditation, or lifestyle advice						
Lee, 2021 **Canada**	Systematic review and meta-analysis	23/22	Intervention: CAU in combination with exercise therapy. Type of exercise included: aerobic and resistant exercise or both combinated. Excluded mind-body exercise.	CAU Active control group for example: health education sessions, stretching/toning light intensity exercise) or non-active control group.	N=1025 Adults (<18y) clinically depressed	HRSD BDI	YES (Cochrane Collaboration's Tool for Assessing Risk of Bias)	NO	Moderate pooled effect in favour of exercise + CAU compared to CAU (**SMD = -0.62, p < 0.00001, I^2 = 70%**), with greatest benefits accruing for more severe patients (**SMD = -0.99, p < 0.00001; I^2 = 0%**). Sensitivity analyses remained significant for trials with lower risk of bias (**SMD = -0.41, p = 0.0009; I^2 = 52%**) and patients with a major depressive disorder diagnosis (**SMD = -0.70, p < 0.0001; I^2 = 72%).**
Schuch, 2016 **Brazil**	Meta-analysis	8	Exercise	Non-active control group, such as CAU, wait-list control conditions, placebo pills, or other social activities	N= 267 (138 participants in exercise arms and 129 controls) Older adults (>60y) clinically depressed	HAM-D BDI GDS CSDD PHQ-9	YES (Cochrane Collaboration's Tool for Assessing Risk of Bias)	NO	Exercise had a large and significant effect on depression (**SMD = -0.90 [95%CI -0.29 to -1.51]**).
Catalán-Matamoros, 2016 **Spain**	Systematic review and meta-analyses	6/3	Exercise	CAU, wait list, no intervention or versus yoga	N=1487 Elderly people (<60y) clinically depressed	CES-D GDS	YES (AMSTAR)	NO	Exercise significantly reduces depressive symptoms (**SMD 0.276, 95% CI 0.482 to 0.070, p <0.009**).

Danielsson, 2013 **Sweden**	Systematic review	14	Aerobic exercise as a first-line intervention. Exclude pharmacological interventions.	Health education Pharmacotherapy CAU placebo exercise (relaxation, yoga) relaxation (Bobath balls, back massage, balance)	N=1.139 Adults with depression (18-60y)	BDI HRSD MADRS	YES (Cochrane Back Review Group criteria)	YES	Aerobic exercise vs. antidepressants **SMD: −0.06 with a 95% CI (−0.36 to 0.23)** and no statistical heterogeneity. For the long-term outcome, the **SMD was −0.19 (CI −0.68 to 0.31).** Aerobic exercise vs. any physical activity **SMD: 0.01 with a 95% CI (−0.23 to 0.24)** Aerobic exercise + CAU vs. CAU **SMD: −0.44 with a 95% CI (−0.79 to −0.09)**
Krogh, 2017 **Denmark**	Systematic review	35	exercise intervention versus a control group	No intervention or CAU or an attention control using light exercise	N=2.630 Adults clinically depressed	HRSD BDI HSCL-D	YES (Cochrane Handbook for Systematic Reviews of Interventions)	YES	Exercise versus control on depression severity **SMD: −0.66 (95% CI −0.86 to −0.46; p<0.001**
Zou, 2018 **China**	Meta-analysis	18/16	meditative movements (Tai Chi, Qigong, and Yoga)	Active and passive conditions	N=844 Adults clinically depressed	HADS BDI CES-D STAI QIDS	NO	NO* (PEDro)	Meditative movement on depression severity (**SMD = -0.56, 95% CI -0.76 to -0.37, p < 0.001, I^2 = 35.76%)**
Heissel, 2022 **Germany**	Systematic review and meta-analysis with meta-regression	41	Exercise intervention. Exclude pharmacological interventions	Non-exercising control group, such as CAU, wait-list control conditions or placebo pills	N=2544 Adults clinically depressed	BDI HRSD	YES (Cochrane risk of bias tool RoB2)	NO	Exercise interventions demonstrate large effects **(SMD=-0.946, 95% CI -1.18 to -0.71)** and moderate effects when analyses were restricted to low risk of bias studies (**SMD=-0.666, 95% CI -0.99 to -0.34)**
Cramer, 2017 **Germany**	Systematic review	8	Exercise-based yoga interventions	CAU or any active control intervention	N=240 Adults with depression (>18y)	BDI HRSD	YES	NO	Compared to aerobic exercise, no short- or medium-term group differences in depression severity was found. Higher short-term depression severity was found for yoga compared to electro-convulsive therapy,
Schuch, 2016 **Brazil** **UK**	Meta-analysis	25	Supervised and unsupervised exercise interventions	CAU, wait-list control conditions, placebo pills	N=1.487 Adults with depression (>18y)	MADRS BDI HAM-D	YES (Cochrane Collaboration's Tool for Assessing Risk of	NO	Exercise interventions (**SMD = 0.98, 95% CI 0.68 to 1.28, p < 0.001, Q = 135, p < 0.01**). Aerobic exercise (**SMD = 1.04, 95% CI 0.65 to**

			(aerobic and resistance)	or other social activities.			Bias)		**1.43, p < 0.001)** Moderate **(SMD = 1.33, 95% CI 0.46 to 2.19, p = 0.003)** Vigorous intensities **(SMD = 1.34, 95% CI 0.43 to 2.24, p = 0.004)** Mixed supervised/unsupervised format **(SMD = 3.01, 95% CI -0.61 to 1.97, p<0.0001)** Supervised by qualified physical exercise professionals **(SMD = 1.26, 95% CI 0.54 to 1.97, p < 0.001**) Results indicate that interventions lasting 45 minutes per session, delivered three times per week for a minimum duration of four weeks, were the most effective.
Kvam, 2016 **Norway**	Meta-analysis	23	Physical exercise (aerobic exercise and nonaerobic exercise	Placebo treatment, CAU, another kind of treatment (e.g., antidepressant medication, psychotherapy, or alternative interventions), no treatment, or be on a waiting list	N=977 Adults (>18y) clinically depressed	HRSD-17 BDI BDI-II SCL-90 HRSD-21 CESD	NO (Only publication bias assessment)	NO	Moderate to large and significant effect in favour of exercise, **g=−0.68 (95% CI =−0.92 to −0.44, p<0.001**). The effect of exercise on depressive symptoms after treatment in follow-up studies was small and nonsignificant, **g=−0.22 (95% CI=−0.53 to 0.09, p=.16).**
Farah, 2016 **USA**	Systematic review	39/42	Cognitive behavioural therapy, naturopathic therapy, biological interventions and physical activity interventions	other treatment or CAU, waiting list or placebo	N= ∼20 000 Adults (>18y) clinically depressed	Standardised depression scales	YES (AMSTAR and Cochrane Collaboration's Tool for Assessing Risk of Bias)	YES	Cognitive behavioural therapy, naturopathic therapy, biological interventions and physical activity interventions reduced depression severity. However, the effect of these interventions on clinical response and remission was unclear.
Chen, 2019 **China**	Systematic review and network meta-analysis	91/32	(Acupuncture, mirtazapine, herbal medicine, venlafaxine, physical exercise, cognitive-	Any inactive intervention (e.g., placebo, waiting list, sham treatment, no care), and above active	N=10.991 adults clinically depressed	HRSD MADRS	YES (Cochrane risk-of-bias tool)	NO	Results of network meta-analyses indicated physical exercise were associated with superior efficacy profiles **(OR: 2.45 IC95% 1.05, 5.75)**

			behavioural therapy (CBT), bupropion, fluoxetine, and vortioxetine)	treatments covered by the study					
Morres, 2018 **Greece**	System atic review and meta-analysis	11	intervention: aerobic exercise. duration (≤4 weeks), frequency (<3 days/week, 3 days/week, or >3 days/week), intensity (lower, moderate, or vigorous), setting (outdoors or indoors), social format (in groups or individually), and delivery format (supervised or non-supervised)	comparisons: non-exercise comparators	N=455 Adults (18-65y) clinically depressed	HRSD BDI	NO	NO (PEDro)	Aerobic exercise was delivered on average for 45 min, at moderate intensity, three times/week, for 9.2 weeks showed a significantly large overall antidepressant effect (**g =–0.79, IC95% = -1.01,–0.57, p< 0.00)**
Nyström, 2015 **Sweden**	System atic review	12	Treatment had to consist of either aerobic or anaerobic activities or a combination of both. Studies also had to have a detailed description of the activity, intensity, duration and frequency of the PA	Controls: - Some type of PA, with stretching as the most used form. - CAU, i.e. pharmacother apy or Psychotherap y -Health education.	N=~1000 Adults clinically depressed	-	YES (Cochrane risk of bias tool)	NO	Ten studies showed a significant reduction in depressive symptoms with treatment, while two found no effect. Remission rates ranged from 26% to 86%, and only one study showed improvement at follow-up. Of the seven studies with sufficient data, six showed a large effect and one a small effect.
Krogh, 2011 **Denmark**	System atic review	13	Exercise intervention for example,	Exercise vs a control group	N=2638 Adults clinically depressed	HRSD BDI PHQ-9	YES (Cochrane Handbook for Systematic	YES	The effect of exercise intervention versus control **(SMD: -0.40 (95% CI, -0.66 to -0.14)**

			running, swimming or weightlifting.	receiving no intervention or CAU or an attention control using light exercise			MADRS HSCL-D	Reviews of Interventions)		
Bridle, 2012 **UK**	Systematic review and meta-analysis	7	Exercise was defined as any planned or structured movement of the body performed systematically in terms of frequency, intensity and duration.	CAU Waiting list Non-active control Attentional control	N=667 clinically depressed	Adults	GDS-15 BDI CES-D HRSD HSCL-20 CSDD	YES (Cochrane risk of bias criteria)	NO	effect of exercise on the severity of depressive symptoms in older people. **SMD = –0.34 (IC 95%: –0.52 a –0.17)**
Fabricatore, 2011 **USA**	Systematic review and meta-analysis	31	-Lifestyle modification -Non-dieting -Dietary counselling -Diet-alone -Exercise program	-Waiting list standard - Advice/ printed materials, an -Attention-control intervention -No treatment.	N=7937 clinically depressed	Adults	BDI HRSD CES-D HSCL-90 Others subscales*	NO	NO	This study shows reduction in symptoms of depression with lifestyle modification (p<0.001), nondieting interventions (P<0.002), diet-alone (P<0.002) and exercise-alone (P<0.006), but not with dietary counselling (P<0.30).
Guo, 2019 **China** **Korea**	Meta-analysis	7	Qigong exercise	control group as a comparison, such as a waitlist, CAU, pharmacological therapy, or walking.	N=382 clinically depressed	Adults	BDI HRSD CES-D	YES (Not Described)	NO	Qigong therapy Vs Control (**Hedges' g = −0.64, 95% CI −0.92 to −0.35, p < 0.001, I2 = 41.73%).** Qigong Vs active control group (**Hedges' g = −0.47, 95% CI −0.81 to −0.12, p = 0.01, I2 = 22.75%)** Qigong Vs passive control group (**Hedges' g = −0.80, 95% CI −1.23 to −0.37, p < 0.01, I2 = 48.07%),**
Mura, 2013 **Italy**	Systematic review	44	Exercise	Standard treatments (including antidepressant drugs or health education), CAU or placebo-control Attention	N=1318 clinically depressed	Adults	HRSD BDI GDS CES-D	Yes (Not described)	NO	Supervised physical exercise shows evidence of being an effective intervention for reducing depressive symptoms, even when compared to other treatments such as health education sessions, usual care, or, in some cases, antidepressant medication.

				group or wait list.					
Nebiker, 2018 **Switzerland Germany**	System atic review and meta-analysis	27	Supervised exercise interventions (Aerobic exercises, strength exercises, functional exercise training, yoga or tai chi)	Behavioural therapy, light therapy, medication therapy, a placebo-group, or an inactive control group.	N=1452 Adults clinically depressed	BDI HRSD	YES (Cochrane risk of bias tool)	PEDro	Exercise interventions large effect size of **g = −0.93 (90% CI: −1.17 to −0.70); p < 0.00001, I^2 = 83%.** Only included studies with good methodological quality still showed a large significant improvement in favour of exercise interventions compared to the control condition **[SMD: −0.83 (90% CI: −1.13 to −0.54); p < 0.00001, I^2 = 79%].**
Seshadri, 2020 **USA**	System atic review and meta-analysis	25	Exercise, Yoga and Tai-Chi	Active control group or CAU.	N=1.112 participants in the intervention groups and 971 in the control groups. Adults clinically depressed	BDI HRSD MADRS EPDS	YES (Cochrane risk of bias tool)	NO	Exercise, yoga, and tai chi showed efficacy in reducing depression symptoms with a moderate favourable effect in reducing depression symptoms compared to all control conditions **Hedges' g=0.63; 95% CI, 0.50–0.76; P<.001)** When we included only the 6 studies meeting criteria for the lowest risk of bias the overall effect size showed low to moderate efficacy in reducing depressive symptoms **(Hedges' g=0.41; 95% CI, 0.14–0.66; P=.007)** Exercise, yoga, and tai chi (combined) were significantly superior to the active group (**Hedges' g = 0.45; 95% CI, 0.26–0.63; P<.01**) and CAU group (**Hedges' g=0.81; 95% CI, 0.59–1.30; P<.001**
Sjösten, 2006 **Finland**	System atic review	13	Exercise	Active controls, combined, attention and wait list control groups	N=1264 Adults clinically depressed.	CES-D BDI HAM-D HRSD SDS	YES (Not described)	NO	Exercise was effective in treating depression among those suffering from major depression in comparation with the control conditions.
Stanton, 2014 **Australia**	System atic review	5	Aerobic or resistance training program, or a combination of both, of any duration.	Any other intervention including pharmacother apy, education, psychotherap y, other exercise program, or no intervention including	- Adults clinically depressed.	Validation rating scales (BDI)	NO	PEDro	Most programs were performed three times weekly and of moderate intensity (45-60min). All included trials used aerobic exercise, either treadmill or outdoor walking, stationary cycle or elliptical cross trainer exercise. Intervention duration ranged from four to twelve weeks. Both group and individual programs were shown to be effective in lowering the symptoms of depression. Some level of supervision is recommended.

					wait list controls.					
Cooney, 2013 **UK**		Systematic review	39	Exercise	Non-intervention or placebo Waiting list control TCC or TCC+exercise Other active controls (pharmacological, psychological and alternative therapies)	N=2326 Adults (>18y) clinically depressed	HDRS BDI	YES (Cochrane Collaboration's Tool for Assessing Risk of Bias)	YES	Comparison 1: Exercise versus 'control' **(SMD): -0.62 (95% (CI) -0.81 to -0.42)** Comparison 2: Exercise versus psychological therapies **(SMD: -0.03 (95% CI -0.32 to 0.26)** Comparison 3: Exercise versus alternative treatments **(SMD -6.40, 95% CI-10.20 to -2.60)** Comparison 4: Exercise versus pharmacological treatments **(SMD: -0.11 (95% CI -0.34 to 0.12)**
Noetel, 2024 **Australia**		Systematic review and network meta-analysis	218	Various exercise modalities (e.g., walking, yoga, strength training)	Placebo, CAU or non-exercise	495 arms N=14170 participants, general population, gender not specified	BDI, HAMD, PHQ-9	Yes (Cochrane RoB Tool)	YES	Compared with active controls, large reductions in depression were found moderate reductions for walking or jogging **(n=1210, κ=51, g −0.63, −0.80 to −0.46)**, yoga **(n=1047, κ=33, g=−0.55, −0.73 to −0.36)**, strength training **(n=643, κ=22, g=−0.49, −0.69 to −0.29)**, mixed aerobic **exercises (n=1286, κ=51, g=−0.43, −0.61 to −0.25),** and tai chi or qigong **(n=343, κ=12, g=−0.42, −0.65 to −0.21).** Moderate, clinically meaningful effects were also present when exercise was combined with SSRIs **(n=268, κ=11, g=−0.55, −0.86 to −0.23)** or aerobic exercise was combined with psychotherapy **(n=404, κ=15, g=−0.54, −0.76 to −0.32)**
Zhang, 2025 **China**		Systematic review & meta-analysis Until late 2023	18 RCTs	Aerobic, resistance and mixed exercise	Non-exercise or CAU	N=1,830 participants / ~60% female Adults clinically depressed.	GDS, BDI, PHQ-9	YES (Cochrane ROB)	YES	Exercise interventions significantly reduced depression in middle-aged and older adults **SMD = -0.41, with a 95% confidence interval of [-0.60, -0.22]**, and **P < 0.0001**. Resistance training slightly more effective.
Bizzozero-Peroni, 2024 **Spain**		Systematic review and	5	Mediterranean diet interventions	Control group (no diet intervention)	N=1507 participants, adults clinically depressed.	BDI, HRSD, PHQ-9 SF-36	YES, Cochrane Risk of Bias Tool	YES	Mediterranean diet interventions reduce depressive symptoms significantly among young and middle-aged adults. (**SMD: –0.53; 95% CI: –0.90 to –0.16; I^2 = 87.1%).**

		meta-analysis							
Pérez Bedoya, Brazil Colombia	**2023**	Systematic review and meta-analysis	9	Various physical exercise modalities (e.g., Tai Chi, Yoga, aerobic exercise). Exclude pharmacological interventions.	Second-generation antidepressants, cognitive behavioural therapy, body-mind exercise, or no exercise interventions	N=678 adults clinically depressed aged 20–72 years; 211 men (31.12%) and 467 women (68.88%)	BDI, HRSD, CES-D	YES, Cochrane Risk of Bias Tool	YES	Physical exercise (e.g., Tai Chi) shows moderate effectiveness in treating depressive symptoms. **(SMD) = -0.27 95% Confidence Interval (CI): [-0.58, 0.04] P-value: 0.09**
Zeng, China	**2023**	Systematic review and meta-analysis	12	Tai Chi	Control group (no Tai Chi)	N=731 participants, older adults clinically depressed	HRSD, BDI	YES, Cochrane Risk of Bias Tool	YES	t Tai Chi significantly improved depression in middle-aged and older adults **[SMD = -1.21, 95% CI (-1.59, -0.83), I2 = 87.6%, P < 0.001].**
Tang, China	**2024**	Systematic review and network meta-analysis	47	Exercise interventions: Walking, Aerobic Exercise, Resistance Training, Yoga, Qigong, Tai Chi	Placebo, CAU or non-exercise	N=2895 older adults (≥60 years) clinically depressed.; exact % female not specified	BDI, HRSD	YES, Cochrane Risk of Bias Tool	YES	Compared with the controls, 6 (85.7%) of 7 exercise types, significantly relieved symptoms of depression, and the SMDs (95% CI) ranged between **-0.87 (-1.24; -0.51)** for Walking to **-0.66 (-1.14; -0.19)** for Taichi. The results of pairwise comparisons showed that Walking, Aerobic Exercise, and Resistance Training were significantly better than Mix in relieving depression symptoms, and Walking ranks first. Results indicate that interventions lasting 30-60 minutes per session, delivered three/five times per week for a minimum duration of eight weeks, were the most effective.
Swainson, Canada	**2023**	Systematic review	5	Whole dietary interventions. Exclude pharmacological interventions	No dietary intervention	N=361 participants, 127 male (35,2%) and 234 female (64,8%)	PHQ-9, BDI	YES, risk of bias assessment conducted	YES	Dietary interventions, especially Mediterranean Diet, improved mood in depressed patients, but more research is needed to clarify mechanisms.
Tian, China	**2024**	Systematic review and Bayesian model-based network meta-analysis	46	Various exercise types: Walking, Aerobic Exercise, Resistance Training, Yoga, Qigong, Tai Chi. Exclude pharmacological interventions	Placebo, CAU or non-exercise	2,895 older adults (≥60 years); exact percentage of female participants not specified	BDI, HRSD, MADRS MET min/week dosage	YES, risk of bias tool used, Cochrane Tool	YES	Aerobic **(SMD) =-0.93; 95% CI: -1.25 to -0.62)** and mind-body exercise **(SMD) =-0.81; 95% CI: -1.19 to -0.42)** improved depressive symptoms better compared to controls, followed by mixed **(SMD =-0.77; 95% CI: -1.20 to -0.34)** and resistance exercise **(SMD =-0.76; 95% CI: -1.24 to -0.28)**

Rossi, 2024 **Brazil**	Systematic review with meta-analysis	7	Strength training	Placebo or CAU	N=2439 participants, adults and older adults clinically depressed	BDI, HRSD	YES, Cochrane Risk of Bias Tool	YES	The overall effect antidepressant of strength training was moderate **(SMD = 0.51, 95 % CI 0.72 to 0.30, p < 0.001).** Specifically, for MDD **(SMD=0.82, 95% CI -1.34 to -0.30; p<0.002)**
Martínez-Calderon, 2023 **Spain**	Systematic review with meta-analysis and meta-regression	23	Yoga-based interventions	No intervention, waitlist or active controls	N=1420 participants, adults clinically depressed.	BDI, PHQ-9	YES, Cochrane Risk of Bias Tool	YES	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%**) were found, but 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); I2=57%)** after excluding three outliers 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%**) were 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%**) were found. Results indicate that supervised yoga interventions lasting 60 minutes per session, delivered two or three times per week for a minimum duration of eight weeks, were the most effective.
Dong, 2023 **China**	Systematic review and network meta-analysis	30	Traditional Chinese Medicine exercise (e.g., Tai Chi, Qigong)	CAU, health education, non-Tradicional Chinese Medicine exercise	N=2806 participants, older adults clinically depressed	BDI, HRSD	YES, Cochrane Risk of Bias Tool	YES	Traditional Chinese Medicine exercise significantly improved depression **(SMD = −0.63, 95% CI = −0.85, −0.41, p < 0.01).** Results indicate that supervised exercise interventions lasting 30-60 minutes per session, delivered 2-5 times per week for a minimum duration between 8-24 weeks, were the most effective. Tai Chi is the most effective exercise for reducing depression in older adults.

Note. *MDD, Major Depression Disorder; CAU, Care As Usual; SMD, Standardized Mean Difference; PHQ, Patient Health Questionnaire; GDS, Geriatric Depression Scale; HSCL-90, Hopkins Symptom Checklist-90;HSCL-D, Hopkins Symptom Depression Checklist; CES-D, Center for Epidemiologic Studies Depression Scale; HRSD, Hamilton Rating Scale for Depression; BDI, Beck Depression Inventory; DASS, Depression Anxiety Stress Scale, CSDD: Cornell Scale for Depression in Dementia: EPDS, Edinburgh Post-natal Depression Center for Epidemiological Studies Depression, MADRS, Montgomery-Asberg Depression Rating Scale; SDS, Zung Depression Self Rating Scale; CDRS, Cornell Dysthymia Rating Scale Self Report; POMS, Profile of Mood States; STAI, Spielberger State–Trait Anxiety Inventory; CDS, Cardiac Depression Scale; QIDS = Quick Inventory of Depression Symptomatology-Clinician HADS, Rating, Hospital Anxiety and Depression Scale*.

Table 2. Summary of findings of included studies with depressive symptoms' population measured with standardized scales.

Wong, 2021 **China**	Meta-analytic review	75/50	Multi-component lifestyle medicine interventions (physical activity, nutritional advice, sleep management, and/or stress management)	CAU, wait list, no intervention or attention control	N=8479 adults with depressive symptoms at baseline.	HADS CES-D DASS GDS BDI-II PHQ-9 CDS EPDS PHQ-8 MADRS	YES (Cochrane Collaboration's Tool for Assessing Risk of Bias)	NO	Multi-component lifestyle modification interventions significantly reduced depressive symptoms compared to CAU (**CAU; p > .001; d = 0.20, 95% CI: 0.12 to 0.28**) and waitlist/no intervention (**WL/NI; p > .01; d = 0.22, 95% CI: 0.14 to 0.30**) at immediate posttreatment. No significant effects were observed relative to active controls. Improvements were maintained in the short-term (1–3 months; **p > .05; d = 0.25, 95% CI: 0.15 to 0.35**), but not in the medium- or long-term. They observed that the face-to-face interventions were more effectives than the online interventions.
VanDammen, 2018 **The Netherlands**	Systematic review and meta-analysis	5	Lifestyle intervention, behavioural therapy, diet, exercise, weight loss	Wait list, usual advice of healthy lifestyle and an active control (with exercise).	N=224 (Reproductive age woman with BMI>25) with depressive symptoms	CESD POMS STAI	YES (Cochrane Collaboration's Tool for Assessing Risk of Bias)	NO	Lifestyle interventions and depression: **SMD to -2.12 (95% CI: -2.93 to -1.32, p < 0.001)**
Young, 2018 **Australia**	Systematic review		Alcohol reduction Improved sleep quality/insomnia reduction Increased physical activity Reduced/ cessation of substance abuse Smoking cessation	Health Watch Generic Information Depression CBT programme Pyscho-education Counselling Education and social support	N=1964 adults with depressive symptoms at baseline.	PHQ-9 BDI MADRS			Three of seven studies reported a significant improvement in depression symptoms, post-intervention. No studies reported significant improvements in depressive symptoms without a change in the target lifestyle behaviour. suggesting that targeting lifestyle behaviours is a valid approach for achieving changes in depression symptoms.
Sjösten, 2006 **Finland**	Systematic review	13	Exercise	Active controls, combined, attention and wait list control	N=1264 adults with depressive symptoms at baseline	CES-D BDI HAM-D HRSD SDS	YES (Not described)	NO	Exercise was effective in reducing depressive symptoms among those with a high number of depressive symptoms at baseline in comparation with the control conditions.

					groups					
Xu, China	**2024**	Systematic review and meta-analysis	11	Mind-body exercise (e.g., Tai Chi, Yoga, Pilates)	Non-exercise	N= 1005 participants, perimenopausal/postmenopausal women with depressive symptoms at baseline	PHQ-9 HADS BDI	YES (Cochrane Risk of Bias Tool)	YES	Mind-body exercises significantly improve depressive symptoms **(SMD, −0.80; 95% CI, −1.17 to −0.44; P <0.0001, I2 = 79%),**
Dong, China	**2024**	Systematic review and network meta-analysis	42	Mind-body exercise (e.g., Tai Chi, Yoga, Pilates). Exclude pharmacological interventions.	Non-exercise	N=2974 participants, older adults with depressive symptoms at baseline	Standarized scales	YES (Cochrane Risk of Bias Tool)	YES	Mind-body exercises improve depression **(SMD = −0.63, 95% CI = −0.85, −0.41, p < 0.01)** with Tai Chi being the most effective.
Tao, China	**2024**	Systematic review and meta-analysis	34	High-intensity interval training (HIIT)	Non-active control group	N=1607 adults with depressive symptoms at baseline	BDI, HRSD	YES, Cochrane Risk of Bias Tool	YES	HIIT had a small but significant effect on depressive symptoms compared to the control group **[SMD = 0.40, 95%CI (0.60, 0.20), I =73%].** However, subgroup analyses revealed no moderating effect of health status or exercise duration on depressive symptoms. HIIT did not have a statistically significant effect on depressive symptoms when compared with other types of exercise **[SMD = 0.15, 95% CI (0.30, 0.01), I 2 = 10%].** HIIT demonstrated a medium effect size in reducing depressive symptoms compared to a non-active control group **[SMD = 0.53, 95% CI (0.84, 0.21), I 2 = 80%].**
Rossi, Brazil	**2024**	Systematic review with meta-analysis	7	Strength training	Placebo or CAU	N=2439 participants, adults and older adults with depressive symptoms at baseline	BDI, HRSD	YES, Cochrane Risk of Bias Tool	YES	The overall effect antidepressant of strength training was moderate **(SMD = 0.51, 95 % CI 0.72 to 0.30, p < 0.001).**
Tian, China	**2024**	Systematic review and meta-analyses	40	Mind-body exercise (Yoga, Qigong, Tai Chi)	No intervention or active controls	5536 participants, older adults with depressive symptoms at baseline	BDI, HRSD, MADRS MET	YES, Cochrane Risk of Bias Tool	YES	Yoga **(SMD)= 0.55; 95% CI: (0.76, 0.35)]b** was the most effective form of exercise for improving depressive symptoms, followed by Qigong **(SMD= 0.52;95%CI: 0.92, 0.11)** and Tai Chi (**SMD= 0.42;95% CI: 0.71, 0.13).**
Tian, China	**2024**	Systematic review and meta-analyse	80	Various exercise modalities (e.g., resistance, mind-body, aerobic)	Placebo, CAU or non-exercise	5536 participants, older adults with depressive symptoms at baseline, 68.5% female	BDI, HRSD MADRS MET	YES, Cochrane Risk of Bias Tool	YES	Resistance exercise **(SMD=− 0.68, 95% confidence interval (CI): − 0.90, − 0.46)** and mind–body exercise **(SMD=−0.54, 95% CI: −0.72, −0.37)** were the most effective forms of exercise for improving depression in older adults, followed by aerobic exercise **(SMD=− 0.31, 95% CI: − 0.50, −**

s	**0.13)** and mixed exercise **(SMD=− 0.23, 95% CI: − 44, − 0.01).**

Note. *MDD, Major Depression Disorder; CAU, Care As Usual; SMD, Standardized Mean Difference; PHQ, Patient Health Questionnaire; GDS, Geriatric Depression Scale; HSCL-90, Hopkins Symptom Checklist-90;HSCL-D, Hopkins Symptom Depression Checklist; CES-D, Center for Epidemiologic Studies Depression Scale; HRSD, Hamilton Rating Scale for Depression; BDI, Beck Depression Inventory; DASS, Depression Anxiety Stress Scale, CSDD: Cornell Scale for Depression in Dementia: EPDS, Edinburgh Post-natal Depression Center for Epidemiological Studies Depression, MADRS, Montgomery-Asberg Depression Rating Scale; SDS, Zung Depression Self Rating Scale; CDRS, Cornell Dysthymia Rating Scale Self Report; POMS, Profile of Mood States; STAI, Spielberger State–Trait Anxiety Inventory; CDS, Cardiac Depression Scale; QIDS = Quick Inventory of Depression Symptomatology-Clinician HADS, Rating, Hospital Anxiety and Depression Scale.*

Table 3. Risk bias assessment.

	Miller, 2020	Wong, 2021	Tsang, 2008	VanDammen, 2018	Cramer, 2013	Lee, 2021	Schuch, 2016 PTE	Catalán-Matamoros, 2016	Danielsson, 2013	Krogh, 2017	Zou, 2018	Heissel, 2022 (37)	Cramer, 2017	Schuch, 2016	Kvam, 2016	Farah, 2016	Chen, 2019	Morres, 2018 (87)	Nyström, 2015	Krogh, 2011	Bridle, 2012	Fabricatore, 2011	Guo, 2019	Mura, 2013
1. Did the research questions and inclusion criteria for the review include the components of PICO?	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡
2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🟢	🔴	🔴	🔴	🟡	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
3. Did the review authors explain their selection of the study designs for inclusion in the review?	🟡	🟢	🟡	🟡	🟡	🟢	🟡	🟡	🟢	🟢	🟡	🟢	🟡	🟡	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
4. Did the review authors use a comprehensive literature search strategy?	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟡	🟢	🟡	🟡	🟢	🟢	🟢	🟢	🟡
5. Did the review authors perform study selection in duplicate?	🟡	🟢	🔴	🟡	🟡	🟢	🟡	🔴	🟢	🟢	🟢	🟢	🟡	🟡	🔴	🔴	🔴	🔴	🔴	🔴	🟢	🔴	🟢	🟢
6. Did the review authors perform data extraction in duplicate?	🟡	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🟢	🔴	🟢	🟡
7. Did the review authors provide a list of excluded studies and justify the exclusions?	🟡	🔴	🔴	🟡	🔴	🟢	🟡	🟡	🔴	🟢	🔴	🟢	🟡	🔴	🔴	🔴	🔴	🔴	🔴	🟡	🔴	🔴	🔴	🟡
8. Did the review authors describe the included studies in adequate detail?	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
9. Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?	🟢	🟢	🔴	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟡	🟢	🟢	🟢	🔴	🟢	🟢	🔴	🟢	🟡	🟢	🟡	🟢	🟡
10. Did the review authors report on the sources of funding for the studies included in the review?	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
11. If meta-analysis was performed, did the review authors use appropriate methods for statistical combination of results?	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟡	🟢	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
12. If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?	🟢	🟢	🔴	🔴	🟡	🟢	🟢	🟡	🟡	🟢	🔴	🟢	🔴	🟢	🔴	🔴	🔴	🔴	🟡	🟡	🟢	🔴	🟢	🔴
13. Did the review authors account for RoB in primary studies when interpreting/discussing the results of the review?	🟢	🟢	🔴	🔴	🟡	🟢	🟢	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🔴	🟡	🔴	🔴	🟢	🟡	🟢	🟡	🟢	🟢
14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴	🟢	🟡	🟢	🟢	🟡	🟢	🟡
15. If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🔴	🔴	🟢	🟡	🟢	🔴	🟢	🟡	🔴	🔴	🟢	🔴	🔴	🟡	🔴	🟢	🟡
16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🟢	🟡	🟢	🟢
AMSTAR-2: Overall confidence in the results of the review	CL	CL	CL	CL	CL	L	L	CL	CL	H	L	H	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	L

Note. 🟢 *Yes;* 🟡 *Partial Yes;* 🔴 *No; H: High (No or one non-critical weakness); M: Moderate (More than one non-critical weakness); L: Low (One critical flaw with or without non-critical weakness): CL: Critically Low (More than one critical flaw with or without non-critical weakness).*

Table 4. Risk bias assessment (continued).

	Nebiker, 2018	Seshadri, 2020	Sjösten, 2006	Stanton, 2014	Young, 2018	Cooney, 2013	Noetel, 2024	Xu, 2024	Dong, 2024	Zhang, 2025	Bizzozero-Peroni, 2024	Pérez Bedoya, 2023	Zeng, 2023	Tang, 2024	Swainson, 2023	Tian, 2024	Tao, 2024	Rossi, 2024	Martínez-Calderon, 2023	Tian, 2024	Tian, 2024	Dong, 2023
1. Did the research questions and inclusion criteria for the review include the components of PICO?	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?	🟡	🟡	🔴	🟡	🟡	🟢	🟢	🟢	🟢	🟡	🟡	🟡	🟡	🟢	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🔴
3. Did the review authors explain their	🟡	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢

Note. Yes; Partial Yes; No; *H: High (No or one non-critical weakness); M: Moderate (More than one non-critical weakness); L: Low (One critical flaw with or without non-critical weakness): CL: Critically Low (More than one critical flaw with or without non-critical weakness).*

Discussion

This umbrella review synthesised evidence from 46 systematic reviews and meta-analyses assessing lifestyle-based interventions for the adjuvant treatment of depression. Overall, the findings provide strong support for incorporating non-pharmacological interventions into standard care for depressive symptoms, even when patients are receiving antidepressant pharmacological treatments. This approach is consistent with current recommendations supporting integrated biopsychosocial treatments for depression, as combining biological, psychological, and social strategies can enhance treatment effectiveness in a shorter timeframe and contribute to improved long-term outcomes [71]. Physical exercise and mind-body therapies exhibit the most consistent and clinically meaningful benefits, while multicomponent interventions offer promising, though more modest, short-term improvements due to their integrative nature. However, further studies are needed to confirm their long-term efficacy. Importantly, these interventions are safe, accessible, and particularly valuable as complementary treatments within multidisciplinary models of depression care.

1. Efficacy of exercise as an adjuvant intervention for depression

Substantial body evidence supports the antidepressant effects of physical exercise across diverse populations with depressive disorders [32, 52, 63, 64, 68]. Exercise modalities, predominantly aerobic but also including resistance and mixed modalities, consistently

demonstrate moderate improvements in depressive symptom severity compared to usual care or non-exercise controls [35, 38, 52]. Meta-analyses have estimated SMDs for exercise interventions in depressive disorders ranging from −0.27 to −0.67, which are comparable to the effect sizes typically reported for pharmacotherapy and psychotherapy [50, 72]. Notably, these estimates derive from both studies where exercise was used as a standalone intervention and those where it served as an adjunct to standard treatments. Evidence suggests that combined approaches, in which exercise is added to pharmacological or psychological therapy, tend to result greater improvements in depressive symptoms [29]

Aerobic exercise has emerged as the most extensively studied and effective modality, with multiple reviews highlighting its superiority in symptom reduction [52, 62]. Resistance training and neuromuscular exercises also show moderate benefits, particularly in older adults [45, 64]. Importantly, exercise appears effective across age groups: adults [52], and older adults [41, 68], with structured exercise programs producing larger effects among institutionalized older adults [49].

1.1. Dose-Response Relationship and Adherence

Emerging evidence points to a nonlinear dose-response relationship between exercise volume and depression outcomes, with optimal effects typically observed between 390 and 1000 MET-minutes per week [58, 61]. Exercise adherence appears to be relatively higher compared to other intensive interventions for depression, such as pharmacotherapy or structured psychotherapy, particularly those requiring frequent clinic visits or sustained cognitive engagement [48]. This enhanced adherence is often attributed to the flexibility and personalization of exercise programs, which are tailored to individual preferences regarding frequency, intensity, and setting. Moreover, group-based or supervised exercise interventions, especially those led by trained professionals, have been consistently associated with greater participant engagement, higher completion rates, and improved clinical outcomes, likely due to enhanced motivation, social support, and accountability mechanisms [38, 50].

1.2. Applicability in clinical practice

Exercise exerts antidepressant effects through multiple biological and psychological pathways, including modulation of inflammatory markers, hypothalamic-pituitary-adrenal (HPA) axis regulation, neurogenesis, and improved neuroplasticity [34]. Psychological benefits include enhanced self-efficacy, improved mood regulation, and stress resilience. Compared to pharmacotherapy, exercise presents fewer side effects and additional health benefits, such as cardiovascular and metabolic improvements [52]. Recent innovations, such as virtual reality-based exercise interventions, have shown promising results in improving depression and quality of life, particularly in older adults [73]. Additionally, high-intensity interval training (HIIT) has demonstrated small-to-moderate benefits, expanding the range of effective exercise modalities for depression [63].

2. Efficacy of adjuvant mind-body therapies for depression

Mind-body therapies follow a holistic framework, emphasizing the bidirectional relationship between mental and physical health through self-regulation strategies, such as relaxation and meditation, that aim to enhance self-awareness and promote behavioural change. These interventions acknowledge the influence of emotional, cognitive, social, and spiritual factors on physiological processes. Mind body techniques

frequently overlap with movement-based mindfulness practices like yoga, tai chi, and qigong, reflecting their shared emphasis on integrating attention, breath, and physical activity to improve overall well-being [74]. There is a growing body of evidence supporting the use of mind-body therapies as effective adjuvant interventions for MDD [24, 25, 27-29, 33, 43, 45, 46, 50, 51, 53, 56-58, 60-62, 65, 66]. Recent systematic reviews and meta-analyses reinforce their clinical relevance by showing consistent reductions in depressive symptoms across diverse populations [60].

Multiple studies confirm that Yoga, Tai Chi, and Qigong are among the most effective mind-body therapies [27, 43, 57, 60]. For instance, yoga was repeatedly identified as a top-performing modality in recent network meta-analyses, with SMDs ranging from −0.55 to −0.69 in reducing depression severity [33, 60], and comparable in effectiveness to aerobic exercise and psychotherapy. This aligns with earlier findings by Cramer et al. and Zou et al., who highlighted yoga's moderate-to-large short-term impact and its comparability to electroconvulsive therapy [27, 28, 33].

Tai Chi has also emerged as an effective therapy, particularly in older adults [51, 57]. Several studies reported effect sizes greater than −1.20, with stronger outcomes in longer-duration interventions (≥24 weeks), especially those using the 24-style Tai Chi format [51, 57]. In network analyses, Tai Chi was ranked highest among mind-body therapies for reducing both anxiety and depression symptoms in older adults [57].

Qigong has also shown significant antidepressant effects, although with slightly smaller effect sizes compared to yoga and Tai Chi. According to Tian et al., Qigong showed a SMD of −0.52, with studies noting enhanced efficacy when combined with dynamic movement or aerobic training [60]. These findings are consistent with those from Guo et al., who reported Hedges' g = −0.64 for Qigong against control groups [43]. Furthermore, the inclusion of mindful components appears to enhance long-term emotional outcomes when compared to non-mindful physical activity like walking or running [51].

2.1. Dose-Response Relationship and Adherence

Several high-quality reviews revealed a nonlinear dose-response relationship, with optimal benefits typically observed between 390–1000 MET-min/week of mind-body therapies practice [58, 60]. Beyond this limit, adherence may decline without further clinical gains. Importantly, these therapies are well tolerated and generally show higher adherence compared to more physically demanding interventions, especially among older populations and individuals with comorbidities [50].

2.2. Applicability in clinical practice

Mind-body therapies enhance emotion regulation capacities, self-efficacy, and resilience —core factors in MDD treatment [53]. Compared to pharmacological treatments or intensive psychotherapies, mind-body therapies, generally, require fewer resources, particularly when delivered in group settings or via digital platforms which increases their cost-effectiveness. Emerging evidence supports the feasibility of internet-based and mobile mind-body interventions, which have also demonstrated effectiveness and feasibility in the clinical setting [75].

3. Efficacy of adjuvant multicomponent interventions for depression

Multicomponent lifestyle modification interventions demonstrated moderate short-term effects in reducing depressive symptoms, with SMDs ranging from −0.20 to −0.22 when compared to usual care or waitlist controls [16]. These improvements were maintained up to three months after the intervention [16]. This finding supports the hypothesis that

the integration of two or three lifestyle components may positively modulate depressive symptomatology, particularly in individuals with depression [16, 26, 42].

One of these studies evaluated interventions promoting healthy diet, physical activity, and, in some cases, smoking cessation in general population samples. While the overall effect was small (SMD = −0.184), the effect sizes decreased when analyses were restricted to studies with low risk of bias, highlighting the critical role of methodological quality in interpreting outcomes [4]. Most of these reviews focused on post-treatment and short-term follow-up results [16].

Evidence from some studies has shown that lifestyle interventions can significantly reduce both depressive symptoms and anxiety levels [26]. These results support the potential of lifestyle-based strategies to deliver short-term mental health benefits [16]. This is further reinforced by findings from digital interventions, such as those reviewed by Young et al., which also demonstrate positive outcomes in the short term [49]. Several authors have emphasized the need to tailor multimodal interventions to vulnerable populations to maximize their effectiveness [4, 26].

3.1. Applicability in clinical practice

Summary, these findings suggest that lifestyle interventions, whether delivered face-to-face or online, can produce rapid improvements in depressive symptoms in the short term. However, their effectiveness appears to depend on study design, methodological quality [4, 36], and the characteristics of the study population [26].

4. Other interventions

To a lesser extent, two reviews focusing exclusively on the effect of diet in the treatment of MDD were selected [55, 59]. These studies provide consistent evidence supporting the positive effects of dietary interventions, particularly Mediterranean diet, on depressive symptoms in individuals with MDD [55, 59]. They found that adherence to a Mediterranean diet significantly improved both self-reported and clinician-rated depression scores with a moderate antidepressant effect, especially when delivered by nutrition professionals [55]. Despite some heterogeneity in study design and dietary protocols, both studies highlight the clinical relevance of diet quality as a therapeutic complement in depression management.

Limitations

Multicomponent interventions exhibit substantial heterogeneity in terms of structure, delivery methods, and the specific combination of lifestyle components (e.g., exercise, diet, smoking cessation, sleep hygiene). This variability complicates the accurate assessment of their efficacy in treating depression, particularly when comparing outcomes across studies. Although many interventions have shown effectiveness in reducing severe depressive symptoms, methodological improvements are needed to reduce bias and enhance comparability across trials. In particular, the inclusion of long-term follow-up assessments is essential to evaluate the sustainability of observed benefits over time.

An additional limitation of this review is the exclusion of grey literature. As a result, potentially relevant unpublished studies may have been missed, which could limit the comprehensiveness of the evidence base and increase the risk of publication bias.

Outcome-related limitations should also be considered. This review included only systematic reviews in which depressive symptoms were assessed as the primary outcome. While this criterion enhanced specificity and clinical relevance, it may have led to the exclusion of studies that assessed depression as a secondary or co-occurring

outcome. Future research should adopt broader inclusion criteria and assess the impact of lifestyle-based interventions on related mental health outcomes, such as anxiety, quality of life, or overall psychological functioning.

Conclusions

There is consistent evidence that lifestyle interventions provide clinically meaningful benefits in reducing depressive symptoms. Among these, supervised aerobic exercise at moderate intensity, performed three times per week for 45–60 minutes over at least 8 weeks, appears as the most effective modality, with optimal results observed within the range of 390–1000 MET-minutes per week. Notably, exercise interventions have shown effects comparable to those of pharmacological treatments in several systematic reviews, highlighting their clinical relevance. Mind-body therapies show comparable effectiveness, coupled with high adherence rates, particularly in older adults. Multicomponent lifestyle interventions showed smaller but clinically relevant improvements. Nevertheless, a high degree of heterogeneity in intervention type, dose, and delivery formats limits direct comparisons across studies.

Furthermore, the methodological quality of the included reviews was predominantly low, underscoring the need for more rigorous research designs. Overall, structured exercise and mind-body therapies remain safe, scalable, and effective adjuvant strategies for depression, demanding integration into routine clinical practice. Further studies are required to clarify optimal dosing strategies, long-term sustainability, and comparative efficacy across modalities.

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Declaration of competing interest

The authors declare they have no conflicts of interest.

Declaration of generative AI and AI-assisted technologies in the writing process.

During the preparation of this work the authors used an IA assistant to improve the readability and language of the manuscript. After using this tool, the authors reviewed and edited the content as needed and takes full responsibility for the content of the published article.

Author’s contribution

XG-G; AGR; MB-V, AMY, MG-T: They prepare the conceptualization and introduction. XG-G, AGR, MB-V: They develop the method section, follow this process and independently screened, review and collect the articles. XG-G, AGR, PG-P: They write the original draft and create the tables and figures. MB-V, AMY, MG-T: They review, and editing based on the original draft with all sections. XG-G; AGR; MB-V, AMY, MG-T: They validation, review and editing the final version.

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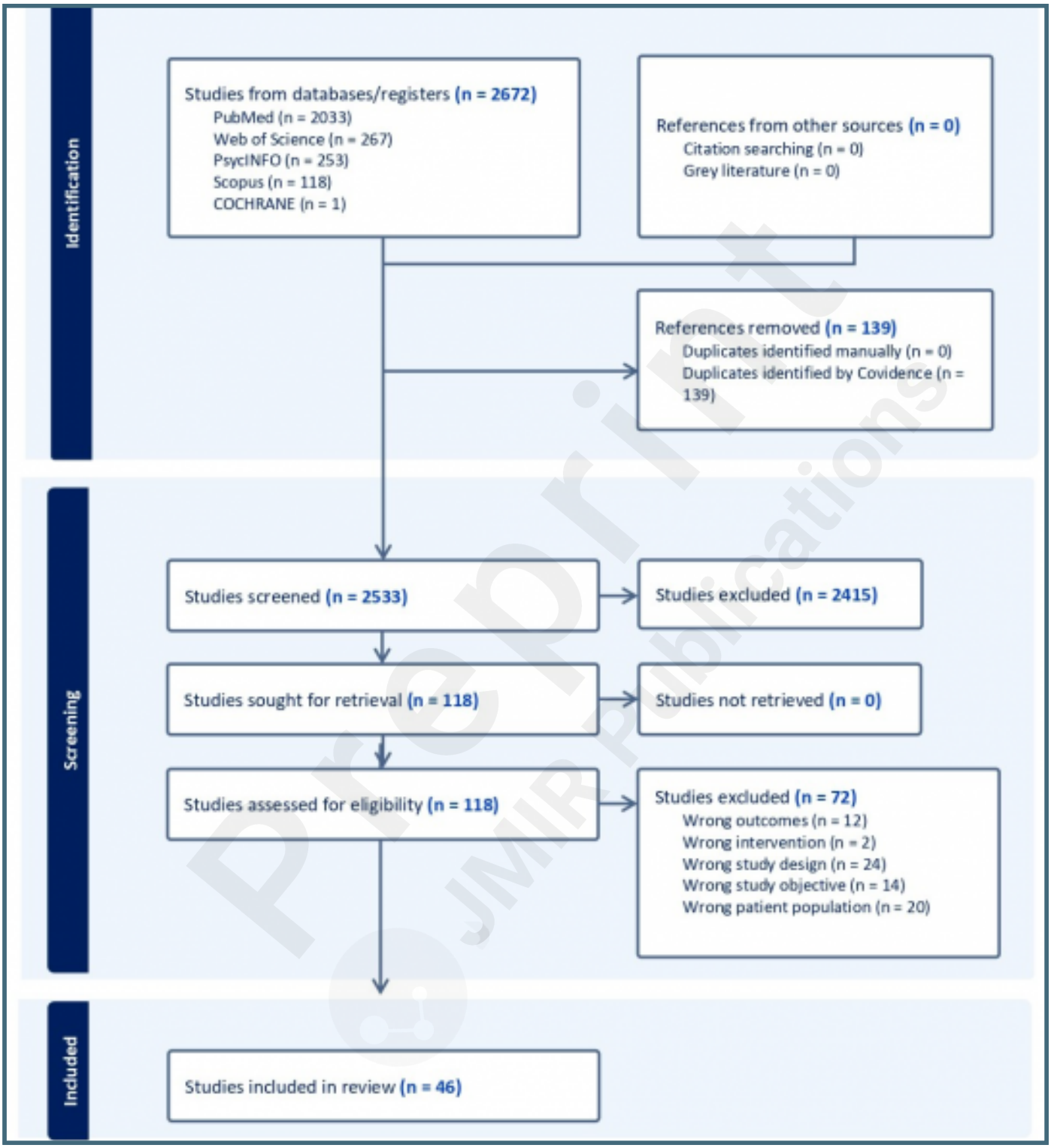
Supplementary Files

Figures

Diagram selection flowchart (PRISMA). Source: covidence.



Multimedia Appendixes

Supplementary material.
URL: http://asset.jmir.pub/assets/2ac4040143930402fc456494676a7cab.docx

CONSORT (or other) checklists

PRISMA checklist.
URL: http://asset.jmir.pub/assets/c982378ae3ddfff3373812265f4b7656.pdf