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Original Article

Effects of the tai chi qigong programme on functional capacity, and lung function in chronic obstructive pulmonary disease patients: A ramdomised controlled trial

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ABSTRACT

Although the beneficial effect of exercise on the health of Chronic Obstructive Pulmonary Disease (COPD) patients has been widely demonstrated, that of Tai Chi Qigong (TCQ), as an alternative exercise, has been inconclusive. Therefore, this study aimed to evaluate the effects of combined center-and home-based TCQ on functional capacity and lung function in patients with mildly and moderately severe COPD. A total of 50 patients, with a mild and moderate degree of COPD, were recruited and randomly assigned to either the TCQ ($n = 25$) or control group ($n = 25$). The TCQ group completed 12-week center-and 12-week home-based training. The control group attended a meeting class once a week for 12 weeks. Outcome measures were assessed at baseline, and the 6th, 12th and 24th week. The primary outcomes were functional capacity (6-min walk test; 6MWT) and lung function. The secondary outcomes were dyspnea score and quality of life. The TCQ group demonstrated significant improvement in functional capacity at week 12 and 24 ($p < 0.05$) and dyspnea score and quality of life at week 6, 12 and 24 ($p < 0.05$) when compared to baseline. Functional capacity, forced expiratory volume in 1st second (FEV_1), dyspnea score, and quality of life were significantly better in the TCQ group from week 6 to week 24 when compared to the control group ($p < 0.05$). Combined center-and home-based TCQ training for patients with mildly and moderately severe COPD is effective in improving functional capacity, dyspnea score, and quality of life.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is one of the most important public health problems worldwide. The World Health Organization estimated that COPD will become the 3rd leading cause of death worldwide by 2030[1] and rank as the 5th Disability-Adjusted Life Years (DALYs) in the same year.[2] COPD is characterized by persistent respiratory symptoms and airflow limitation. The most common respiratory symptoms include dyspnea, cough and/or sputum production.[3] Dyspnea is related with daily life activity. COPD patients often suffer from dyspnea and exacerbation, which leads to inactivity, deconditioning, and poor functional capacity and quality of life.[4, 5] Several interventions have been investigated with the aim of improving lung function, decreasing dyspnea symptoms and improving quality of life in these patients.[6–11] These interventions include pulmonary rehabilitation, exercise, yoga, acupuncture, and Tai chi qigong (TCQ).

TCQ is a mind-body exercise that involves whole body movements, breathing techniques, postural control, and internal

Abbreviations: COPD, Chronic Obstructive Pulmonary Disease; GOLD, The Global Initiative for Chronic Obstructive Lung Disease; SGRQ, St. George Respiratory Questionnaire; TCQ, Tai Chi Qigong; mMRC, modified Medical Research Council Dyspnea Scale; FEV_1, forced expiratory volume in 1 s; FVC, forced vital capacity; 6MWT, 6-min walk test; ERV, expiratory reserve volume.

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awareness.[12] Several studies have demonstrated the advantages of TCQ in elderly persons with chronic diseases,[13] especially those with disorders of the cardio-cerebro-vascular, respiratory and musculoskeletal systems.[14]

Previous studies have investigated the effects of TCQ in COPD patients on several outcomes including functional capacity, lung function, quality of life, and findings have been inconclusive.[12, 15–21] Although, several studies reported significant improvement in functional capacity, lung function and quality of life after TCQ training,[15, 16] a systematic review and meta-analysis concluded that TCQ significantly improved functional capacity but not lung function and quality of life in patients with COPD.[21] The authors noted that the evidenced effect of TCQ on health related quality of life was not conclusive and futher methodologically sound studies were needed before definitive conclusions could be drawn. Factors including heterogeneity of the participants and duration of training might account for less conclusive findings in previous studies, which often included patients with all degrees of COPD severity. Therefore, implementing the same TCQ programme may not fully benefit such patients, since the intensity was not optimised enough to help improving their conditions. Few studies have examined the long term effect of TCQ training on lung function and quality of life of individuals with COPD.[15, 16] Further, TCQ has often been implemented as a center-based programme in these previous studies and then followed up after the training ended. While center-based training could ensure safety and correctness, factors such as lack of transportation and time conflict could be a major constraint for long term training. Thus, combined center-and home based TCQ might be an alternative programme to overcome the shortcoming of center-based training.[15, 16]

Therefore, this study aimed to evaluate the effects of a combined 12-week center-and 12-week home-based TCQ programme on functional capacity, lung function, dyspnea, and quality of life in patients with mild and moderate degree of COPD.

2. Materials and methods

2.1. Design

This study was a randomised controlled trial with concealed allocation, blinding of assessors and intention-to-treat analysis. COPD patients, who were registered at the COPD Clinic, were assigned randomly to either the TCQ (intervention) or non TCQ (control). Randomisation was stratified by the current Global Initiative for Chronic Obstructive Lung Disease (GOLD) stage of COPD in two strata (mild and moderate degree). Each strata was allocated to blocks of four and randomised by drawing lots.

A blinded assessor conducted the assessments at baseline, and the 6th, 12th and 24th week.

2.2. Participants

Fifty participants were recruited from the COPD Clinic of Chiang Dao Hospital, Chiang Mai, Thailand between November 2015 and November 2016 (Fig. 1). The inclusion criteria included clinically diagnosed patients with a mild or moderate degree of COPD, aged 40 years or older and able to walk independently. The exclusion criteria comprised acute exacerbation within 4 weeks before starting the study and having significant, cognitive impairment, tuberculosis, asthma, and musculoskeletal, psychological, cardiovascular and benign conditions that preclude exercise. Sample size calculation was based on previous findings of the therapeutic effects of Qigong on functional capacity by using the 6-min walk test (6MWT),[22] with a power of 80% and an alpha of 5%. Fifty subjects were recruited and randomly assigned to either of the two groups; TCQ (n = 25), or control group (n = 25).

2.3. Ethics approval

The study protocol was approved by the Research Ethics Committee, Faculty of Medicine, Chiang Mai University (Ref No: 497/2015). The participants gave their written informed consent before data collection began.

2.4. Intervention

The TCQ group received the TCQ programme, which was an 8-form modified TCQ from Dr. Pual Lam of the Tai Chi for Health Institute[23] under supervision of one of its certified TCQ instructors. Participants attended TCQ classes 3 times a week in the center-based programme led by a TCQ instructor. They also were assigned to practice at home 2 times a week, and a TCQ poster was given to each participant in order to simplify self-practice at home. After 12 week of center-based TCQ training, all of the participants continued to practice at home, 3 times per week for a futher 12 weeks (i.e. total training duration = 24 weeks), with their training recorded in a logbook. Weekly phone calls and monthly home visits were implemented in order to facilitate adherence. The control group received usual care and did not received any interventions. They attended a meeting once a week for 12 consecutive week in order to share their health experience.

2.5. Outcome measurements

Outcome measurements were taken at baseline, and the 6th, 12th (end of center-based training) and 24th week (end of home-based training). The primary outcomes were functional capacity and lung function. The secondary outcomes were dyspnea score and quality of life.

2.5.1. Primary outcomes

Functional capacity was assessed by using the 6-min walk test (6MWT),[24] which measures the distance that an individual is able to walk as far as possible in 6 min.

Lung functions, including forced expiratory volume in 1 s (FEV_1) and forced vital capacity (FVC), were measured by spirometry.

2.5.2. Secondary outcome

Dyspnea score was measured by using a Thai version of the modified Medical Research Council Dyspnea Scale (mMRC). In a scale of 0–4, 0 indicates “only gets breathless with strenuous exercise” and 4 indicates “too breathless”.[24]

Quality of life was assessed using a Thai version of the St. George's Respiratory Questionnaire (SGRQ), which is used for a specific measurement of quality of life in COPD patients and a 50-item questionnaire designed to measure the impact of COPD. Score ranged from 0 to 100, with higher scores indicating more limitations.[25, 26]

2.6. Statistics

Data were analysed using SPSS version 22.0. Independent t-tests and chi-square tests, were conducted to compare the demographic characteristics and all baseline outcomes measured between the TCQ and control group. The pair *t*-test was used to compare the mean differences within each group. The independent *t*-test was used to assess the mean difference (i.e. 24th week-baseline) between the two groups. A p-value of <0.05 (2-sided) was set as the level of statistical significance. The 95% confidence intervals around the mean differences were calculated. The principle of intention-to-

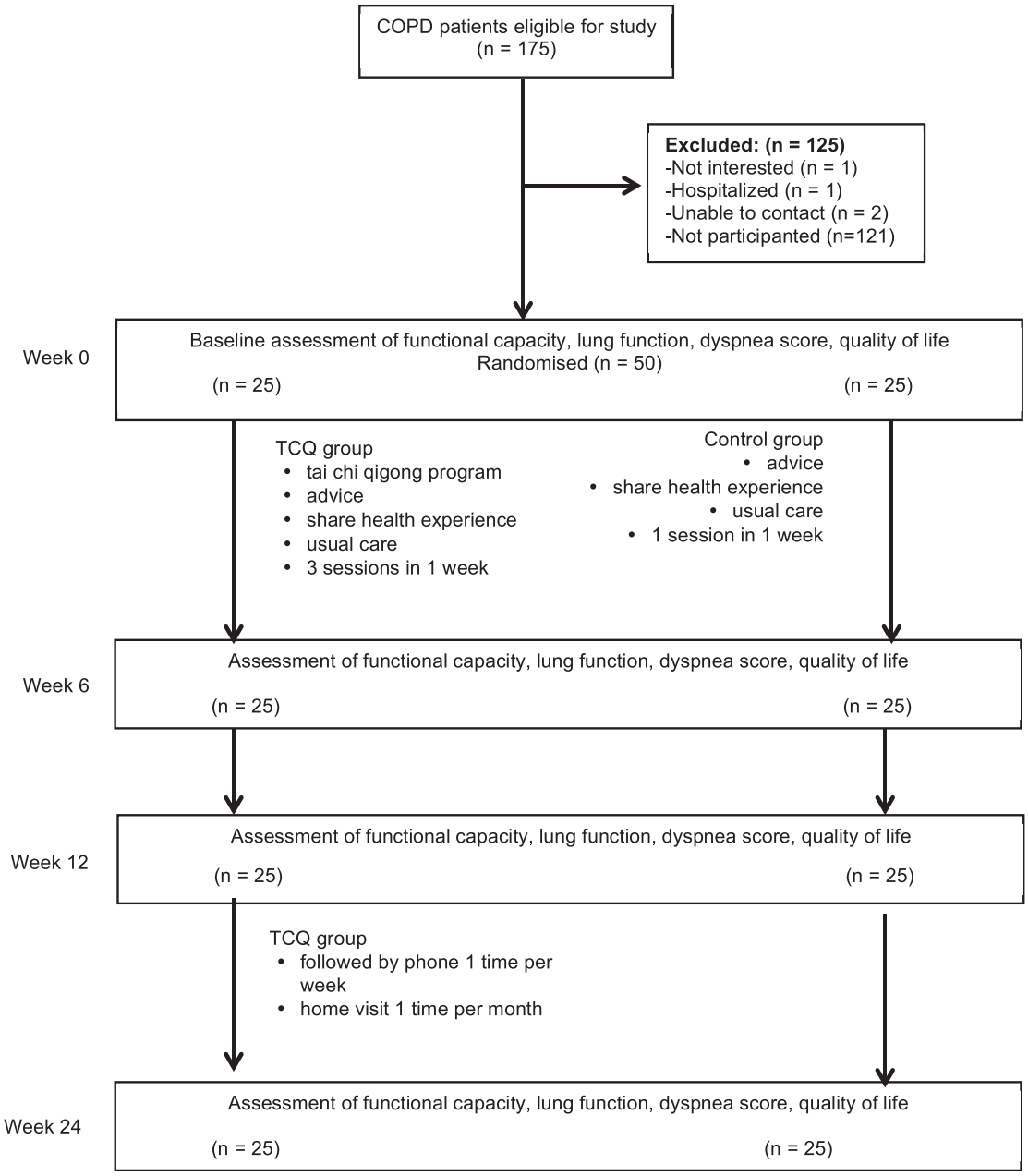

Fig 1. Design and flow of participants through the trial.

treat was applied to all analyses.

3. Results

A total of 175 individuals with COPD were screened and assessed, of which 50 were eligible to participate and complete the study at week 24 (TCQ group = 25, Control group = 25). None of the participants dropped out of the study. The flow of participants throughout the trial is shown in Fig. 1. Demographic data and baseline characteristics of the participants are presented in Table 1. No statistically significant difference was found in any of the demographic variables (Table 1).

Table 2 shows the results of outcomes for each group at assessment time. Outcome data within and between the groups are presented in Table 3.

Functional capacity, as measured by the 6MWT in the TCQ group, significantly improved at week 12 (56.96 ± 38.61 m)($p < 0.05$) and week 24 (73.56 ± 40.28 m)($p < 0.05$) as compared to baseline. In contrast, no significant improvement of functional capacity was observed for the control group across any of the assessment times. When comparing between the two groups, the mean difference in the 6MWT was the TCQ group achieving significantly longer distance that the control group at week 6 [21.12 m (95% CI 2.37 to 39.87)] week 12 [83.56 m (95% CI 48.97 to 118.15)], and week 24 [112.04 m (95% CI 88.93 to 135.15)].

Lung function, as measured by spirometry, did not change significantly across any of the assessment times for either the TCQ or control group. Regarding comparisons between the groups. The TCQ group demonstrated significantly higher FEV_1 than the control group at week 24 [0.15 L (95% CI 0.01 to 0.31)].

Dyspnea score, as measured by mMRC, improved significantly at week 6 (-0.56 ± 0.71)($p < 0.05$), week 12 (-0.76 ± 1.05)($p < 0.05$)

Table 1
Baseline characteristics of participants.

Characteristic	TCQ (n = 25)	Con (n = 25)
Age *(yr)*, mean (SD)	69.68 (7.67)	67.48 (10.17)
Gender, n males (%)	15 (60)	19 (76)
Smoking pack-year, n (%)	32.69 (33.37)	18.83 (17.32)
Years of COPD (yr), mean (SD)	5.70 (5.82)	5.24 (3.91)
Functional capacity (m), mean (SD)		
6MWT	368.72 (77.38)	387.12 (98.89)
GOLD group		
A, n (%)	17 (68)	16 (64)
B, n (%)	8 (32)	9 (36)
Lung function		
FEV_1/FVC (%), mean (SD)	57.82 (9.04)	59.20 (8.76)
FEV_1%predict (%), mean (SD)	68.21 (21.63)	68.37 (18.90)
FEV_1 (L), mean (SD)	1.25 (0.45)	1.36 (0.41)
FVC (L), mean (SD)	2.15 (0.66)	2.28 (0.66)
Dyspnea score		
mMRC mean (SD)	1.16 (0.85)	1.44 (1.19)
SGRQ score, mean (SD)		
Symptoms	39.20 (20.64)	45.41 (25.20)
Activity	50.67 (27.69)	43.88 (28.05)
Impact	39.42 (14.44)	38.27 (20.75)
Total	49.96 (17.28)	41.22 (21.69)

TCQ = tai chi qigong group, Con = control group, COPD = chronic obstructive pulmonary disease, 6MWT = 6-min walk test, FEV_1 = forced expiratory volume in 1 s, FVC = forced vital capacity, mMRC = modified Medical Research Council dyspnea scale, SGRQ = St. George respiratory questionnaire.

and week 24 (-0.88 ± 0.83) ($p < 0.05$) in the TCQ group but not in the control group. The mean difference of dyspnea between the two groups from baseline to week 24 showed significant differences week 6 [-0.6 (95% CI -1.09 to −0.11)], week 12 [-0.88 (95% CI -1.50 to −0.26)], and week 24 [-1.12 (95% CI -1.72 to −0.52)].

Quality of life significantly improved in all aspects in the TCQ group. The mean SGRQ score of the TCQ group continuously improved from week 6 until week 24, which reflected better quality of life. In contrast, there were no significant differences in the SGRQ score in any aspects in the control group during any all the assessment times. The mean difference of total SGRQ score between the TCQ and control group was −31.07 points (95% CI -39.18 to −22.96) at week 6, -28.49 points (95% CI -39.29 to −17.68) at week 12, and a significant difference between the groups continued until the week 24 [-32.39 points (95% CI -43.46 to −21.30)].

4. Discussion

The benefical effect of TCQ training was demonstrated on functional capacity, dyspnea score, and quality of life only after 6 weeks of training, while previous studies showed that TCQ effect improved these outcomes by at least week 12.[12, 15, 17]

The positive finding at the 6th week in the present study could possibly be dued to the high frequency of training. In this study, the paticipants practiced TCQ 3 times a week at the center and 2 times a week at home. This frequency of training appeared to be higher than previous studies and might account for such improvement observed at the 6th week.

The 6MWT distance was increased from baseline to 25 m (14%) and the TCQ group improved significantly at week 12. When the distance was increased to more than 25 m or 14% from baseline, it was considered clinically significant.[27] In contrast, the control group demonstrated a significant decrease in 6MWT distance at week 24 (-38.48 ± 40.98). The 6MWT requires endurance, balance and lower extremity muscle strength. TCQ training involves breathing techniques, postural control, and internal awareness,[12] leading to improved gas exchange, balance and lower-limb muscle strength.[28–32] The results supported previous trials in which patients with COPD received TCQ training and achieved a significant increase in 6-min walking distance.[17, 33, 34]

Dyspnea symptoms in the TCQ group decreased significantly after the 6th week. Airflow limitation in COPD, due to airway obstruction, led to hypercapnia and air tapping[35,36]. The breathing pattern of TCQ; a combination of meditation and slow deep breathing, was likely responsible for a reduction of carbon dioxide (CO_2)[28] and consequently improvement of dyspnea symptoms.

The mean difference of FEV_1 at week 24 (24th week-baseline) was significantly greater in the TCQ than control group, which suggested that TCQ training might help maintain lung function. These results were in line withChan et al. (2013), who reported an improvement in FEV_1 at week 24 in the TCQ group, and suggested that regular TCQ training could maintain lung function and slow down the progress of COPD.[15]

Quality of life, as measured by SGRQ in the TCQ group, was significantly superior to the control group from week 6 and throughout the assessment times (6th, 12th, and 24th week). These results are in line withChan et al. (2013) andWang et al. (2010), who reported that TCQ training could improve quality of life, socio-psychology, self-esteem and decreased anxiety, depression and mood disturbance.[15, 37]

The strengths of this study included sound methodological design, homogeneity of the participants, and combined center-and home-based intervention. The randomised controlled trial and blinding assessors helped to decrease bias in this study. The

Table 2
Mean (SD) for outcomes for each groups at each assessment time.

Outcome	Groups							
	Week 0		Week 6		Week 12		Week 24	
	TCQ (n = 25)	Con (n = 25)	TCQ (n = 25)	Con (n = 25)	TCQ (n = 25)	Con (n = 25)	TCQ (n = 25)	Con (n = 25)
Functional capacity								
6MWT (m), mean (SD)	368.72 (77.38	387.12 (98.89)	377.96 (58.22)	375.24 (88.09)	425.68 (59.17)	360.52 (95.21)	442.28 (60.85)	348.64 (93.26
Lung function								
FEV_1 (L), mean (SD)	1.25 (0.45)	1.36 (0.41)	1.23 (0.53)	1.35 (0.52)	1.26 (0.41)	1.33 (0.44)	1.27 (0.41)	1.22 (0.39)
FVC (L), mean (SD)	2.15 (0.67)	2.28 (0.66)	2.09 (0.79)	2.30 (0.79)	2.14 (0.63)	2.32 (0.62)<	2.16 (0.68)	2.27 (0.60)
Dyspnea score								
mMRC mean (SD)	1.16 (0.85)	1.44 (1.19)	0.6 (0.71)	1.48 (0.87)	0.4 (0.64)	1.56 (0.87)	0.28 (0.46)	1.68 (0.99)
SGRQ score, mean (SD)								
Symptoms	39.20 (20.64)	45.41 (25.20)	18.95 (10.97)	43.54 (21.16)	15.30 (15.26)	38.67 (22.89)	19.54 (18.48)	42.06 (22.03)
Activity	50.70 (27.96)	43.88 (28.06)	11.29 (9.79)	46.06 (17.16)	10.27 (9.80)	46.89 (19.31)	12.62 (10.53)	41.87 (19.35)
Impact	39.42 (14.44)	38.27 (20.75)	14.51 (7.22)	41.51 (18.00)	11.35 (7.31)	33.12 (16.59)	9.71 (9.90)	42.90 (13.72)
Total	42.96 (17.28)	41.21 (21.69)	14.45 (7.37)	43.78 (14.60)	11.60 (5.97)	38.34 (15.34)	11.97 (9.79)	42.61 (14.99)

TCQ = tai chi qigong group, Con = control group, 6MWT = 6-min walk test, FEV_1 = forced expiratory volume in 1 s, FVC = forced vital capacity, mMRC = modified Medical Research Council dyspnea scale, SGRQ = St. George respiratory questionnaire, SD = standard deviation, L = liter

Table 3
Mean (SD) of groups, mean (SD) difference within groups, and mean (95% CI) difference between groups.

Outcome	Difference within groups						Difference between groups			
	Week 6 minus Week 0		Week 12 minus Week 0		Week 24 minus Week 0		Week 6 minus Week 0	Week 12 minus Week 0	Week 24 minus Week 0	
	TCQ	Con	TCQ	Con	TCQ	Con	TCQ-Con	TCQ-Con	TCQ-Con	
Functional capacity										
6MWT (m), mean (SD)	9.24 (33.50)	−11.88 (32.44)	56.96* (38.61)	−26.60 (76.86)	73.56* (40.28)	−38.48 (40.98)	21.12 * (2.37–39.87)	83.56* (48.97–118.15)	112.04* (88.93–135.15)	
Lung function										
FEV1 (L), mean (SD)	−0.02 (0.25)	−0.01 (0.30)	0.01 (0.17)	−0.03 (0.31)	0.02 (0.20)	−0.13 (0.34)	−0.01 (−0.17 to 0.14)	0.04 (−0.11 to 0.18)	0.15* (0.01–0.31)	
FVC (L), mean (SD)	−0.06 (0.35)	0.02 (0.39)	−0.02 (0.36)	0.04 (0.44)	0.01 (0.27)	−0.01 (0.49)	−0.08 (−0.29 to 0.13)	−0.06 (−0.29 to 0.17)	0.02 (−0.21 to 0.24)	
Dyspnea score										
mMRC mean (SD)	−0.56* (0.71)	0.04 (0.98)	−0.76* (1.05)	0.12 (1.13)	−0.88* (0.83)	0.24 (1.23)	−0.6* (−1.09 to −0.11)	−0.88* (−1.50 to −0.26)	−1.12* (−1.72 to −0.52)	
SGRQ score, mean (SD)										
Symptoms	−20.24* (17.43)	−1.87 (18.81)	−23.90* (21.69)	−6.74 (22.51)	−19.65* (21.26)	−3.35 (20.65)	−18.37* (−28.69 to −8.06)	−17.16* (−29.73 to −4.59)	−16.30* (−28.22 to −4.38)	
Activity	−39.41* (25.30)	2.18 (18.50)	−40.42* (28.52)	3.01 (28.22)	−38.08* (25.81)	−2.01 (25.21)	−41.59* (−54.19 to −28.99)	−43.43* (−59.56 to −27.30)	−36.07* (−50.58 to −21.56)	
Impact	−24.91* (12.15)	3.25 (18.21)	−28.06* (15.24)	−5.16 (21.91)	−29.71* (19.59)	4.63 (21.79)	−28.16* (−36.96 to −19.35)	−22.9* (−33.64 to −12.17)	−34.34* (46.12 to −22.56)	
Total	−28.50* (14.25)	2.57 (14.27)	−31.36* (16.47)	−2.87 (21.23)	−30.99* (19.11)	1.40 (19.84)	−31.07* (−39.18 to −22.96)	−28.49* (−39.29 to −17.68)	−32.39* (−43.46 to −21.30)	

TCQ = tai chi qigong group, Con = control group, 6MWT = 6-min walk test, FEV1 = forced expiratory volume in 1 s, FVC = forced vital capacity, mMRC = modified Medical Research Council dyspnea scale, SGRQ = St. George respiratory questionnaire, SD = standard deviation, L = liter.
* Significance $p < 0.05$.

homogeneity of the participants likely gave reasons for completing the TCQ training and not dropping out, and the combination of center-and home-based TCQ training might ensure safety, correctness, and long term training. However, the limitation of this study was no records on the use of bronchodilators for acute exacerbation. If such information had been available, the effect of TCQ on dyspnea, in addition to the dyspnea score, could have been confirmed. As the breathing technique in TCQ is slow deep breaths, assessment of the expiratory reserve volume (ERV) might be another parameter for demonstrating the effect of TCQ on lung function.

5. Conclusion

In conclusion, this study demonstrated that combined center and home-based TCQ training improves functional capacity, dyspnea score, the quality of life of individuals with mild to moderate COPD. Furthermore, TCQ is safe and feasible for mild to moderate COPD patients to practice at home.

Conflicts of interest

The authors declared no potential conflicts of interests with respect to the research, authorship, and/or publication of this article.

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Conflicts of interest

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