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Effectiveness of Tai Chi on fibromyalgia patients: A meta-analysis of randomized controlled trials

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ABSTRACT

Objective: To identify empirical evidence on the effectiveness of Tai Chi in treating fibromyalgia (FM).
Method: We conducted a systematic review and meta-analysis of randomized controlled trials (RCTs) to compare the effectiveness of Tai Chi and standard care or conventional therapeutic exercise in patients with FM. PubMed, Medline, and Physiotherapy Evidence Database were searched for relevant studies published before May 2019. Treatment effectiveness was evaluated using the fibromyalgia impact questionnaire (FIQ), and the total score, pain score, sleep quality index, fatigue, depression, and quality of life were assessing among the patients.
Results: Six RCTs with 657 patients were included. Results of our meta-analysis indicated that Tai Chi exerts significant positive effects on reducing the total FIQ score at 12–16 weeks (standard mean difference [SMD]: −0.61; 95% confidence interval [CI]: −0.90 to −0.31) and pain score (SMD: −0.88; 95% CI: −1.58 to −0.18), improving sleep quality (SMD: −0.57; 95% CI: −0.86 to −0.28), relieving fatigue (SMD: −0.92; 95% CI: −1.81 to −0.04), alleviating depression (SMD: −0.49; 95% CI: −0.97 to −0.01), and enhancing quality of life physically (SMD: 6.21; 95% CI: 3.18–9.24) and psychologically (SMD: 5.15; 95% CI: 1.50–8.81).
Conclusion: Tai Chi exerts significantly greater effects on patients with FM than standard care; therefore, we suggest that Tai Chi can be used as an alternative treatment. However, more large-scale, high-quality, and multicenter trials are required to provide stronger evidence on the effectiveness of Tai Chi, as an alternative to aerobic exercise, compared with conventional therapeutic exercise.

1. Introduction

Fibromyalgia (FM) is a medical condition characterized by chronic widespread musculoskeletal pain, fatigue, non-refreshed sleep, mood disturbance, and cognitive impairment.[1] It affects 2%–4% of the general population, and causes a substantial societal burden because it entails high medical expenditure.[2,3] The etiology of FM remain unclear; however, it is considered as a disorder of pain regulation related to neuroendocrinological changes in the central and peripheral nervous systems.[4]

Treating FM is challenging because its mechanism remains unclear. Universal guideline recommends that the combination of pharmacological and nonpharmacological interventions as initial treatment may achieve favorable outcomes.[5] Current drug interventions such as analgesics, anticonvulsants, and antidepressants provide short-term benefits for FM symptoms; however, recent reviews have debated the clinical effectiveness of such drug interventions because of the side effects and inefficacy.[6–8] Among nonpharmacological interventions,

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conventional therapeutic exercise is one of the recommended strategies, it includes aerobic training, coordination training, flexibility exercises, relaxation techniques, and muscle-strengthening exercises.[9] However, patients have difficulty in performing conventional exercise program because of their poor muscle strength and limited flexibility and thus experience worse pain and poor self-efficacy.[10,11] In recent decades, exercise involving mind and body components has been proven to be effective in alleviating FM symptoms.[12]

Tai Chi is a traditional Chinese exercise that integrates body and mind. It includes breathing control, slow movements, mental relaxation, and meditation. Originating in martial art, the principle of Tai Chi is the appropriate distribution of internal energy, termed "qi," throughout the body. With the harmony of "qi" flowing smoothly and powerfully within the body, people can cultivate both physical and mental health.[13,14] Advances in neural technology have also revealed the effects of Tai Chi on anatomical morphologies and neurological activities in brain.[15]

Recently, exploratory research has increasingly suggested Tai Chi as a safe exercise to support muscular strength, improve quality of life (QoL), relieve musculoskeletal pain, and alleviate other FM-related syndromes.[16–18] However, the treatment efficacy of Tai Chi for FM remains inconclusive. Therefore, we performed a meta-analysis of randomized controlled trials (RCTs) to compare the effectiveness of Tai Chi with standard care or conventional therapeutic exercise in FM management.

2. Materials and methods

2.1. Inclusion criteria

Peer-reviewed RCTs that investigated the effects of Tai Chi among FM patients were included. The inclusion criteria of RCTs selected were as follows: (1) patients diagnosed with FM on the basis of the American College of Rheumatology 1990 and criteria; (2) Tai Chi exercise as the main intervention in the study; (3) outcomes including at least one item of fibromyalgia impact questionnaire (FIQ), such as measurement of pain, sleep quality, and depression.[2,3] We excluded studies that met one or more of the following criteria: (1) before-after studies and (2) duplicate reporting of patient cohorts.

2.2. Search strategy and study selection

Relevant trials published before May 2019 were identified from the databases of PubMed, Medline, and Physiotherapy Evidence Database. The following keywords were used in the database search: (*Tai Chi* OR *Tai Ji* OR *Tai Ji Quan* OR *Tai Ji Chuan* OR *Taiji.mp*) and (*fibromyalgia*). The "related articles" option in PubMed was used to broaden the search, and all abstracts, studies, and citations thus retrieved were reviewed. No language restrictions were applied. The systematic review described herein has been accepted by PROSPERO (CRD42018107149).

2.3. Data extraction

Baseline and outcome data were independently retrieved by two authors (CAC and SNC). Moreover, data on study designs, sample size, subject characteristics, inclusion and exclusion criteria, treatment duration and frequency, outcomes assessed, and assessment time points were extracted. Decisions recorded individually by the authors were compared, and disagreements were resolved by another reviewer (KWT).

2.4. Appraisal of methodological quality

Two authors (CAC and SNC) independently assessed the methodological quality of each study by using the Cochrane risk of bias tool (RoB 2.0).[19] Studies were awarded an overall risk of bias grades of high, some, and low. This grade was calculated by assessing five domains: bias arising from the randomization process; bias owing to deviations from intended interventions; bias owing to missing outcome data; bias in measurement of the outcome; and bias in selection of the reported results.

2.5. Outcomes

The primary outcomes were total FIQ score. The secondary outcomes were pain score, sleep quality index, fatigue, depression, and QoL.

2.6. Statistical analyses

Data were analyzed using Review Manager 5.3 (The Cochrane Collaboration, Oxford, England). A meta-analysis was performed following the Preferred Reporting Items for Systematic Review and Meta-Analyses guidelines.[20] Standard deviations (SDs) were estimated using the following: (1) the provided confidence interval (CI) limits or standard errors or (2) the provided SD of preintervention and postintervention data by using the formula for the pooled SD in the paired *t* test, taking the correlation coefficient as 0.5. The effect sizes of the continuous outcomes were reported as the weighted mean difference (MD) or standardized mean difference (SMD). The precision of the effect sizes was reported at 95% CI. A pooled estimate of the weighted MDs and SMDs was computed using the DerSimonian and Laird random-effects model.[21] A statistically significant result was indicated by a P value of < 0.05 or 95% CI not including zero in weighted MD or SMD.

Statistical heterogeneity and the inconsistency of treatment effects across studies were evaluated using Cochrane Q tests and I^2 statistics, respectively. Statistical significance was set at $P < 0.10$ for Cochrane Q tests. Statistical heterogeneity across studies was assessed using the I^2 test, which quantifies the proportion of the total outcome variability across studies.

3. Results

3.1. Trial characteristics

Fig. 1 illustrates the flowchart of the study screening and selection process. The initial screen yielded 49 citations, of which 36 were ineligible based on the criteria used for screening titles and abstracts. Thus, the full text of 13 studies was retrieved. However, two studies featured repeated content, and five designed as before-after studies. Thus, six trials were eligible for inclusion in this meta-analysis.[22–27]

All trials were published between 2006 and 2018 and included a total of 657 patients. Five trials investigated Tai Chi and standard care,[22–25,27] and one compared Tai Chi and conventional therapeutic exercise.[26] Three trials recruited patients in the United States of America,[23,25,26] one in Italy,[24] one in the United Kingdom,[23] and one in Korea.[27] All patients were diagnosed with FM on the basis of the 1990 ACR criteria. However, the duration of FM symptoms differed slightly among trials; in three trials, durations were less than 10 years, and in the others, durations were more than 10 years.

Tai Chi intervention groups of four trials used the Yang style program,[23,25–27] whereas Hammond et al.[22] used the Tai Chi for Arthritis Programme intermittently in a mixture of cognitive behavioural therapy with education, including theoretical causes of FM, physiological basis of symptoms, the cycle of FM symptom perpetuation, et cetera, and exercise including postural training, stretch, and strengthening exercises using light weights, and Maddali et al.[24] just described its Tai Chi process in the context. The duration of Tai Chi ranged from 10 to 16 weeks, except in Wang et al.,[26] which contained two subgroups: 12 weeks (T1 + T2) and 24 weeks (T3 + T4). Baseline patient characteristics in the six trials are shown in Table 1.

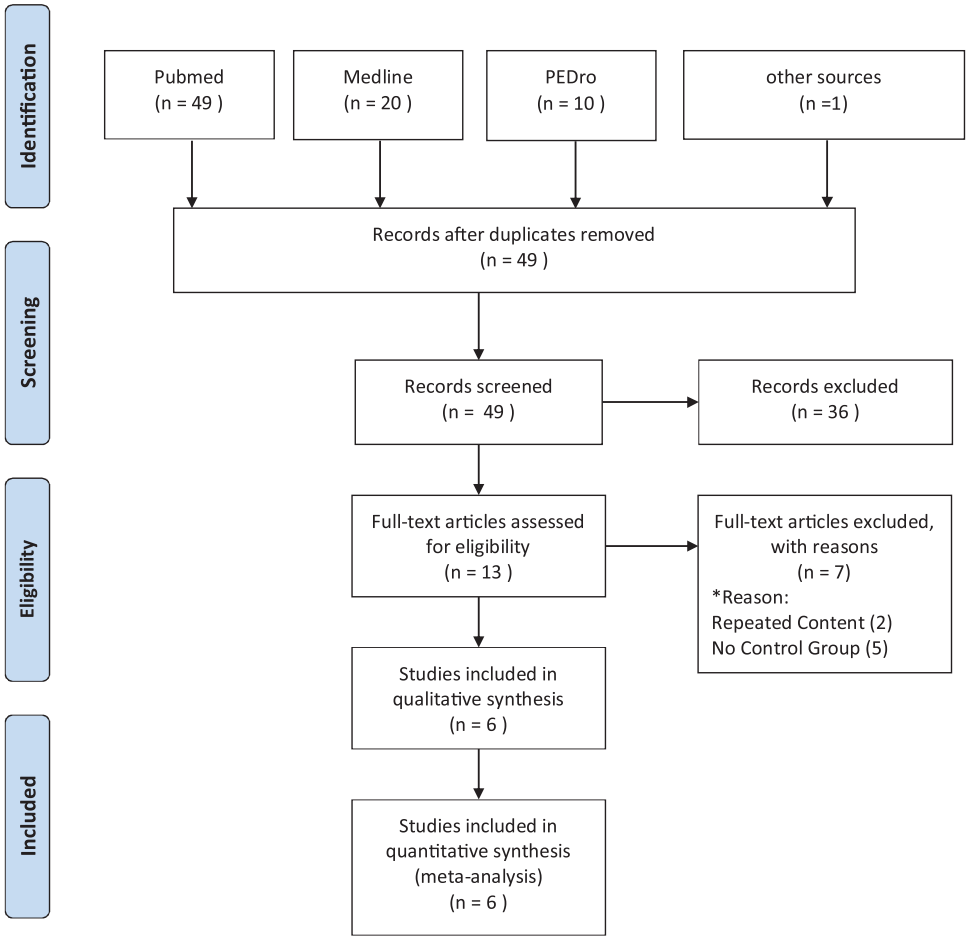

Fig. 1. Flowchart of study selection.

The methodological quality of the included trials is summarized in Table 2. All trials were described as RCTs, or it was stated that random participant allocation to the treatment group had been implemented.[22–27] We categorized all trials as exhibiting some risk of bias arising from the intended intervention because of the lack of sham Tai Chi to offer an objective performance measure. Two trials were ranked as having high risk of attrition bias because of their high percentage of loss to follow-up (> 20%). All trials conducted per-protocol analysis.

3.2. Tai Chi versus standard care

3.2.1. Total FIQ score

Four trials evaluated the total FIQ score among patients in the Tai Chi and control groups.[22–25] FIQ evaluates specific FM disability by using 10 items (each scored on a scale of 0–10) that investigate the problems that patients may experience every day,[28] except in the study by Hammond et al.,[22] in which FM disability was evaluated using eight subscales. The total score ranges from 0 to 100 (or from 0 to 80),[22] with a lower score denoting higher function and fewer symptoms. Therefore, to pool data, we scaled up the range from [0, 80] to [0, 100]. Moreover, four trials assessed the score at 12–16 weeks after Tai Chi intervention,[22–25] and two of these conducted follow-up until 24–32 weeks;[22,25] therefore, we divided these trials into two subgroups. Our pooling result revealed that Tai Chi could significantly reduce the total FIQ score at 12–16 weeks compared with standard care (SMD: −0.61; 95% CI: −0.90 to −0.31). However, the difference between both groups was not statistically significant at 24–32 weeks (SMD: −0.49; 95% CI: −1.56 to 0.58) (Fig. 2).

3.2.2. Pain score

Three trials compared the pain score between the Tai Chi and control groups.[23,25,27] Two trials measured pain severity by using a 10-point visual analog scale (VAS),[25,27] and the other trial measured pain severity by using a 10-point brief pain inventory short form.[25] The overall effect of Tai Chi on relieving pain at 12–16 weeks was significantly different (SMD: −0.88; 95% CI: −1.58 to −0.18) (Fig. 3).

3.2.3. Sleep quality

Three trials assessed sleep quality using the 21-point Pittsburgh Sleep Quality Index (PSQI) between the Tai Chi and control groups.[23–25] Lower scores on PSQI indicate a more favorable sleep condition. An analysis of the Tai Chi group versus the control group revealed significant differences in improvement of sleep quality in 12–16 weeks (SMD: −0.57; 95% CI: −0.86 to −0.28) (Fig. 4).

3.2.4. Fatigue

Fatigue were assessed in three trials.[22,24,27] Hammond et al.[22] reported fatigue using a 10-point FIQ-fatigue subscale; Maddali et al.[24] used a 52-point Functional Assessment of Chronic Illness-Fatigue (FACIT-F); and Wong et al.[27] used a 10-point VAS. Lower scores on these scales indicate lower fatigue. Consequently, FACIT-F was converted into a 10-point scale for data analysis. We observed that Tai Chi had a significant effect on relieving FM patients' fatigue compared with standard care (SMD: −0.92; 95% CI: −1.81 to −0.04) (Fig. 5).

3.2.5. Depression

Depression were evaluated in three trials.[22,24,25] Hammond et al.[22] measured depression by using a 10-point FIQ-depression scale; Maddali

Table 1
Characteristics of the included RCTs.

Author [Year]	Inclusion criteria	No. of patients, female %	Age, mean (SD)	FIQ, mean (SD)	Years with symptons, mean (SD)	Intervention
Tai Chi vs Conventional therapeutic exercise						
Wang [2018]	Age ≥ 21 years; diagnosed as having fibromyalgia on the basis of 1990 and 2010 ACR criteria	T1: 39, 84.6% T2: 37, 81.1% T3: 39, 97.4% T4: 36, 100% C: 75, 96%	T1: 53.0 (12.6) T2: 52.1 (10.3) T3: 50.8 (11.8) T4: 52.1 (13.3) C: 50.9 (12.5)	T1: 52.4 (18.7)* T2: 53.8 (23.3)* T3: 56.5 (15.5)* T4: 60.4 (17.8)* C: 57.3 (20.3)*	T1: 11.1 (8.8) T2: 12.6 (12.1) T3: 12.0 (8.3) T4: 13.8 (10.4) C: 11.3 (8.7)	T1: 60 min x 1 session x 12 week T2: 60 min x 2 sessions x 12 week T3: 60 min x 1 session x 24 week T4: 60 min x 2 sessions x 24 week Yang style program C: 60 min x 2 sessions x 24 week; choreographed aerobic training
Tai Chi vs Standard care						
Hammond [2006]	Age ≥18 years; diagnosed as having fibromyalgia on the basis of 1990 ACR criteria	T: 97, 91.2% S: 86, 87.3%	T: 48.36 (10.91) S: 48.73 (10.95)	T: 56.96 (12.51)# S: 52.55 (12.52)#	T: 6.84 (5.33) S: 6.09 (4.46)	T: 120 min x 1 course x 10 week; education-exercise: Tai Chi for arthritis program(15-45 min) S: 60 min x 1 course x 10 week; relaxation course
Jones [2012]	Age ≥40 years; diagnosed as having fibromyalgia on the basis of 1990 ACR criteria	T: 51, 92.1% S: 50, 93.6%	T: 53.3 (NA) S: 54.8 (NA)	T: 64.1 S: 63.6	T: 17.0 S: 19.8	T: 90 min x 2 sessions x 12 weeks; 8-form Yang style program S: 90 min x 2 courses x 12 week; education about fibromyalgia
Maddali [2016]	Diagnosed as having fibromyalgia on the basis of 1990 ACR criteria	T: 22, NA S: 22, NA	T: 50.36 (13.68) S: 54.30 (10.65)	T: 54.33 (14.61) S: 46.39 (14.46)	T: 9.77 S: 9.45	T: 60 min x 2 sessions x 16 week; Tai Ji Quan exercise S: 2 courses x 16 week; education about fibromyalgia
Wang [2010]	Age ≥ 21 years; diagnosed as having fibromyalgia on the basis of 1990 and 20101 ACR criteria	T: 33, 85% S: 33, 88%	T: 49.7 (11.8) S: 50.5 (10.5)	T: 62.9 (15.5) S: 68.0 (11.0)	T: 11.8 (6.9) S: 10.0 (7.2)	T: 60 min x 2 sessions x 12 week; 10-form Yang style program S: 60 min x 2 courses x 12 week; wellness education and stretching course
Wong [2017]	Diagnosed as having fibromyalgia on the basis of 1990 ACR criteria	T: 18, 100% S: 19, 100%	T: 51 (2) S: 51 (2)	NA	T: 8 (1) S: 9 (1)	T: 55 min x 3 sessions x 12 week; 10-form Yang style program S: no intervention

Values are presented as mean (standard deviation).
T, Tai Chi group; C, conventional therapeutic exercise group; S, standard care group; ACR, American College of Rheumatology; FIQ, Fibromyalgia Impact Questionnaire, with total score ranges from 0 to 100, except # ranges from 0 to 80.
*Revised FIQ used.

Table 2
Methodological quality assessment of included trials.

Study [year]	Hammond [2006]	Jones [2012]	Maddali [2016]	Wang [2010]	Wang [2018]	Wong [2017]
Bias arising from the randomization process	Low risk	Low risk	Some concerns[1]	Low risk	Low risk	Low risk
Bias due to deviations from intended interventions	Some concerns[2,3]	Some concerns[2]	Some concerns[2]	Some concerns[2]	Some concerns[2]	Some concerns[2]
Bias due to missing outcome data	High risk[4]	Low risk	Low risk	Low risk	High risk[4]	Low risk
Bias in measurement of the outcome	Some concerns[5]	Low risk	Low risk	Low risk	Low risk	Some concerns[5]
Bias in selection of the reported result	Low risk	Some concerns[6]	Low risk	Low risk	Low risk	Some concerns[7]
Overall risk of bias	Some concerns	Some concerns	Low risk	Low risk	Some concerns	Low risk

Methodological quality was assessed using the Cochrane risk of bias tool (RoB 2.0).
[1] Lack of randomization method.
[2] Lack of sham Tai Chi to conduct a double-blind trial.
[3] Not only Tai Chi but community education as the independent variable.
[4] Over 25% participants loss to follow up.
[5] Study without mentioning outcome assessor blinding.
[6] Some result data remained controversial; for example. one 95% confidence interval did not contain the mean value.
[7] Lack of baseline FIQ or FIQR assessment.

et al.[24] used a 21-point Hospital Anxiety and Depression Scale (HADS); and Wang et al.[25] used a 60-point Center for Epidemiologic Studies Depression (CES-D). Higher scores on these scales indicate more severe depression. As a result, we converted HADS and CES-D into 10-point scales. A significant difference was observed between the Tai Chi group and the control group; Tai Chi was more effective in alleviating depression in the patients (SMD: −0.49; 95% CI: −0.97 to −0.01) (Fig. 5).

3.2.6. Quality of life

QoL were investigated in two trials by using the Medical Outcomes Survey Short Form-36 (SF-36) questionnaire.[24,25] This self-report questionnaire includes the summary physical index (SPI) and summary mental index (SMI), each scored from 0 to 100, with higher scores corresponding to higher QoL. The pooled mean changes in SPI and SMI scores were 6.21 (95% CI: 3.18 to 9.24) and 5.15 (95% CI: 1.50 to 8.81), respectively, which indicated a significant difference in QoL measures between the Tai Chi and control groups (Fig. 6).

3.3. Tai Chi versus conventional therapeutic exercise

Only one trial compared the outcomes of Tai Chi and conventional therapeutic exercise.[26] The trial reported that compared with aerobics, Tai Chi was as effective as or more effective in managing FM. Primary outcomes included the revised total FIQ score (FIQR),[29] and secondary outcomes included VAS-pain, HADS, SF-36, and arthritis self-efficacy scale (ASES) scores, which were measured at baseline and at 12, 24, and 52 weeks. ASES scores range from 1 to 10, with higher scores denoting higher self-efficacy for FM pain management.[30]

The Tai Chi groups exhibited significantly greater improvement than conventional therapeutic exercise groups based on the FIQR scores at 24 weeks (mean change: 5.5; 95% CI: 0.6–10.4). Moreover, VAS-pain (mean change: 0.9; 95% CI: 0.3–1.4), HADS-anxiety (mean change: 1.2; 95% CI: 0.3–2.1), ASES (mean change: 1.0; 95% CI: 0.5–1.6), and coping strategies (mean change: 2.6; 95% CI: 0.8–4.3), which changed significantly between the Tai Chi and conventional therapeutic exercise groups.

Compared with the 12-week (T1 + T2) Tai Chi intervention groups, outcomes measured at 24 weeks, such as FIQR (mean change: 9.6; 95% CI: 2.6–16.6), HADS-depression (mean change: 1.4; 95% CI: 0.1, 2.6), and SF-36-mental component (mean change: 4.4; 95% CI: 0.8, 8.1), were significantly enhanced in the 24-week (T3 + T4) Tai Chi intervention groups. This evidence indicated that a longer duration of Tai Chi potentially causes greater benefits in FM patients. However, the study revealed no significant increase in FM symptom relief among groups that attended Tai Chi sessions twice a week (T2 + T4) compared with those that attended the sessions once a week (T1 + T3).

4. Discussion

Our meta-analysis revealed that Tai Chi exerted significantly greater effects on patients with FM by reducing the total FIQ score, reducing the pain score, improving sleep quality, relieving fatigue and depression, and enhancing QoL than standard care or conventional

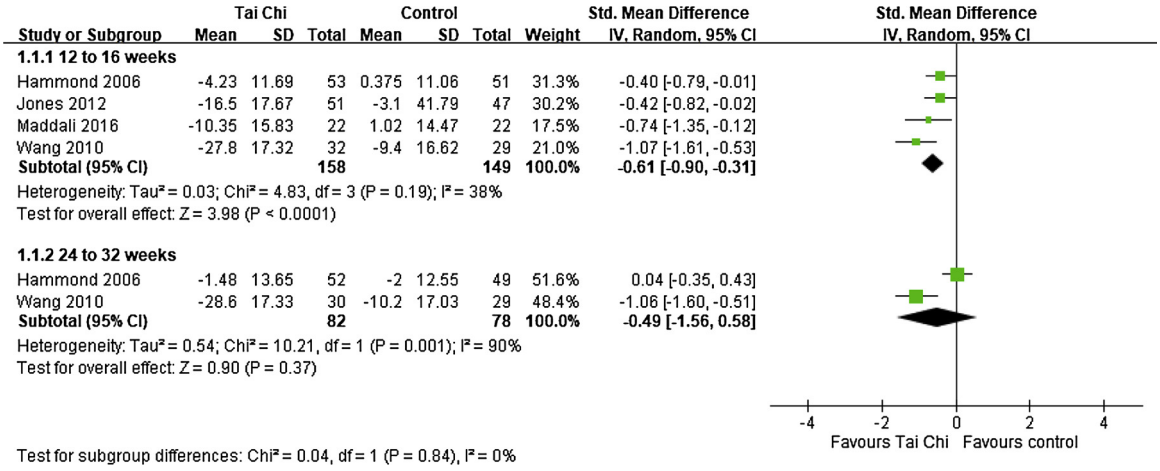

Fig. 2. Forest plot of comparison: Tai Chi vs. standard care; outcome: FIQ change.

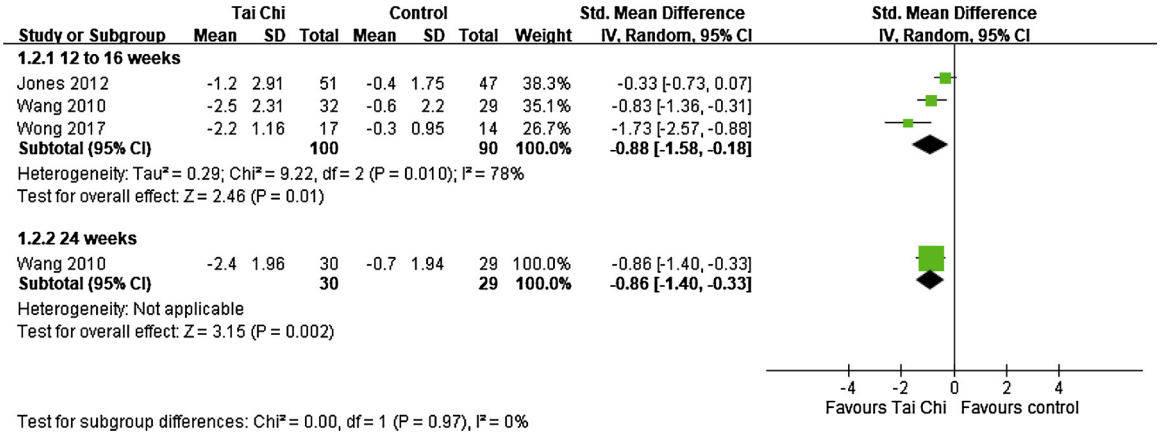

Fig. 3. Forest plot of comparison: Tai Chi vs. standard care; outcome: pain score change.

therapeutic exercise. We found significant differences between the Tai Chi and control groups in all outcomes, except the total FIQ score at 24–32 weeks. This finding may be attributed to the short Tai Chi intervention duration but a longer follow-up time in this subgroup. For example, participants in one trial received only 10 weeks of Tai Chi intervention but were assessed at 16 and 32 weeks.[22] This finding indicated that more studies should further analyze the lasting beneficial effects of Tai Chi.

Our results are consistent with those of studies that have evaluated the benefits of Tai Chi for chronic musculoskeletal pain control, physical and psychological health, and QoL.[30–32] In a pilot study with one group pre-to-post posttest design, Tai Chi significantly improved symptoms in FM patients.[33] Another multiple-patient case report that included only male FM patients revealed positive changes in the total FIQ score and lower body flexibility. Studies have indicated that Tai Chi is potentially beneficial to patients with FM, and the present study is the first meta-analysis on the beneficial effects Tai Chi treatment on FM that included only RCTs.

The duration of symptoms among patients varied in the baseline. In Jones et al.,[23] the mean symptom duration was longer than 15 years, and the duration was approximately 6–11 years in other trials. The different durations of symptom might affect the baseline of the patients' severity of illness and mental condition; thus, subjectively graded results might be affected. Jones et al.[23] reported a worse outcome for the total FIQ score and pain score compared with the other trials. Although symptom duration did not greatly influence our study results, its effect is noteworthy.

The efficacy of Tai Chi in terms of dosage, frequency, and overall duration in patients with FM remains unclear. Tai Chi intervention was frequently practiced in 1-h sessions 1–3 times weekly for 12 weeks.[34] Four included RCTs had similar Tai Chi frequency and duration; each session lasted nearly 1 h.[24–27] However, Jones et al.[23] implemented sessions lasting 90 min, and Hammond et al. gradually increased Tai Chi sessions from 15 to 45 min weekly. Moreover, Hammond et al.[22] applied not only Tai Chi but other mild exercise programs like stretching and community education strategies in the experimental group. Our meta-analysis revealed no significant difference in fatigue and depression in Hammond et al.[22] between groups, which possibly corresponded to the lower frequency and duration of Tai Chi and indicated that the combination of Tai Chi and community education was unnecessary.

Among the included RCTs, only Wang 2018 et al. discussed the influence of different frequencies and durations of Tai Chi on FM patients.[26] Wang 2018 et al. suggested longer durations of Tai Chi intervention (24 weeks) had greater efficacy of FM treatment than shorter durations (12 weeks), whereas the frequency of Tai Chi was not the key variable.[26] To obtain further evidence, more high-quality trials comparing different frequencies and durations of Tai Chi intervention are required.

In most of the included RCTs, in addition to imparting unified Tai Chi training to FM patients, the patients were also encouraged to keep practicing Tai Chi at home by themselves. Despite speculations about whether the participants actually practiced Tai Chi at home, our meta-analysis still showed a significant difference in FIQ total scores, pain scores and QoL between the Tai Chi and control groups. This finding denoted that Tai Chi intervention provided by professional trainers was sufficient for improving FM patients' health.

The design of the control group in the included RCTs slightly differed. Four trials used pure FM education as control,[23–26] whereas Hammond et al.[22] used relaxation training and Wong et al.[27] just asked participants in the control group to maintain regular lifestyle habits, and the controls did not receive any therapeutic effect or benefit. In our

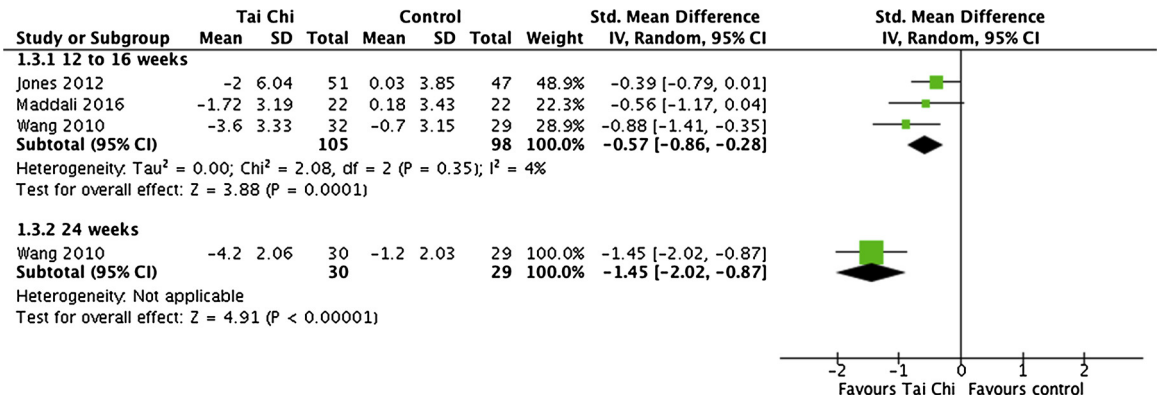

Fig. 4. Forest plot of comparison: Tai Chi vs. standard care; outcome: sleep quality change.

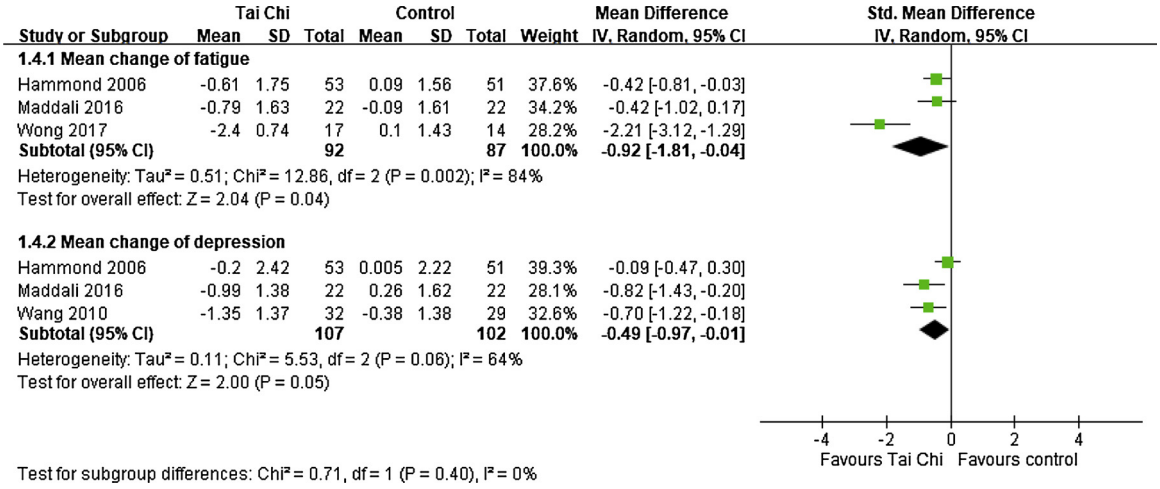

Fig. 5. Forest plot of comparison: Tai Chi vs. standard care; outcome: mental change at 12–16 weeks.

meta-analysis, the pain score was more apparently significantly reduced between the Tai Chi and control groups in the study by Wong et al.[27] than in other RCTs, which possibly resulted from the original large difference between its intervention and control groups.

Many different Tai Chi styles (e.g., Chen, Yang, Wu/Hao, Wu, and Sun) are practiced in modern society. The most popular Tai Chi style is the 24-form Yang style.[34,35] In our systematic review, four RCTs selected the Yang style Tai Chi as the intervention.[23,25–27]

Among them, Wang et al.[25] and Wong et al.[27] selected 10 forms and Jones et al. selected 8 forms, but no standard criteria for form selection were provided. Furthermore, two included trials with no accurate style of Tai Chi still showed that Tai Chi exerted overall potential effects on relieving FM symptoms.[22,24] The pros and cons of different Tai Chi styles and the number of Tai Chi forms in the treatment of patients with FM remains uncertain, but all Tai Chi styles appeared to be effective to some extent.

Aerobic exercise is one of the most essential nonpharmacological initial treatments for FM in clinical practice.[5] Pain and fatigue involved in FM causes difficulty in performing a sufficient level of low-impact aerobic exercise among patients, which induces a symptom flare and worsens the prognosis of patients with FM. Thus, mind-and-body exercises such as Tai Chi has been explored as an alternative therapeutic exercise in this decade. In our included RCTs, Wang et al.[26] denoted that Tai Chi treatment resulted in similar or even higher improvement level compared with aerobic exercise. As a result, FM patients who require an alternative to aerobic exercise may consider Tai Chi.[36] However, due to the insufficient number of trials comparing Tai Chi and conventional therapeutic exercises, we are unable to definitively conclude that Tai Chi is more effective than therapeutic exercise.

The number of dropouts before and after interventions in the included trials was a concern. In studies by Hammond et al.[22] and Wang et al.,[26] > 20% participants were lost to follow-up. Hammond et al.[22] stated that reasons were usually practical constraints, particularly being too fatigued to attend courses at a local recreation center. In addition, Wang et al.[26] suggested that loss to follow-up is higher among those with worse previous outcomes and is correlated with several other factors. Furthermore, patient compliance is a crucial factor. Attendance of participants in the Tai Chi and control groups during intervention was not fully elucidated in the included trial, except by Wang et al.[26] Several participants missed classes, and the days of absence differed in either the intervention or control groups, mostly due to personal reasons of the patients. These may potentially influence results of these trials.

The trials included in our meta-analysis exhibited heterogeneity, which should be considered when deriving a conclusion from our analysis. This heterogeneity is primarily caused by the difference in the baseline values of patients' condition, moderate intervention difference between the Tai Chi and control groups, and varying follow-up durations. In addition, the inconsistent forms of FIQs used in our selected trials might have also affected the results. Such differences resulted in heterogeneity among RCTs.

This study had several limitations. First, the sample size of the included RCTs was small. The sex ratio of our sample was not balanced because the FM has a female predominance. Second, performing a double-blind trial on physiotherapy interventions such as Tai Chi or other exercises was impossible. Thus, participants in the Tai Chi group

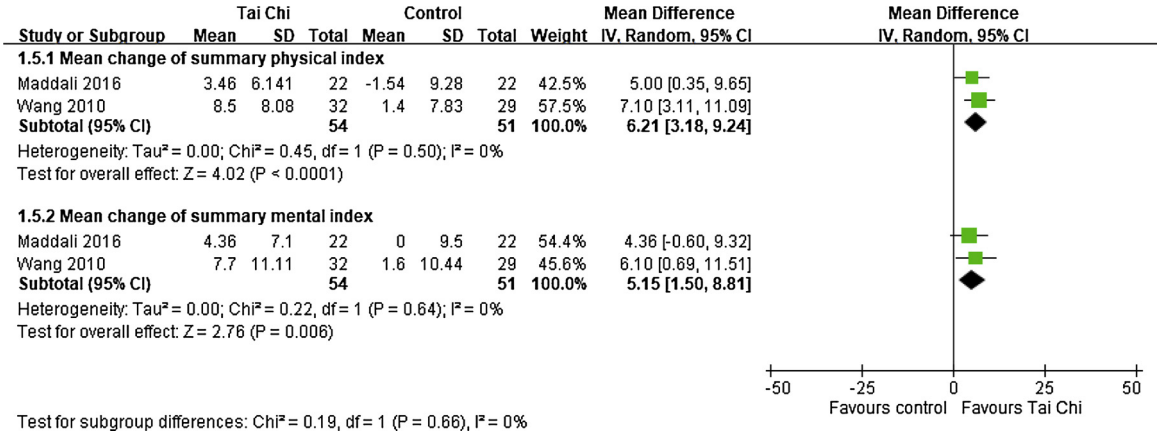

Fig. 6. Forest plot of comparison: Tai Chi vs. standard care; outcome: quality of life change at 12–16 weeks.

had higher expectations, which might have had placebo effects and affected the results.[26] Last, the outcome measurements were mostly assessed subjectively by using questionnaires. These assessments varied individually and possibly had an effect on outcomes.

In conclusion, Tai Chi was significantly effective in the management of FM-related syndromes, such as pain, sleep, depression, and fatigue, and consequently reduced the total FIQ score. This review recommends Tai Chi as an alternative to standard care for FM patients. Further conclusions regarding the effectiveness of Tai Chi compared with conventional therapeutic exercises such as aerobic exercise cannot be firmly drawn due to limited evidence.

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