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Sex differences in adult depression treatment outcome: An umbrella review of systematic reviews and meta-analyses

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Abstract

Major depressive disorder is common and burdensome, with a higher prevalence in women and documented sex differences in treatment response across medicine. However, whether sex differences in adult depression treatment outcomes are consistently reported and synthesized remains unclear. This study aims to synthesize evidence on sex differences in adult depression treatment outcomes and to assess the quality of reviews reporting these differences. It is a secondary analysis of a Campbell Collaboration Evidence and Gap Map (EGM). It is not prospectively registered. PRIOR guidance for overviews of reviews was consulted. We screened 9,475 database records and 995 EGM records; 1,397 full-text reports were assessed, and 48 systematic reviews met inclusion criteria (e.g., reported sex-disaggregated treatment outcomes). We extracted intervention, outcome, and analytical data, assessed methodological quality with AMSTAR-2, and synthesized findings narratively. Among included reviews, 13 (27.1%; 95% CI: 16.6–41.0) found significant sex differences, all with small effect sizes. Pharmacological interventions (selective serotonin reuptake inhibitors, venlafaxine) tended to favor women, psychotherapy (cognitive behavioral therapy, mindfulness) tended to favor men, and complementary and alternative treatments showed variable effects. Over half (52%, 25/48; 95% CI: 38.3–65.5) were critically low quality; 81% (39/48; 95% CI: 68.1–89.8) were low or critically low quality. Sex differences in depression treatment response are underreported. Preliminary trends of female benefit for pharmacotherapy and male benefit for psychotherapy rest on weak evidence. Routine sex-disaggregated reporting and high-quality sex-stratified research are needed. Limitations include restriction to English- and Chinese-language publications, potential overlap of primary studies, and no formal GRADE assessment.

Keywords: Depression; Major depressive disorder; Sex differences; Treatment response; Umbrella review; A MeaSurement Tool to Assess systematic Reviews (2nd edition); Overview of reviews; Personalized medicine

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1. Introduction

Major depressive disorder (MDD) affects 3.8% of the global population, with a 5.7%

prevalence among adults and incidence peaking between ages 18 and 25 years.[1] It imposes a substantial burden on individuals, families, and health systems. Women have a higher prevalence of depression than men globally (5.1% vs. 3.6%),[1] and more than 40% of women face lifetime depression risk.[2] Symptom profiles differ between women and men. Women more often report internalizing symptoms, such as sadness, and somatic complaints, while men more often report externalizing behaviors such as anger and substance misuse. A suicide paradox persists: women attempt suicide more often; men have higher suicide mortality rates.[3] Biological factors (hormonal and neuroendocrine) and psychosocial factors (trauma exposure, social roles, and help-seeking norms) both contribute to sex differences in depression risk and symptom presentation.[4]

Sex differences in response to medical treatment are increasingly recognized.[5] They have been reported in cardiovascular care,[6] cancer immunotherapy,[7] adverse effects,[8] and placebo responses.[9] The underlying mechanisms include sex differences in pharmacokinetics, hormonal status, immune function, and social influences on treatment access and adherence.[10] In depression, some evidence links selective serotonin reuptake inhibitor (SSRI) efficacy to female sex, perhaps through greater drug absorption and slower elimination.[11,12] Psychotherapy results are mixed: some studies suggest that men benefit more from certain psychotherapies, whereas others find no meaningful difference.[11,12] These inconsistencies may reflect differences in study populations, interventions, outcome measures, and analytical methods.

Treatment use also differs by sex. In many settings, women are more likely to receive antidepressants, whereas men are less likely to seek or receive psychotherapy. Adherence and help-seeking vary with social norms, stigma, income, caregiving roles, and comorbidities. These factors may confound observed sex differences. If women respond better to pharmacotherapy, for example, part of this difference may reflect greater treatment exposure or adherence rather than biological differences. Health psychology can help examine these pathways because it links biological, psychological, and social determinants of health behaviors and treatment outcomes.

Sex-disaggregated data remain uncommon in depression research. Systematic reviews and meta-analyses often analyze mixed-sex samples and do not report sex-specific effects. When sex is examined, it is often treated as a secondary or post hoc subgroup analysis. This reduces statistical power and raises the risk of false-negative findings. It also makes it difficult to separate true sex differences from confounding by age, severity, comorbidity, or treatment setting. Currently, no clear sex-specific guidelines for MDD treatment exist.[13]

An umbrella review is appropriate for this question. Systematic reviews of randomized controlled trials (RCTs) provide high-level evidence, and an umbrella review synthesizes this evidence across interventions. A new aggregate-data meta-analysis of sex differences would need consistent sex-stratified effect estimates from primary studies, which are largely unavailable. An individual participant data (IPD) meta-analysis is the preferred design for investigating subgroup questions; however, it requires participant-level datasets and substantial resources. Such data are rarely available in depression treatment research. An umbrella review can map the existing evidence, quantify the proportion of reviews reporting sex-disaggregated outcomes, describe the analytical approaches used, and assess the quality of reviews that report sex differences. The current review follows Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 and draws on a parent Evidence and Gap Map (EGM) of adult depression treatments. However, it was not prospectively registered as a secondary EGM analysis, representing a limitation of this review.

Terminology needs clarification. We use *sex* for the biological variable and *gender* for social, cultural, and behavioral factors. However, primary studies often conflate these concepts, limiting interpretation. For example, a study may describe a difference as "gender-based" when it is based on a biological sex variable, or use "sex" when the mechanism is social. We use "sex" throughout this review because most included reviews reported biological sex or sex categories. Nevertheless, gender-related factors may also influence treatment response, access, and adherence.

Prior work has not systematically quantified the proportion of depression treatment reviews that report sex-disaggregated outcomes or assessed the quality of reviews that examine sex differences. This evidence gap has implications for health psychology and clinical practice. This umbrella review addresses this gap by synthesizing evidence from systematic reviews of adult depression treatments. Specifically, it examines reported sex differences in therapeutic outcomes, the analytical approaches used to investigate these differences, and the quality of the existing evidence base.

2. Objective

The primary objective of this umbrella review is to synthesize the existing evidence on sex differences in treatment outcomes for adult depression from published systematic reviews and meta-analyses of RCTs. Secondary objectives are to: (i) quantify the proportion of depression

treatment reviews reporting sex-disaggregated data; (ii) characterize analytical approaches used to investigate sex differences; (iii) assess methodological quality of reviews reporting sex-stratified outcomes using A MeaSurement Tool to Assess systematic Reviews (2nd edition) (AMSTAR-2); and (iv) identify evidence gaps for future sex-stratified research and guideline development.

3. Study selection and analysis

This review follows PRISMA 2020 and draws on a parent EGM on adult depression treatments. It was not pre-registered as a secondary EGM analysis. We did not follow a formal overview-specific guideline at the protocol stage; instead, Preferred Reporting Items for Overviews of Reviews (PRIOR) guidance was consulted.

3.1. Literature search

We started with 961 systematic reviews from the 2022 depression treatment EGM.[14] The EGM search had a cutoff of June 21, 2022. An updated search was conducted on December 31, 2025, across 16 databases/platforms (PubMed, Embase, Web of Science, American Psychological Association [APA] PsycArticle, JSTOR, APA PsycInfo, Cochrane Library, Campbell Library, Epistemonikos, International Initiative for Impact Evaluation [3ie], China National Knowledge Infrastructure [CNKI], Chinese Biomedical Literature Service System [SinoMed], WanFang Data, VIP Database, Taylor & Francis Online, ScienceDirect) for studies published from June 22, 2022, to December 31, 2025. No geographic restrictions were applied; publications were limited to English/Chinese due to resource constraints. Search strategies for each database are provided in Table S1. One author (Z.W.) is a librarian with 10 years of experience and contributed to the search strategy. We did not search gray literature or clinical trial registries.

3.2. Eligibility criteria

We included peer-reviewed systematic reviews/meta-analyses of RCTs meeting:

- Population: Adults (≥18 years) with depressive symptoms/MDD, including comorbidities;
- Intervention: Any depression prevention/symptom reduction intervention (pharmacotherapy, psychotherapy, complementary and alternative treatments [CATs], and other interventions). The "other intervention" category covered education and training, e-mental health apps, and other treatments.
- Comparison: Placebo, waitlist, treatment-as-usual, or active comparator;
- Outcome: Quantified sex differences. We defined *quantified sex difference* as a reported effect estimate, test statistic, or interaction term for sex. This included results from subgroup analysis, meta-regression with sex as a dummy variable, or interaction tests.
- Study design: Systematic review and meta-analysis of RCTs. We excluded review protocols, non-systematic reviews, and primary studies.

3.3. Study selection

Two independent reviewers screened 961 EGM reviews in Excel; two additional reviewers screened updated records in Rayyan (https://rayyan.ai/) for title and abstract, and in Excel for full text. Disagreements were resolved through multiple rounds of discussion until full consensus was reached.[15] In total, 9,475 database records and 995 EGM records were screened; 1,397 full-text reports were assessed; 48 reviews m*et al*l criteria.

3.4. Data extraction

Two independent reviewers extracted data using a pre-piloted Excel template, with discrepancies resolved by a third reviewer. Extracted data included basic study details (title, author, year, geographic scope); population characteristics (sample size, female percentage); intervention type; outcome measures (depression scales used, sex-stratified effect sizes); analytical approaches for sex differences; and key findings. Missing data were noted as "not reported (NR)".

3.5. Methodological quality assessment

Methodological quality was assessed using AMSTAR-2,[16] a 16-item tool evaluating seven critical and nine non-critical domains. Two independent reviewers (J.H.L. and Y.C.Q.) assigned overall confidence ratings, with disagreements resolved by a third reviewer (G.L.P.). Ratings were defined as:

- High quality: ≤1 non-critical weakness
- Moderate quality: >1 non-critical weakness
- Low quality: 1 critical flaw (± non-critical weaknesses)
- Critically low quality: >1 critical flaw (± non-critical weaknesses)

3.6. Data analysis

A narrative synthesis was the primary approach (aligned with heterogeneous sex difference evidence guidance). We developed an evidence matrix to map interventions to sex-specific effects, coding studies by effect direction (female/male-favoring), magnitude, and outcome measures. Quantitative data (effect sizes, sample sizes) contextualized qualitative findings, with statistically significant sex differences highlighted. We also summarized analytical

approaches for sex differences and AMSTAR-2 quality ratings.

4. Findings

4.1. Study selection and basic characteristics

Of 1,397 screened reviews, 48 reported sex-disaggregated depression treatment outcomes. These reviews included 1,387 primary RCTs (potential duplicates) and 292,928 participants (potential duplicates). All reviews were published from 2009 to 2026; 83.3% ($n = 40$) were published in 2020–2026. Geographically, 91.7% ($n = 44$) had a global scope. A total of 54.2% ($n = 26$) had no language restriction. The PRISMA flowchart is presented in Figure 1.

All reviews focused on adults, with 8 targeting older adults (≥65 years); 12 focused on formal MDD diagnoses, 1 on treatment-resistant depression, 1 on bipolar depression, and 9 on comorbid depression (cancer, type 2 diabetes, post-traumatic stress disorder). Interventions were categorized as pharmacotherapy ($n = 8$; SSRIs, venlafaxine, anti-inflammatory agents), psychotherapy ($n = 13$; cognitive behavioral therapy [CBT], mindfulness, psychodynamic therapy), CATs ($n = 23$; exercise, vitamin D, transcranial direct current stimulation [tDCS]), and other ($n = 4$; health literacy, integrated care). Key characteristics are presented in Table S2.

4.2. Outcome measures

Fifty-one depression assessment tools were used, with 14 employed in multiple reviews: Hamilton Depression Rating Scale (HDRS/DRS; $n = 34$), Beck Depression Inventory (BDI; $n = 26$), Montgomery Åsberg Depression Rating Scale (MADRS; $n = 18$), and the Center for Epidemiologic Studies Depression Scale (CES-D; $n = 18$) were the most frequent (Figure 2).

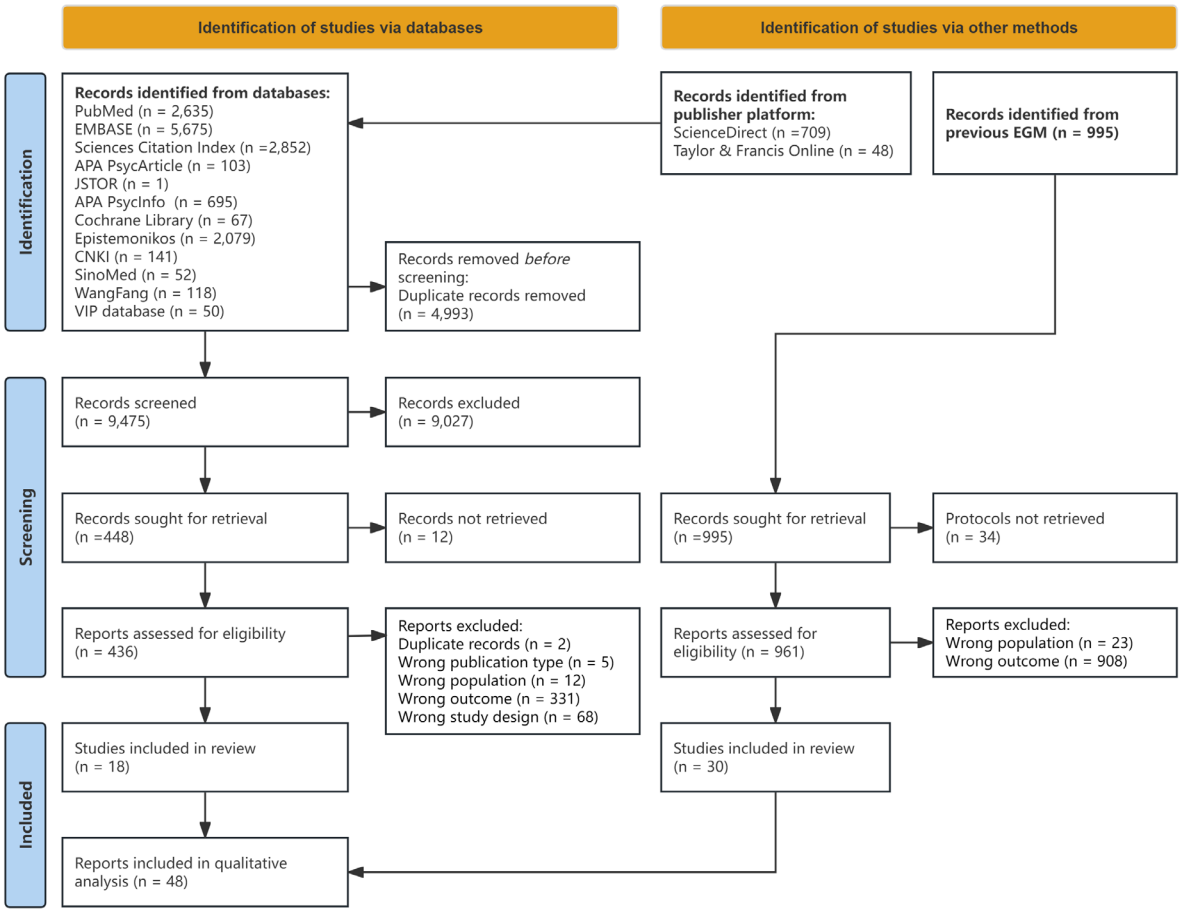


Figure 1. The PRISMA flow diagram for the screening process
Abbreviations: EGM: Evidence and Gap Map; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

The median number of measures per review was 4.5 (interquartile range: 2.75–8). Reviews that used fewer than 4 measures tended to report female-favoring outcomes, while those using 4–8 measures tended to report male-favoring outcomes. However, the distributions overlapped substantially (Figure 3). We therefore treat this pattern as a descriptive observation, not a statistically tested difference.

The 51 instruments differ in content, scoring, and

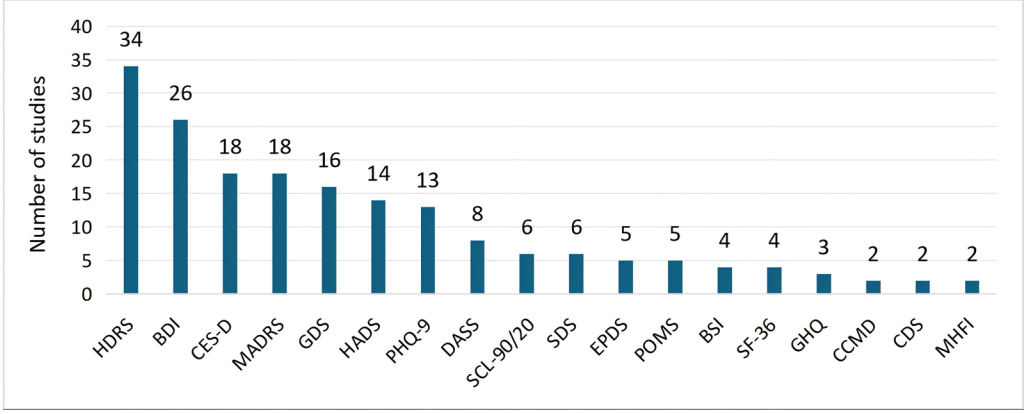


Figure 2. The frequency of measurements used in the included reviews
Abbreviations: BDI: Beck Depression Inventory; BSI: Brief Symptom Inventory; CCMD: Chinese Classification and Diagnostic Criteria of Mental Disorders; CDS: Calgary Depression Scale; CES-D: Center for Epidemiologic Studies Depression Scale; DASS: Depression Anxiety Stress Scales; EPSD: Edinburgh Postpartum Depression Scale; GDS: Geriatric Depression Scale; GHQ: General Health Questionnaire; HADS: Hospital Anxiety and Depression Scale; HDRS: Hamilton Depression Rating Scale; MADRS: Montgomery–Åsberg Depression Rating Scale; MHFI: Mental Health Functioning Index; PHQ-9: Patient Health Questionnaire-9; POMS: Profile of Mood States; SCL-90/20: Symptom Checklist-90/20; SDS: Self-Rating Depression Scale; SF-36: Medical Outcomes Study 36-Item Short Form Health Survey.

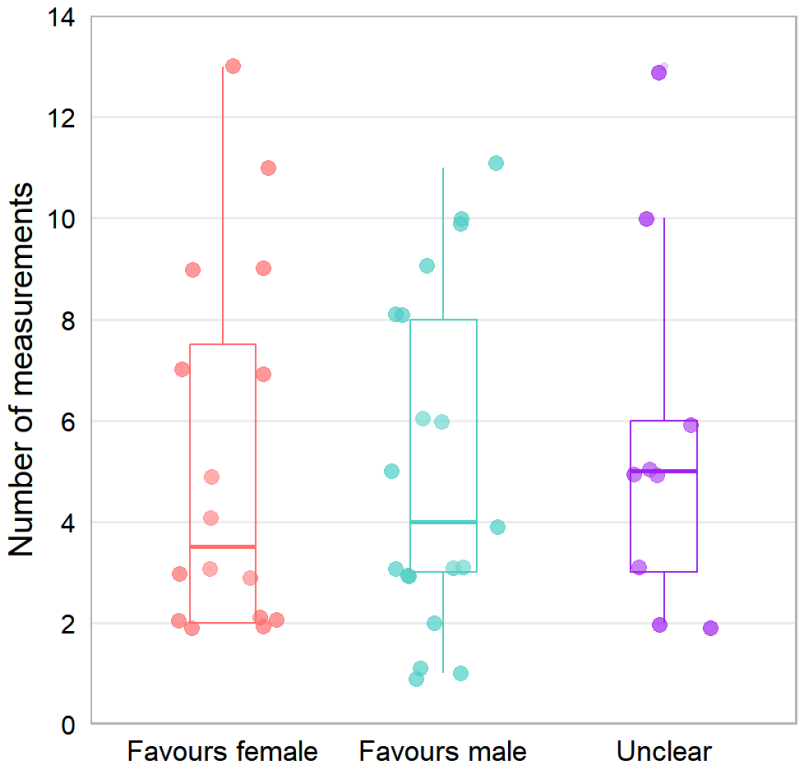


Figure 3. The number of measurements used in the included reviews and outcomes

measurement properties. Some focus on somatic symptoms, others on cognitive or affective symptoms. Some are self-report, others are clinician-rated. These differences limit direct comparison of effect estimates across reviews. They may also contribute to heterogeneity in reported sex differences. For example, the CES-D has been suggested to perform differently in women and men, which could distort estimates of treatment response.

4.3. Analytical approaches for sex differences

Sex was operationalized as a dichotomous dummy variable, a three-category variable (female, male, and both), or the percentage of males/females (Table 1). When a dichotomous dummy was used, most studies compared all-female study populations with mixed populations, likely because studies with only male participants are uncommon, although some studies focused on male populations. The field of depression research seems to contrast with many other areas in which women are generally underrepresented in clinical trials.[17]

Dichotomous dummy variables, which distinguish between male and female study groups or female versus mixed groups, were employed for subgroup analysis in 11 studies and for meta-regression in 7 studies, with 1 study utilizing both methods.[18] Three studies incorporated a sex dummy in an IPD analysis,[19-21] suggesting that these studies are likely to provide the most accurate estimates of sex differences. The three-category variables were used mainly for subgroup analysis; one study used them in meta-regression,[22] which is interpretable only when one category is unoccupied. This limits the comparability of results across reviews. Percentage measures were generally treated as a continuous variable in meta-regression, except for four studies that categorized them either when the majority of the study population is male or female,[23-25] or into quartile categories based on male and female proportions.[26]

Table 1. Sex variable operationalization and analytical methods

Variable	Subgroup analysis	Meta-regression
Dichotomous dummy (female vs. male/mixed)	Cuijpers *et al.*[18]; Bai *et al.*[27]; Fu *et al.*[28]; Gordon *et al.*[29];Mikola *et al.*[30]; Rimmer *et al.*[31]; Soltani *et al.*[32]; Wienicke *et al.*[33]; Xie *et al.*[34]; Xunlin *et al.*[35]; Zhang & Lu[36]	Cuijpers *et al.*[18]; Furukawa *et al.*[19] (IPD); Buntrock *et al.*[21] (IPD); Bellón *et al.*[37]; Goh *et al.*[38]; Moffa *et al.*[39] (IPD); Thase *et al.*[40]
Three categories (male, female, both)	Arsh *et al.*[41]; Ghaemi *et al.*[42]; Mahmoudi *et al.*[43]; Rajaie *et al.*[44]; Rethorst *et al.*[45]; Sun *et al.*[46]; Yosaee *et al.*[47]	Reins *et al.*[22]
Percentage male or female (continuous)	None	Motter *et al.*[20]; Liu *et al.*[25]; Geoffroy *et al.*[48]; Goh *et al.*[49]; Guo *et al.*[50]; Gutsmiedl *et al.*[51]; Magallón-Botaya *et al.*[52]; Mårtensson *et al.*[53]; Medina *et al.*[54]; Morgado *et al.*[55]; Schuch *et al.*[56]; Simmonds-Buckley *et al.*[57]; Tong *et al.*[58]; Rhee *et al.*[59]; Ventura *et al.*[60]; Wang *et al.*[61]; Wong *et al.*[62]; White *et al.*[63]; Yu *et al.*[64]
Percentage male or female (categorical)	Zhu *et al.*[23]; Wei *et al.*[24]; Liu *et al.*[25]; Firth *et al.*[26]	Zhu *et al.*[23]; Wang *et al.*[65]

Abbreviation: IPD: Individual participant data.

4.4. The quality assessment of included studies

Overall quality was poor (Figure 4): critically low 52% (n = 25), low 29% (n = 14), moderate 2% (n = 1), high 17% (n = 8). The absolute difference for critically low quality compared with the parent EGM was −15.1%.[14] The item-by-item AMSTAR-2 results are reported in Table S3.

4.5. Sex-specific treatment effects

Table 2 provides a summary of the narrative synthesis results. Studies were classified by effect direction (female-favoring, male-favoring, or unclear); the labels "favors female" and "favors male" indicate the direction of the effect only. Most associations were not statistically significant.

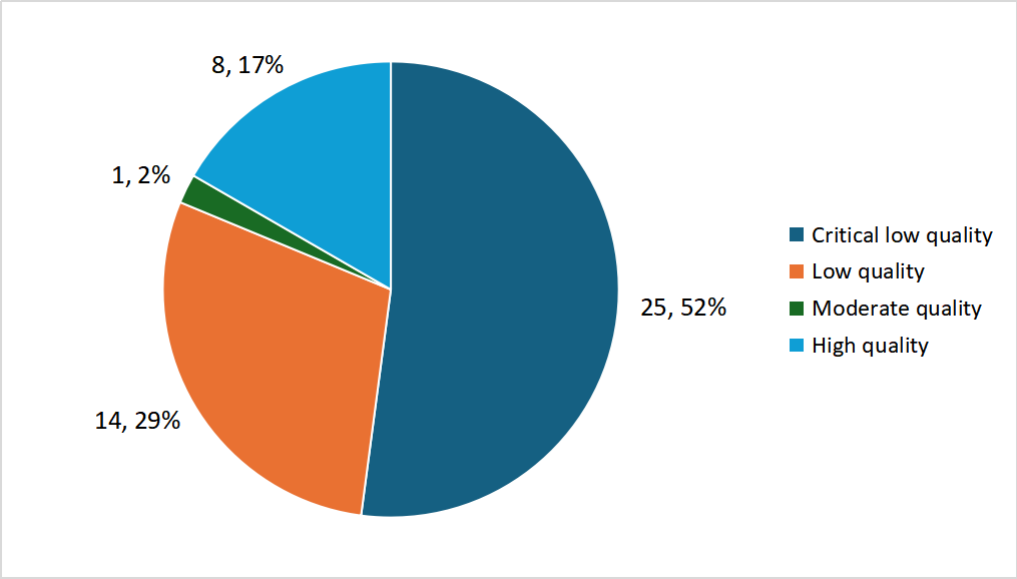


Figure 4. Results of the quality assessment of included reviews (n = 48). Data are presented as n, percentage.

The results are as follows:

(i) Pharmacotherapy. Eight reviews examined pharmacological interventions. Three leaned toward females, and two of these were statistically significant. Three leaned toward males, and two of these were statistically significant. Two reviews had ambiguous outcomes: one reported a significant sex difference but did not report its direction, and the other reported no sex difference.

(ii) Psychotherapy. The scenario differs somewhat for psychotherapies. Of the 13 studies, 6 showed an effect favoring men, and 4 favoring women. Only one in each category showed a statistically significant difference. Three studies reported no sex difference. Notably, one high-quality study[18] identified a significant effect on women with perinatal depression, although this was not consistent across all studies.

(iii) CATs. For CATs, findings were more varied, with approximately equal proportions of studies reporting favorable outcomes for each sex (11 favored females and 10 favored males). For example, among reviews centered on exercise interventions, three demonstrated superior effects in women, whereas the other three indicated more favorable results in men. In contrast, four reviews focused on Vitamin D supplements consistently revealed a more pronounced intervention effect in women.

(iv) Other interventions: Four reviews examined other interventions, including education and training, e-mental health apps, and other treatments. Two favored males (health literacy interventions in primary care with significant difference and computerized cognitive training/self-guided interventions), and the other two reported no sex difference.

Table S4 presents a narrative summary of findings from systematic reviews and meta-analyses explicitly reporting sex-specific differences in depression treatment effects, integrating evidence across intervention types and analytical approaches.

5. Discussion

5.1. Findings on sex differences in depression treatment

Thirteen of the 48 studies reported statistically significant sex differences. This proportion is higher than would be expected by sampling error alone, indicating that some depression interventions may have differential effects by sex. However, the evidence is weak. Most of the included studies were of critically low quality, and significant effects were small. These findings should therefore be read as tentative signals, not as established differences.

Overall, we observed a preliminary pattern. Pharmacological interventions tended to show greater efficacy in women, while psychotherapy tended to show greater benefit in men. CATs were heterogeneous to support a clear direction, with roughly equal numbers of reviews favoring either sex. These patterns were not consistent across all reviews, and many individual results were not statistically significant.

Table 2. Classification of results

Variable	Female-favoring	Male-favoring	Unclear
Pharmacological	Gutsmiedl *et al.*[51] (*n* = 6,373)	Bai *et al.*[27]* (*n* = 1,610)	Goh *et al.*[38]* (*n* = 677)
	Guo *et al.*[50]* (*n* = 46,646)	Wei *et al.*[24]* (*n* = 3,214)	Furukawa *et al.*[19] (*n* = 2,464)
	Thase *et al.*[40]* (*n* = 1,087)	Yu *et al.*[64] (*n* = 208)	
	Cuijpers *et al.* [18] (*n* = 23,908)	Buntrock *et al.*[21] (*n* = 7,201)	Mårtensson *et al.*[53] (*n* = 1,621)
	Reins *et al.*[22] (*n* = 2,186)	Medina *et al.*[54]* (*n* = 3,947)	Morgado *et al.*[55] (*n* = 1,528)
Psychotherapy	Wienicke *et al.*[33]* (*n* = 771)	Wang *et al.*[61]* (*n* = 764)	Wang *et al.*[65] (*n* = 1,777)
	Simmonds-Buckley *et al.*[57] (*n* = 461)	White *et al.*[63] (NR)	
		Wong *et al.*[62] (NR)	
		Xunlin *et al.*[35] (*n* = 3,476)	
	Firth *et al.*[26]* (*n* = 45,826)	Arsh *et al.*[41]* (*n* = 1,362)	Goh *et al.*[49] (*n* = 1,901)
	Fu *et al.*[28] (*n* = 21,561)	Bellón *et al.*[37] (*n* = 1,737)	Ventura *et al.*[60] (*n* = 1,709)
	Geoffroy *et al.*[48]* (*n* = 397)	Mahmoudi *et al.*[43]* (*n* = 1,354)	
	Gordon *et al.*[29] (*n* = 1,258/1,877)	Moffa *et al.*[39] (*n* = 572)	
	Ghaemi *et al.*[42] (*n* = 24,189)	Rajaie *et al.*[44] (*n* = 462)	
Complementary and alternative treatments	Mikola *et al.*[30] (*n* = 53,235)	Rhee *et al.*[59] (*n* = 340)	
	Rethorst *et al.*[45] (*n* = 2,982)	Schuch *et al.*[56] (*n* = 267)	
	Rimmer *et al.*[31] (*n* = 43)	Soltani *et al.*[32] (NR)	
	Xie *et al.*[34] (NR)	Sun *et al.*[46] (NR)	
	Zhang & Lu[36] (*n* = 740)	Yosaee *et al.*[47] (*n* = 836)	
	Zhu *et al.*[23] (*n* = 871)		
Other intervention		Magallón-Botaya *et al.*[52]* (*n* = 2,311)	Motter *et al.*[20] (NR)
		Liu *et al.*[25] (*n* = 5,313)	Tong *et al.*[58] (*n* = 16,706)

Note: *The sex difference is statistically significant.
Abbreviation: NR: Not reported.

Two methodological issues limit interpretation. First, most sex-difference analyses were secondary or post hoc. They were not planned or powered to detect interactions. Interaction tests generally require larger samples than main-effect analyses. A non-significant result may therefore reflect insufficient power rather than a true absence of difference. Second, the review-level evidence is only as good as the primary studies. Many primary trials did not report sex-disaggregated outcomes, and those that did often used different analytical approaches. This makes it difficult to separate true differences from confounding by age, severity, comorbidity, or treatment setting.

5.2. Potential explanations for the results

Several explanations are plausible. First, intervention heterogeneity within CATs is substantial. Resistance exercise has shown greater benefits in female-only populations,[29] while aerobic and combined exercise showed significant improvements in men but not women.[43] Traditional Chinese exercises produced large effects in men and moderate effects in women.[36] Dietary interventions favored women,[26] and tDCS trended toward greater efficacy in men.[31] These differences may reflect hormonal, behavioral, or gut–brain axis mechanisms, but the reviews rarely reported enough detail to test such mechanisms

directly.

Second, subpopulation characteristics matter. Some CAT reviews focused on specific groups: Arsh *et al.*[41] examined adults with comorbid type 2 diabetes, Xunlin *et al.*[35] focused on cancer patients/survivors, and Mahmoudi *et al.*[43] studied healthy older adults. Sex differences in comorbidity management (e.g., women's higher adherence to dietary interventions for diabetes vs. men's engagement in resistance training for muscle strength) or disease-specific biological responses (e.g., cancer-related inflammation modifying exercise efficacy) could explain divergent outcomes. In addition, depression severity (subthreshold vs. MDD) and age (younger vs. older adults) may moderate sex effects; for example, light therapy showed no significant benefit in female-predominant samples,[48] which may reflect unmeasured differences in depression severity or comorbidities.

Third, implementation factors vary. For physical activity interventions, variability in frequency, duration, and intensity (e.g., moderate vs. vigorous exercise) was not consistently reported, but these factors are known to influence antidepressant effects.[45] Similarly, dietary interventions' efficacy may depend on adherence, which could vary by sex due to social or cultural factors (e.g., women's greater engagement in dietary modification vs. men's lower compliance).[26] For physical therapies such as tDCS, differences in electrode placement, session number, or dosage[39] may interact with sex-related neurobiological differences (e.g., brain structure or neurotransmitter levels) to produce variable outcomes.

Fourth, measurement bias is possible. It has long been suggested that the commonly used CES-D exhibits a bias that may increase the likelihood of detecting depression in women compared to men.[66] Should this be the case, even if an intervention effectively alleviates depression, endline assessments using CES-D may still indicate depression in women while failing to detect it in men, potentially distorting observed sex differences in treatment efficacy.

Last, socioeconomic status and treatment adherence may confound the relationship between sex and treatment response. Women and men differ in income, caregiving roles, insurance coverage, and stigma-related barriers to care. They also differ in adherence to pharmacotherapy and psychotherapy. These factors were rarely reported in the included reviews. Publication bias was not assessed in this umbrella review and remains a limitation. Small negative findings may be less likely to be published, which could inflate the apparent consistency of positive sex differences.

These patterns lack robustness. The high proportion of critically low-quality reviews—characterized by multiple critical flaws (e.g., inadequate reporting of search strategies, failure to assess risk of bias in primary studies, lack of transparency in data analysis)—undermines the reliability of these trends. They cannot be construed as definitive evidence of intervention-specific sex differences, but rather as tentative hypotheses requiring validation in higher-quality research, not as clinical guidance.

5.3. Comparison with existing literature

There is no consensus on sex differences in depression treatment. Most research does not analyze sex, suggesting a default assumption of no difference. Pregnancy is a common exception, but outside that context, sex and gender are rarely treated as moderators.[67] Our findings suggest that sex differences may exist for some interventions, but the evidence base is weak.

The IPD meta-analysis by Cuijpers *et al.*[13] is directly relevant. It examined gender as a predictor and moderator of outcome in CBT versus pharmacotherapy for adult depression. That analysis found that gender was not a strong moderator of treatment outcome. Our findings are consistent with that uncertainty. We observed a weak trend toward benefit for females with pharmacotherapy and for males with psychotherapy, but the effect sizes were small, and the underlying reviews were often of low quality. The Cuijpers *et al.*'s analysis had the advantage of IPD, which is the preferred design for subgroup questions. The fact that it did not find strong moderation should temper interpretation of our review-level trends.

For CATs specifically, existing literature aligns with our observation of substantial heterogeneity. Previous reviews have noted that exercise type (aerobic vs. resistance) and patient characteristics (age, comorbidity) moderate antidepressant effects,[45,56] but few have explicitly explored sex as a moderator alongside these factors. Our findings highlight the need for future CAT research to stratify analyses by intervention subtype and to examine sex differences within homogeneous subpopulations. Such approaches could clarify whether the observed heterogeneity reflects true biological or behavioral differences or confounding by unmeasured variables.

Finally, the broader literature on sex differences in treatment response supports the plausibility of our findings but not their certainty. Sex differences have been reported in pharmacokinetics, adverse drug reactions, and placebo responses. These mechanisms may apply to depression treatment. However, review-level evidence cannot confirm them. Higher-quality primary studies and IPD meta-analyses are needed before clinical recommendations can be made.

6. Limitations

This review has several limitations: (i) We did not perform a formal overlap analysis, such as a corrected covered area, and therefore did not quantify the extent to which primary studies or participants were duplicated across the included reviews. (ii) We did not search gray literature or clinical trial registries, and information specialists were not involved. (iii) The restriction to English- and Chinese-language publications may introduce linguistic and geographic bias. (iv) We did not apply Grading of Recommendations Assessment, Development, and Evaluation (GRADE) or an equivalent certainty framework. Analytical approaches were heterogeneous, limiting comparability across reviews. (v) Interaction tests for sex often lack power; therefore, non-significant findings may be false negatives. Primary studies frequently confuse sex and gender. (vi) The review was not prospectively registered. These constraints should be kept in mind when reading the trends reported above.

7. Implications

7.1. Clinical implications

Clinicians may consider sex as a tentative factor when selecting treatments for MDD, not as a definitive guide. Pharmacotherapy (SSRIs, venlafaxine) may be more effective for women, and psychotherapy (CBT, mindfulness) may be more effective for men. For CATs, dietary interventions and vitamin D may be more beneficial for women, and aerobic exercise for men. However, these trends rest on weak evidence. Over half of the included reviews were of critically low quality, and 81% were of low or critically low quality. Clinical recommendations should carry a prominent warning against premature translation. Shared decision-making should explicitly communicate this uncertainty to patients.

Clinical practice should adopt validated, sex-neutral depression scales to reduce measurement bias. The CES-D, for example, may perform differently in women and men, which could distort estimates of treatment responses. Clinicians should also address sex-specific barriers to treatment adherence. Men are less likely to seek mental health services, and women may face cultural norms that affect pharmacotherapy adherence. These barriers can influence outcomes independently of treatment efficacy.

7.2. Research and policy implications

Journals, funders, and research ethics committees should enforce routine sex-disaggregated reporting in primary RCTs and systematic reviews of depression treatments. Primary studies should be powered to detect sex differences in subgroup analysis. Without adequate power, non-significant results may be false negatives rather than evidence of no difference.

Funding should target IPD meta-analyses of depression RCTs. IPD is the preferred design for subgroup questions because it allows consistent adjustment for confounders and provides more reliable interaction estimates. Funding should also support stratified research by intervention subtype (e.g., aerobic vs. resistance exercise) and by patient subpopulation (e.g., uncomplicated MDD vs. comorbid depression) to reduce heterogeneity in CAT outcomes.

Future research should explicitly measure and disentangle biological sex from gendered factors. This includes hormonal status, pharmacokinetics, gender identity, social role, and trauma exposure. Such work would clarify whether observed differences are driven by biology, social influences, or both.

Systematic reviews of depression treatments should adhere to AMSTAR-2 guidelines. They should report sex-stratified analysis transparently, assess risk of bias in primary studies, and report effect sizes with confidence intervals. Future overviews of reviews should follow PRIOR guidance and assess publication bias. This review did not apply GRADE; future work should consider adding a formal certainty assessment, following PRIOR guidance, and assessing publication bias.

Public health depression interventions, such as exercise and dietary programs, should be stratified by sex to optimize efficacy. Additional research is needed into sex-specific barriers to engagement and adherence. Policymakers should use these findings to set reporting standards and to prioritize funding for sex-stratified mental health research.

8. Conclusion

This umbrella review of 48 systematic reviews identified severe underreporting of sex-disaggregated data in depression treatment research. Only 3.4% of screened reviews reported sex-specific outcomes. Thirteen reviews reported small but statistically significant sex differences. Pharmacotherapy tended to favor women, psychotherapy tended to favor men, and CATs were heterogeneous. Over half of the included reviews were of critically low quality, and 81% were of low or critically low quality. These trends are tentative hypotheses, not clinical guidance. The review was not prospectively registered. The search was limited to English- and Chinese-language publications, and we did not apply GRADE.

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Conflict of interest

The authors declare they have no competing interests.

Author contributions

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Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data

The data extracted for this umbrella review are available in the supplementary tables. The parent EGM protocol and data are available from the Campbell Collaboration.

AI tools statement

AI tools (DeepSeek-V3.2) were used only for language polishing and improving readability. AI was not involved in study design, data collection, data analysis, interpretation, or conclusion drawing. All AI-assisted content was manually verified by the authors for accuracy and originality.

References

1. World Health Organization. Depressive disorder (depression). World Health Organization. Accessed April 20, 2025. https://www.who.int/news-room/fact-sheets/detail/depression
2. Abate KH. Gender disparity in prevalence of depression among patient population: a systematic review. *Ethiop J Health Sci*. 2013;23(3):283-288.
   doi: 10.4314/ejhs.v23i3.11
3. Swetlitz N. Depression's problem with men. *AMA J Ethics*. 2021;23(7):E586-E589.
   doi: 10.1001/amajethics.2021.586
4. Salk RH, Hyde JS, Abramson LY. Gender differences in depression in representative national samples: meta-analyses of diagnoses and symptoms. *Psychol Bull*. 2017;143(8):783-822.
   doi: 10.1037/bul0000102
5. Soldin OP, Chung SH, Mattison DR. Sex differences in drug disposition. *J Biomed Biotechnol*. 2011;2011:187103.
   doi: 10.1155/2011/187103
6. Tamargo J, Rosano G, Walther T, *et al*. Gender differences in the effects of cardiovascular drugs. *Eur Heart J Cardiovasc Pharmacother*. 2017;3(3):163-182.
   doi: 10.1093/ehjcvp/pvw042
7. Conforti F, Pala L, Bagnardi V, *et al*. Cancer immunotherapy efficacy and patients' sex: a systematic review and meta-analysis. *Lancet Oncol*. 2018;19(6):737-746.
   doi: 10.1016/S1470-2045(18)30261-4
8. Haack S, Seeringer A, Thürmann PA, Becker T, Kirchheiner J. Sex-specific differences in side effects of psychotropic drugs: genes or gender? *Pharmacogenomics*. 2009;10(9):1511-1526.
   doi: 10.2217/pgs.09.102
9. Vambheim SM, Flaten MA. A systematic review of sex differences in the placebo and the nocebo effect. *J Pain Res*. 2017;10:1831-1839.
   doi: 10.2147/JPR.S134745
10. Chen KJ, Lee MS, Xu H, Zhang Q. Complementary/alternative medicine in cardiovascular diseases 2014. *Evid Based Complement Alternat Med*. 2015;2015:349375.
    doi: 10.1155/2015/349375
11. Romanescu M, Buda V, Lombrea A, *et al*. Sex-related differences in pharmacological response to CNS drugs: a narrative review. *J Pers Med*. 2022;12(6):907.
    doi: 10.3390/jpm12060907
12. Bigos KL, Pollock BG, Stankevich BA, Bies RR. Sex differences in the pharmacokinetics and pharmacodynamics of antidepressants: an updated review. *Gend Med*. 2009;6(4):522-543.
    doi: 10.1016/j.genm.2009.12.004
13. Cuijpers P, Weitz E, Twisk J, *et al*. Gender as predictor and moderator of outcome in cognitive behavior therapy and pharmacotherapy for adult depression: an "individual patient data" meta-analysis. *Depress Anxiety*. 2014;31(11):941-951.
    doi: 10.1002/da.22328
14. Guo L, Ren J, Wei Z, *et al*. Treatment for depression among adults: an evidence and gap map of systematic reviews. *J Evid Based Med*. 2025;18(1):e70011.
    doi: 10.1111/jebm.70011
15. Page MJ, McKenzie JE, Bossuyt PM, *et al*. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Syst Rev*. 2021;10(1):89.
    doi: 10.1186/s13643-021-01626-4
16. Shea BJ, Reeves BC, Wells G, *et al*. AMSTAR 2: a critical

appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ*. 2017;358:j4008.

doi: 10.1136/bmj.j4008

17. Geller JD. The psychotherapy of psychotherapists. *J Clin Psychol*. 2011;67(8):759-765.

doi: 10.1002/jclp.20817

18. Cuijpers P, Karyotaki E, Reijnders M, Huibers MJH. Who benefits from psychotherapies for adult depression? A meta-analytic update of the evidence. *Cogn Behav Ther*. 2018;47(2):91-106.

doi: 10.1080/16506073.2017.1420098

19. Furukawa TA, Maruo K, Noma H, *et al*. Initial severity of major depression and efficacy of new generation antidepressants: individual participant data meta-analysis. *Acta Psychiatr Scand*. 2018;137(6):450-458.

doi: 10.1111/acps.12886

20. Motter JN, Pimontel MA, Rindskopf D, Devanand DP, Doraiswamy PM, Sneed JR. Computerized cognitive training and functional recovery in major depressive disorder: a meta-analysis. *J Affect Disord*. 2016;189:184-191.

doi: 10.1016/j.jad.2015.09.022

21. Buntrock C, Harrer M, Sprenger AA, *et al*. Psychological interventions to prevent the onset of major depression in adults: a systematic review and individual participant data meta-analysis. *Lancet Psychiatry*. 2024;11(12):990-1001.

doi: 10.1016/S2215-0366(24)00316-X

22. Reins JA, Buntrock C, Zimmermann J, *et al*. Efficacy and moderators of internet-based interventions in adults with subthreshold depression: an individual participant data meta-analysis of randomized controlled trials. *Psychother Psychosom*. 2021;90(2):94-106.

doi: 10.1159/000507819

23. Zhu L, Li L, Li XZ, Wang L. Mind-body exercises for PTSD symptoms, depression, and anxiety in patients with PTSD: a systematic review and meta-analysis. *Front Psychol*. 2022;12:738211.

doi: 10.3389/fpsyg.2021.738211

24. Wei X, Xu F, Zhang X, *et al*. Efficacy and tolerability of pramipexole versus antidepressants for Parkinson's disease with depression: a meta-analysis of randomized controlled trials. *J Affect Disord*. 2026;392:120087.

doi: 10.1016/j.jad.2025.120087

25. Liu W, Qin R, Zhang X, *et al*. Effectiveness of integrated care for older adults-based interventions on depressive symptoms: a systematic review and meta-analysis. *J Clin Nurs*. 2024;33(9):3737-3751.

doi: 10.1111/jocn.17317

26. Firth J, Marx W, Dash S, *et al*. The effects of dietary improvement on symptoms of depression and anxiety: a meta-analysis of randomized controlled trials. *Psychosom Med*. 2019;81(3):265-280.

doi: 10.1097/PSY.0000000000000673

27. Bai S, Guo W, Feng Y, *et al*. Efficacy and safety of anti-inflammatory agents for the treatment of major depressive disorder: a systematic review and meta-analysis of randomised controlled trials. *J Neurol Neurosurg Psychiatry*. 2020;91(1):21-32.

doi: 10.1136/jnnp-2019-320912

28. Fu J, Zhang Y, Chen X, *et al*. Efficacy of vitamin D supplementation on depressive symptoms in older patients: a meta-analysis of randomized controlled trials. *Front Med (Lausanne)*. 2024;11:1467234.

doi: 10.3389/fmed.2024.1467234

29. Gordon BR, McDowell CP, Hallgren M, Meyer JD, Lyons M, Herring MP. Association of efficacy of resistance exercise training with depressive symptoms: meta-analysis and meta-regression analysis of randomized clinical trials. *JAMA Psychiatry*. 2018;75(6):566-576.

doi: 10.1001/jamapsychiatry.2018.0572

30. Mikola T, Marx W, Lane MM, *et al*. The effect of vitamin D supplementation on depressive symptoms in adults: a systematic review and meta-analysis of randomized controlled trials. *Crit Rev Food Sci Nutr*. 2023;63(33):11784-11801.

doi: 10.1080/10408398.2022.2096560

31. Rimmer RM, Costafreda SG, Mutz J, *et al*. Transcranial direct current stimulation effects in late life depression: a meta-analysis of individual participant data. *J Affect Disord Rep*. 2022;10:100407.

doi: 10.1016/j.jadr.2022.100407

32. Soltani S, Sangsefidi ZS, Asoudeh F, *et al*. Effect of low-fat diet on depression score in adults: a systematic review and meta-analysis of randomized controlled clinical trials. *Nutr Rev*. 2025;83(3):e741-e750.

doi: 10.1093/nutrit/nuae069

33. Wienicke FJ, Beutel ME, Zwerenz R, *et al*. Efficacy and moderators of short-term psychodynamic psychotherapy for depression: a systematic review and meta-analysis of individual participant data. *Clin Psychol Rev*. 2023;101:102269.

doi: 10.1016/j.cpr.2023.102269

34. Xie F, Huang T, Lou D, *et al*. Effect of vitamin D supplementation on the incidence and prognosis of depression: an updated meta-analysis based on randomized controlled trials. *Front Public Health*. 2022;10:903547.

doi: 10.3389/fpubh.2022.903547

35. Xunlin NG, Lau Y, Klainin-Yobas P. The effectiveness of mindfulness-based interventions among cancer patients and survivors: a systematic review and meta-analysis. *Support Care Cancer*. 2020;28(4):1563-1578.

doi: 10.1007/s00520-019-05219-9

36. Zhang Y, Lu S. Effects of traditional Chinese exercises on mental health in individuals with drug rehabilitee: a systematic review and meta-analysis. *Front Public Health*. 2022;10:944636.

doi: 10.3389/fpubh.2022.944636

37. Bellón J, Conejo-Cerón S, Sánchez-Calderón A, *et al*. Effectiveness of exercise-based interventions in reducing depressive symptoms in people without clinical depression: systematic review and meta-analysis of randomised controlled trials. *Br J Psychiatry*. 2021;219(5):578-587.

doi: 10.1192/bjp.2021.5

38. Goh KK, Liu YW, Kuo PH, Chung YE, Lu ML, Chen CH. Effect of probiotics on depressive symptoms: a meta-analysis of human studies. *Psychiatry Res*. 2019;282:112568.

doi: 10.1016/j.psychres.2019.112568

39. Moffa AH, Martin D, Alonzo A, *et al*. Efficacy and acceptability of transcranial direct current stimulation (tDCS) for major depressive disorder: an individual patient data meta-analysis. *Prog Neuropsychopharmacol Biol Psychiatry*. 2020;99:109836.

doi: 10.1016/j.pnpbp.2019.109836

40. Thase M, Asami Y, Wajsbrot D, Dorries K, Boucher M, Pappadopulos E. A meta-analysis of the efficacy of venlafaxine extended release 75-225 mg/day for the treatment of major depressive disorder. *Curr Med Res Opin*. 2017;33(2):317-326.

doi: 10.1080/03007995.2016.1255185

41. Arsh A, Afaq S, Carswell C, Bhatti MM, Ullah I, Siddiqi N. Effectiveness of physical activity in managing co-morbid depression in adults with type 2 diabetes mellitus: a systematic review and meta-analysis. *J Affect Disord*. 2023;329:448-459.

doi: 10.1016/j.jad.2023.02.122

42. Ghaemi S, Zeraattalab-Motlagh S, Jayedi A, Shab-Bidar S. The effect of vitamin D supplementation on depression: a systematic review and dose-response meta-analysis of randomized controlled trials. *Psychol Med*. 2024;54(15):3999-4008.

doi: 10.1017/S0033291724001697

43. Mahmoudi A, Amirshaghaghi F, Aminzadeh R, Mohamadi Turkmani E. Effect of aerobic, resistance, and combined exercise training on depressive symptoms, quality of life, and muscle strength in healthy older adults: a systematic review and meta-analysis of randomized controlled trials. *Biol Res Nurs*. 2022;24(4):541-559.

doi: 10.1177/10998004221104850

44. Rajaie SH, Soltani S, Yazdanpanah Z, *et al*. Effect of exercise as adjuvant to energy-restricted diets on quality of life and depression outcomes: a meta-analysis of randomized controlled trials. *Qual Life Res*. 2022;31(11):3123-3137.

doi: 10.1007/s11136-022-03146-7

45. Rethorst CD, Wipfli BM, Landers DM. The antidepressive effects of exercise: a meta-analysis of randomized trials. *Sports Med*. 2009;39(6):491-511.

doi: 10.2165/00007256-200939060-00004

46. Sun F, Li L, Wen X, Xue Y, Yin J. The effect of Tai Chi/Qigong on depression and anxiety symptoms in adults with cancer: a systematic review and meta-regression. *Complement Ther Clin Pract*. 2024;56:101850.

doi: 10.1016/j.ctcp.2024.101850

47. Yosaee S, Keshtkaran Z, Abdollahi S, Shidfar F, Sarris J, Soltani S. The effect of vitamin C supplementation on mood status in adults: a systematic review and meta-analysis of randomized controlled clinical trials. *Gen Hosp Psychiatry*. 2021;71:36-42.

doi: 10.1016/j.genhosppsych.2021.04.006

48. Geoffroy PA, Schroder CM, Reynaud E, Bourgin P. Efficacy of light therapy versus antidepressant drugs, and of the combination versus monotherapy, in major depressive episodes: a systematic review and meta-analysis. *Sleep Med Rev*. 2019;48:101213.

doi: 10.1016/j.smrv.2019.101213

49. Goh KK, Chen CH, Chiu YH, Lu ML. Lamotrigine augmentation in treatment-resistant unipolar depression: a comprehensive meta-analysis of efficacy and safety. *J Psychopharmacol*. 2019;33(6):700-713.

doi: 10.1177/0269881119844199

50. Guo X, McCutcheon RA, Pillinger T, *et al*. The magnitude and heterogeneity of antidepressant response in depression: a meta-analysis of over 45,000 patients. *J Affect Disord*. 2020;276:991-1000.

doi: 10.1016/j.jad.2020.07.102

51. Gutsmiedl K, Krause M, Bighelli I, Schneider-Thoma J, Leucht S. How well do elderly patients with major depressive disorder respond to antidepressants: a systematic review and single-group meta-analysis. *BMC Psychiatry*. 2020;20(1):102.

doi: 10.1186/s12888-020-02514-2

52. Magallón-Botaya R, Méndez-López F, Oliván-Blázquez B, Carlos Silva-Aycaguer L, Lerma-Irureta D, Bartolomé-Moreno C. Effectiveness of health literacy interventions on anxious and depressive symptomatology in primary health care: a systematic review and meta-analysis. *Front Public Health*. 2023;11:1007238.

doi: 10.3389/fpubh.2023.1007238

53. Mårtensson E, Coumoundouros C, Sörensdotter R, von Essen L, Woodford J. Psychological interventions for symptoms of depression among informal caregivers of older adult populations: a systematic review and meta-analysis of randomized controlled trials. *J Affect Disord*. 2023;320:474-498.

doi: 10.1016/j.jad.2022.09.093

54. Medina JC, Paz C, García-Mieres H, *et al*. Efficacy of psychological interventions for young adults with mild-to-moderate depressive symptoms: a meta-analysis. *J Psychiatr Res*. 2022;152:366-374.

doi: 10.1016/j.jpsychires.2022.06.034

55. Morgado B, Silva C, Agostinho I, *et al*. Psychotherapeutic interventions for depressive symptoms in community-dwelling older adults: a systematic review with meta-analysis. *Healthcare (Basel)*. 2024;12(24):2551.

doi: 10.3390/healthcare12242551

56. Schuch FB, Vancampfort D, Rosenbaum S, *et al*. Exercise for depression in older adults: a meta-analysis of randomized controlled trials adjusting for publication bias. *Braz J Psychiatry*. 2016;38(3):247-254.

doi: 10.1590/1516-4446-2016-1915

57. Simmonds-Buckley M, Kellett S, Waller G. Acceptability and efficacy of group behavioral activation for depression among adults: a meta-analysis. *Behav Ther*. 2019;50(5):864-885.

doi: 10.1016/j.beth.2019.01.003

58. Tong L, Panagiotopoulou OM, Cuijpers P, Karyotaki E. The effectiveness of self-guided interventions in adults with depressive symptoms: a systematic review and meta-analysis. *EBioMedicine*. 2024;105:105208.

doi: 10.1016/j.ebiom.2024.105208

59. Rhee TG, Shim SR, Forester BP, *et al*. Efficacy and safety of ketamine vs electroconvulsive therapy among patients with major depressive episode: a systematic review and meta-analysis. *JAMA Psychiatry*. 2022;79(12):1162-1172.

doi: 10.1001/jamapsychiatry.2022.3352

60. Ventura F, Frias P, Rodrigues da Silva D, McGirr A, Cotovio G, Oliveira-Maia AJ. Efficacy, effectiveness, and safety of transcranial magnetic stimulation for bipolar depression: a systematic review and meta-analysis. *Biol Psychiatry Glob Open Sci*. 2026;6(1):100618.

doi: 10.1016/j.bpsgos.2025.100618

61. Wang YY, Li XH, Zheng W, *et al*. Mindfulness-based interventions for major depressive disorder: a comprehensive meta-analysis of randomized controlled trials. *J Affect Disord*. 2018;229:429-436.

doi: 10.1016/j.jad.2017.12.093

62. Wong CPS, Yeung JTK, Fong DYT, *et al*. Effectiveness of group cognitive behavioral therapy for depression in adults: a systematic review and meta-analysis of delivery by different healthcare professionals. *Cogn Behav Ther*. 2024;53(3):302-323.

doi: 10.1080/16506073.2024.2313741

63. White V, Linardon J, Stone JE, *et al*. Online psychological interventions to reduce symptoms of depression, anxiety, and general distress in those with chronic health conditions: a systematic review and meta-analysis of randomized controlled trials. *Psychol Med*. 2022;52(3):548-573.

doi: 10.1017/S0033291720002251

64. Yu CL, Liang CS, Yang FC, *et al*. Trajectory of antidepressant effects after single- or two-dose administration of psilocybin: a systematic review and multivariate meta-analysis. *J Clin Med*. 2022;11(4):938.

doi: 10.3390/jcm11040938

65. Wang M, Wu J, Yan H. Effect of music therapy on older adults with depression: a systematic review and meta-analysis. *Complement Ther Clin Pract*. 2023;53:101809.

doi: 10.1016/j.ctcp.2023.101809

66. Stommel M, Given BA, Given CW, Kalaian HA, Schulz R, McCorkle R. Gender bias in the measurement properties of the Center for Epidemiologic Studies Depression Scale (CES-D). *Psychiatry Res*. 1993;49(3):239-250.

doi: 10.1016/0165-1781(93)90064-N

67. Gorman JM. Gender differences in depression and response to psychotropic medication. *Gend Med*. 2006;3(2):93-109.

doi: 10.1016/S1550-8579(06)80199-3