

The Effect of Tai Chi on Chronic Obstructive Pulmonary Disease: A Pilot Randomised Study of Lung Function, Exercise Capacity and Diaphragm Strength



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Background	Although the benefits of exercise on the health of patients with chronic obstructive pulmonary disease (COPD) have been widely reported, the effect of Tai Chi as an alternative exercise has not been thoroughly evaluated in patients with COPD. This study reported a randomised controlled trial, which investigated the effects of Tai Chi on lung function, exercise capacity, and diaphragm strength in patients with COPD.
Trial design	Single blind randomised controlled study.
Setting	Department of Respiratory Medicine, Xiangya Hospital, Central South University.
Methods	Forty patients with COPD were randomised into either a control group or Tai Chi intervention group. Participants in the control group received only routine care, while participants in the Tai Chi group received routine care and completed a six-month Tai Chi exercise program.
Outcomes	Lung function parameters, blood gas parameters, 6-min walking distance (6MWD), and diaphragm strength parameters.
Results	Lung function parameters (FEV_1 : 1.43 ± 0.08 and FEV_1 (%) predicted: 47.6 ± 4.76), 6MWD (476 ± 15) and diaphragm strength parameters (TwPes: 1.17 ± 0.07 , TwPga: -1.12 ± 0.06 , and TwPdi: 1.81 ± 0.09) were found to be significantly increased in participants who successfully completed the six-month Tai Chi program compared to participants in the control group who only received routine care ($p < 0.05$). These parameters were also found to be significantly increased in participants who completed the Tai Chi exercise program compared to the baseline ($p < 0.05$). In contrast, no significant differences in PaO_2 and $PaCO_2$ were observed in participants before or after completing a Tai Chi program or between Tai Chi group and control group ($p > 0.05$).
Conclusions	Tai Chi enhances lung function, exercise capacity, and diaphragm strength. However, this is only preliminary research data and a larger trial is needed for more detailed results.
Keywords	Chronic obstructive pulmonary disease • Tai Chi • Diaphragm strength • Lung function • 6MWD

Introduction

Chronic obstructive pulmonary disease (COPD) is a major cause of mortality and morbidity worldwide. COPD has

become the third leading cause of death in China [1]. Despite improvements in pharmacologic and surgical treatments, many patients still suffer from dyspnoea and disabilities in daily life. At present, the primary goals in COPD

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management are to alleviate symptoms, slow down the deterioration of lung function, and minimise the disabilities of patients [2]. In clinical practice, pulmonary rehabilitation programs are widely accepted as effective non-pharmacotherapies for COPD [3]. However, only a very small percentage of eligible patients actually participated in pulmonary rehabilitation programs [4]. Even for patients who completed these programs, maintaining a high level of activity is problematic, and clinical benefits decline dramatically after one year [5]. Exercise is a major part of pulmonary rehabilitation programs [6]. However, there is an ongoing debate regarding what the optimal type, intensity, and duration of exercise for pulmonary rehabilitation should be [6,7]. Therefore, developing an exercise program that is widely available, easily implemented, low-cost, and able to promote self-efficacy of exercise among patients with COPD is very important. The characteristics of a Tai Chi program make it the perfect candidate [8].

Tai Chi (also known as Tai Chi chuan or taijiquan) is a mind-body exercise developed in ancient China characterised by mild to moderate aerobic activity and lower-extremity as well as unsupported upper-extremity muscle strength training [9]. The Tai Chi program consists of slow, continuous movements and incorporates elements of balance and relaxation [8]. Studies have investigated Tai Chi as an intervention for a variety of health concerns, including chronic cardiovascular diseases [10], cardiorespiratory fitness [11], and musculoskeletal diseases [12]. In particular, the Tai Chi program combines breathing and respiratory muscle training with stress management, which are also essential aspects of COPD management [13]. Thus, Tai Chi may be a suitable exercise used for pulmonary rehabilitation of patients with COPD [14]. We hypothesise that participating in a Tai Chi program can help improve lung function and exercise capacity through increasing diaphragm strength in COPD patients.

Although evidence for the physiological benefits of Tai Chi on COPD is emerging, these studies convey inconsistent results due to wide variations in Tai Chi programs and different measurements used to evaluate the outcomes [9–15]. The primary measurements used in these studies include 6-min walking distance (6MWD) and dyspnoea [15]. Few studies have evaluated the benefits of Tai Chi on lung function and diaphragm strength in people with COPD [9]. In this study, a randomised controlled trial was conducted to evaluate the effect of a Tai Chi program on lung function, exercise capacity, and diaphragm strength in patients with COPD.

Materials and Methods

Trial Design

This is a single blind randomised controlled trial. The participants were assigned randomly to two groups: the control group and Tai Chi group with 1:1 allocation ratio.

Participants

A participant's eligibility for inclusion in the trial was determined by two senior physicians who were involved neither

in the therapy nor in data analysis of the study. A total of 52 COPD patients were recruited from January 2011 to June 2011 from the outpatient clinics of the Department of Respiratory Medicine, Xiangya Hospital, Central South University. The subjects were selected based on the following criteria: (1) moderate to severe COPD diagnosed clinically; (2) $FEV_1 < 65\%$ of predicted, and ratio of FEV_1 to forced vital capacity < 0.70 ; and (3) ≥ 45 years of age. Participants were subjected to the following exclusion criteria: (1) a COPD exacerbation that required systemic steroids, antibiotics, a visit to the ER, or hospitalisation within the past month; (2) any planned major pulmonary intervention in the coming six months (e.g., lung volume-reduction surgery); (3) severe peripheral vascular disease and claudication or other physical condition that would preclude a 6-min walk test; and (4) severe cognitive dysfunction (Mini Mental State Examination score ≤ 24). A total of 12 COPD patients were excluded from the study.

Interventions

Participants in the Tai Chi group underwent four sessions of supervised Tai Chi program and three sessions of home-based Tai Chi program per week with one session per day. The entire program lasted six months. Each session consisted of a 10 min pre-exercise warm up, followed by 30 min of Tai Chi program and 10 min post-exercise relaxation. The intensity of the Tai Chi program was determined by the format of the program and was the first set up based on an individual's limiting factors for exercise as previously described [3]. The intensity was then adjusted for each COPD patient according to her/his toleration to the program. Subjects in the Tai Chi group were trained by a physiotherapist who is an accredited Tai Chi trainer with extensive experience in chronic lung disease therapy. A Tai Chi training booklet and DVD developed by an accredited trainer were provided to each subject in the Tai Chi group for the home sessions. A workout diary was supplied to each participant to record the practice time of each home session and was routinely checked. The program adherence for both the supervised and at home sessions was calculated separately by an average percentage of sessions being completed. The program adherence for supervised session and at home session was 96.93% and 95.21%, respectively. In the control group, participants did not participate in any formal exercise program, but were subjected to routine medical care for six months after baseline measurement. Routine medical care included tiotropium 10 μg inhalation, lip breathing for 10–15 min, and walking for 30 min daily.

Outcome Measures

The outcomes were assessed by researchers who were unaware of the study design. No changes in methods and outcomes were designed after trial commencement.

Primary outcomes

Lung function: Lung function parameters were measured using body plethysmography (Master lab-Compact, Jaeger, Hochberg, Germany) by following the user manual. The

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