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REVIEW ARTICLE

Can Tai Chi Improve Blood Lipid Levels in Patients with Cardiovascular Diseases? A Systematic Review and Meta-Analysis

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ABSTRACT

Background. The outbreak of COVID-19 has increased the threat to patients with cardiovascular disease (CVD) and can easily exacerbate their condition. Several studies have been conducted today using Tai Chi as an alternative therapy. Lipid indicators are one of the main factors in the development of cardiovascular disease, and there is no systematic review of studies related to Tai Chi to improve lipid levels in patients with cardiovascular disease. **Objectives.** This study aimed to measure the effect of Tai Chi on blood lipid levels in patients with cardiovascular disease. **Methods.** Eight electronic repositories were searched, ranging from build to February 2022. Risk of bias assessment was performed independently by 2 researchers according to the criteria provided by the Cochrane Intervention System Assessment Manual. Blood lipid indexes were analyzed using Review Manage5.4 software. **Results.** A total of 1,312 patients from 28 trials were included. The results of the meta-analysis showed a significant positive effect of lipids in the Tai Chi group compared to the non-exercise group for total cholesterol (MD= -0.46, 95%CI [-0.65, -0.27], p<0.00001), triglycerides (MD= -0.41, 95%CI [-0.54, -0.29], P<0.00001), and low-density lipoprotein cholesterol (MD= -0.40, 95%CI [-0.53, -0.26], P<0.00001). High-density lipoprotein was not statistically significant (MD= 0.11, 95%CI [0.09, 0.13], P<0.00001). Tai Chi was not statistically significant compared to the other exercise groups. **Conclusion.** Tai chi is effective in improving lipid levels in patients with cardiovascular disease, especially in diabetic patients and hypertensive patients. Despite this improvement in HDL was not significant, it is still believed that the Tai Chi intervention has a potential positive impact.

KEYWORDS: ***Tai Chi, Cardiovascular Disease, Blood Lipids, Systematic Review, Meta-Analysis***

INTRODUCTION

COVID-19 outbreaks are more threatening to patients suffering from cardiovascular disease (CVD), and patients are very susceptible to developing severe disease (1). CVD is one of the main causes of mortality in the globe, claiming the lives of an estimated 17.9 million people per year (2). Heart attacks and strokes account for more than four-fifths of cardiovascular deaths, with one-third of these occurrences happening in those under the age of 70. Individuals with increased blood pressure, blood glucose, lipids, overweight, and obesity may be affected by behavioral risk factors. When these "indirect risk factors" are prevalent, they signal an increased risk of heart attack, stroke, cardiac arrest, and other consequences, which may be assessed in primary care settings. Dyslipidemia can greatly raise the risk of ischemic cardiovascular morbidity, with elevated total cholesterol accounting for around 10% of all morbidity in the

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population (2). Tai Chi has been proven to have a favorable effect on total cholesterol, HDL-C, and LDL-C in previous research, and while effect sizes are tiny, they all may have for clinically important improvements (3). However, as compared to aerobic activity, Tai Chi was only marginally superior in increasing HDL-C (4). Current studies suggest that conventional treatment plus traditional Chinese exercise therapy (Tai Chi and Baduanjin) is smoothly located in the middle in terms of improving blood glucose and lipids, but there is instability in the results obtained due to heterogeneity and risk of bias, and more experimental studies are needed to confirm their effectiveness (5).

Tai Chi is a healthcare sport developed by the Chinese over thousands of years of heritage and actual combat to prevent and treat disease (6). The process of practicing Tai Chi is gentle, slow, and oriented toward consciousness, exercising the physiological and psychological requirements of the practitioner's mind, qi, form, and spirit, and plays an extremely important role in promoting the physical and mental health of individual human beings and the harmonious coexistence of human communities.

There has been a surge in research on the use of tai chi as an alternative method of disease prevention and treatment. Tai Chi is very effective in improving sleep quality in the elderly (7) and is more effective when combined with muscular endurance training than traditional care (8). In recent years, Tai Chi has had positive effects in the treatment of diabetes, cardiovascular disease, and cancer (9-11). In studies of cardiovascular disease, tai chi is effective in different contexts, and while mostly beneficial, some studies found no statistical significance (3, 12). As blood lipid is one of the main factors causing cardiovascular disease, it is necessary to analyze the research data of blood lipid-related indicators based on existing randomized controlled trials. In our review study, we conducted a comprehensive review of the published randomized controlled trials of Tai Chi and cardiovascular disease in the existing database and used meta-analysis to comprehensively analyze the index data of various studies in recent years. Provide stronger and higher-level evidence for future research.

MATERIALS AND METHODS

Protocol and Registration. Our research follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement's reporting criteria for systematic reviews. PROSPERO was used to register the protocol for this systematic review (Registration Number: CRD42022312402).

Data Sources. The study searched the following databases: PubMed, EMBASE, Cochrane Library, Web of Science, CNKI, VIP, WanFang Data, and MEDLINE. The search period was from the establishment of the database to February 2022. All publications in English and Chinese will be included. The search strategy is divided into two parts: a target (Blood lipid) search and an intervention (tai chi) search, adapted to each database. All searches were identified through multiple pre-searches using a combination of subject searches and free searches. The search strategy was based on advanced search terms, including blood lipid, tai chi, Taiji, Taijiquan, and cardiovascular disease. The following were used as inclusion criteria: 1) RCTs with papers in English and Chinese; 2) studies on tai chi interventions for CVD; 3) tai chi as the primary intervention in the experimental group and no exercise or exercise modalities other than tai chi in the control group; 4) outcome indicators including at least one lipid indicator; and 5) articles published by February 2022. The following were used as exclusion criteria: 1) non-randomized controlled trials and observational trials; 2) non-Tai Chi exercise interventions in the experimental group; 3) papers with inconsistent main study indicators or incomplete data; 4) review papers, duplicate publications, and papers that could not be viewed in their entirety; and 5) serious complications.

Trial Quality Assessment. For the included studies, two researchers independently assessed the risk of bias using the Cochrane Collaboration System Evaluation Manual (version 5.1.0) criteria (13). Random sequence creation (selection bias), blinding of participants and employees (performance bias), blinding of outcome assessment (detection bias), insufficient outcome data (attrition bias), and selective reporting were all listed on the risk of bias scale (reporting bias). Each possible source of bias will be classified as high risk, uncertain, or low risk based on the information gathered from each qualifying study, and any disagreements will be resolved by a third author.

Data Extraction. Two researchers worked together to obtain the data. The first author's name, the date of publication, the journal of publication, the interventions in the experimental and control groups, and the results of the measured indicators were all retrieved by carefully reading the complete text of the included studies. Data extraction was done separately by two researchers, and the findings were cross-checked. If there were any discrepancies, they were identified and resolved, or they were forwarded to a third author for judgment.

Statistical Analysis. Review Manage 5.4 software provided by Cochrane was applied to perform a meta-analysis of lipids. As the results were continuous variables, the effect sizes were expressed using different mean (MD) and 95% confidence intervals (CI). The included studies were tested for heterogeneity using the X2 test, and homogeneity among the results of the studies was expressed as P>0.1, I2<50% using a fixed-effect model; when it was expressed as P<0.1, I2>50%, it indicated significant heterogeneity and a random-effects model was used. When the heterogeneity between groups was too large, descriptive analysis was performed.

RESULTS

Trial Search. We initially identified 448 studies, 41 of which were excluded due to duplication. We screened 38 studies for full text by reading the titles and abstracts and performed a full-text review. The evaluation procedure omitted two studies because the entire text was not accessible, three studies because the indicator data was incomplete, and six studies because the whole text was incomplete. Finally, 27 papers satisfied the inclusion criteria for this analysis. The detailed selection process is shown in the PRISMA flow chart (Figure 1).

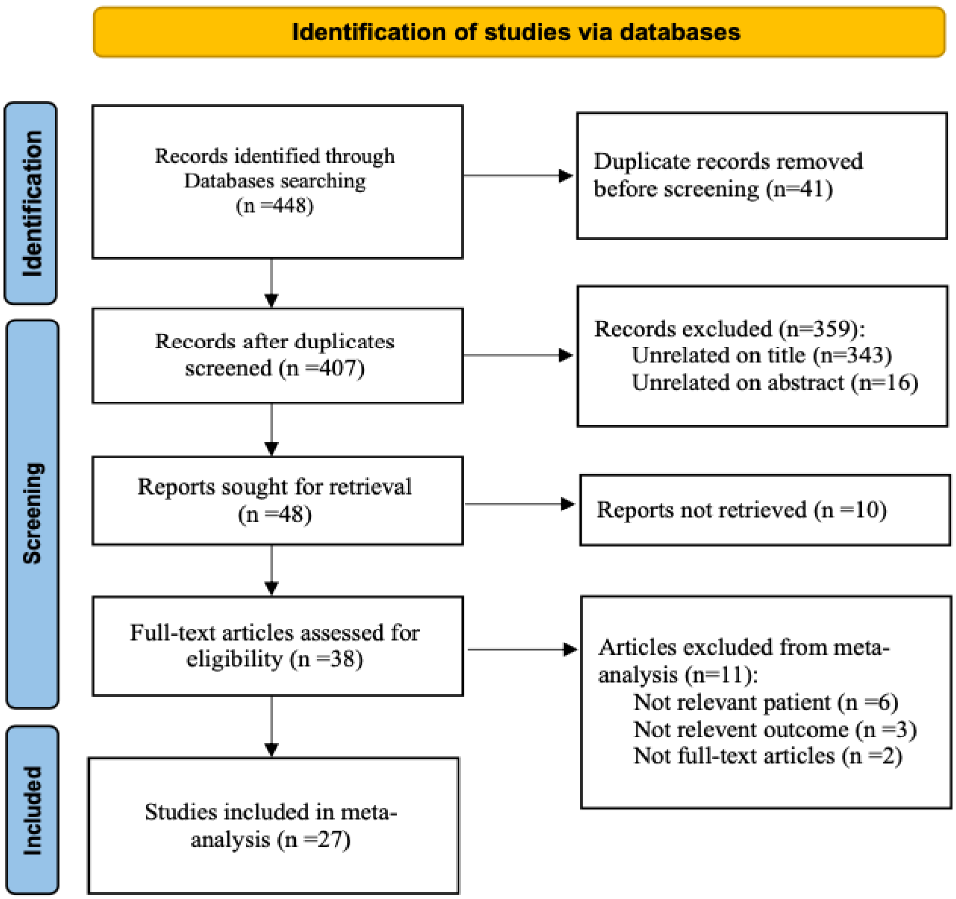

Figure 1. Study selection and identification in the PRISMA flow diagram

Description of Studies. The inclusion report showed that a total of 10 articles were published in English and 17 articles were published in Chinese between 2003 and 2021. Of these, nine studies were related to patients with hypertension (12-20), eight to patients with diabetes (21-28), four to patients with obesity (29-32), two to patients with hyperlipidemia (33, 34), and one each to patients with cardiovascular disease risk and heart failure (35-37). Table 1 summarizes the characteristics of the included studies, which comprised 27 randomized controlled trials with a total of 1,312 people and the size of the sample ranging from 10 to 150. The intervention was 24 forms of Yang-style Tai Chi in 12 research, and the Tai Chi form was not reported in 6 investigations. The control group consisted of a no-exercise group and a group of other exercises, and the other exercise groups were a walking group, an instrument group, and a resistance exercise group. The maximum duration of study supervision was 48 weeks and the minimum duration was 4 weeks. The duration of each intervention was at least 30 minutes, three days a week, with a maximum of 90 minutes per session, 7 days a week.

Table 1. Characteristics of randomized controlled trials included studies

	Patients	**Age, Mean (SD)**		**Characteristics of Intervention**		**Supervision time**	
First author, Year	**Total, E/C**	**EG**	**CG**	**EG**	**CG**	**Per session, per week,**	**duration**
Hong Cai 2018	50, 27/23	64.54	64.51	Tai chi	N	30 min, 3 days	12 weeks
Lirong Zhan 2021	115, 57/58	39.27 (10.12)	40.25 (10.78)	Tai chi	N	50 min, 6 days	24 weeks
Yinghao Chen 2021	52, 26/26	41~62		Tai chi	N	60 min, 3 days	16 weeks
Hanxuan Yang 2021	94, 47/47	69.98 (5.49)	71.32 (6.24)	Tai chi	N	60 min, 6 days	12 weeks
Zhenyang Gong 2020	20, 10/10	65.80 (2.48)	65.30 (2.71)	Tai chi	N	50 min, 1 days	12 weeks
Songqian Li 2021	20, 10/10	46.20 (7.5)	44.90 (7.49)	Tai chi	N	60 min, 7 days	14 weeks
Yangbing Wang 2021	44, 22/22	62.00 (5.67)	59.38 (4.51)	Tai chi	N	90 min, 4 days	12 weeks
	43, 22/21		61.13 (2.67)		Instrumental exercises		
Mendoza-Núñez 2018	85, 48/37	67.4 (4.7)	68.2 (6.6)	Tai chi	N	50 min, 5 days	24 weeks
Xiaoling Shou 2019	198, 98/100	67.4 (4.7)	51.5 (8.26)	Tai chi	N	70 min, 7 days	4 & 12 weeks
Parco M.Siu 2019	282, 144/138	67.4 (4.7)	61.0 (5.7)	Tai chi	N	60 min, 1 days	12 & 38 weeks
	289,144/145		62.2 (6.6)		Conventional Exercise		
Wei Lu 2018	88,44/44	66.31 (4.79)	68.02 (4.62)	Tai chi	W	60 min, 3 days	12 weeks
Dailiang Zhang 2017	82,41/41	66.33 (4.74)	67.51 (4.09)	Tai chi	W	60 min, 3 days	12 weeks
Xianjin Zhou 2014	40,20/20	60 (5.6)		Tai Chi	N	90 min, 4 days	24 weeks
Xiaogang Jiang 2007	31,16/15	N		Tai Chi Sword	N	60 min, N	12 weeks
Nan Zhu 2017	20,10/10	59.76 (5.21)	60.11 (5.59)	Tai chi	N	60 min, 5 days	12 weeks
	20,10/10	60.78 (5.56)		Tai chi	N		
Zhaohua Zhang 2017	28,15/13	55.54 (3.57)	54.85 (4.45)	Tai chi	N	90 min, 3 days	12 weeks
	30,15/15	55.54 (3.57)	54.71 (4.12)	Tai chi	Walking		
YingZhang 2008	20,10/10	57.4 (6.2)		Tai chi	N	60 min, 5 days	14 weeks
JingSun 2015	300,150/150	≧54		Tai chi	N	60 min, 5 days	48 weeks
Yongcai Zheng 2014	79,40/39	62.5 (4.41)	62.9 (4.53)	Tai chi	N	55 min, 3 days	16 weeks

Yan Gao 2014	50,25/25	64.44 (5.03)	66.13 (5.34)	Tai Chi & QG	N	55 min, 5 days	20 weeks
Rong Yi 2015	40,25/15	69.79 (6.66)	67.07 (4.45)	Tai chi	N	55 min, 5 days	20 weeks
Shih Chueh 2010	104,62/55	59.1 (6.2)	57.4 (5.8)	Tai chi	N	60 min, 3 days	12 weeks
Jen Chen 2003	88,37/39	51.6 (16.3)	50.5 (9.8)	Tai chi	N	50 min, 3 days	12 weeks
Jo Lynne 2014	96,47/49	42.52 (0.78)	45.22 (0.71)	Tai chi	N	60 min, 2 days	8 weeks
Nowen 2012	32,16/16	60.4 (6.2)	62.6 (5.9)	Tai chi	N	45 min, 3 days	16 weeks
Paul Lam 2008	53,28/25	63.2 (8.6)	60.7 (12.2)	Tai chi	N	60 min, 2 days	24 weeks
Rifeng Huang 2014	50,25/25	55-70		Tai chi	N	45 min, 7 days	8 weeks

Notes: EG: experimental group. CG: control group. SD: standard deviation. N: no exercises. NR: not reported. Min: minute. W: walking.QG: qigong.

Risk of Bias Assessment. The Cochrane Collaboration's tool evaluation revealed that all of the studies included were at low-risk. The danger of insufficient data on the production of randomized sequences and outcomes was rated as low, while the risk of blinding and reporting bias was rated as uncertain. Seventy-eight percent of the 27 studies were assessed as an unclear risk because blinding was not explicitly reported, only 14% of the studies selected for reporting were evaluated as low risk, and 75% of the studies were evaluated as unclear risk (Figure 2).

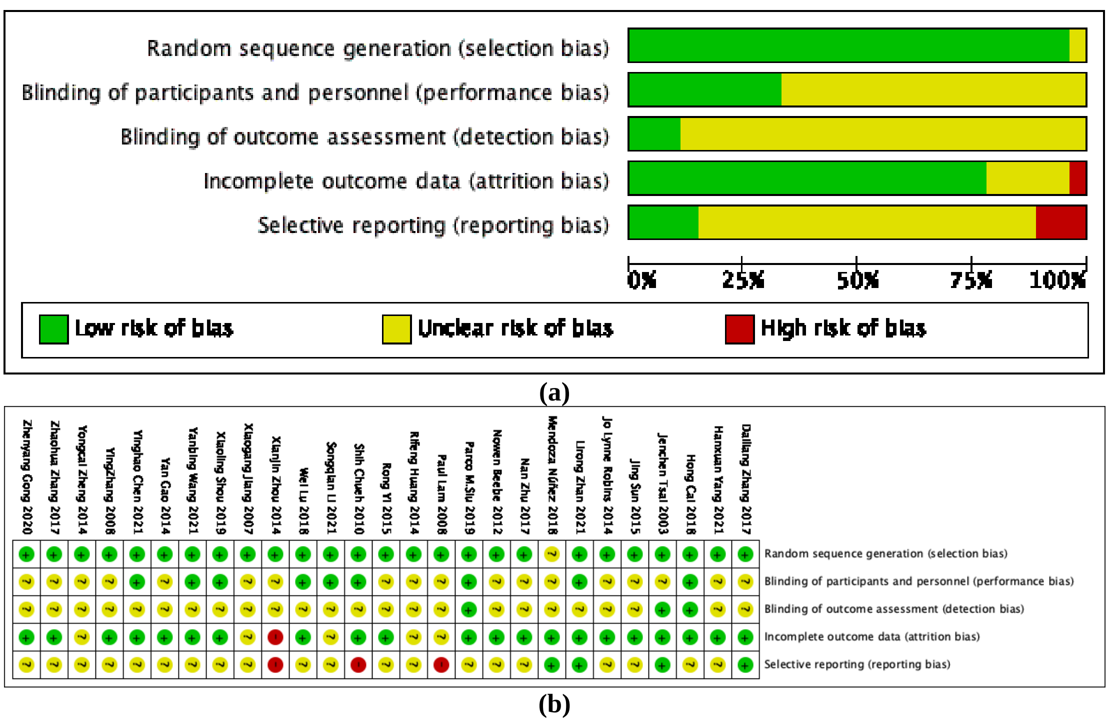

Figure 2. (a) Risk of bias graph and (b) Risk of bias summary

OUTCOMES

Total Cholesterol. Tai Chi versus No Exercise. All 23 studies assessed the effect of the Tai Chi (n=1.156) and no-exercise group (n=1.107) on TC. The heterogeneity of the included studies showed a high heterogeneity (P<0.00001, I2=94%), and a random-effects model was used for meta-analysis (Figure 3). Excluding studies that resulted in excessive heterogeneity (14, 17, 20, 22, 23, 28), the combined data showed a statistically significant difference between the two groups (MD = -0.46, 95%CI [-0.65, -0.27], P < 0.00001), and suggested that Tai Chi could improve total cholesterol levels.

However, the results of the subgroup analysis on obese patients did not show statistical significance between the two groups (MD = -0.31, 95% CI [-0.69, 0.07], P = 0.11). The results of the subgroup analysis for patients with other diseases also did not show statistical significance between the two groups either (MD=-0.01, [0.15, 0.13], P= 0.88).

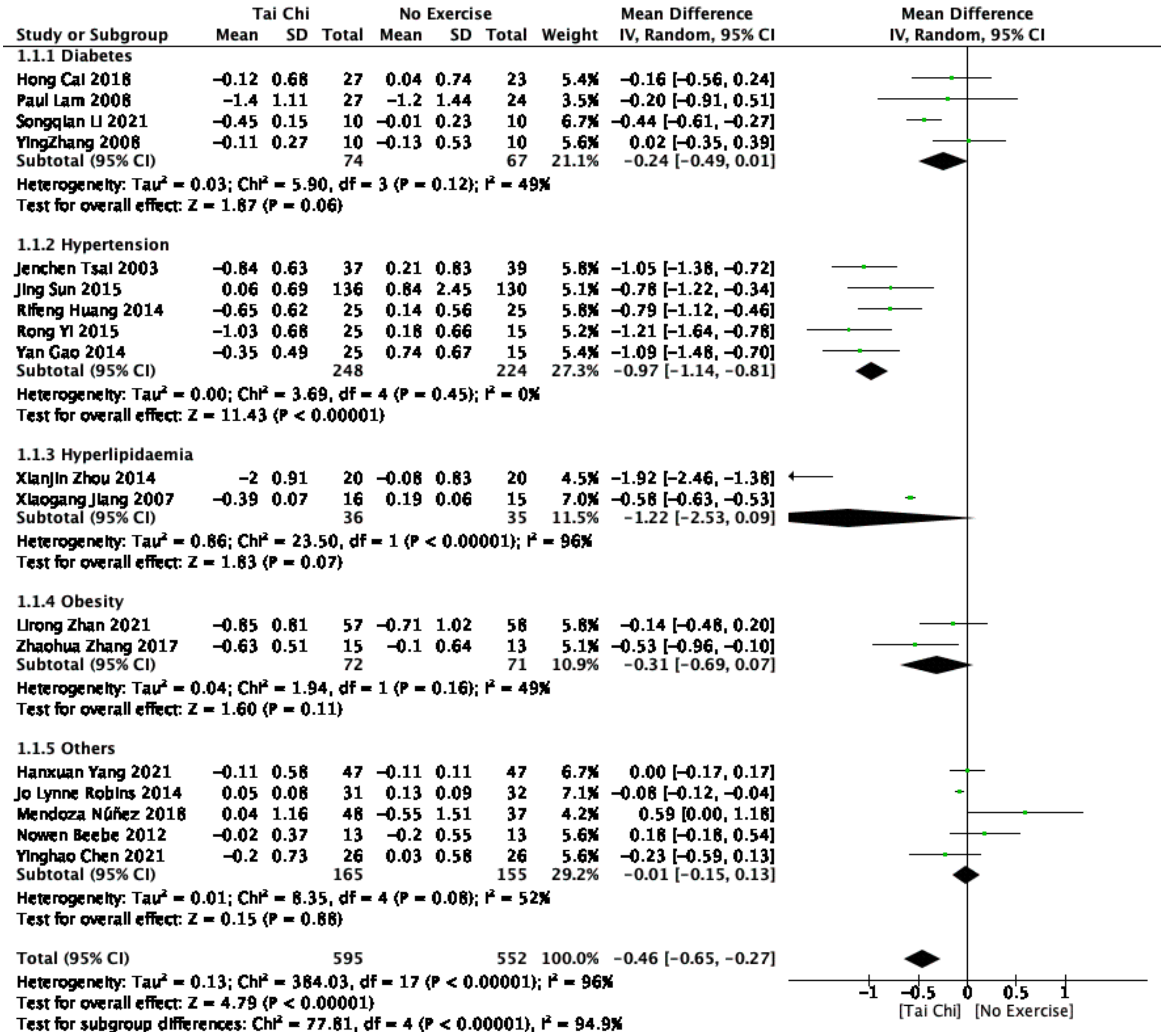

Figure 3. Forest plot of comparison: comparing TC between Tai Chi Group and No Exercise Group.

Tai chi versus Other Exercise. A total of four studies reported the effect of the Tai Chi group (n=112) and other exercise groups (n=114) on TC (17, 19, 26, 32). The heterogeneity of the included studies showed (P= 0.33, I2=13%) a low heterogeneity and a meta-analysis was performed using a fixed-effects model (Figure 4). The results after combining the data did not show statistical significance between the two groups (MD= -0.10, 95% CI [-0.27,0.06], P= 0.21). The subgroup analysis showed 2 studies each concerning hypertension patients and other diseases, with no statistically significant differences between the groups concerning hypertension patients with hypertension (MD= -0.19, 95% CI [-0.43,0.05], P= 0.12). Similarly, there were no statistically significant differences between the groups regarding patients with other diseases (MD= -0.03, 95% CI [-0.26,0.20], P= 0.82).

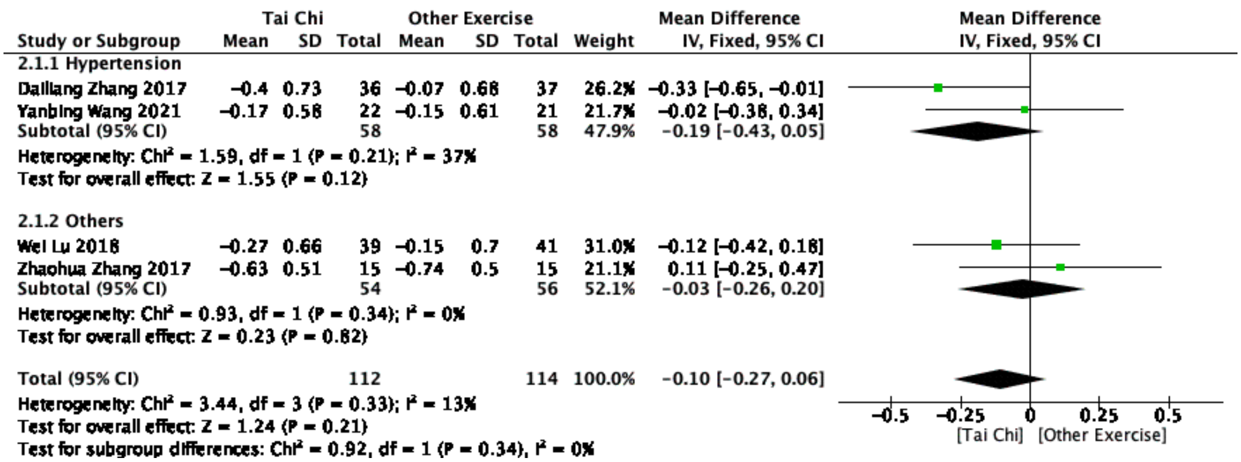

Figure 4. Forest plot of comparison: comparing TC between Tai Chi Group and Other Exercise Group

Triglycerides. Tai Chi versus No Exercise. A total of 23 studies assessed the effect of the Tai Chi group (n = 1156) and the no-exercise group (n = 1107) on TG. The heterogeneity of these studies showed ((P < 0.00001), I² = 92%), with high heterogeneity, so a random-effects model was used for meta-analysis (Figure 5). Studies that caused excessive heterogeneity were excluded (15, 17, 24, 30). The results after combining the data showed a statistically significant difference between the two groups (MD = -0.41, 95% CI [-0.54, -0.29], P < 0.00001). Two studies reported TG data in patients with hyperlipidemia, and the subgroup analysis did not show statistical significance between the two groups (MD = -0.71, 95% CI [-1.77, 0.35], P = 0.19). Heterogeneity was shown to be high (I2 = 96%), as there were only two relevant studies, and it was not possible to determine the cause of the greater heterogeneity. There were 3 studies on TG data in other patients and the analysis did not show statistical significance between the two groups (MD = -0.00, 95% CI [-0.03, 0.03], P = 0.87).

Tai chi versus other exercises. A total of five studies reported the effect of the Tai Chi group (n = 400) and other exercise groups (n = 404) on TG (17, 19, 26, 30, 32). The heterogeneity of these studies showed (P = 0.90, I² = 0%), low heterogeneity and meta-analysis using a fixed effect model (Figure 6). The results after combining the data did not show statistical significance between the two groups (MD = 0.05, 95% CI [-0.02, 0.12], P = 0.14). The subgroup analysis showed that 2 studies reported TG data in hypertensive patients and there was no statistical significance between the two groups (MD = -0.03, 95% CI [-0.24, 0.18], P = 0.78). 2 studies reported data in obese patients and the results showed that improving TG levels with other exercises was more effective than Tai Chi (MD = 0.06, 95% CI [- 0.01, 0.13], P = 0.09).

High-density Lipoprotein Cholesterol. Tai Chi versus No Exercise. A total of 23 studies evaluated the effect of Tai Chi (n = 1165) and no exercise group (n = 1108) on HDL-C levels. The heterogeneity of these studies showed (P < 0.00001, I² = 82%) a high heterogeneity and a meta-analysis was performed using a random effects model (Figure 7). Excluding studies that caused excessive heterogeneity (15, 18, 22, 28), Tai chi did not enhance HDL-C levels in patients, according to the pooled data (MD = 0.11, 95% CI [0.09, 0.13], P < 0.00001).

Tai chi versus Other Exercise. A total of five studies evaluated the effect of Tai Chi group (n = 414) and other exercise groups (n=420) on HDL-C (17, 19, 26, 30, 32). Heterogeneity in these studies was demonstrated (P = 0.05, I² = 54%), and meta-analysis was performed using a random effects model (Figure 8). Combining the data showed no statistical significance between the two groups (MD = -0.02, 95% CI [-0.08,0.03], P = 0.36).

Low-density Lipoprotein Cholesterol. Tai Chi versus No Exercise. A total of 19 studies evaluated the effect of the Tai Chi group (n=777) and no exercise group (n=739) on LDL-C. The heterogeneity of these studies was high (P<0.00001, I2=96%) and the meta-analysis was performed using a random-effects model (Figure 9). Exclusion of studies that resulted in excessive heterogeneity (15, 16, 20, 28, 36), combined data showed statistically significant differences (MD= -0.40, 95% CI [-0.53, -0.26], P< 0.00001) and Tai Chi improved LDL-C levels. The subgroup analysis showed that the two studies on hyperlipidemic patients were not statistically significant between the two groups (MD=-0.88, 95%CI [-2.05,0.30], P= 0.14). Similarly, studies on other patients did not show statistically significant results (MD=-0.14, 95%CI [-0.37,0.08], P= 0.2).

Tai chi versus Other Exercise. A total of four studies evaluated the effect of Tai Chi group (n = 112) and other exercise groups (n = 114) on LDL-C (17, 19, 26, 32). These studies showed high heterogeneity ($P < 0.00001$; $I^2 = 91\%$) and meta-analysis using a random-effects model (Figure 10). Results after combining the data showed that Tai Chi improved LDL-C levels compared to other exercises (MD = -0.44, 95% CI [-0.89,0.00], P = 0.05).

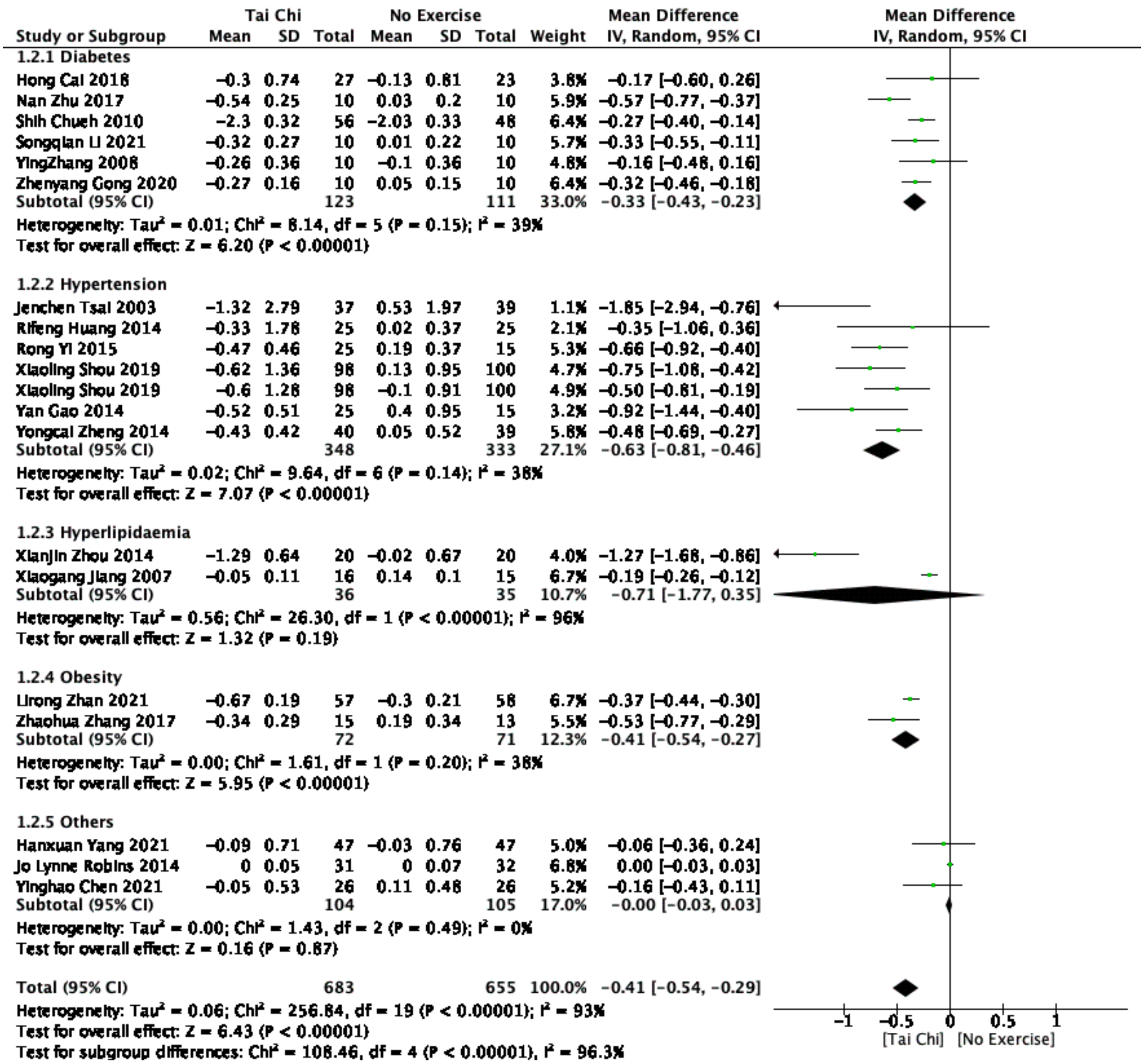

Figure 5. Forest plot of comparison: comparing TG between Tai Chi Group and No Exercise Group.

However, in the two investigations on hypertensive patients, subgroup analysis demonstrated no significant differences between the groups (MD = -0.21, 95% CI [-0.58,0.16], P= .27). Similarly, in the 2 studies on other patients, the similarity between the two groups was also statistically significant (MD= -0.77, 95% CI [-2.24,0.70], P= 0.30). Heterogeneity was shown to be higher in the subgroup, but the reasons for the excessive heterogeneity could not be verified due to the minimal number of included studies.

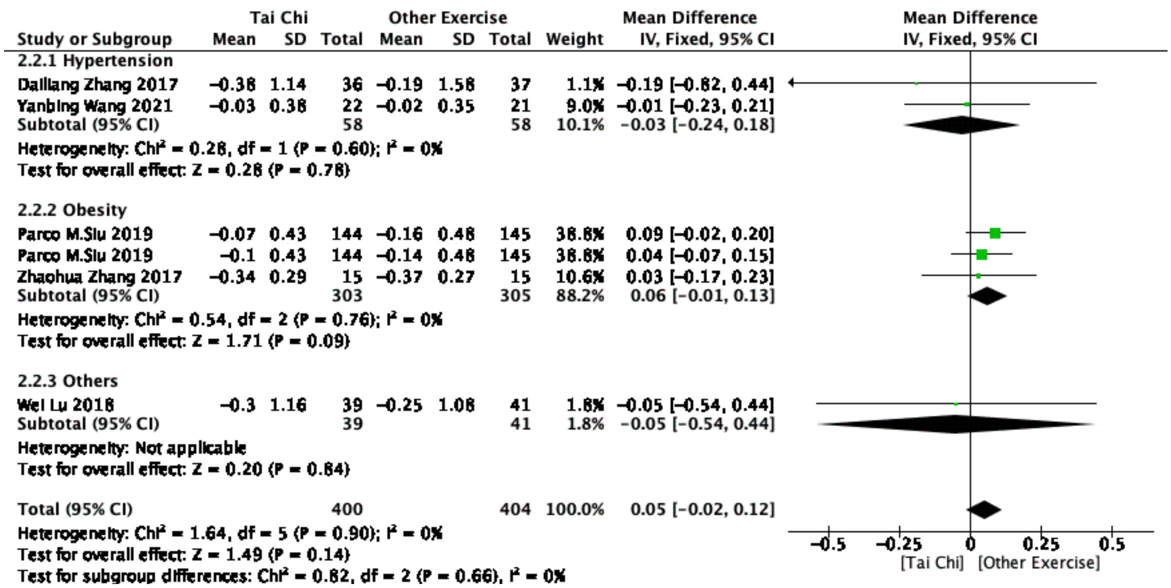

Figure 6. Forest plot of comparison: comparing TG between Tai Chi Group and Other Exercise Group

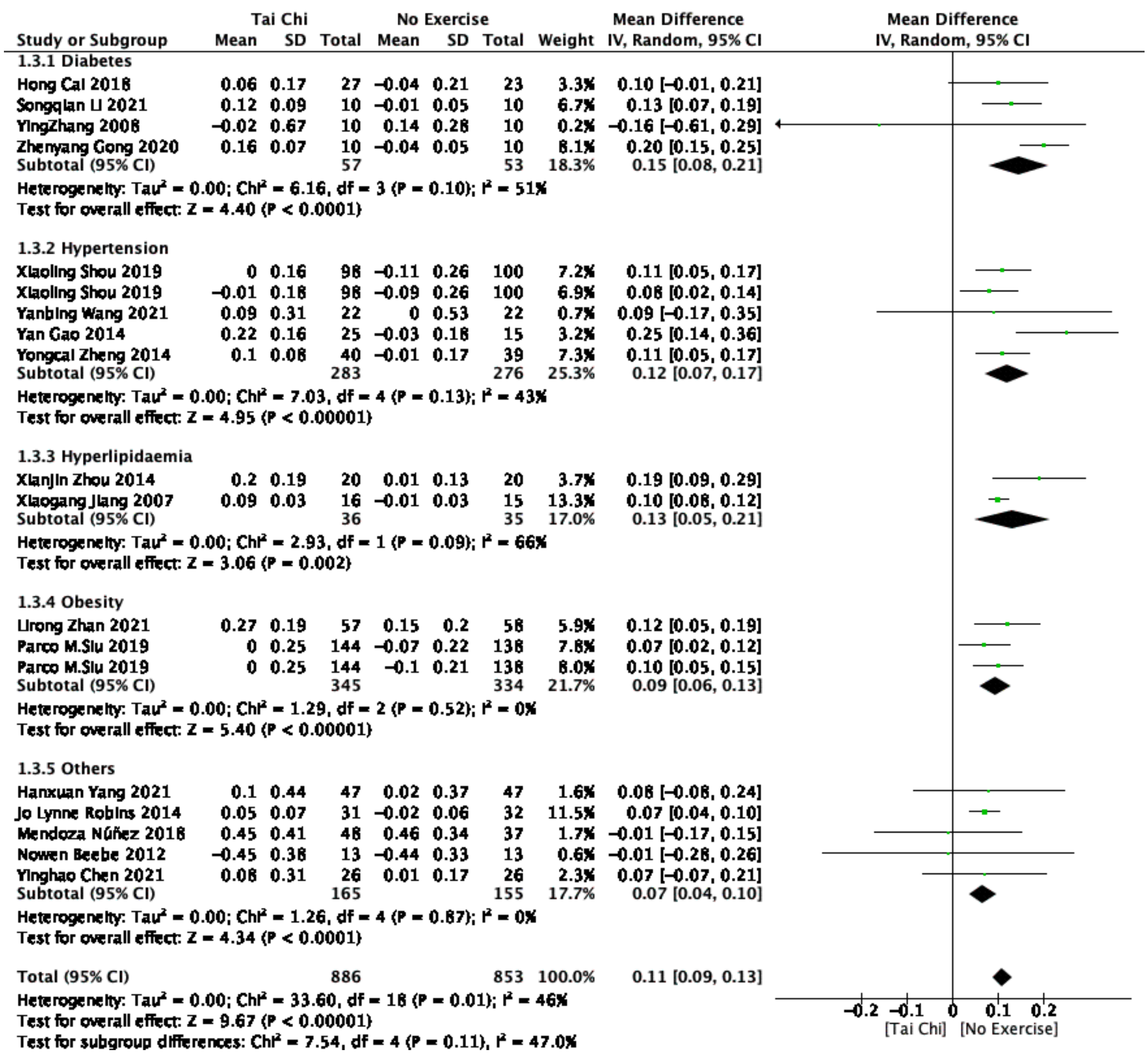

Figure 7. Forest plot of comparison: comparing HDL-C between Tai Chi Group and No Exercise Group.

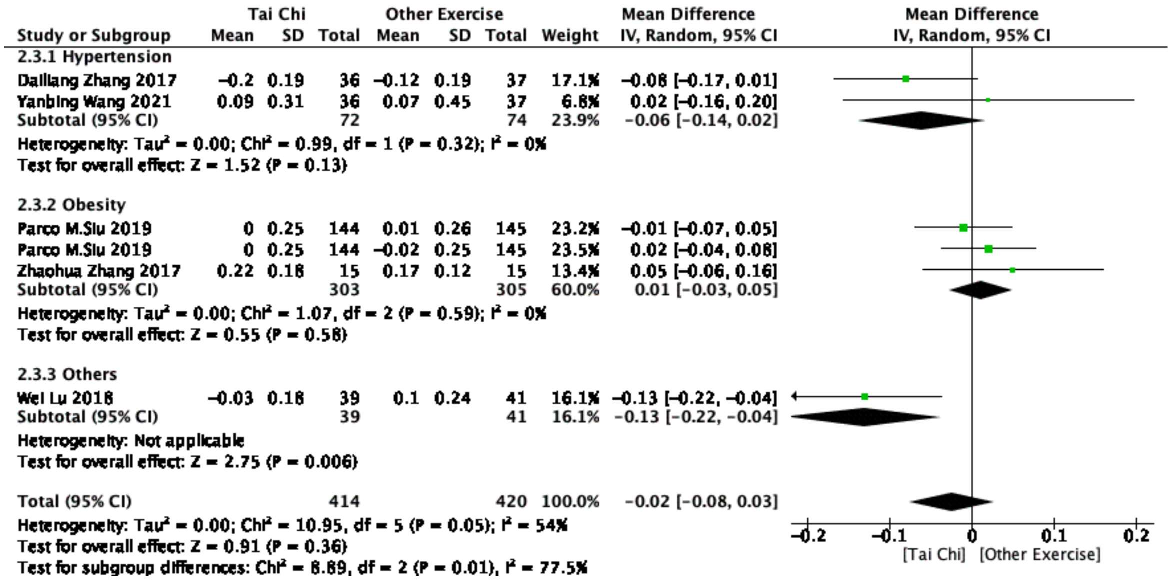

Figure 8. Forest plot of comparison: comparing HDL-C between Tai Chi Group and Other Exercise Group.

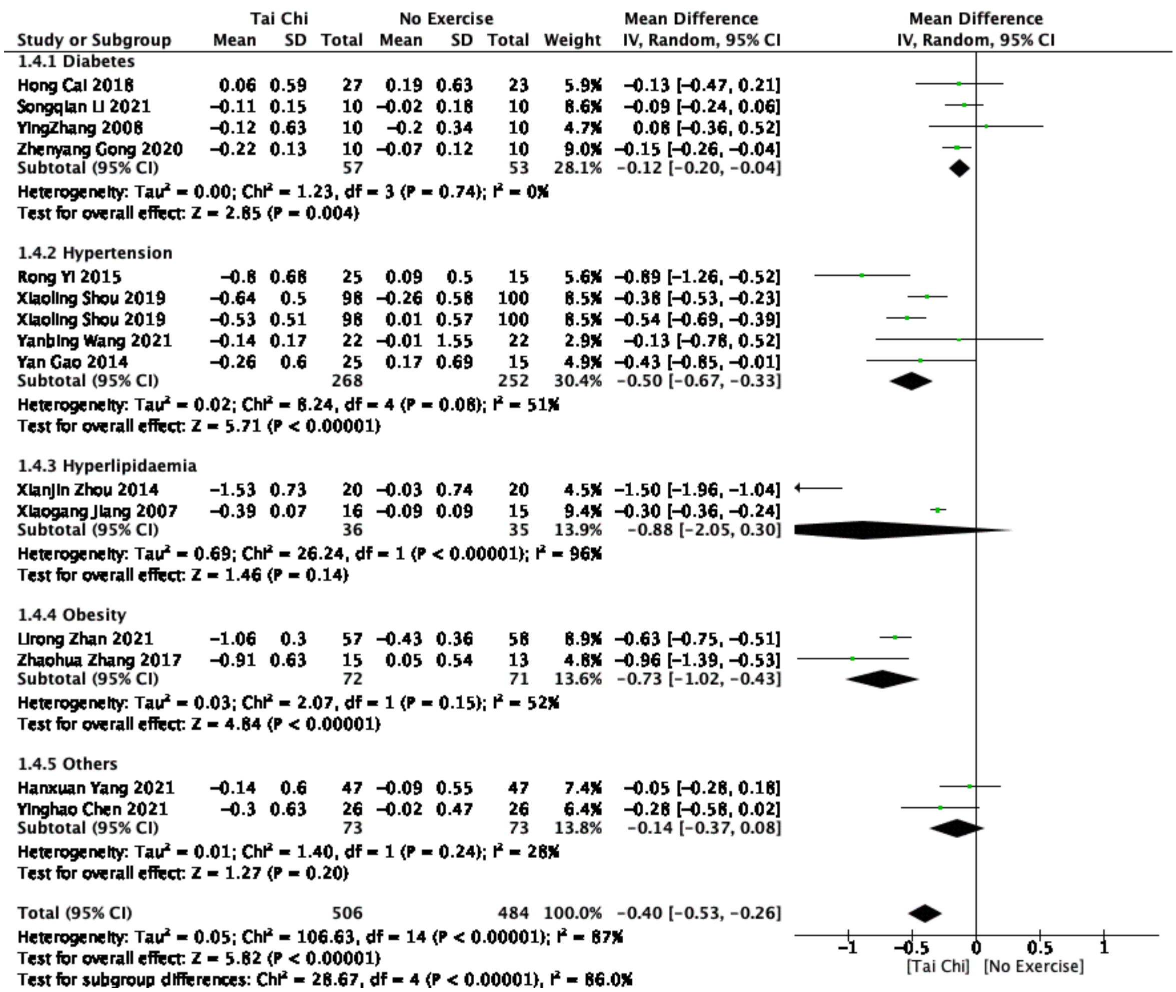

Figure 9. Forest plot of comparison: comparing LDL-C between Tai Chi Group and No Exercise Group.

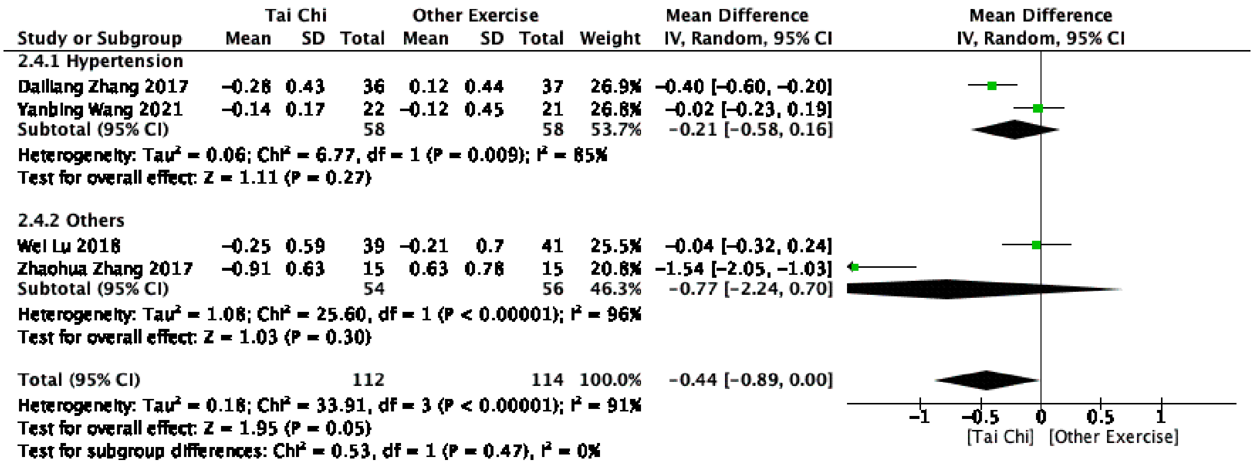

Figure 10. Forest plot of comparison: comparing LDL-C between Tai Chi Group and Other Exercise Group.

PUBLICATION BIAS EVALUATION

Publication Bias Evaluation between Taichi and No Exercise. A total of 17 studies was included, using funnel plots to analyze lipids in the tai chi and non-exercise groups. As can be seen in Figure 11, the included studies were asymmetrically distributed, with most studies scattered outside the confidence interval. The findings imply a possibility of publication bias and substantial heterogeneity in the included research.

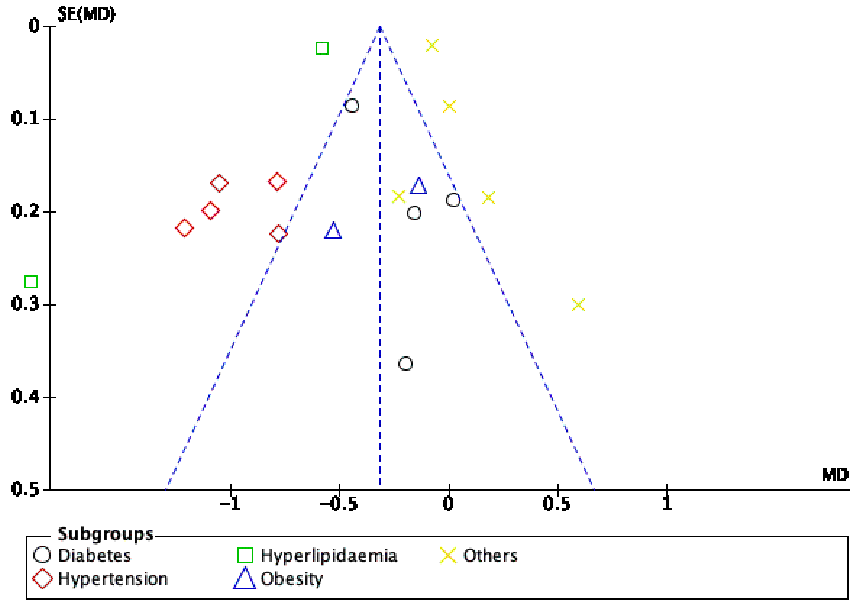

Figure 11. The blood lipids in the Taichi and no exercise group of the funnel plots.

Evaluation of Publication Bias between Taichi and Other Exercise. For the Tai Chi and other exercise groups, blood lipids were analyzed using funnel plots across four studies. The results showed that the included studies were symmetrically distributed and that there was no risk of bias in the included studies (Figure 12).

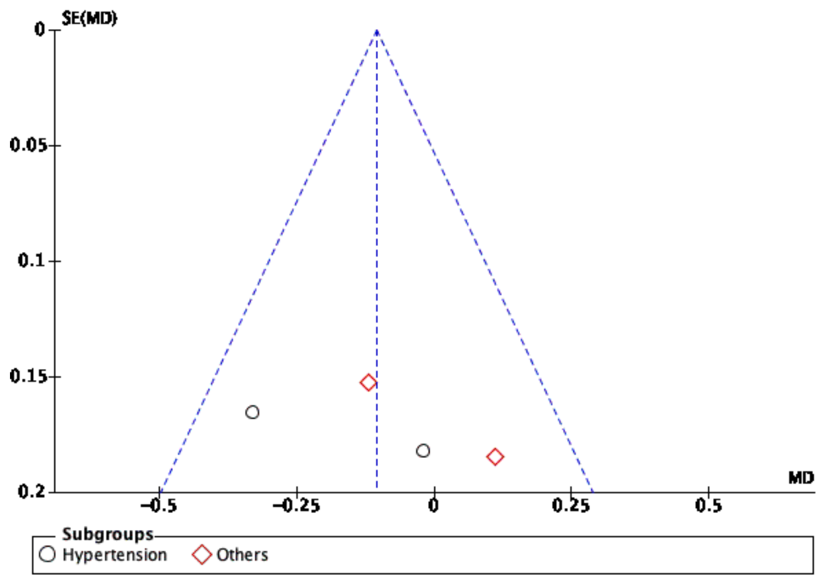

Figure 12. The blood lipids in the Taichi and other exercise groups of the funnel plots.

DISCUSSION

This study discussed the effect of tai chi on blood lipids in patients with cardiovascular disease through systematic evaluation and meta-analysis. Tai Chi as a popular traditional fitness exercise for more than 22,000 years, is used as an adjunctive alternative therapy to exercise (35). Compared to patients without exercise, tai chi significantly improved TC, TG, and LDL-C indices in patients with cardiovascular disease, while HDL-C indices did not change significantly. This result is consistent with the findings of Guo and Liu (4, 40). On the other hand, the results of comparing Tai Chi with other exercises revealed that Tai Chi had a significant impact on improving LDL-C indexes, except for other indexes that did not differ significantly. Tai Chi to improve lipid levels in patients with CVD appears to be an effective treatment modality (11). Compared to non-exercise, Tai Chi has a better impact in improving lipid levels in patients with diabetes and hypertension, and randomized controlled trials in patients with diabetes and hypertension are adequate and previous studies confirm the reliability of the present results (41-43). There are also studies with different results, in the study of Chen et al (22), Tai Chi significantly reduced TG levels and raised HDL-C levels without having a significant effect on TC. Similarly, no effect of Tai Chi on TC indicators was observed in the study by Thomas et al (44). In contrast, for hyperlipidemic patients, there was a significant improvement in only TC indicators, while other indicators showed no significant difference. The reason for this may be that there are fewer relevant randomized controlled trials included in this review and insufficient evidence to conclude conclusively that Tai Chi does not improve blood lipid levels. The analysis of Tai Chi in obese patients resulted in improvements in TG and LDL-C markers. A randomized controlled experiment in obese and overweight persons was previously studied (45) and showed that only the TG index improved significantly, while the other indexes were not significant. In other patients, there was a significant improvement in LDL-C indicators only, but not in other indicators. Individual differences may arise in the outcome data presented in different categories of patients, and similarly, Alenazi et al. concluded that tai chi may have potential benefits on lipid profiles in different age groups and populations (3). The results of this review were not favorable to HDL-C metrics, as Tai Chi was not statistically significant when compared to non-exercise. A subset of studies has previously reported improvements in HDL-C metrics with Tai Chi (22, 46, 47) and a subset of studies has reported small differences between groups (15, 44, 48, 49). Generally, most studies concluded that Tai Chi had a positive effect on HDL-C metrics, and most had a small positive effect despite conflicting results regarding lipids.

The significant disparity was not seen in blood lipid indices between Tai Chi and other exercises compared in this review. As one of the aerobic exercises, tai chi is practiced slowly and gently and can effectively regulate the physical and mental health of the practitioner by regulating breathing combined with body movements (50). compared to other aerobic exercises, the benefits of practicing tai chi are thought to be greater for people with cardiovascular disease. Tai Chi is an exercise that emphasizes the harmonization of yin and yang, the unity of body and mind, and soothing movements and breathing regulation. As a traditional exercise that has been handed down for more than 2,000 years, Tai Chi is a suitable exercise for patients with cardiovascular disease because it incorporates the theories of traditional medicine such as meridians and channels, Yu points, qi and blood, guidance, and zangyi. Some high-intensity exercises are not suitable for patients with cardiovascular disease and may threaten the health of the patient. However, most patients with cardiovascular disease cannot continue in any fast-paced or intense programs due to physical reasons (51), which leads to shorter duration or abandonment. In addition, Tai Chi is heavier than other exercises, the included sample types are too small, the results of the meta-analysis are not accurate enough, and more randomized controlled trials are needed for further validation. Our study should also consider some limitations. First, the study was limited by the condition that only English and Chinese literature were included. Second, different interventions can also have some effect on the results, for example, different postures, frequency, and intensity of Tai Chi exercises, and some studies will be supplemented with medication or dietary treatment. Third, most of the risk of bias assessments in the included studies did not explicitly state blinded assessments and selection reports. Fourth, the sample size of the included studies can also make a large difference in the results of the studies; therefore, the experimental methods need to be more standardized to improve the reliability of the studies.

CONCLUSION

Tai chi is effective in improving lipid markers in patients with cardiovascular disease, especially diabetic patients and hypertensive patients. Despite this insignificant improvement in HDL-C, a potential positive effect of the Tai Chi intervention is still considered. Because too few studies of hyperlipidemic and obese patients were included to identify the causes of excessive heterogeneity during the meta-analysis, which could potentially lead to inaccurate meta-analysis results, more studies are required to improve the credibility of the results.

APPLICABLE REMARKS

- Tai chi has a controlling and restorative effect on the risk factors that trigger cardiovascular disease.
- Although the style of Tai Chi is slow, the practice should still pay attention to the rhythm to prevent injuries during the exercise.
- Tai chi practice combined with medication is a common treatment nowadays, and it is beneficial to develop an exercise prescription suitable for Tai Chi practice combined with medication is a common treatment nowadays, and it is beneficial to develop an exercise prescription suitable for the patient's health.

AUTHORS' CONTRIBUTIONS

Chao proposed the project and registered with its research proposal. Chao and Xiang conducted the literature search and data extraction; Ding and Yang performed the data analysis; Chao drafted the draft; Tengku made further changes and comments on the draft; and all authors confirmed the final manuscript.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest related to this article.

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