

Tai Chi: a new star for the administration of chronic diseases?

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Highlights

The current evidences regarding the effects of Tai Chi on the cardiovascular system, respiratory system, nervous system, musculoskeletal disorders, rheumatism, and cancer were summarized.

Editor's Summary

Tai Chi integrates deep diaphragmatic breathing with body movements to achieve a harmonious balance between the body and mind.



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Abstract

Tai Chi Quan (Tai Chi), a traditional Chinese martial art, has become increasingly popular in western countries. Tai Chi integrates deep diaphragmatic breathing with body movements to achieve a harmonious balance between the body and mind, which facilitates the flow of internal energy (Qi). An increasing number of studies have reported that Tai Chi significantly benefits aerobic capacity, muscular strength, balance, and psychological well-being. In addition, Tai Chi offers unique advantages for physical fitness and the treatment of chronic diseases. This paper reviews the existing literatures on Tai Chi, introduces its health-promotion effects and the potential clinical applications, and summarizes recent studies that prove Tai Chi is safe and effective for patients with neurological diseases, rheumatological diseases, musculoskeletal diseases, cardiovascular diseases, chronic obstructive pulmonary diseases, and cancers. After reviewing the literatures in this field, we conclude that the long-term results of practicing Tai Chi may benefit the cardiovascular system, motor system, respiratory system, and nervous system. However, the potential role and mechanism of Tai Chi has not yet been determined. Further studies with long follow-up periods are necessary to meet the standards of clinical applications.

Keywords: Tai Chi, Health, Rehabilitation, Chronic diseases

摘要

太极是中国传统武术的一种，不仅在中国很受欢迎，在西方国家也逐渐被关注。太极将腹式呼吸与身体运动相整合，以使人达到身心平衡。越来越多的研究证实，太极具有提高有氧耐力、加强肌肉力量、促进身体平衡和改善心理健康的作用。在此，本文总结了最近的研究成果，证明太极训练在心血管疾病、慢性阻塞性肺病、神经系统疾病、风湿病和癌症患者的恢复过程中是安全可行的。然而，太极的潜在作用机制仍有待挖掘，更多的长期随访研究需要开展。

关键词: 太极；健康；康复；慢性疾病

Abbreviations: QOL, Quality of life; CHD, Coronary heart disease; COPD, Chronic obstructive pulmonary disease; OA, Osteoarthritis; RA, Rheumatoid arthritis.

Competing interests: The authors declare that there is no conflict of interests regarding the publication of this paper.

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Background

Tai Chi Quan (Tai Chi) is an ancient Chinese martial art involving the concepts of Yin and Yang, which was originally devised in the Song Dynasty (906 A.D. - 1279 A.D.) by San-Feng Zhang, and originally created for fighting [1-3]. Over time, Tai Chi has developed into multi-element movement forms. All styles of Tai Chi are composed of slow, gentle movements and actions including stretching, balance, posture adjustment, concentration, relaxation, and breathing control, which can be practiced by people of all ages [1]. Therefore, Tai Chi has become increasingly popular in western society in recent years, especially among the elderly. During Tai Chi, deep diaphragmatic breathing is integrated into body movement to achieve the harmony of physical and mental balance and increase internal energy (Qi) in the body [1]. Participants may choose a full set of Tai Chi or individual actions according to their needs. Previous studies have confirmed that Tai Chi has a vital effect on health promotion. Regular Tai Chi practice can improve aerobic capacity, reduce blood lipid levels, regulate heart rate, increase lung capacity, improve balance, and improve health-related quality of life (QOL) and mental health. Recent studies have also shown that Tai Chi is safe and effective for people with neurological diseases such as stroke and Parkinson's disease, rheumatoid diseases such as rheumatoid arthritis and multiple sclerosis, orthopedic diseases such as osteoarthritis and lumbar pain, cardiovascular diseases such as hypertension, coronary artery bypass surgery, heart failure, chronic obstructive pulmonary disease (COPD), and postoperative rehabilitation of cancer [2, 4 - 11]. Tai Chi is a moderate exercise. It causes no hypoxia or injuries to the human body, but can fulfill the human body's exercise requirements and is suitable for implementation in the community. The evidence below will inform health-care practitioners of important considerations when prescribing Tai Chi to people with multiple morbidities, especially older adult patients.

The effects of Tai Chi on the cardiovascular system

Reduction of cardiovascular risk factors

Adherence to Tai Chi can regulate lipid metabolism and microcirculation and adjust the heart rate, which can strengthen the protection of the cardiovascular system mechanism. Jen-Chen *et al.* found that after 12 weeks of Tai Chi training, total serum cholesterol levels in the treatment group decreased by 15.2mg/dL and high-density lipoprotein cholesterol levels increased by 4.7mg/dL [12]. In a study by Pan *et al.*, the Tai Chi group showed a lower level of blood triglycerides in follow-up and baseline than the control group [13]. In another study, Wang *et al.* found higher skin blood flow, higher cutaneous vascular conductance, and higher skin temperature at both rest and during exercise in geriatric Tai Chi practitioners than in sedentary men matched for

age and body size [14]. As Tai Chi is an aerobic exercise of moderate intensity, it may adjust heart rate, reduce resting blood pressure, and improve the exercise capacity of individuals who regularly practice. Zheng *et al.* compared Tai Chi exercise with non-intervention in 20 studies that included 1783 healthy adults. They showed that Tai Chi might significantly improve cardiovascular efficiency by reducing resting blood pressure (systolic pressure: standard mean difference = -0.93, diastolic blood pressure: standard mean difference = -0.94) and resting heart rate, and improve the stroke volume and output (mean difference = 0.32L/min) [15].

Rehabilitation effects in patients with cardiovascular disease

Physical inactivity is a major modifiable lifestyle risk factor for cardiovascular disease. A variety of cardiopulmonary fitness indicators have been examined for Tai Chi, and researches have demonstrated that Tai Chi has beneficial effects for patients with heart disease [16]. Pan *et al.* suggested that Tai Chi might improve the QOL of patients with coronary heart disease (CHD) and could be considered for inclusion in cardiac rehabilitation programs [10]. Chang *et al.* conducted a six-month cardiac rehabilitation program using Tai Chi that included 54 patients with CHD. They reported that patients had improved peak RPP (heart rate-blood pressure product) and RPP reserve during exercise testing. The results of these studies suggest that a Tai Chi exercise program may result in improving prognosis for cardiac events in patients with CHD [17].

The effects of Tai Chi on the respiratory system

Increasing lung capacity and improving gas exchange capacity

The exercise intensity of Tai Chi, height of the postures, and the duration can improve the overall aerobic capacity. Lan *et al.* showed that at peak, the Tai Chi group showed a 19% higher oxygen intake (VO₂ peak) compared with sedentary people [18]. Ngai *et al.* concluded that the 6-min walking distance of the Tai Chi group and the first second forced expiratory volume improved compared to the control group [11]. Hirley *et al.* analyzed 12 studies that included 984 participants and found that Tai Chi plus ordinary care subjects also showed a longer 6-min walking distance and improved lung function compared to control subjects [19]. Song *et al.* studied 180 elderly men who did not exercise regularly and found that with prolonged exercise, Tai Chi significantly improved the respiratory system (vital capacity increased from 2.84±0.32L to 3.57±1.39L, maximum minute ventilation improved from 97.26±14.71L/min to 117.25±14.86L/min) [20].

Rehabilitation effects in respiratory disease

People with COPD frequently experience dyspnea. Tai Chi reduces dyspnea and improves the exercise capacity and physiological and psychosocial well-being of people with COPD [19]. Qiu *et al.* compared physiological work



as measured by oxygen uptake, esophageal pressure swing, and diaphragm electromyography elicited by Tai Chi compared with that elicited by constant-rate treadmill walking at 60% of maximal load in 11 patients with COPD (Mean FEV1 61% predicted, FEV1/FVC 47%). They found that Tai Chi constituted a physiological stimulus similar to treadmill exercise and might be an acceptable modality for pulmonary rehabilitation [21]. Gloria *et al.* studied 10 patients with moderate to severe COPD who participated in 12 weeks of Tai Chi plus usual care (n = 5), or usual care alone. After training, there was significant improvement in the chronic respiratory questionnaire score of the Tai Chi group compared with the usual-care group [22]. Leung *et al.* reported that Tai Chi significantly increased endurance shuttle walk time, reduced medial-lateral body sway during a semi-tandem stand, and increased the total score of the chronic respiratory disease questionnaire compared to controls [23]. Therefore, Tai Chi may be an option for patients with moderate to severe COPD.

The effects of Tai Chi on the nervous system

Improvement of psychological well-being

Tai Chi can be classified as a mind/body technique, potentially reducing stress, affecting physical as well as mental health parameters. A recent meta-analysis of 20 eligible studies that included 2,553 participants showed that Tai Chi could enhance cognitive function in older adults [24, 25]. Lam *et al.* observed 389 seniors for 1 year and found that subjects in the Tai Chi intervention group showed an improvement in global cognitive function and decreased recall and subjective cognitive complaints [26]. Zheng *et al.* analyzed nine studies, including four randomized controlled trials and non-randomized controlled trials, and concluded that most results of Tai Chi in the cognitive domain showed a positive effect [27]. At the psychological level, Wang *et al.* concluded that Tai Chi practice, whether short-term or long-term, seems to have mental health benefits that can help both healthy subjects and patients with chronic conditions of mental health, self-esteem, and life satisfaction [28]. Therefore, the effective use of Tai Chi to improve the mental state is meaningful.

Rehabilitation effects in patients with nervous system diseases

The result of a stroke is a significant decline in the QOL, determined not only by damage to the nervous system, but also by the impairment of cognitive function. Many stroke patients have impaired balance and motor function, and they can increase exercise endurance by increasing oxygen intake and walking distance. Tai Chi may have a potential role in stroke therapy. Zhang *et al.* randomly divided 50 stroke patients into a control group and a Tai Chi group. Through the assessment of sports injury recovery, the results proved that Tai Chi could be used with another rehabilitation program to treat stroke patients during the recovery phase [4]. Cwiekala-Lewis *et al.* analyzed seven randomized clinical trials and four

quasi-experimental studies and found that Tai Chi participants had better balance and one or more aspects of happiness, although the results were mixed [29]. Based on the above-mentioned results, we can conclude that Tai Chi can be used as rehabilitation training for stroke patients, but some of the studies were not perfect. Further research requires more rigorous study design, larger sample sizes, adequate Tai Chi practice, and carefully selected measurements of the results. Before extensive recommendations, the role and effect of Tai Chi on nervous system diseases must be assessed.

The effects of Tai Chi on musculoskeletal disorders

Balance improvement and fall prevention

In daily activities, poor balance is associated with a high frequency of significant falls, which increases the social and economic burden of patients. This loss of balance is due to specific deterioration in the function of various musculoskeletal systems. Fortunately, proper exercise training can improve balance and prevent accidental falls [3]. Gatts and Woollacott analyzed how Tai Chi improved balance from a biomechanical perspective. Twenty-two elderly people with a history of knee, hip, or back surgery were randomly divided into a control group or a Tai Chi group; each group trained 1.5 hours per day, 5 days per week, for 3 weeks. The final results showed that Tai Chi control training significantly reduced tripping and medial cross-step distance and increased the use of swing leg heel strike. Therefore, Tai Chi training can strengthen the balance response and use balance more actively to control the step strategy of the wobble leg [30]. Li *et al.* randomly assigned 256 physically inactive older adults to Tai Chi or an exercise stretching control group, followed by six months of follow-up. The Tai Chi group reported significantly fewer falls, a lower proportion of fallers, and fewer injurious falls than the control group [31]. In another study, Voukelatos *et al.* assigned 702 people who lived in the community to a 16-week Tai Chi training course. The Tai Chi group showed fewer falls than did the control group. After 16 weeks and 24 weeks, the risk ratio for Tai Chi was 0.72 and 0.67, respectively [32]. Therefore, improved functional balance through Tai Chi training is associated with subsequent reductions in fall frequency.

Rehabilitation effects of musculoskeletal disorders

Few remedies effectively treat long-term pain and disability from knee osteoarthritis (OA), but studies suggest that Tai Chi alleviates the symptoms. Hartman *et al.* first showed that patients with OA benefitted from 6-20 weeks of Tai Chi training [33]. In a randomized controlled study of 79 patients with OA, Song *et al.* found that after 12 weeks of training, the Tai Chi group perceived significantly less joint pain and stiffness and reported fewer perceived difficulties in physical functioning than the control group [20]. Wang *et al.* reported that Tai Chi reduced pain and improves physical function, self-efficacy, depression, and health-related



QOL for knee OA [2, 34]. In another study, Hall *et al.* found that a 10-week Tai Chi program reduced pain and disability outcomes and could be considered a safe and effective intervention for those experiencing long-term symptoms of lower back pain [35]. The results of the above-mentioned studies show that Tai Chi has beneficial effects for the treatment of knee OA, it can reduce pain, improve physical function, and improve the QOL.

The effects of Tai Chi on rheumatism

Rheumatoid arthritis (RA) is a chronic systemic inflammatory disease characterized by articular and extra-articular involvement. In a recent study, Li *et al.* assigned 40 patients to a Tai Chi or a control group after 8 weeks of home-based Tai Chi physical training. The Tai Chi group showed a significant improvement in disease activity and flexibility [3]. Shin *et al.* studied 56 patients with rheumatoid arthritis and found that Tai Chi improved endothelial dysfunction and hardening of the arteries in older women and was a useful strategy for cardiovascular disease prevention in patients with RA [6]. Zou *et al.* studied a number of sources using electronic and manual searches. They analyzed 10 studies related to their

inclusion criteria and reported that existing evidence supports Tai Chi's effectiveness in improving QOL and functional balance in patients with multiple sclerosis. Based on these findings, it is reasonable to assume that Tai Chi can help patients with RA.

The effects of Tai Chi on cancer

There are approximately 14.1 million cancer survivors worldwide, and this figure is expected to increase to 24 million by 2035 [36]. Physical exercise has been recommended to reduce the symptoms of breast cancer, including QOL, fatigue, and depression [37]. It can also contribute to cancer prevention and may help prevent recurrence. Tai Chi has been reported to be beneficial for physical, emotional, and neuropsychological functions in patients with breast cancer and lung cancer [38, 39].

Zhang *et al.* conducted a randomized trial of Tai Chi compared with low-impact exercise as a control intervention. They reported that Tai Chi was an effective intervention to manage cancer-related fatigue in patients with lung cancer undergoing chemotherapy. It decreased general fatigue and physical fatigue, and increased vigor [36]. Pan *et al.* analyzed nine randomized controlled trials

Table 1 The latest important researches on Tai Chi in the past two years

Study, Year [Reference]	Disease	Study Design	Patient Characteristics and Age	Treatment	Results
Shin <i>et al.</i> , 2015 [6]	Rheumatoid arthritis	Randomized controlled trial	56 female patients with RA (age, > 50 years)	Tai Chi exercise group (29 patients received a 3-month exercise intervention once per week for 3 months) vs. Control group (27 patients received general information about the benefits of exercise)	Improved endothelial function in the Tai Chi exercise group (initial: 5.85±2.05; 3 months: 7.75±2.53%) compared with the control group (initial: 6.31±2.12; 3 months: 5.78±2.13%)
Guo <i>et al.</i> , 2016 [11]	Chronic obstructive pulmonary disease	Randomized controlled trial	11 patients with COPD (age range, 54-70 years)	Tai Chi group vs. Constant rate tread-mill walking group	The EMGdi and esophageal pressure at the end of the exercise period were similar for both treadmill exercise and Tai Chi (EMGdi: 0.109±0.047 mV vs. 0.118±0.061 mV; esophageal pressure: 22.3±7.1 cmH ₂ O vs. 21.9±8.1 cmH ₂ O)
Yeh <i>et al.</i> , 2016 [8]	Chronic heart failure	Randomized controlled trial	100 patients with chronic systolic heart failure (mean age, 68±9 years)	12-week Tai Chi intervention group vs. Education group	Tai Chi participants reported not only self efficacy and social support, but overall empowerment with additional gains such as internal locus of control, self-awareness, and stress management.
Zhang <i>et al.</i> , 2016 [36]	Lung cancer	Randomized controlled trial	96 patients (mean age, 62.8 years)	Tai Chi exercise group vs. Low-impact exercise group	At 6 and 12 weeks, the Tai Chi group had a lower MFSI-SF total score than the control group (Tai Chi: 59.5±11.3 vs. 66.8±11.9, $P < 0.05$; control: 53.3±11.8 vs. 59.3±12.2, $P < 0.05$)



that included 322 patients with breast cancer and found that Tai Chi subjects showed improvements in hand strength as measured by a hand dynamometer. The short-term effects of Tai Chi may have potential benefits in upper limb functional mobility in patients with breast cancer [40]. In another study, Sprod *et al.* reported that Tai Chi may improve health-related QOL by regulating inflammatory responses and other biomarkers associated with side effects from cancer and its treatments [41]. Rehabilitation of cancer patients is critical and affects the patient's QOL. The above summary suggests that Tai Chi can be used as an effective rehabilitation for cancer patients. However, more reasonable exercise is needed for further study.

Conclusion

In conclusion, given the essential contribution of an exercise regimen, Tai Chi has recently emerged as a new and interesting therapy. Tai Chi is an ancient Chinese practice similar to yoga and has multiple effects on both physical and psychological health. This paper reveals the benefits of Tai Chi in nervous system disease, rheumatology, musculoskeletal disorders, cardiovascular diseases, respiratory diseases, and cancer. Representative clinical trials of the last two years which proved Tai Chi was effective are summarized in (Table 1). The primary reasons to choose Tai Chi as a treatment for chronic diseases are as follows. a) Tai Chi can reduce cardiovascular risks factors by regulating lipid metabolism, improving peripheral microcirculation, and adjusting heart rate. b) Tai Chi may promote the rehabilitation of patients with chronic lung disease by reducing dyspnea and improving exercise capacity. c) Tai Chi can ease motor system disease by reducing pain, improving balance, and preventing accidental falls. d) Tai Chi can improve QOL and balance in patients with rheumatism. e) Tai Chi may provide potential benefits to cancer patients by improving physical, emotional, and neuropsychological functions. In conclusion, Tai Chi effectively promotes health, and it can be prescribed as an alternative exercise program for patients with certain chronic diseases. Unfortunately, many of the effects of Tai Chi on the body have not yet been determined, and more focused research is needed to determine the specific mechanisms considering the variability of the role played by Tai Chi in each disease.

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