Diabetes, Metabolic Syndrome and Obesity

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REVIEW

Efficacy and Safety of Acupoint Catgut Embedding for Obesity Associated with Polycystic Ovary Syndrome: A Qualitative and Quantitative Analysis

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Aim: Obesity is common in women with polycystic ovary syndrome (PCOS) and can exacerbate PCOS symptoms. Although Acupoint catgut embedding (ACE) is frequently used to treat the clinical symptoms of simple obesity, it is unclear how it will affect obesity associated with PCOS. We conducted a systematic review and meta-analysis of randomized clinical trials (RCTs) to evaluate the effectiveness of ACE in treating obesity in women with PCOS.

Methods: We searched databases from inception to January 8, 2025. Two independent reviewers extracted data and assessed the risk of bias. All meta-analyses used random effects models, and the GRADE approach was used to assess the certainty of the evidence.

Results: We included 25 RCTs (1,663 participants). Based on usual care, compared to blank treatment, ACE probably reduces body mass index (BMI), waist-to-hip ratio (WHR), and waist circumference (WC), and may enable a greater proportion of patients to achieve a weight loss no less than 5% (relative risk [RR] 1.33, 95% CI 1.15 to 1.55) and may reduce triglycerides (TG). Furthermore, when compared to active comparators, ACE probably enables a greater proportion of patients to achieve a weight loss no less than 5% (RR 1.40, 95% CI 1.11 to 1.76) and reduces WC and may also reduce BMI and TG. All effects were supported by low to moderate certainty evidence.

Conclusion: When compared to blank treatment, on the basis of usual care, ACE for obesity associated with PCOS may improve obesity-related outcomes. When compared to active comparators, it may have comparable or greater therapeutic efficacy and fewer adverse events. Such improvements in obesity-related indicators may help alleviate metabolic and reproductive symptoms in women with PCOS. As all included trials were conducted in China, further high-quality studies in diverse populations are needed to confirm the generalizability of these findings.

Keywords: obesity, polycystic ovary syndrome, acupoint catgut embedding, meta-analysis

Introduction

Polycystic Ovary Syndrome (PCOS) is a prevalent endocrine disorder that affects 10% to 13% of women of reproductive age.[1] It is characterized by hyperandrogenism, ovulatory dysfunction, and polycystic ovaries.[2] Obesity is highly prevalent among women with PCOS, with estimates suggesting that 50% to 80% of the affected women are overweight or obese.[3] The interplay between obesity and PCOS is complex, with obesity exacerbating the symptoms of PCOS and vice versa. Insulin resistance, a key feature of both conditions, plays a central role in this relationship.[4] The INSR gene, which encodes the insulin receptor, is pivotal in this relationship. Genetic variations in INSR have been associated with high insulin levels, further aggravating the metabolic and hormonal imbalances observed in PCOS. These mutations likely disrupt insulin receptor function, impairing glucose metabolism and amplifying the symptoms of both obesity and PCOS.[5] Pharmacological treatment of obesity in PCOS spots the improvement of weight loss and insulin sensitivity, involving Metformin, Liraglutide, Orlistat, and combined oral contraceptives.[6–9] Despite the availability of several pharmacological options, challenges remain, including side effects, cost, and patient adherence. Long-term management

https://doi.org/10.2147/DMSO.S553787
Received: 15 July 2025
Accepted: 26 January 2026
Published: 21 February 2026

is essential, but frequent relapses after discontinuation of treatment are common.[3,8,10–12] Further treatment has to focus on alternative therapies with fewer side effects and better long-term efficacy.

Acupoint catgut embedding (ACE), an advanced technique rooted in Traditional Chinese Medicine (TCM), involves the precise insertion of biodegradable surgical catgut into designated acupoints. This method is intended to deliver a sustained, stable, and mild form of stimulation to the body, which can persist for several weeks to months.[13] Among its numerous benefits, ACE stands out for its minimal side effects, robust stimulation, long-lasting therapeutic outcomes, and cost-effectiveness.[14,15] These characteristics render it especially advantageous for the management of chronic conditions like PCOS when accompanied by obesity. The mechanisms of ACE are multifaceted and include the regulation of the hypothalamic-pituitary-ovarian axis, improvement of insulin resistance, reduction of inflammation, and modulation of intestinal flora.[16] Compared to pharmacological treatments, which often necessitate ongoing medication and may result in a range of side effects from mild to severe, ACE provides an alternative with minimal side effects and long-lasting therapeutic outcomes. It has the potential to regulate hormonal imbalances, enhance insulin sensitivity, and assist in weight management without the associated adverse reactions.[17] Systematic reviews have demonstrated the potential of ACE in mitigating the clinical symptoms of simple obesity.[18] Despite growing clinical interest, the current evidence base remains limited by several factors. Most existing studies on ACE focus primarily on simple or abdominal obesity and exhibit considerable heterogeneity in acupoint selection, embedding materials, implantation depth, and treatment duration. Additionally, the overall quality of evidence varies substantially across studies.[19,20] Moreover, the pathophysiology of PCOS-related obesity—characterized by insulin resistance, hyperandrogenism, and reproductive dysfunction—differs markedly from that of simple obesity, raising concerns about whether findings from general obesity studies can be directly extrapolated to PCOS populations. To bridge this gap, this systematic review and meta-analysis aim to assess the clinical efficacy of ACE for obesity associated with PCOS. By synthesizing the available evidence, this study endeavors to provide a comprehensive understanding of the therapeutic potential of ACE, thereby informing clinical practice and guiding future research.

Methods

Our systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement,[21] (Supplement Table 1) and its protocol has been registered on PROSPERO (CRD42024521230). We made two changes to our protocol: (1) we added the proportion of participants reducing their bodyweight no less than 5% because a 5% reduction in baseline weight improves obesity-related metabolic risk factors and coexisting disorder[4,22] and (2) we added subgroup analyses of ACE combined with different treatments.

Literature Search

From the establishment of the databases to March 3, 2024, and updated to January 8, 2025, several studies were identified through systematic literature retrieval from eight electronic literature databases, including PubMed, Cochrane Library, Embase, Web of Science, Chinese National Knowledge Infrastructure (CNKI), VIP Database for Chinese Technical Periodicals, Wan Fang, and Sinomed. (Supplement Table 2) Additionally, Clinical Trials.gov and the WHO International Clinical Trials Registry Platform (ICTRP) were searched. The search terms included polycystic ovary syndrome, obesity, and acupoint catgut embedding.

Study Selection

All retrieved literature was independently reviewed and screened by two reviewers (Dong-ni Yuan and Zhuo-ya Hu). First, the titles and abstracts were read to identify potentially eligible studies, followed by a full-text review to determine if they met the inclusion criteria. In case of any disagreement, a third reviewer (Xing-xian Li) was consulted for evaluation.

We included trials that: (1) Patients diagnosed with PCOS based on the 2003 Rotterdam criteria and who met the WHO Asia-Pacific obesity standard with a BMI ≥25 kg/m^2, regardless of age, race, nationality, or course of disease. (2) Participants were randomly assigned to either a treatment group or a control group, where the treatment group included ACE monotherapy or combined with usual care, and the control group included usual care (including medication or lifestyle control). (3) Follow-up was conducted for at least three months or three menstrual cycles. (4) At least one of the

outcome indicators was reported: bodyweight, body mass index (BMI), waist circumference (WC), waist-to-hip ratio (WHR), testosterone (T), homeostasis model assessment for insulin resistance (HOMA-IR), triglycerides (TG), or adverse events. We excluded: (1) Comparison of ACE with other acupuncture techniques or traditional Chinese medicine, and (2) Studies that did not use internationally standardized units for outcome measures.

Data Abstraction and Risk of Bias Assessment

Two reviewers (Dong-ni Yuan and Jun-xin Zhao) independently extracted data from all eligible trials. We collected information on study characteristics (including first author name, year of publication, funding source, study location, sample size, and length of follow-up), interventions, and all patient-important outcomes. When a study reported results at multiple time points, we selected the most commonly used time point in the eligible trials. We calculated the change data by comparing baseline data with outcome data to account for within-person variability.

Two reviewers (Dong-ni Yuan and Jun-xin Zhao) independently assessed the risk of bias using the modified Cochrane Risk of Bias Tool 1.0,[23,24] including random sequence generation, allocation concealment, blinding of patients, health care providers, data collectors, outcome assessors, and data analysts, incomplete outcome data (missing data ≥20% indicating high risk of bias), and other potential sources of bias. For each item, the response options were scored as "definitely or probably yes" (assigned a low risk of bias) and "definitely or probably no" (assigned a high risk of bias). If there was a disagreement between reviewers, it would be resolved through a third party (Xing-xian Li).

Data Synthesis

For dichotomous outcomes, we calculated the relative risk (RR) and its corresponding 95% confidence interval (CI): the proportion of participants achieving a bodyweight reduction no less than 5% and adverse effects. In cases where the percentage change in body weight was not provided by the authors of the randomized controlled trials (RCTs), this information was approximated based on the reported data.[25] For continuous outcomes, we calculated the weighted mean difference (WMD) and its corresponding 95% CI: (1) BMI, higher score indicated worse outcome; (2) WC, higher score indicated worse outcome; (3) WHR, higher score indicated worse outcome; (4) T, higher score indicated worse outcome; (5) TG, higher scores indicate worse outcomes; (6) HOMA-IR, higher score indicated worse outcome.

For all meta-analyses, we used a DerSimonian-Laird random effects model. The statistical heterogeneity across pooled estimates was evaluated using the Cochrane Q test and the I^2 statistic, while subgroup analyses were conducted to explore potential sources of heterogeneity. In line with Cochrane guidelines, we interpreted I^2 values as follows: 0% to 40% as "possibly not important", 30% to 60% as "moderate heterogeneity", 50% to 90% as "substantial heterogeneity", and 75% to 100% as "considerable heterogeneity".[26] Data analysis was conducted using STATA software version 17 (Stata Corp, College Station, TX, USA). All comparisons were two-tailed using a threshold of $p \leq 0.05$.

Certainty of Evidence

We applied the GRADE (Grading of Recommendations, Assessment, Development, and Evaluation) method to assess the certainty of evidence for each outcome. Evidence can be downgraded from high to moderate, low, or very low certainty due to the risk of bias, consistency, directness, precision, and potential publication bias.[27] We assessed publication bias through a visual assessment of funnel plot asymmetry only when a meta-analysis included at least 10 contributing studies.

Results

Search Results and Study Characteristics

We screened 3022 citations, and 25 trials involving a total of 1663 participants met the eligibility criteria.[28–52] (Figure 1) All studies were conducted in China, and they were all single-center trials. Nine studies were funded by government,[28,31–33,35,36,40,47,49] and sixteen without funding.[29,30,34,37–39,41–46,48,50–52] Among 23 trials that reported age, the average age median of the patients was 26.09 years (IQR 23.02 to 29.40). The median of the average duration of condition was 35.52 months (IQR 22.01 to 56.70) among 22 trials reporting this information. Twenty-two trials compared ACE to blank treatment, on the basis of usual care,[28–40,42–44,46,47,49–52] and five compared ACE to

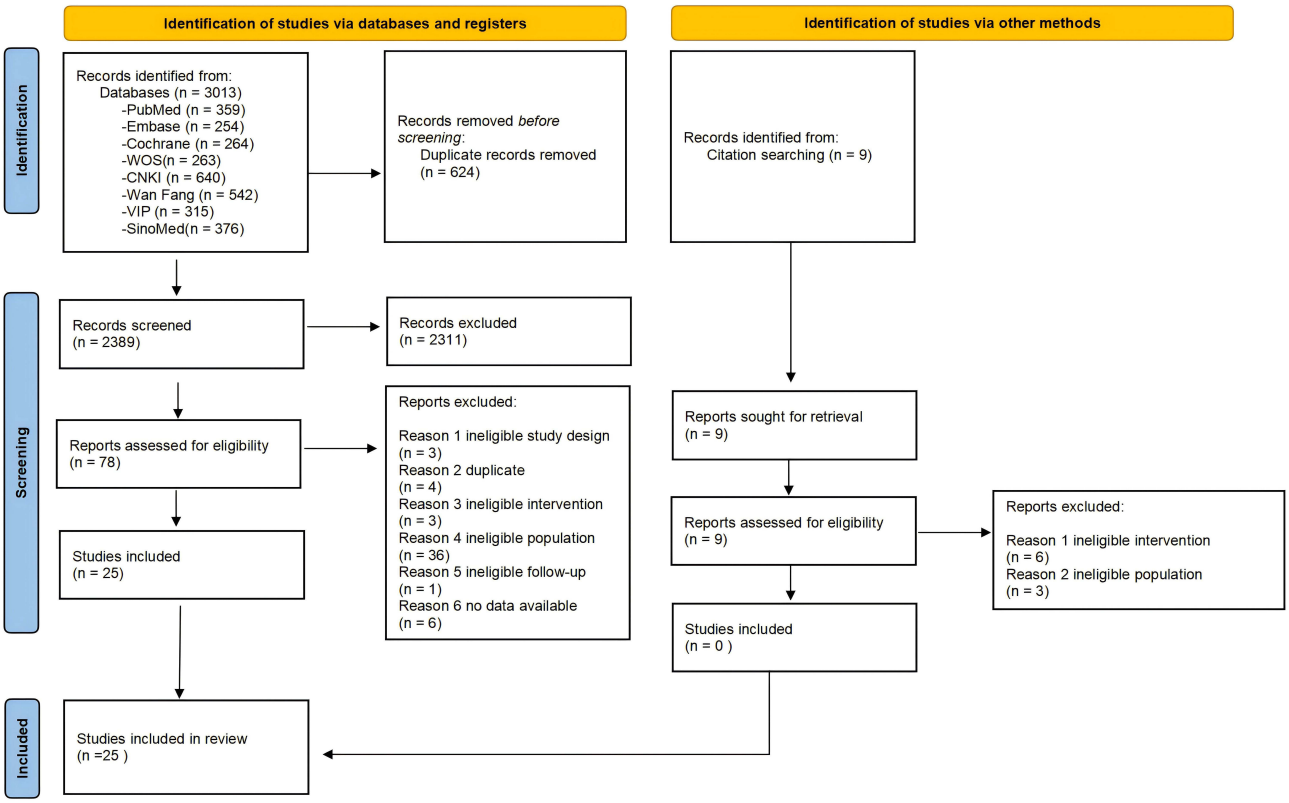

Figure 1 Flowchart of the search results and the selection details.

pharmacotherapy (including metformin,[32,41,48] metformin and ethinylestradiol and cyproterone acetate tablets (EE/CPA),[45] and drospirenone and ethinylestradiol tablets(II) (DRSP/EE(II))[40] (Table 1).

Risk of Bias

Among the 25 eligible trials, 16 (64%) adequately generated randomization sequences. All trials were at high risk in at least one domain involving allocation concealment or blinding. One trial (4%) reported ≥20% missing outcome data (Supplement Table 3).

ACE vs Blank Treatment on the Basis of Usual Care

Bodyweight Reduction No Less Than 5%

Low certainty evidence from 5 trials (381 patients) shows that on the basis of usual care, compared to blank treatment, a greater proportion of patients who received ACE may reduce their bodyweight no less than 5% (RR 1.33, 95% CI 1.15 to 1.55; Table 2, Figure 2).[37,40,42,46,50]

BMI

Moderate certainty evidence shows that compared to no treatment, patients who received ACE probably experience a greater BMI reduction on the basis of pharmacotherapy (6 trials, 494 patients, WMD −2.98, 95% CI −3.41 to −2.55),[28,33,35,40,49,50] traditional Chinese herbs (10 trials, 443 patients, WMD −1.43, 95% CI −1.98 to −0.89),[29,30,36,38,39,43,44,46,47,51] and the combination of pharmacotherapy, traditional Chinese herbs, and health instruction (1 trial, 58 patients, WMD −3.13, 95% CI −4.22 to −2.04).[42] (Table 2, Figure 3).

Table 1 Baseline Characteristics of Included Studies

Study	Intervention	Control	Funding	Country	Number of Participants at Baseline, n	Length of Follow-Up (Months)	Mean Duration of Condition (SD), Months	Mean Age (SD), Years
Bian YY 2023 [41]	ACE	metformin	NR	China	30	6	24.7(9.76)	31(2.49)
Xiao M 2023 [50]	ACE & EE/CPA & metformin	EE/CPA & metformin	NR	China	80	3	24.0(7.6)	28.6(4)
Li YR 2022 [42]	ACE & Dydrogesterone & TCM	Dydrogesterone & TCM	NR	China	58	3	3.3(1.26)	30.8(6.22)
Sheng WZ 2021 [45]	ACE	EE/CPA & metformin	NR	China	120	3	24.0(8.85)	24(2.33)
He DJ 2020A [32]	ACE	metformin	government	China	122	3	27(12.92)	25(6.5)
	ACE & metformin	metformin			123	3	27.5(12.6)	24.5(6)
Ma GZ 2020 [33]	ACE & metformin	metformin	government	China	84	3	60(3.27)	25.5(1.65)
Jiang XL 2020 [31]	ACE & metformin and TCM	metformin and TCM	government	China	84	3	NR	29.6(6.42)
He DJ 2020B [40]	ACE	DRSP/EE(II) and metformin	government	China	122	3	24.0(9.67)	23.3(4.35)
	ACE & DRSP/EE(II) and metformin	DRSP/EE(II) and metformin			124	3	23.7(10.02)	23.3(4.41)
Zhang R 2019 [37]	ACE & Brisk walking therapy	Brisk walking therapy	NR	China	67	3	55.8(29.55)	28.4(4.38)
Zhang XS 2016 [28]	ACE & CC Capsules	CC Capsules	government	China	120	3	36.8(15.86)	28.7(2.83)
Zhang JF 2016 [35]	ACE & metformin	metformin	government	China	60	3	53.8(17.37)	23.8(12.65)
Cai XB 2016 [48]	ACE	metformin	NR	China	55	3	NR	NA
Tang LY 2015 [34]	ACE & metformin	metformin	NR	China	60	3	54.0(17.51)	23.8(12.65)
Cheng R 2015 [39]	ACE & TCM	TCM	NR	China	40	3	41.8(28.26)	24.7(4.65)
Lu J 2014 [49]	ACE & EE/CPA	EE/CPA	government	China	32	3	57.3(50.66)	25.3(3.88)
Xiao SF 2014 [52]	ACE & EE/CPA & metformin	EE/CPA & metformin	NR	China	72	3	55.0(28.89)	23.5(3.59)
Wan QZ 2014 [43]	ACE & TCM	TCM	NR	China	49	3	42.8(2.76)	25.2(4.62)
Yu W 2011 [46]	ACE & TCM	TCM	NR	China	52	3	79.4(22.97)	26.2(3.01)
Liu GY 2010 [29]	ACE & TCM	TCM	NR	China	45	3	58.8(22.84)	27.1(3.75)
Tao LL 2010 [30]	ACE & TCM	TCM	NR	China	41	3	NA	NR
Long YL 2007 [38]	ACE & TCM	TCM	NR	China	42	3	56.6(27.55)	24(4.11)
Gu N 2018 [44]	ACE & TCM	TCM	NR	China	40	3	42.6(28.3)	24.8(4.72)
Gao YC 2023 [47]	ACE & TCM	TCM	government	China	62	3	44.3(28.22)	28.2(5.33)
Zhao Y 2022 [51]	ACE & TCM	TCM	NR	China	52	3	34.8(10.5)	30(4.29)
Qin WM 2016 [36]	ACE & TCM	TCM	government	China	41	3	78.4(20.6)	28.5(4.9)

Abbreviations: ACE, acupoint catgut embedding; NR, not reported; EE/CPA, ethinylestradiol and cyproterone acetate tablets; TCM, Traditional Chinese medicine; DRSP/EE(II), drospirenone and ethinylestradiol tablets (II); CC Capsules, clomifene citrate capsules; NA, not available.

https://doi.org/10.2147/DMSO.S553787

Table 2 Grade Evidence Profile of Acupoint Catgut Embedding for Obesity Associated with Polycystic Ovary Syndrome

No. of Trials (No. of Patients)	Follow-Up, Months	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Treatment Association (95% CI)	Overall Quality of Evidence
Acupoint catgut embedding vs blank treatment on basis of usual care								
Bodyweight reduction no less than 5%								
5 (381)	3	Serious[a]	Not serious, I^2=0.00%	Not serious	Serious[b]	NA	RR 1.33(1.15, 1.55)	Low
BMI:lower is better								
6 (494)	3	Serious[a]	Not serious, I^2=9.73%	Not serious	Not serious	NA	WMD −2.98 (−3.41, −2.55)	Moderate
WHR:lower is better								
9 (499)	3	Serious[a]	Moderate, I^2=45.89%	Not serious	Not serious	NA	WMD −0.05 (−0.06, −0.03)	Moderate
WC:lower is better								
6 (416)	3	Serious[a]	Not serious, I^2=36.20%	Not serious	Not serious	NA	WMD −4.00 (−5.51, −2.50)	Moderate
TG:lower is better								
7 (476)	3	Serious[a]	Moderate, I^2=51.19%[c]	Not serious	Not serious	NA	WMD −0.31 (−0.47, −0.14)	Low
HOMA-IR:lower is better								
9 (607)	3	Serious[a]	Moderate, I^2=51.97%[c]	Not serious	Not serious	NA	WMD −0.45 (−0.73, −0.18)	Low
T:lower is better								
9 (595)	3	Serious[a]	Moderate, I^2=40.80%	Not serious	Not serious	NA	WMD −0.09 (−0.13, −0.05)	Moderate
Adverse effects								
2 (208)	3	Serious[a]	Not serious, I^2=0.00%	Not serious	Not serious	NA	RR 1.18(0.69, 2.04)	Moderate
Acupoint catgut embedding vs active comparators								
Bodyweight reduction no less than 5%								
1 (122)	3	Serious[a]	NA	Not serious	Not serious	NA	RR 1.40(1.11, 1.76)	Moderate
BMI:lower is better								
4 (322)	6 or 3	Serious[a]	Moderate, I^2=47.07%	Not serious	Serious[b]	NA	WMD −1.45 (−2.02, −0.88)	Low
WC:lower is better								
1 (122)	3	Serious[a]	NA	Not serious	Not serious	NA	WMD −5.29 (−8.03, −2.55)	Moderate

(*Continued*)

Table 2 (Continued).

No. of Trials (No. of Patients)	Follow-Up, Months	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication Bias	Treatment Association (95% CI)	Overall Quality of Evidence
TG:lower is better								
2 (152)	6 or 3	Serious[a]	Not serious I^2=0.00%	Not serious	Serious[b]	NA	WMD −0.12 (−0.20, −0.04)	Low
HOMA-IR:lower is better								
2 (177)	3	Serious[a]	Not serious I^2=0.00%	Not serious	Serious[d]	NA	WMD 0.10 (−0.28, 0.48)	Low
T:lower is better								
3 (267)	6 or 3	Serious[a]	Moderate, I^2= 46.72%	Not serious	Serious[d]	NA	WMD 0.00 (−0.04, 0.04)	Low
Adverse effects								
3 (267)	6 or 3	Serious[a]	Not serious I^2=0.00%	Not serious	Serious[b]	NA	RR 0.35(0.18, 0.68)	Low

Notes: [a]High risk of bias in adequate allocation concealment and blinding; [b]Small sample size; [c]Inconsistency of more than 50%; [d]Small sample size and 95% CI crossed the null line.
Abbreviations: 95% CI, 95% confidence interval; NA, not available; RR, relative risk; BMI, body mass index; WMD, weighted mean difference; WHR, waist-to-hip ratio; WC, waist circumference; TG, triglycerides; HOMA-IR, homeostasis model assessment for insulin resistance; T, testosterone.

WHR

Moderate certainty evidence from 9 trials (499 patients) shows that on the basis of usual care, compared to blank treatment, patients who received ACE probably reduce WHR (WMD −0.05, 95% CI −0.06 to −0.03; Table 2, Figure 4).[36,37,39,40,42–44,49,51]

WC

Evidence from 7 trials (497 patients) shows that on the basis of usual care, compared to blank treatment, patients who received ACE may experience a greater WC reduction (I^2= 63.58%).[30,33,37,40,42,46,50] To explore the sources of heterogeneity, a sensitivity analysis was conducted using a stepwise exclusion approach. When Ma GZ 2020[33] was excluded, the heterogeneity significantly decreased (I^2= 36.20%). This suggests that Ma GZ 2020[33] may be a source of heterogeneity. The study included participants under the age of 18, which may have contributed to the increased heterogeneity.

Moderate certainty evidence shows that, on the basis of usual care, compared to blank treatment, patients who received ACE probably experience a greater WC reduction (WMD −4.00 cm, 95% CI −5.51 to −2.50 cm; Table 2, Figure 5).

TG

Low certainty evidence from 7 trials (476 patients) shows that on the basis of usual care, compared to blank treatment, patients who received ACE may experience a greater reduction in TG (WMD −0.31 mmol/L, 95% CI −0.47 to −0.14 mmol/L; Table 2, Supplement Figure 1).[30,32,33,36,42,47,50]

HOMA-IR

Low certainty evidence from 9 trials (607 patients) shows that, on the basis of usual care, compared to blank treatment, patients who received ACE may obtain a greater reduction in HOMA-IR (WMD −0.45, 95% CI −0.73 to −0.18; Supplement Figure 2).[30–33,35,36,42,46,50]

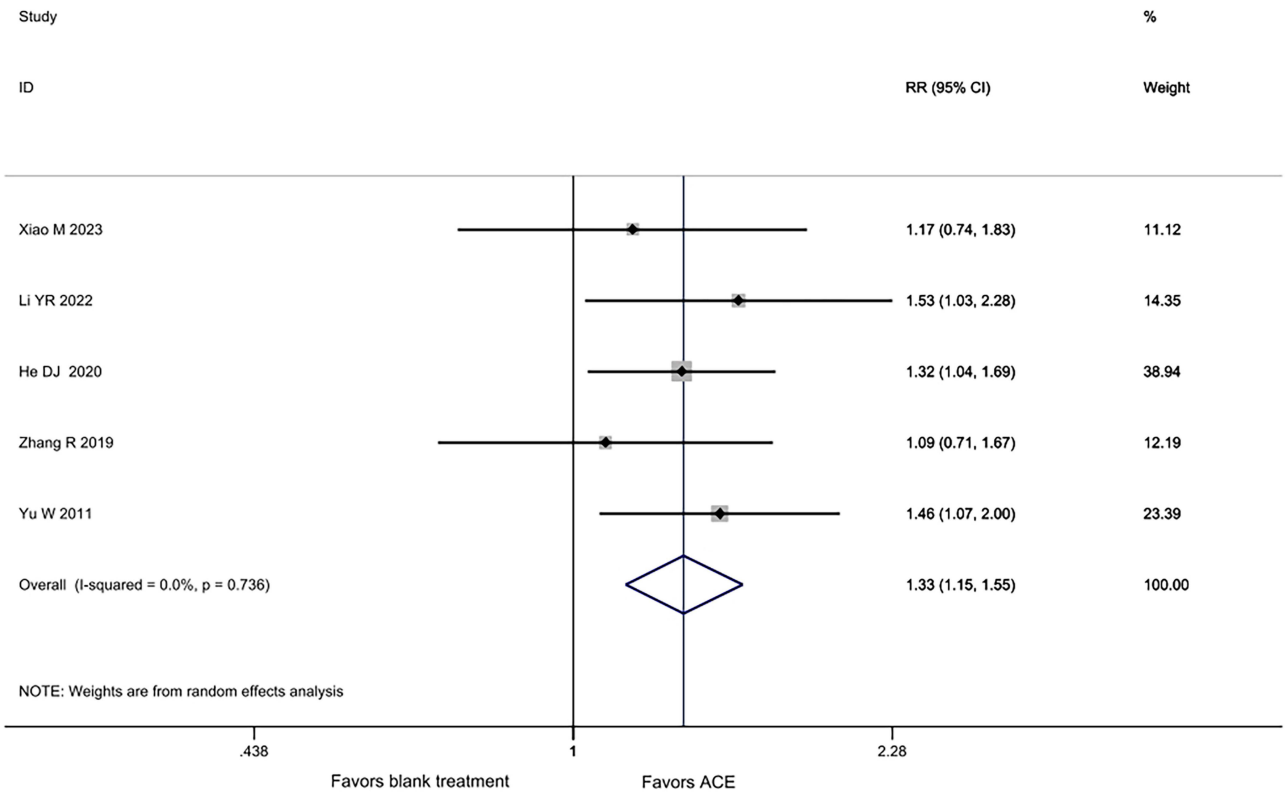

Figure 2 Bodyweight reduction no less than 5% among patients who received acupoint catgut embedding compared to blank treatment, on the basis of usual care.

T

Moderate certainty evidence from 9 trials (595 patients) shows that on the basis of usual care, compared to blank treatment, patients who received ACE probably obtain a greater reduction in T (WMD −0.09 ng/mL, 95% CI −0.13 to −0.05 ng/mL; Table 2, Supplement Figure 3).[28,29,38,40,43,46,47,49,50]

Adverse Effects

Moderate certainty evidence from 2 trials (208 patients) shows that there is probably little to no difference in adverse effects between ACE and blank treatment on the basis of usual care. (RR 1.18, 95% CI 0.69 to 2.04 Table 2, Supplement Figure 4).[31,40]

ACE vs Active Comparators

The active comparators include metformin, metformin combined with EE/CPA, or DRSP/EE(II).

Bodyweight Reduction No Less Than 5%

Moderate certainty evidence from one trial (122 patients) suggests that compared to metformin and DRSP/EE(II), a greater proportion of patients who received ACE probably reduce their bodyweight no less than 5% (RR 1.40, 95% CI 1.11 to 1.76; Table 2). [40]

BMI

Low certainty evidence from 4 trials (322 patients) suggests that, compared to active comparators, patients who received ACE may experience a greater reduction in BMI (WMD −1.45, 95% CI −2.02 to −0.88; Table 2, Figure 6). [40,41,45,48]

WHR

From one trial (122 patients) suggests that, compared to DRSP/EE(II) and metformin at 3 months of treatment, patients who received ACE may reduce WHR (WMD −0.04, 95% CI −0.06 to −0.02).[40] From one trial (55 patients) suggests that, compared to metformin at 3 months of treatment, patients who received ACE may experience a greater reduction in WHR

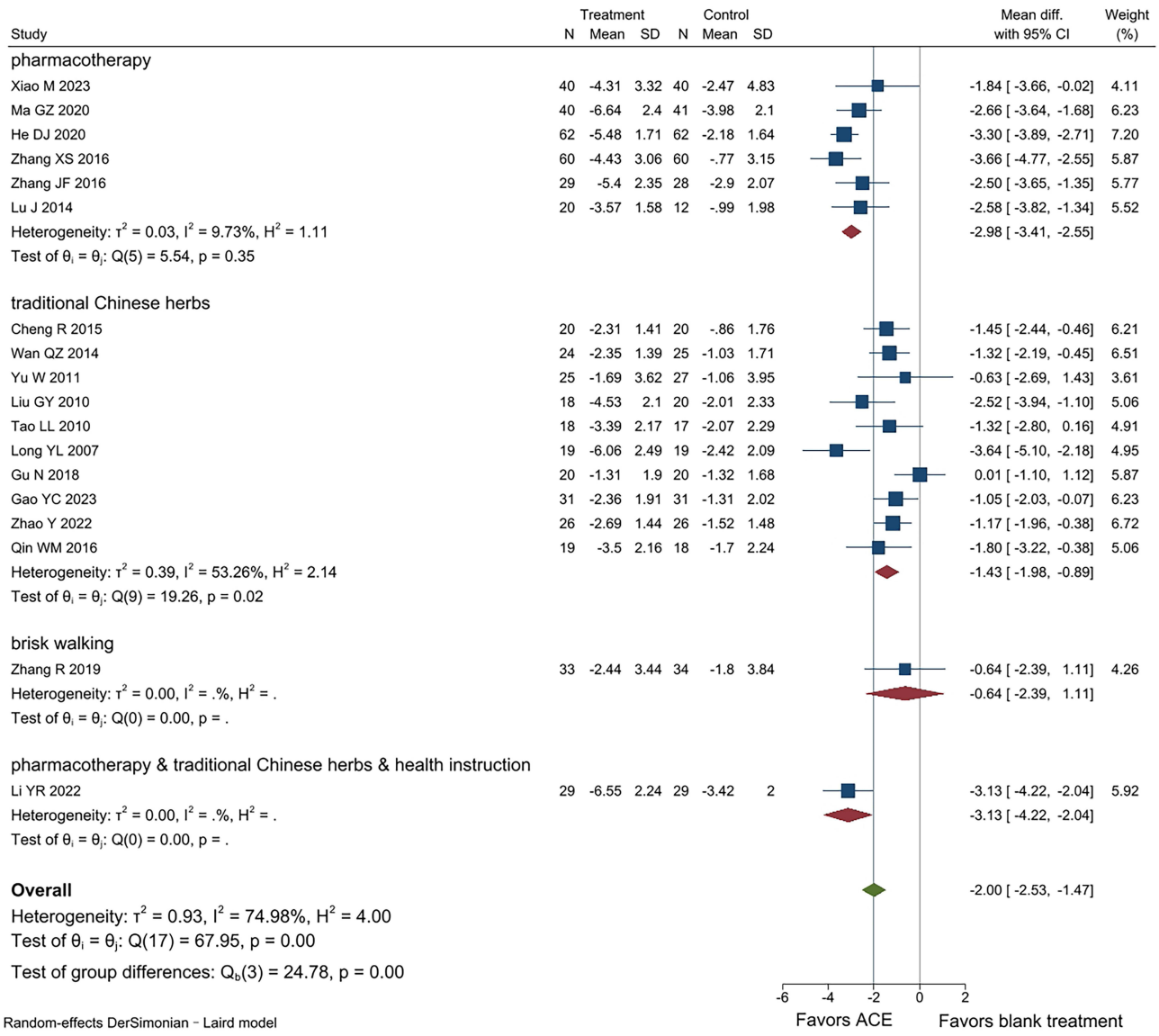

Figure 3 BMI among patients who received acupoint catgut embedding compared to blank treatment, on the basis of usual care.

(WMD −0.11, 95% CI −0.14 to −0.08).[48] From one trial (30 patients) suggests that, compared to metformin at 6 months of treatment, patients who received ACE may experience little to no difference in WHR (WMD 0.01, 95% CI −0.00 to 0.02).[41]

WC

Moderate certainty evidence from one trial (122 patients) suggests that compared to DRSP/EE(II) and metformin, patients who received ACE probably experience a greater reduction in WC (WMD −5.29 cm, 95% CI −8.03 to −2.55 cm; Table 2). [40]

TG

Low certainty evidence from 2 trials (152 patients) suggests that, compared to metformin, patients who received ACE may obtain a reduction in TG (WMD −0.12 mmol/L, 95% CI −0.20 to −0.04 mmol/L; Table 2, Supplement Figure 5).[32,41]

HOMA-IR

Low certainty evidence from 2 trials (177 patients) suggests that, compared to metformin, patients who received ACE may experience little to no difference in HOMA-IR reduction (WMD 0.10, 95% CI −0.28 to 0.48; Table 2, Supplement Figure 6).[32,48]

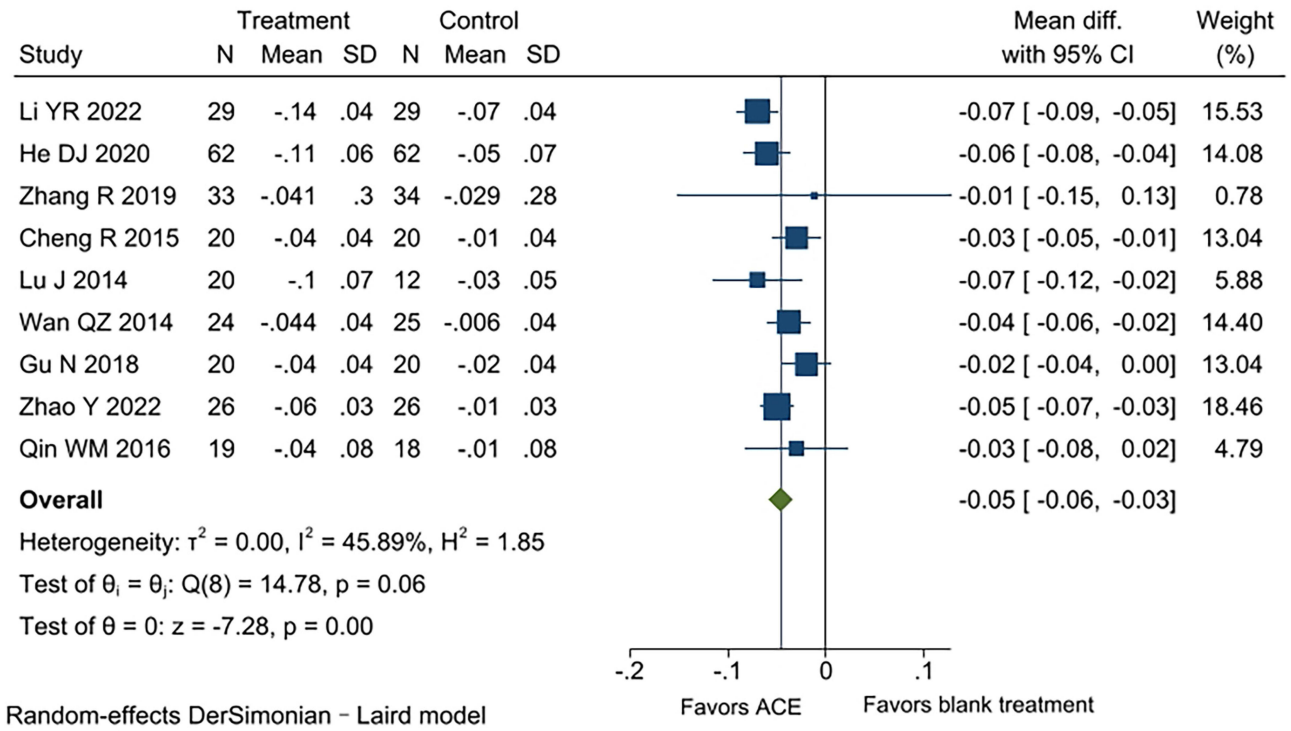

Figure 4 WHR among patients who received acupoint catgut embedding compared to blank treatment, on the basis of usual care.

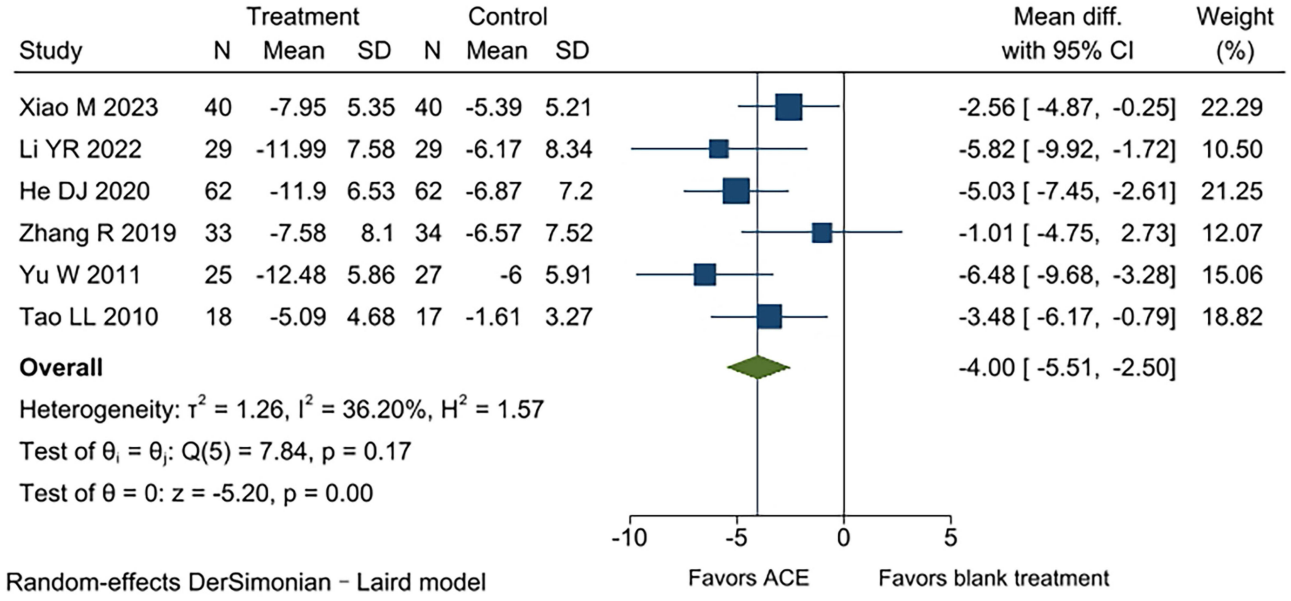

Figure 5 WC among patients who received acupoint catgut embedding compared to blank treatment, on the basis of usual care.

T

Low certainty evidence from 3 trials (267 patients) suggests that, compared to active comparators, patients who received ACE may experience little to no difference in T reduction (WMD 0.00 ng/mL, 95% CI −0.04 to 0.04 ng/mL; Table 2, Supplement Figure 7).[40,41,45]

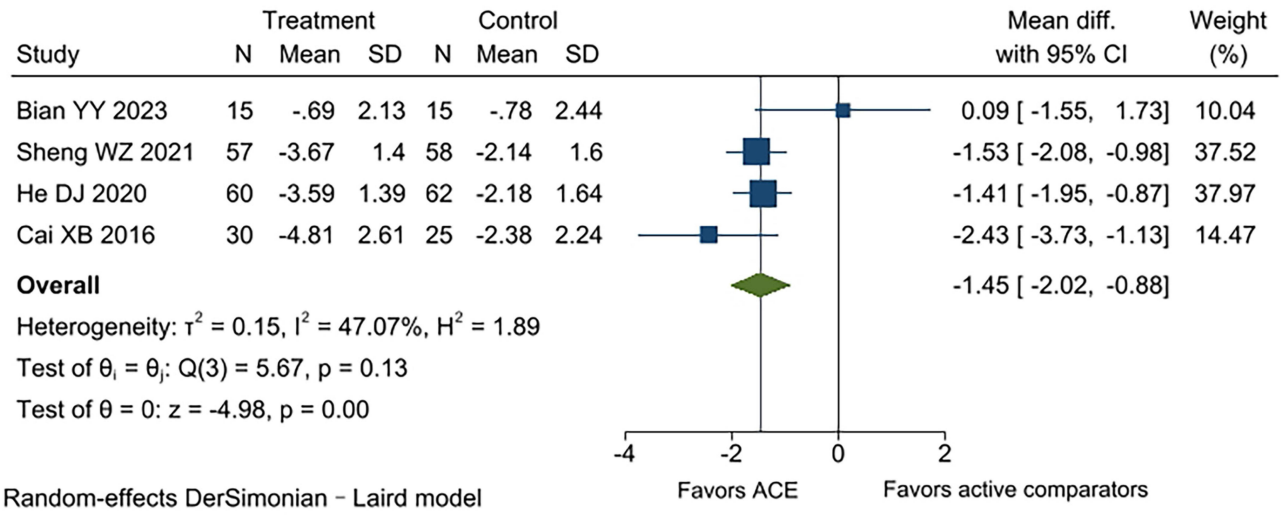

Figure 6 BMI among patients who received acupoint catgut embedding compared to active comparators.

Adverse Effects

Low certainty evidence from 3 trials (267 patients) suggests that there may be fewer adverse effects when applying ACE compared to active comparators (RR 0.35, 95% CI 0.18 to 0.68; Table 2, Supplement Figure 8).[40,41,45]

Discussion

Overall Findings

On the basis of usual care, compared to blank treatment, patients who received ACE probably experience greater reductions in BMI, WHR, WC and T; and may experience a greater proportion of reducing their bodyweight no less than 5%, as well as reductions in TG and HOMA-IR. Compared to active comparators, patients who received ACE probably experience a greater proportion of reducing their bodyweight no less than 5% and a reduction in WC; in addition, these patients may experience reductions in BMI and TG, as well as fewer adverse effects, but may have little to no difference in reductions in HOMA-IR and T. All effects were supported by low to moderate certainty evidence.

Through subgroup analysis, we found that in reducing BMI, ACE may have varying effects in combination with different treatments, with the benefits of ACE being greater in the group combined with pharmacotherapy than in the group combined with traditional Chinese herbs.

Relation to Other Studies

There have been three previous systematic reviews of ACE for PCOS.[53–55] We reviewed all the included studies, evaluated whether they were initially included, and the reasons to exclude them can be found in Supplement Table 4. However, their focus was solely on patients with PCOS, rather than those with obesity associated with PCOS. Therefore, there is still insufficient evidence to confirm the effectiveness of ACE in treating obesity associated with PCOS.

We evaluated the practical significance of ACE in managing obesity associated with PCOS and assessed the quality of evidence. Additionally, we included obesity-related outcomes such as bodyweight reduction no less than 5%, BMI, WHR, WC, and TG to objectively evaluate the clinical significance of ACE in treating obesity associated with PCOS.

Strengths and Limitations

Due to individual weight heterogeneity, the weight loss cannot explain the magnitude of clinical efficacy. Therefore, we converted the absolute value of bodyweight to the proportion of bodyweight reduction of no less than 5% as the primary outcome.

There are several limitations in this review. First, many of the studies only used the term “random” without specifying the allocation concealment or blinding, which may introduce the risk of bias. Second, we were unable to objectively

assess the long-term effects of ACE, as only one study in the eligible literature had a follow-up period longer than three months, resulting in a lack of observation and tracking of long-term efficacy. Third, all of the included studies were conducted in China, which may limit the generalizability of the findings to other populations or regions.

Implications

Low to moderate certainty evidence suggests that, compared to blank treatment and active comparators, ACE may enable a greater proportion of patients to achieve a weight loss of 5% or more and may result in reductions in BMI, WC, and TG. Additionally, compared to active comparators, ACE may offer comparable therapeutic efficacy in terms of HOMA-IR, and T, while leading to fewer adverse effects. This suggests that ACE may provide better improvement in obesity, as well as obesity-related metabolic risk factors and coexisting diseases. PCOS and obesity form a vicious cycle; weight reduction can help alleviate metabolic and reproductive symptoms in women with PCOS. Reducing TG helps lower cardiometabolic risk in patients with obesity-related PCOS, while decreasing T is especially significant due to its impact on reproductive, metabolic, and dermatologic symptoms. Additionally, improved HOMA-IR reflects enhanced insulin sensitivity, which is crucial for reducing the risk of long-term metabolic complications like type 2 diabetes. And ACE may have varying effects in combination with different treatments. Therefore, attention should be paid not only to the efficacy of ACE as a standalone treatment but also to its role in different combination therapies, further optimizing clinical treatment protocols. However, these conclusions are based on moderate or low certainty evidence. Additionally, well-designed randomized controlled trials are necessary to clarify the role of ACE in managing obesity associated with PCOS. Trials should incorporate methodological safeguards to prevent bias, including rigorous scientific randomization methods, allocation concealment, and blinding, and patients should be followed up for at least 6 months (and ideally for 1 year). Future studies should also ensure adequate sample sizes, employ multicenter designs to improve the generalizability of findings, and adopt standardized outcome measures to facilitate comparability across trials.

Conclusion

In this systematic review and meta-analysis of RCTs of patients with obesity associated with PCOS, ACE probably reduces BMI, WHR, WC and T, and may enable a greater proportion of patients to achieve a weight loss no less than 5% and reduce TG and HOMA-IR, when compared with blank treatment, on the basis of usual care. Comparisons with active comparators suggest that ACE probably enables a greater proportion of patients to achieve a weight loss no less than 5% and reduces WC and may reduce BMI and TG and result in fewer adverse effects. However, as all findings are based on evidence of low to moderate certainty, these results should be interpreted with caution. Further large-scale, high-quality randomized controlled trials are needed to validate these findings.

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author, Lei Lan, upon reasonable request.

Acknowledgments

The authors especially thank the editors and reviewers for their valuable feedback, which significantly improved the quality of the paper.

Author Contributions

Xing-xian Li: Data curation, Formal analysis, Writing – original draft, Writing – review and editing. Lei Lan: Formal analysis, Writing – review and editing. Zhuo-ya Hu: Writing – original draft, Data curation. Dong-ni Yuan: Writing–original draft, Data curation. Jun-xin Zhao: Writing–original draft, Data curation. Wen-bin Ma: Writing–original draft, Data curation.

All authors gave final approval for the version to be published; have agreed on the journal to which the article has been submitted; and agreed to be accountable for all aspects of the work.

Funding

This work was supported by the Sichuan provincial project (Grant No. 2022YFS0401) and Chengdu University of Traditional Chinese Medicine University-Institute Joint Innovation Fund (Grant No. LH202402049).

Disclosure

The authors declare that they have no conflict of interest.

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