European Journal of Integrative Medicine 12 (2017) 153–162

Contents lists available at ScienceDirect

European Journal of Integrative Medicine

journal homepage: www.elsevier.com/locate/eujim

Research paper

Effects of Tai chi on adults with essential hypertension in China: A systematic review and meta-analysis

Ziyu Lian[a], Lili Yang[b,c], Yaoyao Bian[d], Li Zeng[b], Mingzhen Li[d], Yu Sun[d], Wenlin Li[b,*]

[a] School of Second Clinical Medicine, Nanjing University of Chinese Medicine, Nanjing, China
[b] Jingwen Library, Nanjing University of Chinese Medicine, Nanjing, China
[c] School of First Clinical Medicine, Nanjing University of Chinese Medicine, Nanjing, China
[d] School of Nursing, Nanjing University of Chinese Medicine, Nanjing, China

ARTICLE INFO

Keywords:
Tai chi
Essential hypertension
Systematic review
China

ABSTRACT

Introduction: Essential hypertension is a common disease that could result in various health problems and remains a major threat to public health. This systematic review and meta-analysis was performed to examine the therapeutic effects of Tai chi on adults with essential hypertension in China.

Method: Four English databases and three Chinese databases were searched for randomized controlled trials (RCTs) from the earliest data available to October 31 st 2016. Methodological quality was evaluated and a meta-analysis was also performed.

Results: Twenty trials met the eligibility criteria showed that Tai chi exerted favorable effects on the systolic blood pressure (SBP), diastolic blood pressure (DBP) [SMD = −0.84, 95% CI (−1.18, −0.50)], body mass index [SMD = −0.39, 95% CI (−0.73, −0.06)], waist circumference [SMD = −0.53, 95% CI (−0.74, −0.32)], nitric oxide (NO) content and quality of life of participants compared with no-treatment. Compared with antihypertensive drugs, Tai chi showed favorable effects on SBP, DBP, NO and quality of life of hypertensive patients. Compared with wellness education and walking, Tai chi also showed a reduction on blood pressure.

Conclusion: Although some of the RCTs suggested that Tai chi can be useful in the management of hypertension, further rigorous studies would be required to look into the potential of Tai chi as preventative measure and method of management of hypertension in China.

1. Introduction

Essential hypertension (EH) is a clinical syndrome clinically characterized by systemic elevated arterial pressure; this syndrome remains a major threat to public health [1]. Long-term elevation of arterial pressure can lead to cardio-cerebrovascular diseases, such as myocardial infarction, stroke, and heart failure. Hypertension has become the leading cause of mortality worldwide and has become the third leading cause of adult disability [2]. A large-scale, multi-ethnic epidemiological study among Chinese adults showed that the prevalence rates of prehypertension and hypertension are 29.5% and 36.4%, respectively, in 47,495 participants, suggesting that approximately two-thirds of the population suffer from hypertension or prehypertension [3].

The main therapeutic method for primary hypertension is taking oral antihypertensive drugs regularly. However, patient compliance is poor because of the high cost and different degrees of adverse effects, such as hypokalemia, bronchospasm, and angioedema [4], of long-term medication. Thus, an effective and harmless therapy is required.

Tai chi is a traditional Chinese martial art that promotes health preservation in ancient China. It combines martial arts, dao yin, and meridian theory into an organic whole [5]. Tai chi encompasses holistic traditional Chinese medical theory, which aims to regulate the body's homeostatic mechanisms. JX Li [6] conducted a retrospective study of 2216 participants and found that Tai chi improves the physiological functions (e.g., cardiopulmonary function, immunity, and intelligence) and delays the senescence of participants. Since the first article about Tai chi for high blood pressure was published by the Institute of Sports Medicine of Beijing Medical College in 1959 [7], an increasing number of studies have investigated the effects of Tai chi on essential hypertension. There have been systematic reviews reported that traditional Chinese exercise can reduce systolic blood pressure (SBP) and diastolic blood pressure (DBP) and provided benefits for patients with cardiovascular disease [8]. In addition, Gloria [9] and Ching Lan's

* Corresponding author at: Jingwen Library, Nanjing University of Chinese Medicine, 138 Xianlin Rd, Nanjing 210023, Jiangsu, China.
E-mail addresses: liantcm@126.com (Z. Lian), goodlili@foxmail.com (L. Yang), bianyy@njucm.edu.cn (Y. Bian), zengbingli@163.com (L. Zeng), 1691424330@qq.com (M. Li), 1312287030@qq.com (Y. Sun), njliwl@njucm.edu.cn (W. Li).

http://dx.doi.org/10.1016/j.eujim.2017.05.007
Received 6 January 2017; Received in revised form 23 May 2017; Accepted 24 May 2017

studies [10] reported that Tai chi may improve cardiovascular health and may as an alternative therapy for patients with cardiovascular disease and cardiovascular risk factors.

The number of hypertensive patients in China increases by approximately 10 million yearly [11]. Hypertension was associated with excess mortality significantly and the diagnosis, treatment, and control of hypertension in Chinese populations was inferior to that in Western populations [12]. This study focuses on the solution of this health problem in China and the treatment of adult hypertensive patients. Since the implementation of health care reform, the Chinese government attaches importance to the heritage and development of health preservation of traditional Chinese medicine, and the people also began to keen on health preservation. Given its Chinese origin, Tai chi is highly popular among the Chinese. Tai chi culture, as part of Chinese culture, has been spread widely and deeply rooted in the people's consciousness. Chinese people have been affected by thought of unity of heaven and man and balance of yin and yang for thousands of years. So they may be able to better understand the Tai chi culture and better experienced the essentials, which may lead to better therapeutic effect. Thus, we conducted a systematic review and meta-analysis of the latest published research on the effects of Tai chi on adults with essential hypertension in China.

2. Methods

2.1. Eligibility criteria

2.1.1. Study

Randomized controlled trials (RCTs) were conducted in China, not all of the studies were blinded.

2.1.2. Participants

Adult Chinese with essential hypertension were included in this study. The criteria for essential hypertension were SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg, measured thrice on at least two separate days without antihypertensive drugs, on the basis of *"WHO-ISH guidelines for the management of hypertension (1999)", "Chinese Guidelines for the Management of Hypertension-2005", and "Chinese Guidelines for the Management of Hypertension-2010."* Participants were selected regardless of gender and race.

2.1.3. Intervention

Tai chi alone or in combination with other treatments.

2.1.4. Control

The control group comprised hypertensive patients without Tai chi. The participants in the experimental and control groups were randomized except for the intervention.

2.1.5. Outcome

Primary outcome: systolic blood pressure and diastolic blood pressure. Secondary outcomes: nitric oxide (NO) content, body mass index (BMI), waist circumference (WC) and quality of life.

2.1.6. Exclusion criteria

The reason why we excluded the studies were as follows: 1. Studies focusing on adolescent hypertension. 2. Non-Tai chi studies. 3. Studies without measuring blood pressure as the outcome.

2.2. Search strategy

We searched the following electronic databases: Pubmed, the Cochrane Library, Web of Science, EMBASE, China National Knowledge Infrastructure, Wanfang, and China Biology Medicine disc. We also searched reference lists of papers for further studies. Language was limited to Chinese and English. Databases were retrieved from the earliest data available to October 31st 2016.

We searched terms related to Tai chi (including a Mesh search using 'Tai Ji' and a keyword search using "Tai Ji"; "Taiji"; "Tai chi"; "Taijiquan"; "Tai chi chuan" and "Shadow boxing") and terms related to hypertension (including a Mesh search using "Hypertension" and a keyword search using "high blood pressure" and "blood pressure").

2.3. Study selection and data extraction

Two review authors (Ziyu Lian and Lili Yang) independently screened the literature using predetermined inclusion criteria and extracted data of trials as follows: study design, participant characteristics, intervention and outcome data, adverse effects, and methodological quality. If data were incomplete, we tried to contact authors and ask for detailed research data. We resolved any disagreements about study inclusion extracted data by consensus and consulted a third review author (Yaoyao Bian) if disagreements persisted.

2.4. Risk of bias

We assessed risk of bias according to the evaluation criteria provided by Cochrane Handbook for Systematic Reviews of Interventions [13], examining the random sequence generation, allocation concealment, incomplete outcome data, blinding (participants, personnel, and outcome assessment), selective reporting, and other biases. Two review authors (Ziyu Lian and Lili Yang) independently assessed the risk of bias of the included studies and judged each domain as having a low risk of bias, a high risk of bias, or an unclear risk of bias.

2.5. Statistical analysis

We used Revman 5.3 software provided by the Cochrane Collaboration for data analysis. For continuous variables, we used standardized mean difference and 95% confidence interval (CI) for statistics. We conducted tests of heterogeneity of each outcome using Chi-squared test and I^2 statistic. When no significant heterogeneity was observed ($P > 0.1$ and $I^2 < 50\%$), the fixed-effects model was used to perform meta-analysis. When heterogeneity was detected ($P < 0.1$ and $I^2 \geq 50\%$), the existing heterogeneity was explained. If the heterogeneity could not be explained, we either provided a narrative overview or used a random-effects model with appropriate cautious interpretation. We also performed sensitivity analysis to examine the result stability and performed Egger tests to examine the publication bias.

3. Results

3.1. Literature search

We identified 311 studies after the preliminary search, comprising 163 studies in English and 148 studies in Chinese. No study was obtained from the manual retrieval. After excluding 97 duplicated studies, the remaining 214 studies were identified for their titles and abstracts. Then, we screened 86 studies with full texts. Finally, we included 20 studies according to the inclusion criteria after reading the full texts. The literature screening process and results are shown in Fig. 1.

3.2. Study characteristics

We obtained 20 studies [14–33] involving 1641 participants aged 30–97 years old. The duration of intervention varied from 6 weeks to 1 year. All studies had a consistent baseline and included both male and female subjects. The health status of participants varied between studies; four studies [17,19,22,27] recruited participants with stage I hypertension (140 mmHg ≤ SBP ≤ 159 mmHg and/or 90 mmHg ≤ DBP ≤ 99 mmHg), six studies [18,24,26,29–31] recruited participants with stage I and stage II hypertension (160 mmHg ≤ SBP ≤ 179 mmHg and/or