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Systematic review

The effects of Qigong exercises on blood lipid profiles of middle-aged and elderly individuals: A systematic review and network meta-analysis

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ABSTRACT

Introduction: Studies have confirmed that various kinds of Qigong exercises improve blood lipid profiles in middle-aged and elderly individuals, but the type of Qigong exercise that is the best option remains unclear. We employed a network meta-analysis to evaluate the comparative effectiveness of Qigong exercises on blood lipid profiles in middle-aged and elderly individuals.

Methods: English and Chinese databases were searched from the inception of each database through 28 December 2018. Databases included PubMed, Embase, the Cochrane Library, China National Knowledge Infrastructure, Wanfang Database, Chongqing VIP and Chinese Biomedical Database. Literature from randomized controlled trials (RCTs) comparing the effects of Qigong exercises on blood lipid profiles in middle-aged and elderly individuals were included. Records were screened for eligible studies, and data were extracted and analysed using STATA version 15.0. The methodological quality of the included studies was evaluated using the Cochrane risk of bias tool.

Results: Twenty studies encompassing 1571 patients were included. The results revealed that Wuqinxi (WQX) and Baduanjin (BDJ) are most effective in improving blood lipids based on the comparison of all interventions, but no statistically significant difference was found between WQX and BDJ. Node-splitting analysis showed no significant inconsistency in our network meta-analysis.

Conclusions: The four kinds of Qigong exercises included in the study are all effective in improving blood lipids; WQX and BDJ seem to be more effective, and WQX might be the most effective exercise.

1. Introduction

With the increasing numbers of middle-aged and elderly individuals, the deterioration of physical function is often accompanied by the disorder of blood lipid levels, which seriously affects the health of these individuals. Dyslipidaemia is one of the important factors leading to atherosclerosis and is an independent risk factor for atherosclerotic cardiovascular disease (CVD) and stroke [1]. Improving blood lipid profiles has been well known as the key for the treatment of abnormal blood lipid metabolism and cardiovascular diseases and includes reducing total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C) and triglyceride (TG) levels and increasing the high-density lipoprotein cholesterol (HDL-C) level [2–4]. Statins are widely used in the treatment of dyslipidaemia and as a primary prevention for people at high risk for cardiovascular disease [5,6]. However, statins alone have also encountered bottlenecks in lowering cholesterol. On the one hand, due to the limitations of statin lipid-lowering drug strength, the effect of increasing the dose of dose-dependent lipid-lowering drugs is limited. On the other hand, with the increase in the dose of statins, the occurrence of adverse reactions may increase accordingly, such as statin-associated myopathy and liver damage [7–9]. In addition, the safety in the context of multiple diseases and along with a combination of drugs is also questioned [10]. Therefore, some patients with elevated blood lipid levels seek complementary and alternative medicine (CAM)

Abbreviations: RCTs, randomized controlled trials; YJJ, Yijinjing; BDJ, Baduanjin; WQX, Wuqinxi; LZJ, Liuzijue; NEI, no exercise intervention; AE, aerobic exercises; TC, total cholesterol; TG, triglyceride; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; MD, mean difference; CrI, credible interval; CVD, atherosclerotic cardiovascular disease; CAM, complementary and alternative medicine; TCM, traditional Chinese medicine

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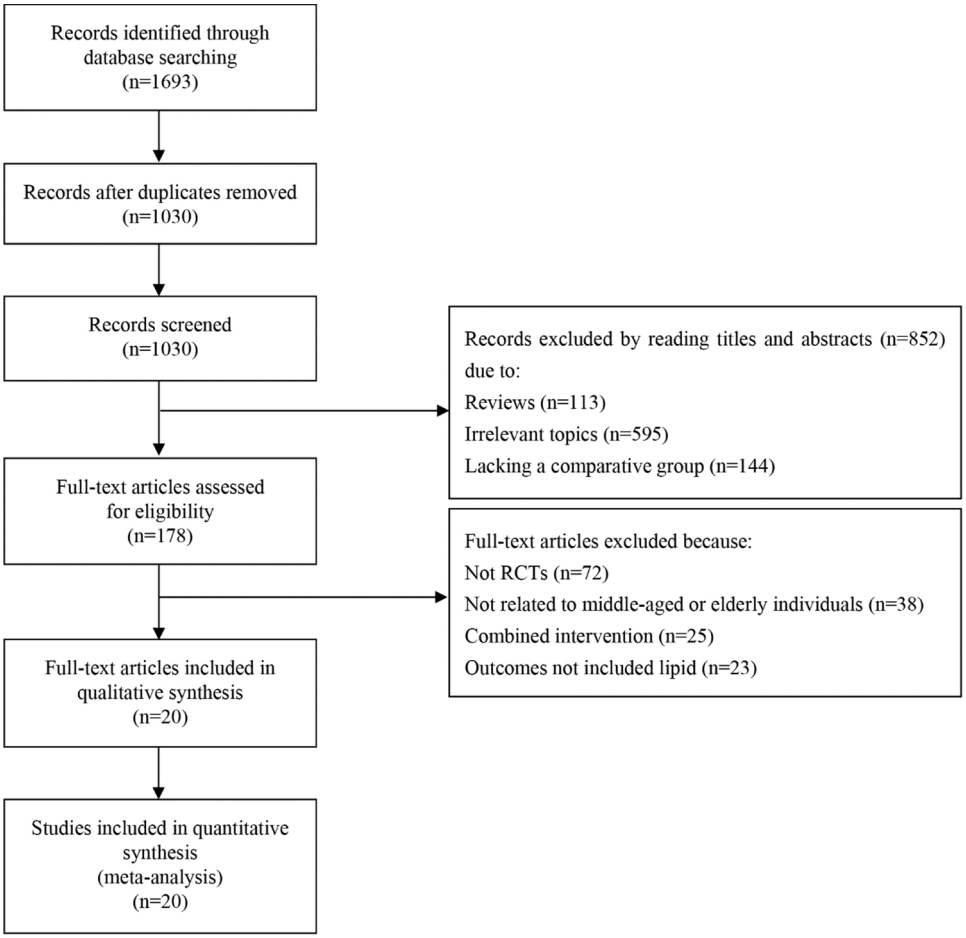

Fig. 1. Flow chart of the study selection procedure.

lipid-lowering techniques.

Many traditional Chinese health regimens, as a form of CAM, have a good effect on reducing blood lipids, and among these methods, Tai Chi and Qigong are the two most popular and are considered to be mind and body therapies [11]. Tai Chi is a type of Chinese martial art, and Qigong is a type of exercise included in traditional Chinese medicine. Qigong, which came into being earlier than Tai Chi, has been recognized as a medical exercise in the traditional Chinese medicine field for thousands of years [12]. The positive effect of Tai Chi on lipid profiles has been confirmed, and Qigong exercise has been reported to be a primary preventive measure against CVD [13–15].

Although there are various types of Qigong worldwide, the most common types are Yijinjing (YJJ), Baduanjin (BDJ), Wuqinxi (WQX) and Liuzijue (LZJ), which are officially recognized and have been promoted by the General Administration of Sport of China since the establishment of the Chinese Health Qigong Association in 2004 [16,17]. In 2010, the General Administration of Sport of China released five additional types of Qigong, including Mawangdui Daoyin, Tai *J*i Yang Sheng Zhang, Shi Er Duan Jin, Daoyin Yang Sheng Gong Shi Er Fa, and Da Wu [18]. As mind-body therapies, the slow and gentle movements of Qigong exercises are suitable for middle-aged and elderly people who are limited by exercise intensity [19]. However, it is not clear which type of Qigong exercise is better for improving blood lipids in middle-aged and elderly individuals. Therefore, we employed a network meta-analysis to evaluate the comparative efficacy and safety of various kinds of Qigong exercises on blood lipid profiles in an attempt to determine which Qigong exercise is the best option for middle-aged and elderly individuals.

2. Materials and methods

2.1. Data sources

A literature search was performed using the following online databases from their inception until 28 December 2018: PubMed, Embase, the Cochrane Library, China National Knowledge Infrastructure (CNKI), Wanfang Database, Chongqing VIP (VIP), and Chinese Biomedical Database. No publication type or date restrictions were set and the search was performed via the following medical subject headings (MeSH) and keywords: “blood lipid”, “dyslipidemia”, “hyperlipidemia”, “blood fats”, “total cholesterol”, “triglyceride”, “high-density lipoprotein cholesterol”, “low-density lipoprotein cholesterol”, “Qigong”, “Ch'i Kung”, “Qi Gung”, “Yijinjing”, “Tendon Change Classic”, “Baduanjin”, “Eight Pieces of Brocade”, “Eight Silken Movements”, “Eight Section Brocade”, “Wuqinxi”, “Five-animal exercises”, “Five-animal Play”, “Liuzijue”, “Six Healing Sounds”, “Yang Sheng Zhang”, “Shi Er Duan Jin”, “Yang Sheng Gong”, “Mawangdui Daoyin”, and “Da Wu”. The language was limited to English and Chinese. The search strategy

Table 1
The characteristics of the included studies.

Study ID	Interventions	Age	Sex (male/female)	Sample size	Frequency	Duration	Adherence	Outcomes
Yuan 2014 [20]	YJJ vs AE	40-65	N/A	29 vs 29	5 times per week for 30 minutes	6 months	Good	(a)(b)(c)(d)
Liu 2010 [21]	YJJ vs NEI	62-69	Female	32 vs 30	6 times per week for 40-50 minutes	3 months	Good	(a)(b)(c)(d)
Su 2012 [22]	YJJ vs NEI	55-69	Female	35 vs 35	5 times per week for 60 minutes	3 months	N/A	(a)(b)(c)(d)
Sun 2008 [23]	BDJ vs AE vs NEI	60-69	Male	19 vs 17 vs 20	5 times per week for 30-50 minutes	3 months	Poor	(a)b)(c)(d)
Liu 2005 [24]	BDJ vs AE	55-65	N/A	21 vs 22	14 times per week for 20 minutes	3 months	Good	(c)(d)
Liu 2006 [25]	BDJ vs AE	55-65	N/A	21 vs 20	14 times per week for 30 minutes	3 months	N/A	(a)(b)(c)(d)
Miao 2009 [26]	BDJ vs NEI	56-71	25 vs 24	25 vs 24	5-7 times per week for 50-60 minutes	18 months	Good	(a)(b)(c)(d)
Zhang 2008 [27]	BDJ vs NEI	(41.0 ± 5.61) / (40.9 ± 4.82)	Female	13 vs 10	5 times per week for 50-60 minutes	2 months	Good	(a)(b)(c)(d)
Yang 2013 [28]	BDJ vs NEI	49-71	31 vs 29	30 vs 30	7 times per week	2 months	N/A	(a)(b)(c)(d)
Liang 2014 [29]	BDJ vs AE	(54.8 ± 7.6) / (55.7 ± 8.8)	38 vs 22	30 vs 30	14 times per week for 20 minutes	6 months	Good	(a)(b)(c)(d)
Fang 2014 [30]	BDJ vs AE vs NEI	(58.24 ± 8.91) / (56.62 ± 8.85) / (57.38 ± 8.90)	48 vs 41	30 vs 29 vs 30	14 times per week for 30 minutes	3 months	Poor	(a)(b)(c)(d)
Li 2009 [31]	WQX vs AE	45-72	N/A	33 vs 33	7 times per week for 30 minutes	4 months	N/A	(a)(b)(c)(d)
Ru 2013 [32]	WQX vs AE vs NEI	60-69	N/A	19 vs 18 vs 20	5 times per week for 40-50 minutes	6 months	N/A	(a)(b)(c)(d)
Yan 2009 [33]	WQX vs NEI	52.6 ± 8.7	45 vs 17	31 vs 31	7 times per week for 60 minutes	6 months	N/A	(a)(b)(c)(d)
Liu 2012 [34]	WQX vs NEI	65-72	40 vs 40	40 vs 40	7 times per week	24 months	Poor	(a)(b)(c)(d)
Sen 2015 [35]	WQX vs NEI	35-59	N/A	48 vs 56	5 times per week for 60 minutes	12 months	Good	(a)
Sha 2010 [36]	WQX vs NEI	(57.78 ± 5.50)/ (57.68 ± 5.46)	Female	40 vs 40	5 times per week for 60 minutes	5 months	N/A	(a)(b)(c)(d)
Yu 2008 [37]	WQX vs NEI	(61.6 ± 3.8)/ (58.5 ± 4.1)	N/A	34 vs 35	4 times per week for 45 minutes	6 months	Poor	(a)(b)(c)(d)
Yuan2011 [38]	WQX vs NEI	60-69	69 vs 142	54 vs 47	5 times per week for 45 minutes	3 months	Good	(b)(c)(d)
Wei 2007 [39]	YJJ vs BDJ vs WQX vs LZJ	50-70	104 vs 16	30 vs 30 vs 30 vs 30	5 times per week for 60 minutes	3 months	Good	(a)(b)(c)(d)

Notes: N/A, not available; (a), TC; (b), TG;(c), LDL-C; (d), HDL-C.

undertaken in PubMed is described in Appendix A. Similar search terms were used with the other databases. Two investigators searched the literature and reviewed the titles and abstracts of articles independently to screen out the potential ones. The full texts of the selected articles were assessed according to the inclusion and exclusion criteria, and the third reviewer examined the divergent articles.

2.2. Inclusion criteria

Studies were included based on the following criteria: (1) Randomized controlled trials (RCTs) have been used to investigate the impact of Qigong exercises on at least one of four main lipid parameters (TC, TG, HDL-C, and LDL-C); (2) middle-aged and elderly individuals without critical diseases who practised Qigong exercises as described by the Qigong Management Center of General Administration of Sport of China; (3) Studies comparing different kinds of interventions on blood lipid profiles, with at least one control group, and the eligible control intervention included those receiving no exercise intervention or conventional aerobic exercise therapies such as jogging or walking; and (4) RCTs that addressed ethical approval.

2.3. Exclusion criteria

The following studies were excluded: (1) literature reviews; (2) duplicate studies; (3) studies using blood lipid-lowering drugs; (4) studies in which the intervention was a combination of Qigong and other types of exercises.

2.4. Data extraction

Two reviewers independently extracted data and collected the following information: (1) basic characteristics, including author information, year of publication, intervention, sex, age, sample size, frequency of the intervention, duration of the intervention, adherence and outcomes, and (2) outcome measurements, including TC, TG, HDL-C, or LDL-C.

2.5. Quality assessment

The risk of bias assessment of the RCTs was evaluated based on the following Cochrane criteria: random sequence generation (selection bias), allocation concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias), selective reporting (reporting bias) and other bias. Every study was assessed as having a low risk, unclear risk or high risk of bias. Quality assessment was independently performed by two reviewers, and disagreements were resolved by a third reviewer, when necessary.

2.6. Statistical analysis

A network meta-analysis was carried out using STATA version 15.0. Continuous variables (TC, TG, HDL-C and LDL-C) were analysed using mean differences (MDs) and 95% credible intervals (CrIs). First, a pairwise meta-analysis was conducted for the included RCTs by random effects model, and the result indicated no statistical inconsistency when P was > 0.05. Second, a Bayesian network meta-analysis was used to synthesize the effects of direct and indirect evidence comparisons. Third, surface under the cumulative ranking (SUCRA) probabilities were used to rank the interventions in terms of an outcome. Large SUCRA values indicate a more effective or safer intervention. Furthermore, node-splitting analysis was performed to estimate inconsistency by comparing the difference between direct and indirect evidence, and there was no significant inconsistency when P was > 0.05.

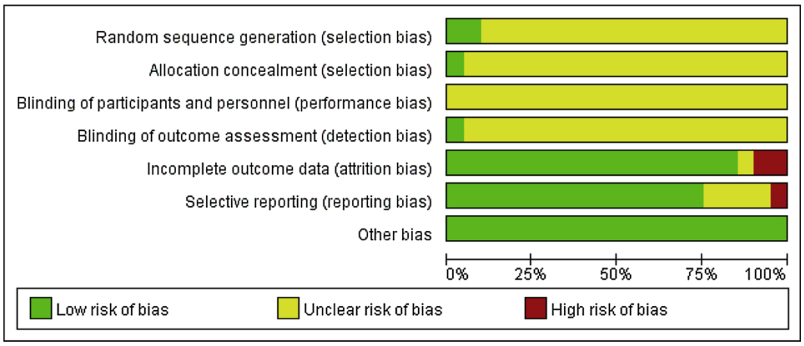

Fig. 2. Risk of bias graph for included RCTs.

3. Results

3.1. Identification of the relevant studies

A total of 1693 articles were identified in our initial search, of which 663 were duplicates and excluded. Of the remaining 1030 articles, 113 were excluded for being systematic reviews, 595 were excluded due to irrelevant topics and 144 were excluded for not being controlled studies by checking titles and abstracts, and the full texts of 178 articles were obtained to check eligibility. After full-text reviews, 72 trials did not use a randomized controlled design, 38 trials were not related to middle-aged or elderly individuals, 25 trials were excluded for combined interventions, and 23 trials were excluded for outcomes that did not include lipid parameters; finally, 20 studies [20–39] were included in our analysis. Fig. 1 shows the selection process for the relevant studies.

3.2. Characteristics of the included studies

The review included 20 trials involving 1350 patients, and all the included studies were RCTs. The total sample sizes in the 20 RCTs ranged from 23 to 120 patients, the duration of the study/time at outcome measurement ranged from 2 to 24 months, the practice frequency ranged from 5 to 14 times per week for 20 min to 60 min. Of the included studies, three were three-arm studies, one was a four-arm study, and the rest were parallel-designed studies. Of the included studies, 7 [32–38] compared WQX with no exercise intervention (NEI), 2 studies [31,32] compared WQX with aerobic exercises (AE), 5 studies [23, 26–28, 30] compared BDJ with NEI, 5 studies [23–25, 29,30] compared BDJ with AE, 2 studies [21,22] compared YJJ with NEI, 1 study [20] compared YJJ with AE, 3 studies [23,30,31] compared NEI with AE, and 1 study [39] compared the four kinds of Qigong exercises. Moreover, the included studies involved a total of 329 patients in the WQX group, 219 patients in the BDJ group, 126 patients in the YJJ group, 30 patients in the LZJ group, 198 patients in the AE group, and 448 patients in the NEI group. Adverse reactions were not reported in any of the 20 studies. The main characteristics of each included study are presented in Table 1.

3.3. Quality assessment

The risk of bias graph and summary are shown in Figs. 2 and 3. Of the 20 RCTs [20–39], 18 [20–28, 31, 21–39] did not state the method of randomization in detail, and only 2 studies [29,30] employed a computer table of random numbers for randomization. Seventeen RCTs [20–23, 26–34, 36, 21–39] had complete data.

3.4. The results of the network meta-analysis

As shown in Fig. 4, 18 studies [20–23, 25–37, 39] involving 1206 patients reported TC levels. Compared with the NEI group, the WQX and BDJ groups were superior in decreasing TC levels. Compared with the AE group, the WQX and BDJ groups were superior in decreasing TC levels. When compared with the YJJ group, the WQX group was more effective in decreasing TC levels, while other group comparisons were not statistically significant (Table 2). Based on the included studies, the cumulative probability of WQX, BDJ, LZJ, YJJ, AE and NEI being the best intervention was 92.6%, 74.1%, 65.2%, 29.9%, 22.2% and 16.1%, respectively (Fig. 5 and Table 3).

With respect to the TG outcome, the data from 18 studies [20–23, 25–34, 36–39] involving 1203 patients were merged for analysis (Fig. 4). Compared with the NEI group, the WQX, BDJ and AE groups were superior in decreasing TG levels. Compared with the AE group, the WQX and BDJ groups were superior in decreasing TG levels. When compared with the YJJ group, the WQX and BDJ group were superior in decreasing TG levels. When compared with the LZJ group, the WQX and BDJ groups were superior in decreasing TG levels (Table 2). Based on the studies included, the cumulative probability of WQX, BDJ, AE, YJJ, LZJ and NEI being the best intervention was 90.7%, 88.4%, 53.2%, 34.4%, 22.4% and 10.9%, respectively (Fig. 5 and Table 3).

In terms of HDL-C, 19 studies [20–34, 36–39] involving 1246 patients were merged for analysis (Fig. 4). Compared with the NEI group, the WQX, BDJ, YJJ and AE groups were superior in increasing HDL-C levels (Table 2). Based on the studies included, the cumulative probability of WQX, BDJ, LZJ, YJJ, AE and NEI being the best intervention was 75.0%, 73.1%, 56.2%, 54.2%, 39.2% and 2.2%, respectively (Fig. 5 and Table 3).

In terms of LDL-C, 19 studies [20–34, 36–39] involving 1246 patients were merged for analysis (Fig. 4). Compared with the NEI group, the WQX, BDJ, LZJ, YJJ and AE groups were superior in decreasing LDL-C levels (Table 2). Based on the studies included, the cumulative probability of WQX, BDJ, LZJ, YJJ, AE and NEI being the best intervention was 73.4%, 72.2%, 63.9%, 59.1%, 30.9% and 0.5%, respectively (Fig. 5 and Table 3).

3.5. Consistency analysis

Node-splitting analysis was performed to evaluate inconsistencies, and we found P values greater than 0.05 by comparing the difference between direct and indirect effects, indicating that no significant inconsistency existed and that the results were reliable (Table 4).

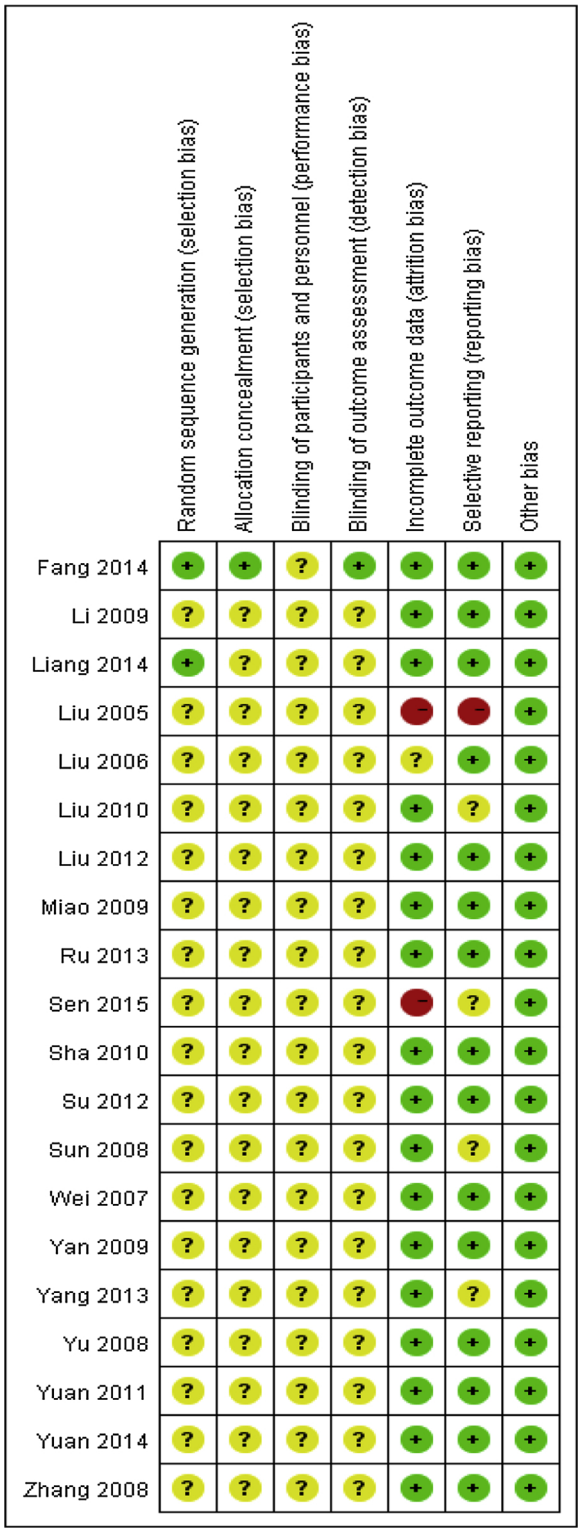

Fig. 3. Risk of bias summary for included RCTs.

4. Discussion

Qigong is a traditional Chinese medicine (TCM) exercise for longevity and health maintenance with a history of several thousand years. The three main doctrines of Qigong are Tiao Xin (mind regulation), Tiao Shen (body regulation), and Tiao Xi (breath regulation) [40]. Four kinds of Qigong exercises, including YJJ, BDJ, WQX, and LZJ, have their own practice methods and characteristics, which lead to different therapeutic effects on various diseases. YJJ comprises a series of forms, such as meditation, deep breathing, and slow movement of the extremities [41]. BDJ is characterized by its simple, slow, and relaxing actions. BDJ involves movements and activations of every part of the body, including all the movable joints and voluntary muscles from head to the foot, and emphasizes slow, relaxing and systematic movements [42]. WQX comprises a set of complex movements and postures that mimic the activity characteristics of five animals, including tigers, deer, bears, monkeys and birds. Exercisers should concentrate on the mind and breath to experience mood stabilization and improve strength. According to TCM theory, WQX is an intervention to improve physical health in general [43]. LZJ is the art of respiration in which six specific sounds are produced within a specific movement routine without moving the feet. Each sound and movement routine is repeated six times, emphasizing that breathing should coordinate with the body movement [44]. According to TCM theory, the four kinds of Qigong exercises integrate physical activity, breathing and psychological adjustment to achieve a harmonious flow of Qi (vital energy) throughout the body [45].

To our knowledge, this study was the first network meta-analysis to compare the effectiveness and safety of four kinds of Qigong exercises, including YJJ, BDJ, WQX and LZJ, on the regulation of blood lipid profiles in middle-aged and elderly individuals. Based on the common control, an indirect comparison of the effects of different Qigong exercises on blood lipid profiles was performed. The results of both direct and indirect comparative evidence were merged, and the intervention measures were quantitatively ranked in order to obtain the optimal scheme, to offer a suggestion for regulating the blood lipid profiles of middle-aged and elderly individuals using appropriate Qigong exercises. Twenty RCTs were included in this study, involving four kinds of Qigong exercises and two common control groups. The network meta-analysis of direct and indirect evidence showed that, compared with the NEI group, the WQX and BDJ groups were superior in improving TC, TG, HDL-C, and LDL-C levels; the AE group was superior in improving TG, HDL-C and LDL-C levels; the YJJ group was superior in improving HDL-C and LDL-C levels; and the LZJ group was superior in decreasing LDL-C levels. Compared with the AE group, the WQX and BDJ groups showed superior decreases in TC and TG levels. When compared with the YJJ group, the WQX group was superior in decreasing TC and TG levels, and the BDJ group was superior in decreasing TG levels. When compared with the LZJ group, the WQX and BDJ groups were superior in decreasing TG levels. Taken together, these data suggest that WQX and BDJ are more effective in improving blood lipids based on the comparison of all interventions. In addition, no statistically significant difference was found between WQX and BDJ. However, the results of the cumulative probability ranking showed that WQX had the highest SUCRA and PrBest values in all items, which indicated that WQX might be the most effective Qigong exercise for improving the blood lipid profiles of middle-aged and elderly individuals.

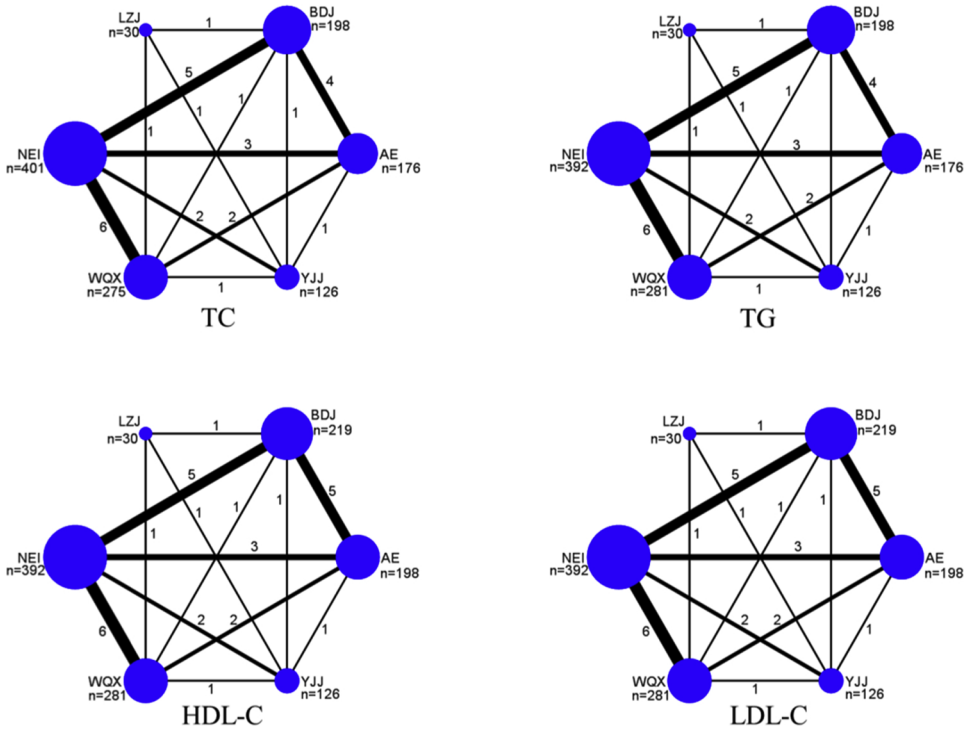

Fig. 4. Network of treatment comparisons (notes: the width of the lines is proportional to the number of trials comparing every pair of treatments. The size of every circle is proportional to the sample size of the interventions.).

Table 2
The results of the network meta-analysis.

Items	YJJ	AE	NEI	BDJ	WQX	LZJ
TC						
YJJ	1	0.06(-0.39, 0.51)	0.10(-0.30, 0.51)	−0.38(-0.81,0.06)	−0.58(-1.01, -0.14)	−0.31(-0.89, 0.27)
AE	−0.06 (-0.51, 0.39)	1	0.04(-0.29, 0.37)	−0.44(-0.78, -0.11)	−0.64(-1.01, -0.28)	−0.38(-0.98, 0.22)
NEI	−0.10 (-0.51, 0.30)	−0.04(-0.37, 0.29)	1	−0.48(-0.78, -0.17)	−0.68(-0. 97, -0.39)	−0.41(-0. 99, 0.16)
BDJ	0.38 (-0.06, 0.81)	0.44(0.11, 0.78)	0.48(0.17, 0.78)	1	−0.20(-0. 57, 0.16)	0.06(-0. 50, 0.63)
WQX	0.58(0.14, 1.01)	0.64(0.28, 1.01)	0.68(0.39, 0.97)	0.20 (-0.16, 0.57)	1	0.27(-0. 30, 0.83)
LZJ	0.31(-0.27, 0.89)	0.38(-0.22, 0.98)	0.41(-0.16, 0. 99)	−0.06 (-0.63, 0.50)	−0.27(-0.83, 0.30)	1
TG						
YJJ	1	−0.08(-0.27, 0.10)	0.08(-0.08, 0.25)	−0.24(-0.41, -0.07)	−0.25(-0.43, -0.07)	0.05(-0.17, 0.26)
AE	0.08 (-0.10, 0.27)	1	0.17(0.04, 0.30)	−0.16(-0.29, -0.02)	−0.17(-0.32, -0.02)	0.13(-0.10, 0.36)
NEI	−0.08 (-0.25, 0.08)	−0.17(-0.30, -0.04)	1	−0.32(-0.44, -0.21)	−0.33(-0.46, -0.21)	−0.04(-0. 25, 0.18)
BDJ	0.24(0.07, 0.41)	0.16(0.02, 0.29)	0.32(0.21, 0.44)	1	−0.01(-0. 15, 0.13)	0.28(0. 07, 0.49)
WQX	0.25(0.07, 0.43)	0.17(0.02, 0.32)	0.33(0.21, 0.46)	0.01(-0.13, 0.15)	1	0.30(0. 08, 0.51)
LZJ	−0.05(-0.26, 0.17)	−0.13(-0.36, 0.10)	0.04(-0.18, 0.25)	−0.28(-0.49, -0.07)	−0.30(-0.51, -0. 08)	1
HDL-C						
YJJ	1	−0.04(-0.24, 0.15)	−0.19(-0.37,-0.01)	0.05(-0.14, 0.23)	0.05(-0.14, 0.25)	0.00(-0.25, 0.25)
AE	0.04 (-0.15, 0.24)	1	−0.15 (-0.30, -0.01)	0.09(-0.05, 0.22)	0.09(-0.08, 0.27)	0.04 (-0.22, 0.31)
NEI	0.19(0.01, 0.37)	0.15 (0.01, 0.30)	1	0.24(0.12, 0.36)	0.25 (0.13, 0.36)	0.20 (-0.05, 0.44)
BDJ	−0.05(-0.23, 0.14)	−0.09(-0.22, 0.05)	−0.24(-0.36,-0.12)	1	0.01 (-0.15, 0.16)	−0.04 (-0.29, 0.21)
WQX	−0.05(-0.25, 0.14)	−0.09 (-0.27, 0.08)	−0.25 (-0.36, -0.13)	−0.01 (-0.16, 0.15)	1	−0.05 (-0.30, 0.20)
LZJ	0.00(-0.25, 0.25)	−0.04 (-0.31, 0.22)	−0.20 (-0.44, 0.05)	0.04 (-0.21, 0.29)	0.05 (-0.20, 0.30)	1
LDL-C						
YJJ	1	0.15 (-0.20, 0.49)	0.46 (0.15, 0.78)	−0.06 (-0.39, 0.27)	−0.07 (-0.41, 0.26)	−0.04 (-0.47, 0.39)
AE	−0.15 (-0.49, 0.20)	1	0.32 (0.06, 0.58)	−0.21 (-0.45, 0.04)	−0.22 (-0.50, 0.06)	−0.18 (-0.63, 0.26)
NEI	−0.46 (-0.78, -0.15)	−0.32 (-0.58, -0.06)	1	−0.53 (-0.78, -0.27)	−0.54 (-0.77, -0.31)	−0.50 (-0.93, -0.07)
BDJ	0.06 (-0.27, 0.39)	0.21 (-0.04, 0.45)	0.53 (0.27, 0.78)	1	−0.01 (-0.29, 0.27)	0.03 (-0.39, 0.44)
WQX	0.07 (-0.26, 0.41)	0.22 (-0.06, 0.50)	0.54 (0.31, 0.77)	0.01 (-0.27, 0.29)	1	0.04 (-0.38, 0.46)
LZJ	0.04 (-0.39, 0.47)	0.18 (-0.26, 0.63)	0.50 (0.07, 0.93)	−0.03 (-0.44, 0.39)	−0.04 (-0.46, 0.38)	1

Notes: Data are MD (95% CrI) of the column-defining treatment compared with the row-defining treatment.

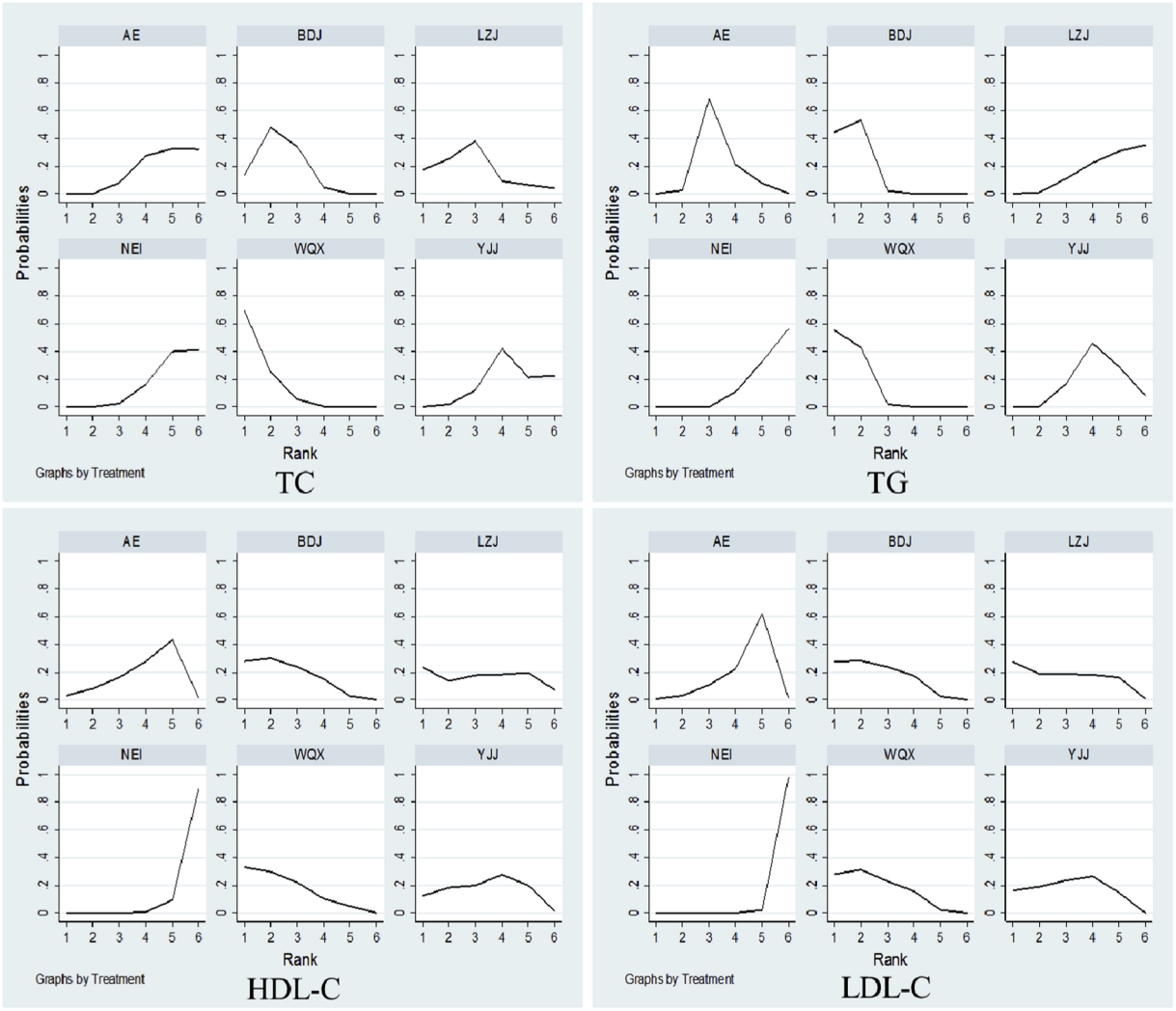

Fig. 5. The surface under the cumulative ranking plots based on the cumulative probabilities of the interventions.

It is well established that chronic aerobic exercise exerts a positive impact on abnormal lipid profiles [46]. Moreover, it has been reported that low and moderate exercise intensities may promote more benefits on lipid profiles than high-intensity exercise [47]. As a low-intensity aerobic exercise, Qigong is considered as a mind-body therapy that combines slow and gentle movements, breathing techniques and mindful meditation [45]. In comparison with general AE, Qigong focuses more on breathing and psychological adjustment, and has lower exercise intensity. Moreover, Qigong exercise is not limited by exercise equipment, site and climatic condition, and can even be practised in the home [48]. Thus, Qigong is suitable for middle-aged and elderly people who are limited by exercise intensity and facilities. Although Qigong exercises always emphasize the combination of movement and meditation, different kinds of Qigong exercises often have different emphases and effectiveness levels. For instance, YJJ and LZJ emphasize more on breathing techniques and mental relaxation. It has been reported that YJJ and LZJ practice can help regulate breath by increasing pulmonary ventilation function and relieve dyspnea, which may exert beneficial effects on respiratory diseases [41,44,49]. On the other hand, WQX and BDJ are considered to emphasize more on systemic physical activity [50,51]. Moderate-intensity physical activity has been shown to improve metabolic health and reduce cardiovascular disease risk [52]. Furthermore, it has been proposed that physical exercise can readily alter the antioxidant system and thus influence a wide range of signalling processes, including lipid metabolism [53]. Consistently, several studies demonstrated that WQX and BDJ have beneficial effects on metabolic diseases [16,54]. Therefore, it is possible that the mechanism by which WQX exerts better effectiveness in terms of improving blood lipid profiles may be associated with its moderate-intensity physical activity and antioxidative effect, but its exact mechanism still needs further study.

The methodological strong points of this network meta-analysis are as follows: The study (1) used a comprehensive search strategy to reduce the risk of publication bias; and (2) used the probabilities of a rank plot to estimate the best possible intervention. However, some limitations were noted in the present review. First, the small sample sizes and large sex differences of some RCTs should be taken into account when interpreting findings. Second, the RCTs included were all conducted in China and published in Chinese, which may lead to indirectness when interpreting the findings. Third, the heterogeneity of the included

Table 3
Results of the surface under the cumulative ranking and probability.

Treatments/outcomes	SUCRA	PrBest	Mean Rank
TC			
YJJ	29.9	0.0	4.5
AE	22.2	0.0	4.9
NEI	16.1	0.0	5.2
BDJ	74.1	13.6	2.3
WQX	92.6	69.3	1.4
LZJ	65.2	17.1	2.7
TG			
YJJ	34.4	0.1	4.3
AE	53.2	0.2	3.3
NEI	10.9	0.0	5.5
BDJ	88.4	44.4	1.6
WQX	90.7	55.2	1.5
LZJ	22.4	0.1	4.9
HDL-C			
YJJ	54.2	12.5	3.3
AE	39.2	3.1	4.0
NEI	2.2	0.0	5.9
BDJ	73.1	28.0	2.3
WQX	75.0	33.0	2.2
LZJ	56.2	23.4	3.2
LDL-C			
YJJ	59.1	16.2	3.0
AE	30.9	0.7	4.5
NEI	0.5	0.0	6.0
BDJ	72.2	27.8	2.3
WQX	73.4	28.0	2.3
LZJ	63.9	27.3	2.8

Notes: Data are probability in the rows of "SUCRA" and "PrBest". SUCRA, surface under the cumulative ranking; PrBest, probability of being the best treatment. Larger SUCRA and PrBest scores indicate better ranking of the intervention.

outcomes was inevitable because the effects of Qigong interventions depend not only on the coach's instruction but also on the participants' proficiency.

5. Conclusion

Our network meta-analysis suggested that four kinds of Qigong exercises, YJJ, BDJ, WQX and LZJ, are all effective in improving blood lipid profiles, while WQX and BDJ seem to be more effective than the other two. WQX might be the most effective among the four kinds of Qigong exercises. However, because of the limitations of this study, subsequent RCTs need to incorporate the qigong practice with individuals with specific disease states and compare different practice times and frequencies to determine the appropriate duration and frequency of practice for specific disease states. Furthermore, high-quality clinical trials are needed in the future to strengthen the supportive evidence.

Data availability

The data supporting this network meta-analysis and systematic review are from previously reported studies and datasets, which have been cited.

Author contributions

Qinhe Yang conceptualized the paper. Maoxing Pan, Yuanjun Deng and Chuiyang Zheng performed the literature search. Maoxing Pan, Yuanjun Deng, Chuiyang Zheng, Huan Nie, Kairui Tang and Yupei Zhang participated in the literature screening and study quality assessment. All authors analysed and interpreted the data. Maoxing Pan and Yuanjun Deng drafted this manuscript. Qinhe Yang reviewed this manuscript. All authors critically finalized the manuscript.

Table 4
Results of node-splitting analysis.

Side	Direct		Indirect		Difference		
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	P > |z|
TC							
A B	0.71	0.48	−0.13	0.26	0.84	0.54	0.12
A C	−0.26	0.31	0.37	0.27	−0.62	0.41	0.12
A D	−0.44	0.48	−0.36	0.26	−0.08	0.54	0.89
A E	−0.39	0.47	−0.64	0.26	0.25	0.53	0.65
A F	−0.27	0.46	−0.35	0.40	0.08	0.61	0.91
B C	0.19	0.27	−0.07	0.22	0.26	0.35	0.45
B D	−0.54	0.23	−0.33	0.26	−0.21	0.35	0.55
B E	−0.41	0.32	−0.77	0.23	0.36	0.39	0.36
C D	−0.32	0.21	−0.68	0.23	0.36	0.31	0.25
C E	−0.85	0.17	−0.34	0.25	−0.51	0.30	0.10
D E	0.05	0.48	−0.25	0.20	0.30	0.52	0.57
D F	0.17	0.47	0.00	0.37	0.17	0.60	0.78
E F	0.12	0.46	0.36	0.38	−0.24	0.60	0.69
TG							
A B	0.09	0.22	−0.12	0.10	0.21	0.24	0.37
A C	−4.73	0.14	0.14	0.11	−0.14	0.18	0.45
A D	−0.32	0.18	−0.21	0.11	−0.11	0.21	0.60
A E	−0.15	0.19	−0.29	0.11	0.14	0.21	0.53
A F	0.05	0.18	0.04	0.15	0.01	0.23	0.97
B C	0.21	0.10	0.13	0.09	0.08	0.14	0.56
B D	−0.17	0.10	−0.14	0.10	−0.03	0.14	0.86
B E	−0.16	0.14	−0.18	0.10	0.01	0.17	0.94
C D	−0.25	0.08	−0.43	0.09	0.19	0.12	0.12
C E	−0.40	0.08	−0.21	0.10	−0.19	0.12	0.12
D E	0.17	0.18	−0.05	0.08	0.22	0.20	0.27
D F	0.37	0.17	0.22	0.14	0.15	0.22	0.51
E F	0.20	0.18	0.36	0.14	0.16	0.23	0.48
HDL-C							
A B	−0.02	0.19	−0.05	0.12	0.03	0.220	0.88
A C	−0.35	0.15	−0.11	0.11	−0.24	0.190	0.21
A D	0.08	0.21	0.04	0.11	0.04	0.24	0.86
A E	0.20	0.21	0.01	0.11	0.19	0.24	0.41
A F	0.06	0.19	−0.05	0.18	0.11	0.26	0.68
B C	−0.27	0.10	−0.05	0.10	−0.22	0.14	0.12
B D	0.17	0.08	−0.06	0.11	0.22	0.14	0.11
C D	0.18	0.08	0.33	0.10	−0.15	0.13	0.25
C E	0.21	0.06	0.42	0.15	−0.20	0.16	0.20
D E	0.12	0.23	−0.01	0.10	0.13	0.24	0.59
D F	−0.02	0.21	−0.06	0.16	0.04	0.27	0.89
E F	−0.14	0.21	0.01	0.16	−0.15	0.26	0.58
LDL-C							
A B	−0.15	0.39	0.22	0.20	−0.37	0.44	0.39
A C	0.26	0.25	0.60	0.21	−0.35	0.33	0.29
A D	0.12	0.34	−0.12	0.20	0.24	0.40	0.54
A E	0.18	0.34	−0.16	0.20	0.34	0.39	0.38
A F	0 .11	0.34	−0.14	0.30	0.25	0.45	0.57
B C	0.54	0.22	0.18	0.17	0.36	0.27	0.19
B D	−0.36	0.15	0.07	0.20	−0.43	0.25	0.09
B E	−0.24	0.26	−0.21	0.18	−0.03	0.31	0.92
C D	−0.34	0.19	−0.68	0.17	0.35	0.26	0.18
C E	−0.61	0.14	−0.40	0.20	−0.22	0.25	0.38
D E	0.06	0.34	−0.03	0.16	0.09	0.38	0.81
D F	−0.01	0.34	0.05	0.28	−0.06	0.45	0.89
E F	−0.07	0.34	0.11	0.28	−0.18	0.44	0.68

Notes: A, Yijinjing; B, aerobic exercise walking and running; C, no exercise intervention; D, Baduanjin; E, Wuqinxi; F, Liuzijue.

Declaration of Competing Interest

The authors declare no conflicts of interest.

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Appendix A

Table A1

Table A1
Search strategy for the PubMed database.

Number	Search terms
1	blood lipid
2	blood fats
3	lipidemia
4	dyslipidemia
5	hyperlipidemia
6	hyperlipaemia
7	hypercholesterolemia
8	hypertriglyceridemia
9	hyperlipoproteinemia
10	total cholesterol
11	triglyceride
12	high-density lipoprotein cholesterol
13	low-density lipoprotein cholesterol
14	Or 1-13
15	Qigong
16	Ch'i Kung
17	Qi Gung
18	Yijinjing
19	Tendon Change Classic
20	Baduanjin
21	Eight Pieces of Brocade
22	Eight Silken Movements
23	Eight Section Brocade
24	Wuqinxi
25	Five-animal exercises
26	Five-animal Play
27	Liuzijue
28	Six Healing Sounds
29	Yang Sheng Zhang
30	Shi Er Duan Jin
31	Yang Sheng Gong
32	Mawangdui Daoyin
33	Da Wu
34	Or 15-33
35	14 and 34

Appendix B

Fig. A1–A4 Network meta-analysis summary plot

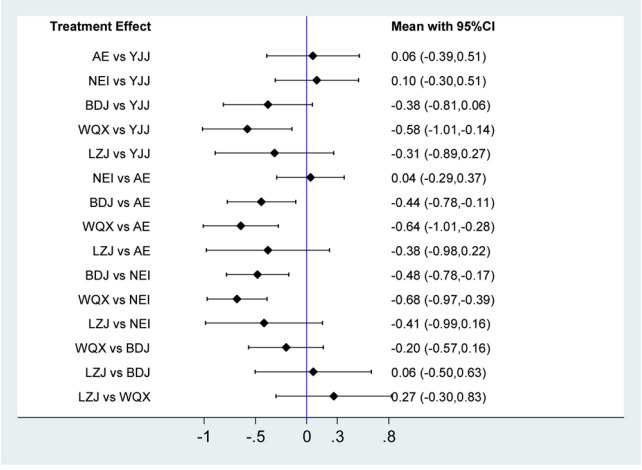

Fig. A1. TC.

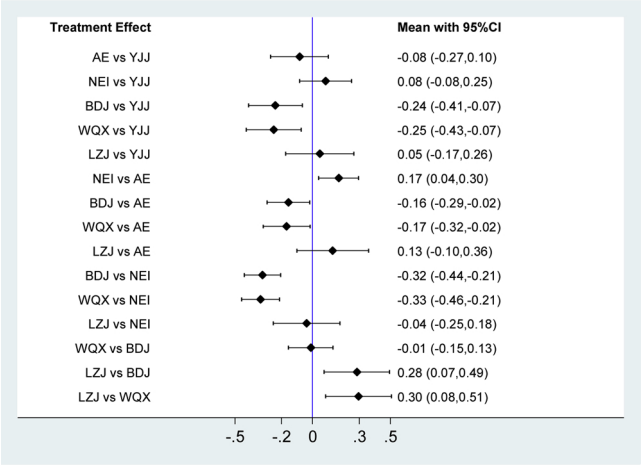

Fig. A2. TG.

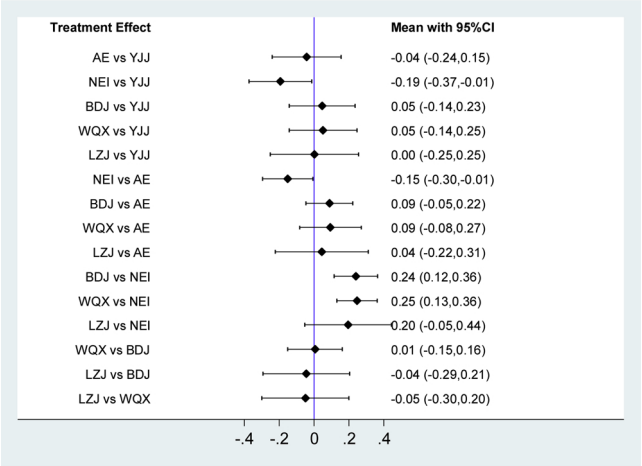

Fig. A3. HDL-C.

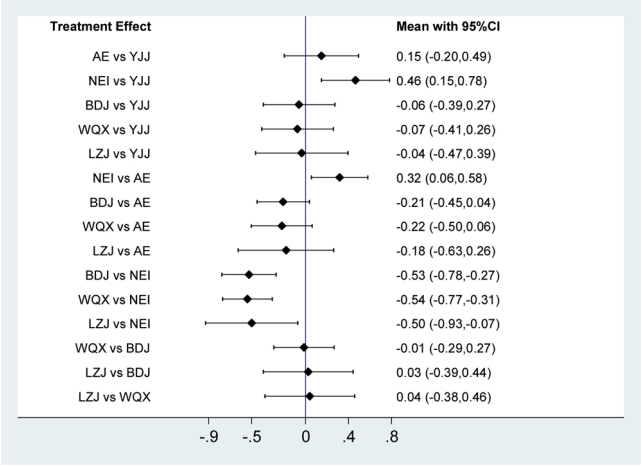

Fig. A4. LDL-C.

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