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HEALTH ASPECTS

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Effects of Chinese traditional exercises on depression in perimenopausal and postmenopausal women: a meta-analysis

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Key words: Chinese traditional exercises, female, perimenopause, postmenopause, depression

Abstract

Background. Chinese traditional exercise (CTE) is showing promise in the treatment of depressive symptoms in perimenopausal and postmenopausal women, yet its overall effectiveness has not been evaluated based on existing randomized controlled trials (RCTs).

Problem and aim. To systematically evaluate the effects of CTE on depressive symptoms in perimenopausal and postmenopausal women.

Material and methods. Databases including China Knowledge Network, Wanfang Data Knowledge Service Platform, PubMed, Web of Science, and Springer ebook were searched to identify randomized controlled trial studies regarding the effects of CTE (including Taichi, Baduanjin, Yijinjing, and Qigong) on depressive symptoms in perimenopausal and postmenopausal women. The search time frame was from the inception of each database to September 2022.

Results. A total of 19 randomized controlled trials was included with 608 subjects for treatment and 594 for control. The pooled results showed that CTE significantly reduced depressive symptoms in perimenopausal and postmenopausal women ($p = 0.0001$). The subgroup analyses revealed significant effects of Taichi and Baduanjin on depressive symptoms ($p < 0.05$), while the effects of Yijinjing and Qigong appeared to be ineffective ($p > 0.05$). The exercise interventions that lasted for 1-12 weeks showed significant effects ($p = 0.0007$), while those that lasted for 12-48 weeks showed non-significant effects ($p > 0.05$).

Conclusions. CTE may effectively treat depressive symptoms in perimenopausal and postmenopausal women. Taichi and Baduanjin are effective exercises, and an intervention duration of 1-12 weeks may be appropriate.

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Introduction

Depression is a common chronic mental illness linked to high-risk behaviors, such as suicide and self-harm [Stringaris 2017]. Women are susceptible populations, particularly those middle aged [Salk *et al.* 2017]. For example, women in perimenopause and postmenopause are at more than three times the risk for depression and anxiety [Freeman *et al.* 2004]. The reduced estrogen levels and recession of ovarian function may cause various vasodilatory and psychoneurological symptoms in some women [Bachmann 1999; Berendsen 2000]. The elevated adiponectin and decreased leptin during postmenopausal may also be connected with negative moods such as anxiety and sadness [Wu *et al.* 2021]. In the *2018 China Health and Aging Tracking Survey*, Li Jiaxing *et al.* [2021] found that 35.5% of the 2807 middle-aged female participants suffered from depression, and the altered functioning at this biological age was assumed a major reason for this phenomenon. Specifically, the decreased estrogen and ovarian levels can increase adiponectin and reduce leptin [Wu *et al.* 2021], which can therefore lead to a variety of vasodilatory and psychoneurological symptoms [Bachmann 1999; Berendsen 2000]. These facts collectively underline the value and importance of maintaining women's health during the perimenopausal and postmenopausal periods.

Patients with perimenopausal syndromes are usually treated with medication, but these medications usually have side effects, such as nausea, vomiting, sexual dysfunction, and addiction [Molero *et al.* 2018]. By comparison, Chinese traditional exercises (CTE), such as Taichi [Innes *et al.* 2008], Baduanjin [Carcelen-Fraile *et al.* 2022], and Yijinjing [Li *et al.* 2023], may have advantages in coping with this health issue. CTE originated from Chinese medicine, which combines training and treatment in the form of "toning the body, toning the breath, and toning the mind [Sancier 1996]". CTE has shown potential in preventing and treating hypertension, cognitive disorders, and chronic obstructive pulmonary disease (COPD) [Li *et al.* 2022; Li *et al.* 2022; Zhang *et al.* 2021]. In recent years, CTE has also contributed to treating perimenopausal depression, with stable effects and less recurrence [Carcelen-Fraile *et al.* 2023]. These studies have implied the role of CTE in this research topic. However, limited by insufficient sample size, solid evidence is lacking to support the benefits of CTE [Wang *et al.* 2017]. Therefore, to prescribe useful interventions to promote the health of middle-aged women, we conducted a meta-analysis to examine the effects of Taichi, Baduanjin, Yijinjing, and Qigong on depressive symptoms in perimenopausal and postmenopausal women.

Material and methods

Literature retrieval

This study was conducted in accordance with the Cochrane Handbook and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines statement for systematic reviews. To offer evidence for causal inference, randomized controlled trials regarding the effects of Chinese traditional exercise (including Taichi, Baduanjin, Yijinjing, and Qigong) on the depressive symptoms of peri- or postmenopausal women were considered. The timeframe of this literature search was between the inception of databases and September 2022. The searched databases included China Knowledge Network (in Chinese), Wanfang Data Knowledge Service Platform (in Chinese), PubMed, Web of Science, and Springer ebook. The search terms in Chinese included "traditional gongfu [传统功夫], Taichi [太极], Qigong [气功], Baduanjin [八段锦], Yijinjing [易筋经], perimenopause [围绝经期], depression [抑郁], psychology [心理], randomized control [控制对照]," etc. The search terms in English were "Taichi/taijiquan, Baduanjin, Yijinjing, Qigong/ breathing exercise, menopause/Perimenopause, depression, psychology," etc.

Eligibility Criteria

Our eligibility criteria obeyed the PICOS principle as follows:

P (population): women in perimenopausal or postmenopausal (age > 40 years); Absence of health problems such as heart and blood pressure; Absence of dysfunctional cognitive diseases.

I (intervention): Taichi, Baduanjin, Yijinjing, and Qigong for the experimental groups.

C (comparison): blank controls or other exercise modalities.

O (outcome): depressive symptoms assessed by questionnaires

S (study design): randomized controlled trials (RCTs).

Literature quality evaluation

In this study, three authors independently assessed the quality of the included literature using the tool from the Cochrane Handbook of Systematic Evaluation. Articles were systematically evaluated in six aspects: (1) description of the randomization method; (2) concealment of the allocation scheme; (3) double-blind principle; (4) blinding principle of outcome evaluation; (5) data completeness, selective reporting of outcome results; and (6) the presence of other bias assessments.

Statistical analysis

The effect size was determined by calculating the standardized mean difference (SMD). Random-effect models were selected for the integration of pooled data throughout the text due to the heterogeneity of the meta-analysis. Statistical analysis was performed using Review Manager

5.4.1 (China Cochrane Centre, Cochrane Collaboration Network). The confidence interval (CI) was 95%, and heterogeneity was tested using I^2. An I^2 of 0-50% or 50-100% were evidence of low or high heterogeneity. The leave-one-out (LOO) method was performed as a sensitivity analysis to track and eliminate heterogeneity.

Results

Literature screening results

Initially, a total of 324 articles were identified, and then 213 articles were left after review according to the title and abstract. After excluding 93 studies that were not related to the topic, there were still 120 articles to be evaluated in full text. Among them, 47 non-RCT and 54 unrelated interventions (non-Taichi, non-Baduanjin, non-Yijinjing, non-Qigong) were excluded. Finally, 19 studies were eventually included (Figure 1).

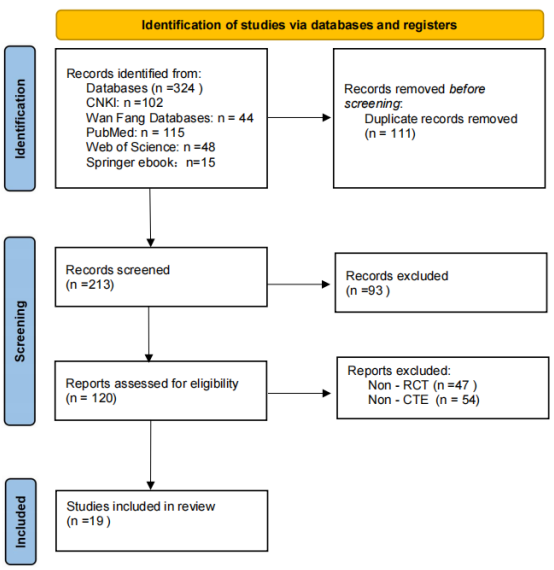

Figure 1. The flow chart of literature inclusion screening

Incorporate Basic characteristics of literature

The meta-analysis included 19 RCTs, from which outcome data were extracted. The total number of subjects included in the literature was 1202, including 608 subjects in the CTE experimental group (205 for Taichi, 168 for Baduanjin, 119 for Yijinjing, and 116 for Qigong). There were 594 subjects in the control group, including 312 in the blank control group and 282 in the conventional treatment group. The conventional treatment group encompassed aerobic exercise, cognitive behavioral therapy, conventional drug therapy, health education, stretching training, and conventional rehabilitation. All subjects were approximately between 45 to 80 years old, and the duration of intervention ranged from 6 weeks to 48 weeks. A total of four types of CTE exercises were included, including Taichi (n = 8), Baduanjin (n = 4), Yijinjing (n = 4), and Qigong (n = 3). Table 1 displays the detailed information.

Quality evaluation included in the study

Nineteen studies were described as using random grouping methods, such as the random number table method. High-risk assessments comprised three studies in which allocation concealment was not discovered, one paper did not use the principle of blinding for outcome assessors, and one paper had inadequate outcome data. The other risk factors were rated as low risk or "unknown", meaning that no risk factors were discovered (Figure 2).

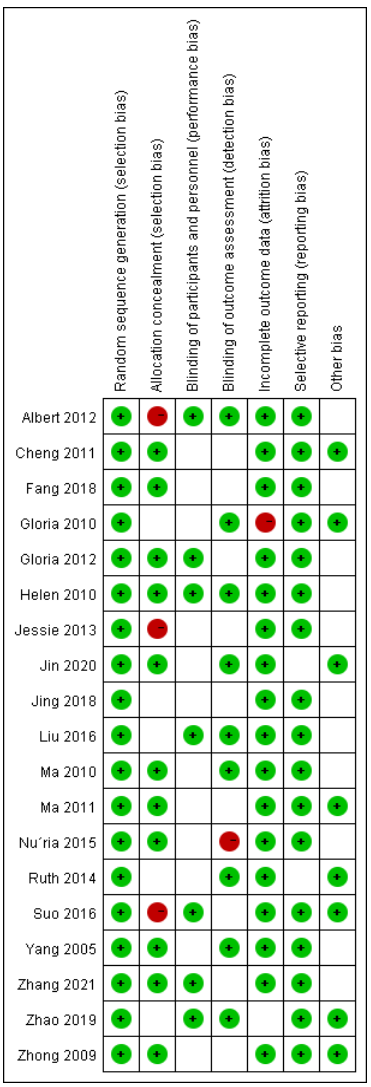

Figure 2. The bias risk assessment included in the literature Green represents low risk and red represents high risk; White represents uncertainty.

Meta-analysis

Overall Effects of CTE on depression in perimenopausal and postmenopausal women

A high level of heterogeneity (I^2 = 89 %) was observed in the pooled result, so the random effect model was

Table 1. Basic features included in the study

Inclusion research	Experimental group			control group			Intervention time
	number of people	Age (years)	Intervention measure	number of people	Age (years)	Intervention measure	
[Zhao 2020]	36	49.70±3.90	Taichi (24-simplified Taichi)	38	49.40±4.90	Blank control	48 weeks
[Liu 2016]	32	66.30±2.70	Taichi(24-simplified Taichi)	31	65.80±3.20	Blank control	16 weeks
[Taylor-Piliae *et al.* 2014]	53	71.50±10.30	Taichi (Yang style 24- short-form)	48	68.20±10.30	Blank control	12 weeks
[Yeh *et al.* 2013]	8	68.00±11.00	Taichi (Yang-style short form)	8	63.00±11.00	Conventional treatment	12 weeks
[Yeung *et al.* 2012]	26	54.00±12.00	Taichi (Yang-style Taichi)	13	58.00±7.00	Blank control	12 weeks
[Cheng *et al.* 2012]	12	81.00±7.70	Taichi (seated 12-form Yang style TC)	12	82.50±7.10	Blank control	24 weeks
[Lavretsky *et al.* 2011]	33	69.10±7.00	Taichi (simplified version)	35	72.00±7.40	Conventional treatment	14 weeks
[Yeh *et al.* 2010]	5	65.00±6.00	Taichi (Yang-style short form)	5	66.00±6.00	Blank control	12 weeks
[Jing *et al.* 2018]	39	75.25±6.82	Baduanjin (Not specified)	40	75.08±5.26	Conventional treatment	24 weeks
[Suo, Yu 2016]	30	44 56	Baduanjin (Not specified)	30	45 55	Conventional treatment	12 weeks
[Ma *et al.* 2011]	49	46.89±2.69	Baduanjin (New- Baduanjin)	50	46.92±2.31	Blank control	12 weeks
[Ma *et al.* 2010]	50	49.08±2.76	Baduanjin (New- Baduanjin)	50	49.30±2.59	Blank control	12 weeks
[Zhang *et al.* 2022]	22	55.76±8.37	Yijinjing (New-Yijinjing)	21	53.40±10.66	Conventional treatment	12 weeks
[Jin *et al.* 2020]	31	74.90±5.64	Yijinjing (Improved fixed Yijinjing)	30	76.43±4.29	Conventional treatment	12 weeks
[Fang *et al.* 2018]	30	49.40±3.21	Yijinjing (New-Yijinjing)	30	48.90±2.63	Conventional treatment	12 weeks
[Zhong *et al.* 2009]	36	49.31±2.58	Yijinjing (New-Yijinjing)	38	48.84±2.35	Conventional treatment	24 weeks
[Martinez *et al.* 2015]	25	76.10±8.10	Qigong (Not specified)	29	72.50±8.00	Conventional treatment	8 weeks
[Chan *et al.* 2013]	72	42.40±6.70	Qigong (Wu Xing Ping Heng Gong)	65	42.50±6.40	Blank control	12 weeks
[Yang *et al.* 2005]	19	72.58±5.41	Qigong (External Qigong)	21	72.67±7.49	Conventional treatment	6 weeks

employed and the Meta-analysis showed that CTE can significantly improve depressive symptoms in perimenopausal and postmenopausal women (SMD = -0.73; 95 % CI = -1.10 to -0.35; $p = 0.0001$) (Figure 3).

Subgroup analyses regarding different exercise types

A subgroup analysis was performed to investigate the effects of different types of CTEs on depressive symptoms. As shown in Figure 4, Taichi (SMD = -0.48; 95 % CI = -0.94 to -0.02; $p < 0.05$) and Baduanjin (SMD = -1.29; 95 % CI = -2.36 to -0.22; $p = 0.02$) significantly reduced depressive symptom. In contrast, Yijinjing (SMD = -0.80; 95 % CI = -1.66 to -0.06; $p > 0.05$) and Qigong (SMD = -0.50; 95 % CI = -1.33 to -0.32; $p > 0.05$) did not show a significant effect.

Subgroup analyses regarding different intervention duration

The duration of the included studies ranged from 3 to 12 months. Therefore, a subgroup analysis of the duration of exercise intervention was performed to compare the effects of CTE exercise duration on depression in perimenopausal and postmenopausal women. Subgroup analysis showed that shorter intervention (≤ 12 weeks) showed a significant effect (SMD = -0.84; 95 % CI = -1.33 to -0.35; $p = 0.0007 < 0.05$) (Figure 5).

Sensitivity analysis

The results of the meta-analysis showed high heterogeneity. We found that excluding any one study failed to lower

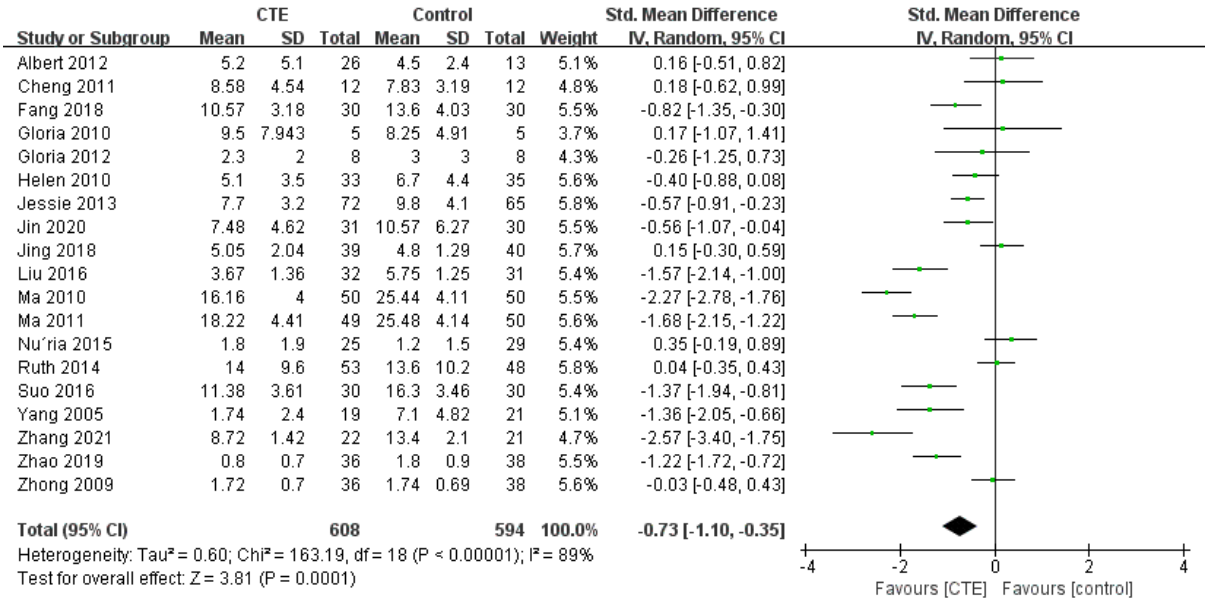

Figure 3. Intervention effect of traditional exercise on depression

CTE - Chinese traditional exercises; SD - standard deviation; CI - confidence interval. The black diamond represents the pooled effect estimates and CI for all studies included in the meta-analysis.

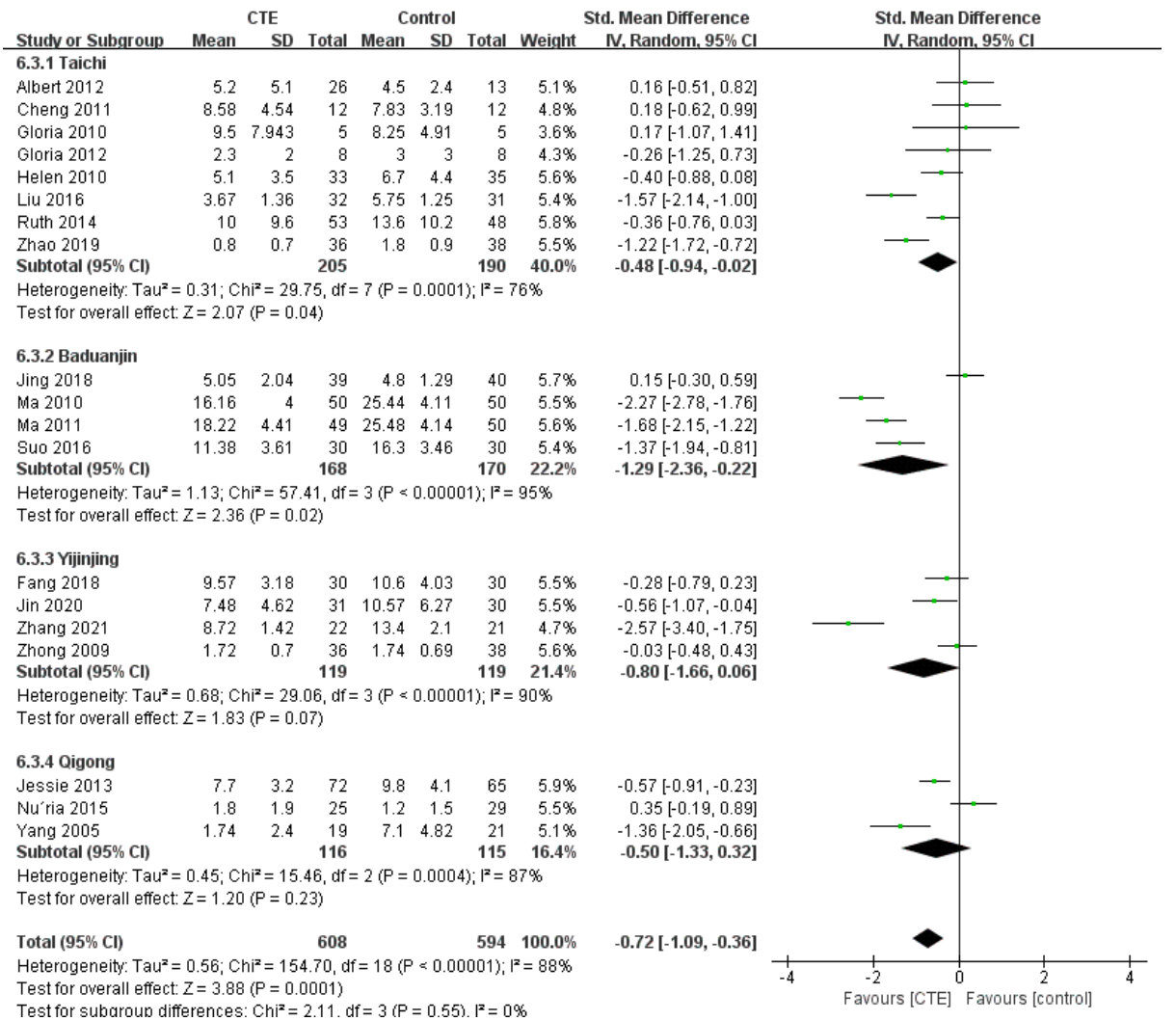

Figure 4. Results of subgroup analysis of exercise style on depression

CTE - Chinese traditional exercises; SD - standard deviation; CI - confidence interval. The black diamonds represent the pooled effect estimates and CI for all studies included in the meta-analysis.

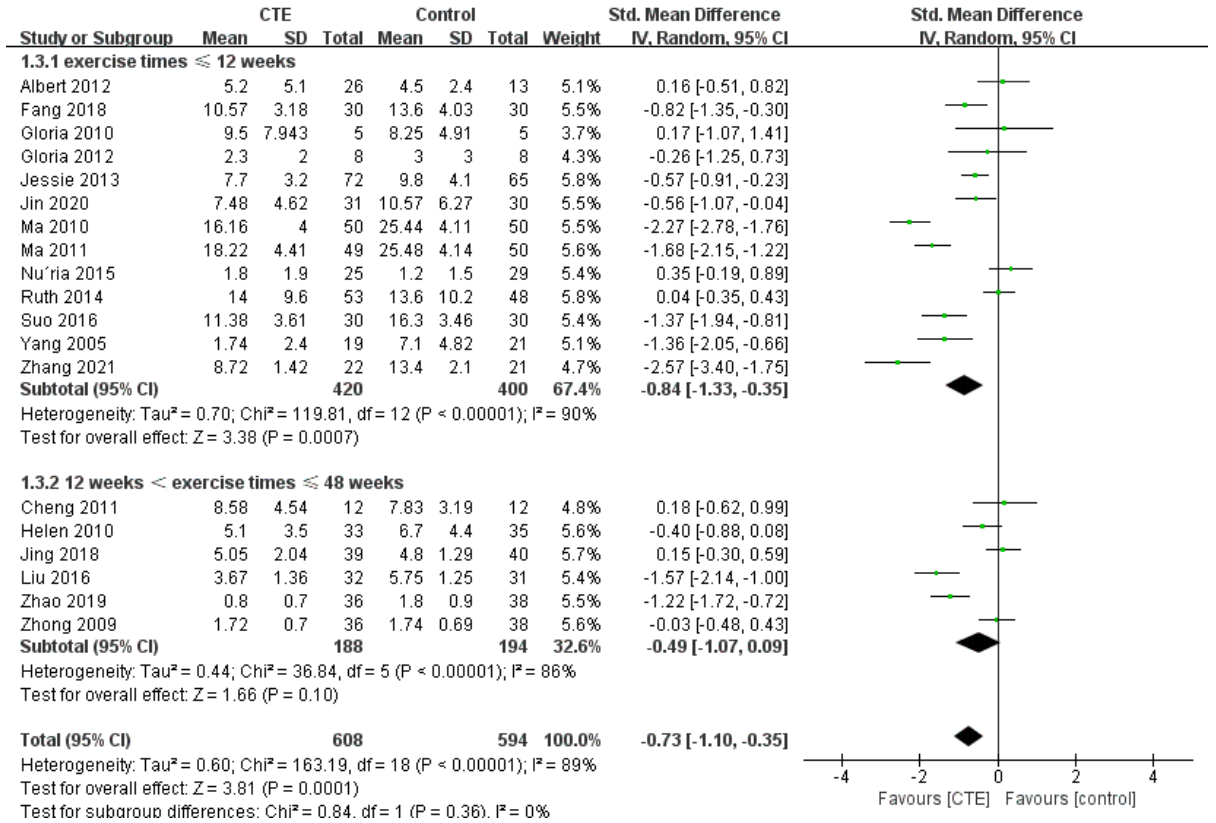

Figure 5. Results of subgroup analysis of exercise intervention cycle on depression

P represents the statistical test value of the combined effect quantity, $P < 0.05$, indicating a significant difference; $P < 0.01$, indicating a significant difference. CTE - Chinese traditional exercises; SD - standard deviation; CI - confidence interval. The black diamond represents the pooled effect estimates and CI for all studies included in the meta-analysis.

the heterogeneity level. Thereafter, we found that the heterogeneity was significantly reduced to a relatively low level ($I^2 = 47$ %) after excluding eight studies [Zhang *et al.* 2022; Liu 2016; Martinez *et al.* 2015; Ma *et al.* 2011; Ma *et al.* 2010; Yang *et al.* 2005; Zhao 2020; Suo, Yu 2016]. The excluded studies included two on Taichi [Zhao 2020; Liu 2016], three on Baduanjin [Suo, Yu 2016; Ma *et al.* 2011; Ma *et al.* 2010], one on Yijinjing [Zhang *et al.* 2022], and two on Qigong[Martinez *et al.* 2015; Yang *et al.* 2005]. The re-analysis without the eight studies provided significantly beneficial result (SMD = -0.24; 95 % CI = -0.40 to -0.09; $p = 0.002 < 0.05$), which was similar to our main result.

Discussion

The current study aimed to examine the effectiveness of CTE on depressive symptoms in perimenopausal and postmenopausal women. Psychometric meta-analyses usually have higher heterogeneity [Li *et al.* 2022; Yao *et al.* 2021], and our study is no exception. Considering this, our results should be understood with caution.

The effect of CTE interventions on depression

We found that CTE generally mitigated the reported depressive symptoms in perimenopausal and postmenopausal women, indicating that CTE may be an effective intervention to serve this population. The effectiveness of CTE may be related to the benefits of general physical activity. For example, exercise can enhance the well-being, vasodilatory state, and cognitive processes like memory and attention of middle-aged women, which are essential for strengthening women's perceived health and psychological resilience [Mansikkamaki *et al.* 2015]. Furthermore, the appropriate intensity and variable forms of CTE may be another reason. A study has suggested that low-intensity and diverse exercise is more effective than high-intensity exercise in alleviating depressive symptoms, heart palpitations, and irritability in women who are going through or have been through menopause [Li 2017]. Hormonal changes regulated by CTE may explain the improved symptoms. Some scholars found that menopausal women who engaged in Qigong training showed significantly lower anxiety and sadness scores, as well as higher follicle-stimulating hormone (FSH), estradiol (E2), and 5-hydroxy tryptamine (5-HT) levels [Lu *et al.* 2020; Tsang *et al.* 2013]. These clues imply that CTE may alleviate depression by increasing patient-specific hormones and depression-specific variables.

Subgroup analysis of exercise types

Our subgroup analysis showed that Taichi and Baduanjin, rather than Yijingjin and Qigong, reduced depressive

symptoms in perimenopausal and postmenopausal women. Since the load of exercise may affect the benefits of exercise, we speculate that the different loads of these CTEs may be one reason for the discrepancy we found. Compared with Yijinjing and Qigong, Taichi and Baduanjin are more difficult to practice, and these two exercises usually require more attention due to their technical complexity, which may result in greater exercise load, and ultimately better effect on depressive symptoms [Tao, Yu 2014]. On the other hand, non-static/dynamic exercise may be more effective in improving depressive symptoms compared to static training [Goyal *et al.* 2014]. From the perspective of the exercise motion, the four CTEs are all characterized by slow and gentle full-body movements. When practicing Taichi, muscles and bones need to complete a series of stretching and rotating at various angles [Kong *et al.* 2019]. The Baduanjin mainly coordinates the upper and lower limb movements through specific postures. The practitioner must move the center of body gravity between the legs when the hip and knee flexion movements are converted [Dai *et al.* 2020]. In short, Taichi and Baduanjin require practitioners to maintain balance by shifting their center of body gravity, rotating their bodies, and standing in various positions on one leg, thereby are more difficult. By comparison, Yijinjing is primarily standing and requires isometric muscle contraction [Guo *et al.* 2023]. Similar to Yijinjing, Qigong also requires practitioners to focus their mind and body perception and has fewer body movements. Nonetheless, there are many types of Qigong, and the required movement is not fixed across different kinds and some do not require any move. The Qigong exercises included in this study are mainly five-element balance work and external qigong. They have low practice difficulty and exercise intensity, and most importantly, are generally static [Feng *et al.* 2020]. These differences may explain why Taichi and Baduanjin appeared to be more effective than Yijingjin and Qigong in improving depressive symptoms in our study.

Subgroup analysis of exercise duration

Our subgroup analysis showed that CTE was effective in alleviating depressive symptoms in perimenopausal and postmenopausal women at no more than 12 weeks, while the intervention effect of CTE was not significant beyond 12 weeks. Studies have shown that depression can be alleviated by increasing serotonin levels in the brain through short-term activity lasting 4 [Ozkan *et al.* 2020] or 6 weeks [Haussleiter *et al.* 2020]. EunHee *et al.* [Noh *et al.* 2020] found that a 12-week exercise improved the mental health of menopausal women. Similarly, some other studies have also confirmed that CTE exercises with similar durations are sufficient to treat depressive symptoms in perimenopausal and postmenopausal women effectively [Carcelen-Fraile *et al.* 2022; Hsu *et al.* 2008; Wang *et al.* 2017]. Aside from our included studies, Yeh and Chang [2012] reported significant an improvement in menopausal symptoms in perimenopausal women at 6 and 12 weeks underwent a type of Qigong called Ping Shuai. These studies and our findings collectively suggest the effectiveness of CTE interventions lasts for 12 weeks maximum. On the other hand, it is notable that other studies have found CTE over 12 weeks to be effective, which is inconsistent with our results. Tsang [Tsang *et al.* 2006] observed that 16 weeks of Taichi exercise could help older people with depression by enhancing self-efficacy and personal well-being. It is possible that the different populations (the mentioned study recruited non-perimenopausal women) have contributed to the discrepancy. However, we could not further explore the underlying mechanisms, which remains a future research topic.

Limitations

This meta-analysis has the following limitations.

Firstly, the diversity of CTE styles included in the study has contributed to a significant level of heterogeneity. Different CTE schools/styles, techniques, and training methods may exert varying effects on depression in women, thereby introducing instability in the results. Moreover, due to the nature of CTE, there might exist inadequately controlled or unaccounted variables in the studies, further contributing to the heterogeneity. Although we tried to largely reduce the heterogeneity for our main results, the heterogeneity was not completely eliminated. Therefore, future studies may consider focusing on a certain type with better study designs to cope with issues when more relevant studies emerge.

Secondly, a relatively small sample size is also a noteworthy limitation. Given the limited number of studies included, it might not have provided sufficient statistical power to detect potential effects, especially during subgroup analyses. The number of studies included for the subgroup analyses was also unbalanced for each group (some only contain very limited studies and samples), which may lead to overestimation or underestimation of certain CTE types. A small sample size for these analyses may lead to result instability and biases, thus affecting the analysis's reliability and generalizability.

Thirdly, although efforts were made to encompass a range of CTEs, it was practically impossible to avoid some schools or to include a representative selection comprehensively. This incompleteness may hinder a comprehensive understanding of the overall impacts across the breadth of CTE.

Furthermore, we must also recognize inherent limitations associated with meta-analyses. For instance, the possibility of publication bias cannot be completely ruled out; studies with significant outcomes are more likely to be published, potentially skewing our results. Additionally, due to constraints in the available literature, we may not have had access to all relevant data, thereby affecting our statistical analyses.

Conclusions

We conducted a meta-analysis to test whether CTE can reduce depressive symptoms in perimenopausal and postmenopausal women. The effects of four CTE (Taichi, Baduanjin, Yijinjing, and Qigong) were also tested respectively. We found that CTE generally reduced self-reported depressive symptoms, and Taichi and Baduanjin were two effective CTE types. The effect of CTE may change with the duration of intervention, and the intervention of no more than 12 weeks may be effective. However, due to the high heterogeneity and other limitations, our findings must be treated with caution.

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We acknowledge that all authors listed meet the criteria for authorship and that all authors have an agreement with the manuscript.

Data availability

The raw data supporting the conclusions of this manuscript will be made available by the authors, without undue reservation, to any qualified researcher.

Disclosure statement

The authors declare no conflict of interest.

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Wpływ tradycyjnych chińskich ćwiczeń na depresję u kobiet w okresie okołomenopauzalnym i pomenopauzalnym: metaanaliza

Słowa kluczowe: Chińskie ćwiczenia tradycyjne, kobiety, perimenopauza, postmenopauza, depresja

Streszczenie.
Tło. Chińskie ćwiczenia tradycyjne (CTE) są obiecujące w leczeniu objawów depresji u kobiet w okresie okołomenopauzalnym i pomenopauzalnym, jednak ich ogólna skuteczność nie została oceniona na podstawie istniejących randomizowanych badań kontrolowanych (RCT). Problem i cel. Systematyczna ocena wpływu CTE na objawy depresji u kobiet w okresie okołomenopauzalnym i pomenopauzalnym.
Materiał i metody. Przeszukano bazy danych, w tym China Knowledge Network, Wanfang Data Knowledge Service Platform, PubMed, Web of Science i Springer ebook w celu zidentyfikowania randomizowanych, kontrolowanych badań dotyczących wpływu CTE (w tym *Taichi*, *Baduanjin*, *Yijinjing* i *Qigong*) na objawy depresyjne u kobiet w okresie okołomenopauzalnym i pomenopauzalnym. Ramy czasowe wyszukiwania obejmowały okres od powstania każdej bazy danych do września 2022 roku.
Wyniki. Uwzględniono łącznie 19 randomizowanych, kontrolowanych badań z udziałem 608 osób leczonych i 594 osób kontrolnych. Zbiorcze wyniki wykazały, że CTE znacząco zmniejszyło objawy depresji u kobiet w okresie okołomenopauzalnym i pomenopauzalnym ($p = 0{,}0001$). Analizy podgrup ujawniły znaczący wpływ *Taichi* i *Baduanjin* na objawy depresji ($p < 0{,}05$), podczas gdy efekty *Yijinjing* i *Qigong* okazały się nieskuteczne ($p > 0{,}05$). Interwencje ćwiczeń, które trwały od 1 do 12 tygodni, wykazały znaczące efekty ($p = 0{,}0007$), podczas gdy te, które trwały od 12 do 48 tygodni, wykazały nieistotne efekty ($p > 0{,}05$).
Wnioski. CTE może skutecznie leczyć objawy depresji u kobiet w okresie okołomenopauzalnym i pomenopauzalnym. *Taichi* i *Baduanjin* są skutecznymi ćwiczeniami, a czas trwania interwencji od 1 do 12 tygodni może być odpowiedni.