Respir. Med and Res 75 (2019) 13–25

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

Original article

Efficacy of yoga, tai chi and qi gong on the main symptoms of chronic obstructive pulmonary disease: A systematic review

G. Reychler[a,b,c,*], W. Poncin[a,b], S. Montigny[c], A. Luts[e], G. Caty[d], T. Pieters[a,b]

[a] Institut de recherche expérimentale et clinique (irec), pôle de pneumologie, ORL & dermatologie, université Catholique de Louvain, Brussels, Belgium
[b] Service de pneumologie, cliniques universitaires Saint-Luc, Brussels, Belgium
[c] Haute école Leonard de Vinci–institut d'enseignement supérieur Parnasse-Deux Alice, Brussels, Belgium
[d] Service de médecine physique et réadaptation, cliniques universitaires Saint-Luc, Brussels, Belgium
[e] Département de psychiatrie adulte, cliniques universitaires Saint Luc, Brussels, Belgium

ARTICLE INFO

Article history:
Received 22 January 2019
Received in revised form 19 March 2019
Accepted 8 April 2019
Available online 16 April 2019

ABSTRACT

Introduction. – The aim of this systematic review was to summarize the effects of yoga, qi gong or tai chi in COPD patients.
Methods. – Studies evaluating effects of the selected complementary therapies on lung function, dyspnea, quality of life or functional exercise capacity in COPD patients were identified and reviewed from three databases.
Results. – Eighteen studies were included. Six studies evaluated the effects of yoga and the others focused on tai chi or qi gong separately or combined. The duration of the programs ranged from 6 weeks to 6 months and the frequency from 2 to 7 times a week. Each session reached 30 to 90 minutes. Benefits were observed on lung function and functional exercise capacity but benefit was clearly stated neither on quality of life nor on dyspnea.
Conclusion. – This systematic review highlights the potential of these therapies as complementary therapeutic approach in COPD patients.

1. Introduction

The World Health Organization estimated that Chronic obstructive pulmonary disease (COPD) caused 3 million deaths in the world in 2015 and was responsible for about 5% of global disability–adjusted life years [1]. COPD is an irreversible lung disease characterized by impaired health-related quality of life (HRQOL) in relationship to dyspnea, anxiety, depression and reduced functional exercise capacity [2]. Therefore, optimizing HRQOL and dyspnea is a cornerstone of the treatment in these patients.

Complementary therapies involving movement or body positioning, meditation, and breathing control are gaining popularity, especially in Asia [3]. They look to improve physical and mental well-being. Tai Chi, Yoga, and Qigong are considered the most popular complementary health approaches [4] and they are feasible by all age groups with different health conditions. Tai chi and Qigong are coming from the philosophy of medicine and martial arts from China while Yoga originated in India. These approaches are closely related together and focus on body movement, breathing exercises and relaxation training.

These therapies have been explored in different diseases such as COPD. They demonstrated benefits on various outcomes such as depression, functional exercise capacity or lung function [5] and they have been recently included in evidence-based guidelines on the management of different chronic diseases. Recently, another systematic review has been addressed to summarize all the literature regarding the effects of the main complementary therapies (yoga, qi gong or tai chi) on the major outcomes found in COPD patients [6]. However, some important outcomes regarding functional exercise capacity and quality of life were not addressed.

The aim of this systematic review was to summarize the benefits of yoga, qi gong or tai chi on lung function, dyspnea, quality of life or functional exercise capacity in COPD patients.

2. Method

2.1. Protocol

This systematic review followed the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines for the stages of design, analysis, and reporting of the results [7].

* Corresponding author at: Pneumology Unit, cliniques universitaires St-Luc (UCL), avenue Hippocrate 10, 1200 Brussels, Belgium.
E-mail addresses: gregory.reychler@uclouvain.be (G. Reychler), William.poncin@uclouvain.be (W. Poncin), montigny.sophie@wanadoo.fr (S. Montigny), alain.luts@uclouvain.be (A. Luts), gilles.caty@uclouvain.be (G. Caty), thierry.pieters@uclouvain.be (T. Pieters).

https://doi.org/10.1016/j.resmer.2019.04.002

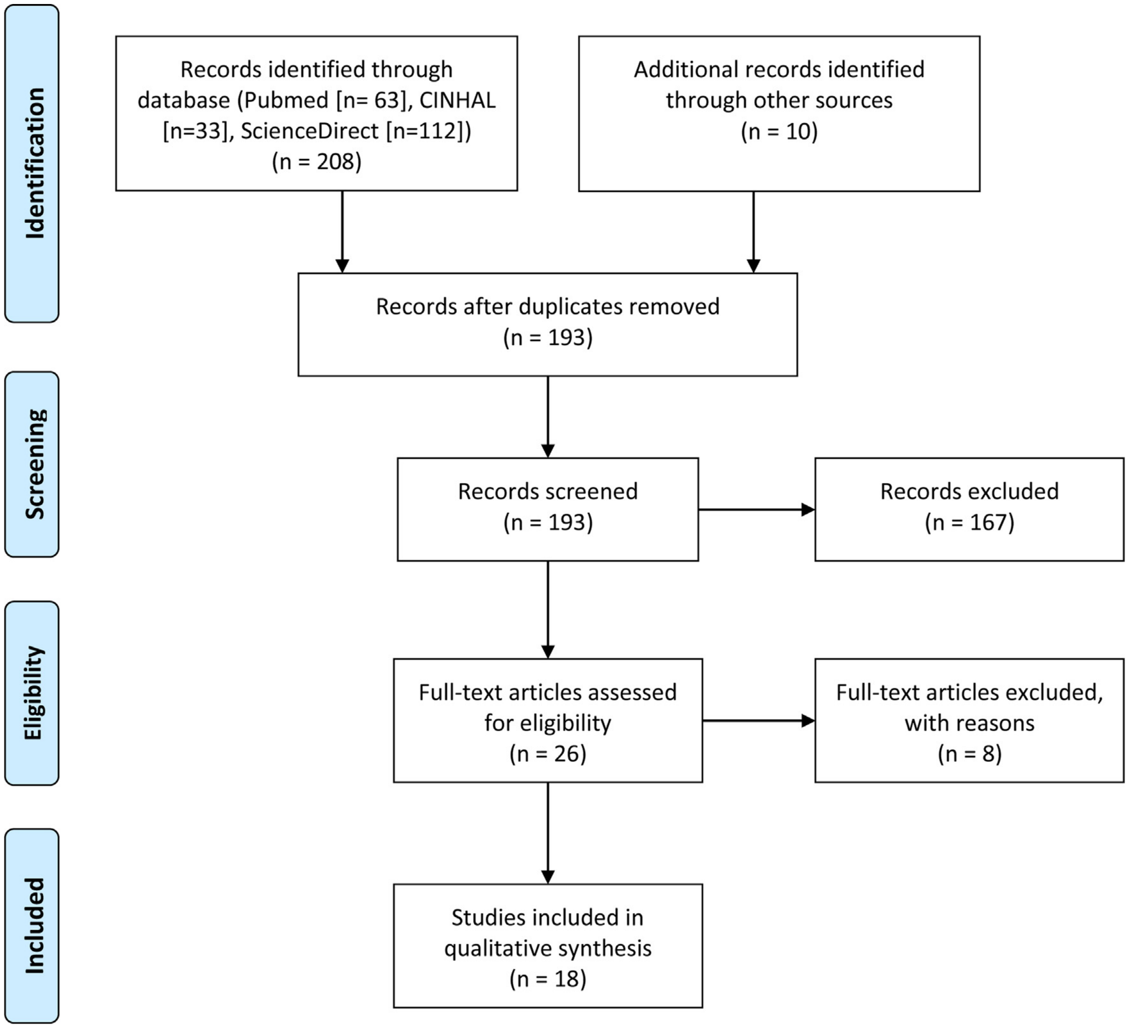

Fig. 1. Flow diagram (Prisma Statement).

According to these guidelines, structured search, studies selection, risk-of-bias assessment of individual studies and synthesis of the results of the retrieved studies were performed.

2.2. Eligibility criteria, sources and search strategy

PubMed, *CINHAL* and *ScienceDirect* online databases were screened for the primary search strategy from inception to January 2017. Different key terms were combined: "chronic obstructive pulmonary disease", "COPD", "chronic obstructive lung disease" and "yoga", "tai chi", "qi gong" for the patient and interventions category, respectively.

The full search strategy for *PubMed* was adapted for other databases using terms and medical subject headings (MeSH) combined with Boolean operators. A hand-searching reference lists from the identified articles, citation tracking of included articles, and use of the *PubMed* related articles option completed the database searches to avoid missing relevant studies.

2.3. Study selection and exclusion criteria

After duplicates' removal, a critical and independent check of the abstracts for relevance was performed by two independent investigators (S.M. and G.R.). Articles were included if they were evaluating effects of the selected complementary therapies on lung function, dyspnea, quality of life or functional exercise capacity in COPD patients, written in English or French and not classified as case report, review or meta-analysis. Studies about exacerbations or patients with concomitant diseases were excluded. The investigators reviewed full-text articles when inclusion or exclusion was unclear based on the title and abstract. Any disagreement about eligibility was resolved by a consensus meeting.

2.4. Data extraction, study quality appraisal and risk of bias assessment

Two investigators (S.M. and G.R.) extracted data from the retrieved studies. The design, sample characteristics (including number of participants, age group, gender, disease classification), intervention (therapy, frequency and duration) and outcomes related to quality of life or lung function were collected for each study.

The same two investigators assessed the internal validity of the randomized controlled and crossover studies using the PEDro scale and applied the quality Index developed by Downs and Black for assessing the quality of reporting (10 items), the external validity (3 items), the bias and confounding elements (13 items) and the statistical power (1 item) of all the studies. This quality index comprises 27 questions with a total maximum score of 28 [8]. A grade ranging from "poor" (< 14 points) to "excellent" (24–28 points) was assigned to each study evaluated by this quality index [8].

2.5. Data synthesis

The investigators considered the results of the studies. Descriptive results and mean comparison were reported.

3. Results

3.1. Study selection

Two hundred and eight references were originally retrieved from the three databases (Fig. 1). Ten additional records were identified from other sources. After removal of duplicates, 193 articles were identified and screened. At the end of the process, 18 studies were included in the systematic review.

3.2. Characteristics of the studies

3.2.1. Population

The characteristics of the populations are described in Table 1. Sample size of the studies varied from 10 to 206 patients for a total of 1893 patients. Age ranged from 40 to 80 years. Three studies included only men [9–11].

3.2.2. Interventions

Out of the retrieved studies, 17 were randomized controlled studies (RCT) and the other one was a longitudinal study. Six studies evaluated the effects of yoga. The other studies focused on tai chi or qi gong separately or combined.

The groups of the complementary therapies were compared to usual care or to interventions including or combining breathing exercises (diaphragmatic breathing or pursed lips breathing) or walking exercise. At baseline, the groups were similar. Only three studies showed difference at baseline for sex [12,13] and disease severity [14], respectively.

The characteristics of the different interventions are described in Table 1. The duration of the programs ranged from 6 weeks to 6 months and the frequency between 2 and 7 times a week. Each session reached 30 to 90 minutes. Different styles of these complementary therapies were investigated. Ninety percent of the studies mentioned clearly the teacher and his qualification. Seventy percent of the studies recommended to practice at home. In 58 percent of these studies proposing complementary exercises at home, the patients received a support (audiovisual, folder, pictures). Half of the studies included a regular control of the adherence by phone call, diary or electronic file. Only one study evaluated the effect of tai chi added to a pulmonary rehabilitation program but the comparator was relaxation [15].

3.2.3. Outcomes

The analyzed lung function parameters were usual (forced expiratory volume in one second and vital capacity) (10 studies). Quality of life was quantified by different specific or generic questionnaires and this evaluation included anxiety and depression (14 studies). Dyspnea was measured by the specific domain of the chronic respiratory questionnaire (CDBQ), the San Diego shortness of breath questionnaire or the Borg scale (8 studies). Functional performance was determined by different tests (14 studies): 6 minute walking test (6MWT), incremental (ISWT) or endurance shuttle walk test (ESWT) and modified physical performance battery test that assesses multiple dimensions of physical function with different levels of difficulty.

3.3. Quality and design of the studies

The quality assessment of the reviewed studies is presented in Table 1 and Table 2 in Online Supplement. RCT ranged from 4 to 8 on PEDro scale. Scores obtained by downs and black scale ranged from 8 to 25 and the median score was 20/28. Only one study was classified as “Poor” and seven as “Fair” in the quality appraisal. Eleven studies were grade as “Good” to “Excellent”.

3.4. Results of the studies

All the results are reviewed in Table 2 and the main results are summarized hereunder by outcome.

3.4.1. Effects on lung function

Forced expiratory volume in one second (FEV1) improved (from 40 to 420 mL) in half of the studies with statistical difference on this parameter between groups favoring complementary therapies [13,15–18]. The long-term studies showed a significant and clinical improvement whereas the short-term studies are less convincing. Four out of the 5 studies without improvement investigated yoga. Vital capacity improved in all studies (from 130 to 190 mL) (4 studies/4). The improvement was clinically significant for the short and long term studies.

3.4.2. Effects on dyspnea

Improvement of dyspnea was observed in all studies but the intergroup comparison was significantly different in only 50% of the studies [10,19,20]. All favored the complementary therapies. The effects are regardless the kind of the therapy. The distinction between the short and long term effects was not possible due to the heterogeneity of the studies.

3.4.3. Effects on quality of life

Benefits on quality of life were observed in 60% of the studies within intervention group and between intervention and control groups. When a generic questionnaire was used, no benefit was observed [20–22]. It appears that quality of life associated to symptoms showed the better improvement [10,12,19,23]. The benefit on emotion, anxiety or depression is less convincing. The effect on quality of life seems neither related to the kind of complementary therapy nor to the timing of evaluation (short or long term).

3.4.4. Effects on functional exercise capacity

Twelve studies evaluated the functional exercise capacity by the 6MWT and one study used the ISWT and ESWT.

The walked distance improved by more than 25 m for 6MWT in all except one study (+19 m) [21]. The improvement observed in the short-term studies was less important than in the long term studies. This latter study was based on a short (3 months) program of yoga. The improvement was different between groups in 10 out of the 12 studies.

The ISWT (+39 m) and ESWT (+336 s) improved also significantly and the difference was significant between groups. Modified physical performance battery test showed a greater improvement in intervention group.

4. Discussion

To our knowledge, even if they are systematic reviews on psychosocial intervention in COPD patients, none summarized the effects of yoga, tai chi, qi gong on the four main outcomes related to COPD. The results of this systematic review complete the previous systematic reviews that only examined the effect of Tai Chi or some outcomes related to one isolated complementary therapy and highlight the benefits of these complementary therapies on these outcomes in COPD patients.

One of the main findings of this systematic review is the long-term benefit of these complementary therapies. Indeed, the long term follow-up of patients involved in a program based on one

Table 1
Characteristics of the retrieved studies.

Author	Year of publication	Type of study	Sample size	Age	Gender	Disease severity	Intervention	Program	Drop out (decl–stop)
Kulpati et al. [9]	1982	RCT	*n* = 75 GY = 25 GE = 25 CG = 25	GY = 50.6 ± 12.2 GE = 48.1 ± 8.4 CG = 49.2 ± 10.0	75 ♂	NA	Yoga (asanas)	GY: 3 months, 30 min yoga, 2t/d. GE: 3 months, 30 min PLB + DB + postural drainage, 2t/d. CG: Usual care	NA
Donesky-Cuenco et al. [21]	2009	Pilot RCT	*n* = 29 GY = 14 CG = 15	69.9 ± 9.5 GQ = 72.2 ± 6.5 CG = 67.7 ± 11.5	GY: ♂ = 4 ♀ = 10 CG: ♂ = 4 ♀ = 11	Stable COPD	Yoga (Iyengar + asanas)	GY: 3 months, 1 h yoga, 2t/w. CG: Usual care.	46/210–1/20
Chan et al. [12]	2010	RCT	*n* = 206 GTQ = 70 GE = 69 CG = 67	64-82 GTQ = 71.7 ± 8.2 GE = 73.6 ± 7.5 CG = 73.6 ± 7.4	GTQ: ♂ = 69 ♀ = 1 GE: ♂ = 61 ♀ = 8 CG: ♂ = 58 ♀ = 9	GOLD I/2/3 GTQ = 7/31/32 GE = 13/26/30 CG = 12/29/26	Taichi + Qigong (Breathing regulating)	GTQ: 3 months, 60 min taichi + qi gong, 4t/w. GE: 3 months 60 min BE + walking, 7t/w. CG: Usual care.	154/243–2/70
Yeh et al. [31]	2010	RCT	*n* = 10 GT = 5 CG = 5	GT = 65 ± 6 CG = 66 ± 6	GT: ♂ = 3 ♀ = 2 CG: ♂ = 3♀ = 2	FEV1 < 65%	Taichi	GT: 3 months, 1 h taichi, 2t/w supervised + 3t/w at home. CG: Usual care.	20/84–1/5
Chan et al. [13]	2011	RCT	*n* = 206 GTQ = 70 GE = 69 CG = 67	GTQ = 71.7 ± 8.2 GE = 73.6 ± 7.5 CG = 73.6 ± 7.4	GTQ: ♂ = 69 ♀ = 1 GE: ♂ = 61 ♀ = 8 CG: ♂ = 58 ♀ = 9	GOLD 1/2/3 GTQ = 7/31/32 GE = 13/26/30 CG = 12/29/26	Taichi + Qigong (Breathing regulating)	GTQ: 3 months, 60 min taichi + qigong, 2t/w. GE: 3 months 60 min BE + walking, 7t/w. CG: Usual care.	154/243–2/70
Ng et al. [22]	2011	RCT	*n* = 80 GQ = 40 CG = 40	GQ = 71.7 ± 1.1 GE = 73.1 ± 1.3	GQ: ♂ = 37 ♀ = 3 CG: ♂ = 34♀ = 6	FEV1 < 70%	Qigong (Baduanjin)	GQ: 6 months, 45 min qigong, 4t/w. GE: 15 min PLB + 30 min walking/d, 4t/w.	2/83–7/40
Fulambaker et al. [48]	2012	Longitudinal study	*n* = 33	NA	NA	COPD stable	Yoga (pranayama, asanas, kapalabhati, sithali)	6 weeks, 1 h yoga, 3t/w.	NA
Liu et al. [30]	2012	RCT	*n* = 118 GQ = 51 GPR = 32 CG = 35	GQ = 61.8 ± 7.7 GPR = 61.3 ± 8.3 CG = 62.2 ± 6.3	GQ: ♂ = 40 ♀ = 11 GPR: ♂ = 23 ♀ = 9 CG: ♂ = 28 ♀ = 7	GOLD 1/2: GQ = 25/26 GPR = 15/17 CG = 17/18	Qigong (Helath)	GQ: 6 months, 1 h qigong, 3t/w GE: 1 h PLB + walking or ball game, 3t/w. CG: Usual care.	3/140–5/60
Chan et al. [16]	2013	RCT	*n* = 206 GTQ = 70 GE = 69 CG = 67	GTQ = 71.7 ± 8.2 GE = 73.6 ± 7.5 CG = 73.6 ± 7.4	GTQ: ♂ = 69 ♀ = 1 GE: ♂ = 61 ♀ = 8 CG: ♂ = 58 ♀ = 9	GOLD 1/2/3: GTQ = 7/31/32 GE = 13/26/30 CG = 12/29/26	Taichi + Qigong (Breathing regulating)	GTQ: 3 months, 60 min taichi + qigong, 4t/w GE: 3 months, 60 min BE + walking, 7t/w. CG: Usual care.	154/243–4/70
Chan et al. [24]	2013	RCT	*n* = 206 GTQ = 70 GE = 69 CG = 67	GTQ = 71.7 ± 8.2 GE = 73.6 ± 7.5 CG = 73.6 ± 7.4	GTQ: ♂ = 69 ♀ = 1 GE: ♂ = 61 ♀ = 8 CG: ♂ = 58 ♀ = 9	GOLD 1/2/3: GTQ = 7/31/32 GE = 13/26/30 CG = 12/29/26	Taichi et Qigong (Breathing regulating)	GTQ: 3 months, 60 min taichi + qigong, 4t/w. GE: 3 months, 60 min BE + walking, 7t/w CG: Usual care.	154/243–4/70

Table 1 (*Continued*)

Author	Year of publication	Type of study	Sample size	Age	Gender	Disease severity	Intervention	Program	Drop out (decl–stop)
Leung et al. [19]	2013	Pilot RCT	*n* = 42 GT = 22 CG = 20	73 ± 8	27 ♂–15 ♀	FEV1 < 80%	Taichi (Sun style)	GT: 2 weeks, 1 h taichi, 2t/w + 30 min/j at home, then 3 months unsupervised, 30 min/j. CG: Usual care.	25/139–0/22
Gupta et al. [23]	2014	RCT	*n* = 50 GY = 25 CG = 25	GQ = 52.5 ± 3.9 CG = 52.0 ± 4.1	GY: ♂ = 24 ♀ = 1 CG: ♂ = 24♀ = 1	GOLD 2/3 (NA)	Yoga (pranayama, asanas)	GY: 6 months, 30 min Pranayam yoga, 14t/w. CG: Usual care.	NA
Ng et al. [15]	2014	Pilot RCT	*n* = 192 GT = 94 GPR = 98	GT = 74.2 ± 6.5 GPR = 74.1 ± 6.8	GT: ♂ = 88 ♀ = 6 GPR: ♂ = 87♀ = 11	NA	Taichi (Sun style)	GT: 6 months, 1h05 PR + 15 min taichi, 5 to 7t/w. GPR: 6 months, 1h05 PR + 15 min relaxation, 5 to 7t/w.	30/398–2/72
Niu et al. [17]	2014	Pilot RCT	*n* = 40 GT = 20 CG = 20	GT = 59.7 ± 2.8 CG = 61.3 ± 2.9	GT: ♂ = 19 ♀ = 1 CG: ♂ = 18♀ = 2	GOLD 2/3 + FEV1 < 65%	Taichi	GT: 6 months, 50 min taichi, 7t/w (4 supervised and 3 at home). CG: Usual care.	2/52–0/20
Xiao et al. [20]	2015	RCT	*n* = 126 GQ = 63 CG = 63	65–85 71.1 ± 2.27 GQ = 70.9 ± 1.4 CG = 72.2 ± 1.7	GQ: ♂ = 59 ♀ = 4 CG: ♂ = 58 ♀ = 5	FEV1 < 70%	Qigong (Liuzije)	GQ: 6 months, 45 min qigong + 30 min walking/d, 7 to 4t/w. GE: 6 months, 45 min PLB + 30 min walking/d, 7 to 4t/w.	2/129–2/63
Ranjita et al. [10]	2016	RCT	*n* = 72 GY = 36 CG = 36	36–60 GY = 53.7 ± 5.7 CG = 54.4 ± 5.4	72 ♂	GOLD 2/3: GY = 19/17 CG = 21/15	Yoga (Pranayama, asanas)	GY: 3 months, 90 min yoga, 6t/w. CG: Usual care.	9/81–4/41
Ranjita et al. [11]	2016	RCT	*n* = 72 GY = 36 CG = 36	36–60 GY = 53.7 ± 5.7 CG = 54.4 ± 5.4	72 ♂	GOLD 2/3: GY = 19/17 CG = 21/15	Yoga (Pranayama, asanas)	GY: 3 months, 90 min yoga, 6t/w. CG: Usual care.	36/279–4/41
Zhang et al. [18]	2016	Pilot RCT	*n* = 130 GQ = 42 GE = 43 CG = 45	58–72 GQ = 64.8 ± 11.1 GE = 63.3 ± 7.9 CG = 62.4 ± 9.3	GQ: ♂ = 33 ♀ = 9 GE: ♂ = 32 ♀ = 11 CG: ♂ = 35 ♀ = 10	Gold 1/2/3: GQ = 9/30/3 GE = 8/29/6 CG = 11/26/4	Qigong (Yi Jinjing)	GQ: 6 months, 60 min qigong, 7t/w (3 supervised and 4 at home). GE: 6 months, 60 min walking + DB + PLB, 7t/w. CG: Usual care.	NA

RCT: Randomized controlled trail; GPR: Group Pulmonary rehabilitation; GE: Group Exercise; GY: Group Yoga; GT: Group Taich i; GQ: Group Qigong; GTQ: Group Taichi: Qigong; CG: Control group; FEV1: Forced expiratory volume in one second; BE: breathing exercise; DB: Diaphragmatic breathing; PLB: Pursed-lips breathing; NA: Non available; decl: decline to participate; d: discontinue (voluntary) the intervention.

Table 2
Results of the studies.

Lung function Studies	FEV1			
Kulpati et al., 1982 [9]	Initial (L): CG = 1.29 ± 0.51 GE = 1.19 ± 0.55 GY = 1.31 ± 0.45	After 3 months: CG = 1.11 ± 0.39 GE = 1.14 ± 0.56 GY = 1.35 ± 0.44		NS
Donesky-Cuenco et al., 2009 [21]	Initial (% predicted): CG = 44.4 ± 19.0 GY = 51.2 ± 10.5	After 3 months: CG = 45.9 ± 20.2 GY = 51.2 ± 10.6		$P = 0.49$
Chan et al., 2011 [13]	Initial (L): CG = 0.89 ± 0.39 GE = 0.91 ± 0.39 GTQ = 0.89 ± 0.38	After 6 weeks: CG = 0.85 ± 0.36 GE = 0.92 ± 0.39 GTQ = 0.96 ± 0.40 After 3 months: CG = 0.85 ± 0.35 GE = 0.92 ± 0.38 GTQ = 0.96 ± 0.39		GTQ vs CG: $P = 0.001$ GTQ vs GE: $P = 0.001$
Fulambaker et al., 2012 [48]	Initial (L): 1.38 ± 0.58	After 6 weeks: 1.41 ± 0.63	$P = 0.499$	
Liu et al., 2012 [30]	Initial (% predicted): CG = 75.31 ± 13.79 GE = 75.31 ± 12.84 GQ = 74.43 ± 12.93	After 6 months: CG = 75.34 ± 12.89 GE = 76.22 ± 12.47 GQ = 75.47 ± 12.43		$P = 0.95$
Chan et al., 2013 [24]	Initial (L): CG = 0.89 ± 0.39 GE = 0.91 ± 0.39 GTQ = 0.89 ± 0.38	After 3 months: CG = 0.85 ± 0.35 GE = 0.92 ± 0.38 GTQ = 0.96 ± 0.39 After 6 months: CG = 0.84 ± 0.39 GE = 0.94 ± 0.42 GTQ = 0.99 ± 0.42		$P < 0.001$
Gupta et al., 2014 [23]	Initial (% predicted): CG = 49.6 ± 8.6 GY = 51.2 ± 8.7	After 3 months: CG = 49.1 ± 8.7 GY = 53.3 ± 8.8		$P > 0.05$
Ng et al., 2014 [15]	Initial (L): GE = 1.23 ± 0.45 GT = 1.10 ± 0.45	After 2 months: GE = 1.31 ± 0.55 GT = 1.20 ± 0.50 After 6 months: GE = 1.28 ± 0.51 GT = 1.21 ± 0.52	GE: $P = 0.045$ at 2 months and $P = 0.140$ at 6 months GT: $P < 0.001$ at 2 and 6 months	
Niu et al., 2014 [17]	Initial (L): CG = 1.18 ± 0.09 GT = 1.21 ± 0.10	After 6 months: CG = 1.18 ± 0.09 GT = 1.43 ± 0.08		$P = 0.038$
Zhang et al., 2016 [18]	Initial (L): CG = 1.65 ± 0.43 GE = 1.68 ± 0.43 GQ = 1.70 ± 0.55	After 3 months: CG = 1.62 ± 0.51 GE = 1.72 ± 0.72 GQ = 1.91 ± 0.28 After 6 months: CG = 1.61 ± 0.38 GE = 1.83 ± 0.53 GQ = 2.12 ± 0.37	GQ: $P < 0.001$	$P < 0.001$
Vital capacity (L)				
Chan et al., 2011 [13]	Initial (L): CG = 1.82 ± 0.58 GE = 1.84 ± 0.52 GTQ = 1.97 ± 0.62	After 6 weeks: CG = 1.73 ± 0.56 GE = 1.87 ± 0.59 GTQ = 2.08 ± 0.65 After 3 months: CG = 1.74 ± 0.58 GE = 1.92 ± 0.63 GTQ = 2.10 ± 0.62		GTQ vs GE: $P = 0.002$ GTQ vs CG: $P = 0.002$
Fulambaker et al., 2012 [48]	Initial (L): 2.30 ± 0.71	After 6 weeks: 2.45 ± 0.78	$P = 0.02$	
Chan et al., 2013 [24]	Initial (L): CG = 1.82 ± 0.58 GE = 1.84 ± 0.52 GTQ = 1.97 ± 0.62	After 3 months: CG = 1.74 ± 0.58 GE = 1.92 ± 0.63 GTQ = 2.10 ± 0.62 After 6 months: CG = 1.69 ± 0.48 GE = 1.95 ± 0.62 GTQ = 2.16 ± 0.63		$P < 0.001$

Table 2 (*Continued*)

Lung function Studies	FEV1			
Ng et al., 2014 [15]	Initial (L): GE = 2.26 ± 0.80 GT = 2.05 ± 0.66	After 2 months: GE = 2.33 ± 0.94 GT = 2.20 ± 0.75 After 6 months: GE = 2.26 ± 0.77 GT = 2.18 ± 0.75	GT: *P*= 0.003 and *P* = 0.013 at 2 and 6 months	
Dyspnea Borg				
Chan et al., 2011 [13] and 2013 [24]	Initial: CG = 1.51 ± 1.43 GE = 1.38 ± 1.74 GTQ = 1.98 ± 1.21	After 3 months: CG = 2.06 ± 1.53 GE = 1.70 ± 1.38 GTQ = 1.86 ± 1.25 After 6 months: CG = 1.84 ± 1.48 GE = 1.57 ± 1.28 GTQ = 1.81 ± 1.20		*P* = 0.052
Ranjita et al., 2016 [11]	Initial: CG = 5.25 ± 1.61 GY = 5.08 ± 1.40	After 3 months: CG = 4.93 ± 2.02 GY = 3.84 ± 1.75		*P* = 0.018
Chronic Respiratory Questionnaire (dyspnea domain)				
Yeh et al., 2010 [31]	Initial: CG = 6.0 (5.4–7.0) GT = 4.4 (1.8–6.0)	After 3 months: CG = 6.4 (5.2–6.8) GT = 5.7 (4.4–6.7)		*P* = 0.29
Ng et al., 2011 [22]	Initial: CG = 5.03 ± 0.17 GQ= 4.76 ± 0.19	After 6 months: CG = +0.25 ± 1.05 GQ = +0.29 ± 1.12		*P* = 0.87
Leung et al., 2013 [19]	Initial: CG =3.8 ± 1 GT = 3.6 ± 1	After 3 months: CG = 3.7 ± 1 GT = 4.4 ± 1		S (*P*: NA)
Xiao & Zhuang. 2015 [20]	Initial: CG = 5.0 ± 0.2 GQ = 5.0 ± 0.2	After 6 months: CG = 5.0 ± 0.2 GQ = 5.8 ± 0.3		*P* = 0.05
San Diego Shortness of Breath				
Yeh et al., 2010 [31]	Initial: CG = 20 (6–50) GY = 39 (23–69)	After 3 months: CG = 22 (12–37) GY = 27 (19–58)		*P* = 0.40
Quality of life Chronic Respiratory Questionnaire				
Donesky-Cuenco et al., 2009 [21]	Fatigue Initial: CG = 16.0 ± 3.7 GY = 18.0 ± 4.4 Emotion Initial: CG = 34.1 ± 6.3 GY = 35.7 ± 5.0 Mastery Initial: CG = 19.5 ± 5.0 GY = 22.4 ± 3.5	Fatigue After 3 months: CG = 16.3 ± 5.2 GY = 16.8 ± 5.1 Emotion After 3 months: CG = 35.1 ± 6.2 GY = 35.4 ± 5.9 Mastery After 3 months: CG = 19.4 ± 5.3 GY = 22.4 ± 4.0		Fatigue *P* = 0.34 Emotion *P* = 0.28 Mastery *P* = 0.85
Yeh et al., 2010 [31]	Fatigue Initial: CG = 5.0 (4.0–6.2) GT = 3.7 (2.7–5.2) Emotion Initial: CG = 5.8 (4.4–7.0) GT = 4.4 (18–4.8) Mastery Initial: CG = 6.0 (4.0–7.0) GT = 4.2 (3.5–5.5)	Fatigue After 3 months: CG = 5.7 (3.7–6.0) GT = 5.2 (4.0–6.0) Emotion After 3 months: CG = 4.7 (4.1–6.7) GT = 5.0 (4.1–6.1) Mastery After 3 months: CG = 5.7 (4.2–7.0) GT = 6.5 (3.7–7.0)		Fatigue *P* = 0.17 Emotion *P* = 0.04 Mastery *P* = 0.07
Ng et al., 2011 [22]	Fatigue Initial: CG = 4.69 ± 0.20 GQ = 4.66 ± 0.18 Emotion Initial: CG = 5.31 ± 0.20 GQ = 5.05 ± 0.20	Fatigue After 6 months: CG = –0.07 ± 1.32 GQ = +0.11 ± 0.82 Emotion After 6 months: CG = –0.07 ± 0.85 GQ = +0.24 ± 1.23		Fatigue *P* = 0.48 Emotion *P* = 0.11

Table 2 (*Continued*)

Lung function Studies	FEV1			
	Mastery Initial: CG = 5.27 ± 0.19 GQ = 5.01 ± 0.19	Mastery After 6 months: CG = +0.21 ± 1.07 GQ= +0.48 ± 1.13		Mastery *P* = 0.28
Leung et al., 2013 [19]	Fatigue Initial: CG = 4.3 ± 1 GT = 4.8 ± 1 Emotion Initial: CG = 5.0 ± 2 GT = 5.6 ± 1 Mastery Initial: CG = 5.2 ± 1 GT = 5.6 ± 1	Fatigue After 3 months: CG = 4.2 ± 1 GT = 5.3 ± 1 Emotion After 3 months: CG = 5.0 ± 2 GT = 6.0 ± 1 Mastery After 3 months: CG = 5.1 ± 1 GT = 6.0 ± 1		Fatigue S (*P*: NA) Emotion S (*P*: NA) Mastery S (*P*: NA)
Xiao & Zhuang., 2015 [20]	Fatigue Initial: CG = 4.7 ± 0.3 GQ = 4.6 ± 0.2 Emotion Initial: CG = 5.2 ± 0.1 GQ = 5.4 ± 0.2 Mastery Initial: CG = 5.2 ± 0.2 GQ = 5.6 ± 0.2	Fatigue After 6 months: CG = 4.8 ± 0.2 GQ = 4.9 ± 0.2 Emotion After 6 months: CG = 5.1 ± 0.3 GQ = 5.8 ± 0.2 Mastery After 6 months: CG = 5.1 ± 0.2 GQ = 6.0 ± 0.2		Fatigue *P* = 0.85 Emotion *P* = 0.35 Mastery *P* = 0.44
Short Form 36				
Donesky-Cuenco et al., 2009 [21]	Physical domain: Initial: CG = 38.6 ± 8.4 GY = 36.8 ± 10.4 Mental domain: Initial: CG = 51.5 ± 9.3 GY = 54.2 ± 6.1	Physical domain: After 3 months: CG = 36.8 ± 8.8 GY = 35.4 ± 9.7 Mental domain: After 3 months: CG = 52.3 ± 9.6 GY = 54.8 ± 8.0		Physical domain: *P* = 0.87 Mental domain: *P* = 0.93
Ng et al., 2011 [22]	Initial: CG = 49.48 ± 3.69 GQ = 42.58 ± 3.38		After 6 months: CG: −4.0 ± 19.17 GQ: +1.4 ± 17.66	*P* = 0.39
Xiao & Zhuang., 2015 [20]	Physical domain: Initial: CG = 66.6 ± 4.1 GQ = 64.8 ± 4.0 Total score: Initial: CG = 48.4 ± 3.6 GQ = 43.9 ± 3.5	Physical domain: After 6 months: CG = 74.1 ± 4.9 GY = 72.3 ± 5.6 Total score: After 6 months: CG = 47.3 ± 5.0 GY = 51.8 ± 5.6		Physical domain: *P* = 0.82 Total score: *P* = 0.54
Saint-George's Respiratory Questionnaire				
Chan et al., 2010 [12]	Initial: CG = 39.4 ± 16.2 GE = 37.0 ± 16.6 GTQ = 42.7 ± 15.1	After 6 weeks: CG = 41.5 ± 15.4 GE = 39.3 ± 15.7 GTQ = 41.2 ± 15.8 After 3 months: CG = 43.4 ± 14.8 GE = 40.4 ± 16.1 GTQ = 41.8 ± 15.2		*P* = 0.065 Symptoms: *P* = 0.010 Activity: *P* = 0.35
Fulambaker et al., 2012 [48]	Initial: 50.80 ± 17.30	After 6 weeks: 41.09 ± 18.67	*P* < 0.0001	
Chan et al., 2013 [16]	Initial: CG = 39.4 ± 16.2 GE = 37.0 ± 16.6 GTQ = 42.7 ± 15.1	After 3 months: CG = 43.4 ± 14.8 GE = 40.4 ± 16.1 GTQ = 41.8 ± 15.2 After 6 months: CG = 44.1 ± 15.0 GE = 41.6 ± 15.7 GTQ = 40.3 ± 16.9		*P* = 0.002

Table 2 (*Continued*)

Lung function Studies	FEV1			
Ng et al., 2014 [15]	Initial: GE = 30.44 ± 17.16 GT= 34.89 ± 18.39	After 2 months: GE = 26.40 ± 16.60 GT = 30.16 ± 18.39 After 3 months: GE = 26.72 ± 18.39 GT = 28.60 ± 18.33	GT: $P < 0.001$ at 2 months and at 6 months GE: $P < 0.001$ at 2 months and $P = 0.026$ at 6 months	
COPD Assessment Test				
Gupta et al., 2014 [23]	Initial: CG = 21.6 ± 2.7 GY = 21.2 ± 2.7	After 3 months: CG = 21.4 ± 2.7 GY = 17.4 ± 2.5	CG: NS GY: $P < 0.001$	<0.001
Ranjita et al., 2016 [10]	Initial: CG = 21.81 ± 5.48 GY = 20.69 ± 5.53	After 3 months: CG = 22.36 ± 5.65 GY = 15.92 ± 6.51		$P = 0.001$
Zhang et al., 2016 [18]	Initial: CG = 27.46 ± 6.71 GE = 28.47 ± 5.19 GQ = 27.67 ± 6.24	After 3 months: CG = 29.27 ± 5.37 GE = 26.07 ± 5.28 GQ = 23.22 ± 6.89 After 6 months: CG = 30.15 ± 7.18 GE = 25.18 ± 4.27 GQ = 21.78 ± 4.62		$P < 0.001$
Modified Borg scale (Fatigue)				
Chan et al., 2011 [13]	Initial: CG = 1.31 ± 1.44 GE = 1.38 ± 1.42 GTQ = 1.49 ± 1.46	After 6 weeks: CG = 1.78 ± 1.61 GE = 1.38 ± 1.36 GTQ = 1.72 ± 1.35 After 3 months: CG = 1.66 ± 1.37 GE = 1.42 ± 1.32 GTQ = 1.56 ± 1.39		NA
Chan et al., 2013 [24]	Initial: CG = 1.31 ± 1.44 GE = 1.38 ± 1.42 GTQ = 1.49 ± 1.46	After 3 months: CG = 1.66 ± 1.37 GE = 1.42 ± 1.32 GTQ = 1.56 ± 1.39 After 6 months: CG = 1.43 ± 1.331 GE = 1.52 ± 1.34 GTQ = 1.53 ± 1.32		$P = 0.379$
Ranjita et al., 2016 [10]	Initial: CG = 4.78 ± 1.69 GY = 4.91 ± 1.34	After 3 months: CG = 4.51 ± 1.68 GY = 3.64 ± 1.64		$P = 0.028$
Zhongshan questionnaire				
Liu et al., 2012 [30]	Activity of daily life Initial: CG = 22.43 ± 3.11 GE = 22.42 ± 3.39 GQ = 22.73 ± 3.07 Anxiety Initial: CG = 14.77 ± 2.66 GE = 14.69 ± 2.53 GQ = 15.41 ± 2.70 Depression Initial: CG = 12.69 ± 1.92 GE = 12.19 ± 1.94 GQ = 12.78 ± 1.90	Activity of daily life After 6 months: CG = 21.83 ± 2.89 GE = 20.38 ± 3.00 GQ = 19.04 ± 2.95 Anxiety After 6 months: CG = 15.03 ± 2.81 GE = 13.47 ± 2.62 GQ = 13.57 ± 2.62 Depression After 6 months: CG = 12.71 ± 1.99 GE = 11.41 ± 1.52 GQ = 11.39 ± 1.92		Activity of daily life GQ vs CG: $P < 0.001$ Anxiety GE vs CG: $P = 0.05$ GQ vs CG: $P = 0.04$ Depression GE vs CG: $P = 0.01$ GQ vs CG: $P < 0.001$
Chronic obstructive pulmonary disease Self-Efficacy Scale				
Ng et al., 2014 [15]	Initial: GE = 0.684 ± 0.165 GT = 0.638 ± 0.152	After 2 months: GE = 0.704 ± 0.160 GT = 0.665 ± 0.14 After 6 months: GE = 0.733 ± 0.143 GT = 0.685 ± 0.137	GE at 6 months: $P < 0.001$ GT at 2 and 6 months: $P < 0.001$	
Monitored functional task evaluation				
Ng et al., 2011 [22]	Initial: CG = 17.53 ± 0.53 GQ =17.23 ± 0.45	After 6 months: CG: +0.505 ± 1.78) GQ: +1.07 ± 3.08)		$P = 0.31$

Table 2 (*Continued*)

Lung function Studies	FEV1		
Xiao & Zhuang., 2015 [20]	Initial: CG = 17.8 ± 0.6 GQ = 17.5 ± 0.5	After 6 months: CG = 18.4 ± 0.3 GQ = 19.3 ± 0.4	*P* = 0.07
Center of epidemiological depression scale			
Donesky-Cuenco et al., 2009 [21]	Initial: CG = 12.6 ± 9.4 GY = 9.5 ± 4.5	After 3 months: CG = 11.4 ± 6.0 GY = 9.8 ± 7.0	*P* = 0.48
Yeh et al., 2010 [31]	Initial: CG = 12 (2-17) GY = 14 (11-46)	After 3 months: CG = 8 (0–17) GY = 5 (1–27)	*P* = 0.24
Bode Depression index			
Ranjita et al., 2016 [10]	Initial: CG = 24.14 ± 9.21 GY = 22.25 ± 8.4	After 3 months: CG = 23.36 ± 10.49 GY = 16.56 ± 7.03	*P* = 0.002
Leung et al., 2013 [19]	Depression Initial: CG = 3 ± 2 GT = 4 ± 3 Anxiety Initial: CG = 5 ± 4 GT = 4 ± 3	Depression After 3 months: CG = 4 ± 4 GT = 3 ± 3 Anxiety After 3 months: CG = 6 ± 6 GT = 3 ± 3	Depression NS (*P*: NA) Anxiety S (*P*: NA)
Spielberg state anxiety inventory			
Donesky-Cuenco et al., 2009 [21]	Initial: CG = 33.8 ± 9.0 GY = 30.2 ± 8.0	After 3 months: CG = 32.3 ± 9.1 GY = 31.0 ± 8.8	*P* = 0.51
State-trait anxiety inventory			
Ranjita et al., 2016 [10]	Initial: CG = 77.78 ± 19.27 GY = 80.67 ± 16.06	After 3 months: CG = 79.11 ± 19.77 GY = 68.86 ± 17.96	*P* = 0.024
Regulatory emotion self-efficacy questionnaire			
Zhang et al., 2016 [18]	Initial: CG = 34.69 ± 4.37 GE = 33.89 ± 3.89 GQ = 35.12 ± 5.36	After 3 months: CG = 33.09 ± 4.76 GE = 33.01 ± 5.78 GQ = 41.21 ± 8.19 After 6 months: CG = 33.23 ± 5.68 GE = 32.29 ± 4.69 GQ = 41.59 ± 6.98	*P* < 0.001
Functional exercise capacity 6 Minutes walk test			
Donesky-Cuenco et al., 2009 [21]	Initial (m): CG = 460.5 ± 60.8 GY = 423.0 ± 124.4	After 3 months: CG = 452.1 ± 69.8 GY = 442.8 ± 123.8	*P* = 0.04
Yeh et al., 2010 [31]	Initial (m): CG = 422 (121–526) GT = 401 (240–575)	After 3 months: CG = 381 (121–522) GT = 428 (379–624)	*P* = 0.09
Chan et al., 2011 [13]	Initial (m): CG = 289.75 ± 72.97 GE = 284.64 ± 79.11 GTQ = 297.91 ± 68.53	After 6 weeks: CG = 283.55 ± 82.25 GE = 291.33 ± 84.82 GTQ = 316.37 ± 60.15 After 3 months: CG = 294.57 ± 78.05 GE = 290.04 ± 80.09 GTQ = 330.74 ± 61.86	GTQ vs CG: *P* = 0.001 GTQ vs GE: *P* = 0.001
Ng et al., 2011 [22]	Initial (m): CG: 310.15 ± 15.0 GQ: 310.8 ± 10.7	After 6 months (m): CG:+10.65 ± 59.43 GQ:+27.25 ± 52.26	*P* = 0.26
Liu et al., 2012 [30]	Initial (m): CG = 381.91 ± 28.94 GE = 378.91 ± 31.03 GQ = 375.28 ± 31.12	After 6 months: CG = 407.14 ± 22.75 GE = 435.69 ± 23.78 GQ = 434.53 ± 28.70	GE vs CG: *P* < 0.001 GQ vs CG: *P* < 0.001
Chan et al., 2013 [24]	Initial (m): CG = 289.75 ± 72.97 GE = 284.64 ± 79.11 GTQ = 297.91 ± 68.53	After 3 months: CG = 294.57 ± 78.05 GE = 290.04 ± 80.09 GTQ = 330.74 ± 61.86 After 6 months: CG = 297.09 ± 85.25 GE = 298.07 ± 87.74 GTQ = 349.41 ± 70.69	*P* < 0.001

Table 2 (*Continued*)

Lung function Studies	FEV1			
Gupta et al., 2014 [23]	Initial (m): CG = 251.1 ± 38.0 GY = 257.1 ± 40.5	After 3 months: CG = 249.2 ± 36.8 GY = 264.0 ± 4.0		$P < 0.05$
Ng et al., 2014 [15]	Initial (m): GE = 320.2 ± 71.86 GT = 312.1 ± 64.15	After 2 months: GE = 241.0 ± 73.81 GT = 339.5 ± 69.43 After 6 months: GE = 335.1 ± 68.49 GT = 340.2 ± 74.20	GE vs GT: $P < 0.001$	
Niu et al., 2014 [17]	Initial (m): CG = 422 ± 20.0 GT = 431 ± 22.8	After 6 months: CG = 416 ± 22.5 GT = 476 ± 15.0		$P = 0.031$
Xiao & Zhuang., 2015 [20]	Initial (m): CG = 301.0 ± 13.5 GQ = 301.0 ± 10.9	After 6 months: CG = 310.9 ± 14.4 GQ = 321.5 ± 15.5		$P = 0.04$
Ranjita et al., 2016 [10]	Initial (m): CG = 304.67 ± 67.59 GY = 298.36 ± 65.20	After 3 months: CG = 321.08 ± 80.17 GY = 375.81 ± 73.45		$P = 0.047$
Zhang et al., 2016 [18]	Initial (m): CG = 294.18 ± 9.12 GE = 295.47 ± 10.29 GQ = 294.34 ± 7.89	After 3 months: CG = 293.18 ± 6.17 GE = 298.12 ± 10.11 GQ = 312.22 ± 9.09 After 6 months: CG = 292.95 ± 8.89 GE = 302.25 ± 7.74 GQ = 324.23 ± 10.67	GQ: S (*P*: NA)	$P < 0.001$
Timed up and go				
Yeh et al., 2010 [31]	Initial (s): CG = 9 (7–20) GT = 10 (7–13)	After 3 months: CG = 8 (6–17) GT = 8 (5–9)		$P = 0.44$
Incremental shuttle walk test				
Leung et al., 2013 [19]	Initial (m): CG = 402 ± 179 GT = 349 ± 136	After 3 months: CG = 386 ± 169 GT = 388 ± 135		S (*P*: NA)
Endurance shuttle walk test				
Leung et al., 2013 [19]	Initial (s): CG = 442 ± 334 GT = 467 ± 276	After 3 months: CG = 430 ± 383 GT = 803 ± 364		S (*P*: NA)
Modified physical performance battery test				
Leung et al., 2013 [19]	Initials: CG = 2.35 ± 0.5 GT = 2.16 ± 0.4	After 3 months CG = 2.25 ± 0.5 GT = 2.31 ± 0.5		S (*P*: NA)

GE: Group Exercise; GY: Group Yoga; GT: Group Tai chi; GQ: Group Qigong; GTQ: Group Tai chi + Qigong; CG: Control group; FEV1: Forced expiratory volume in one second; BE: breathing exercise; DB: Diaphragmatic breathing; PLB: Pursed-lips breathing; NS: Non significant.

of these therapies showed more benefits than the short term follow-up of the same patients [12,13,16,24,25]. It can be also related to the learning effect of these therapies. It is commonly accepted that these therapies improves with the practice. In these studies, the minimal clinically important difference (MCID) of the different outcomes was only reached after 3 months. It means that these therapies produced a slow but increasing effect with the time. Moreover, the rate of adherence was good. Only a few people discontinued the program of the complementary therapy even if a great number of patients refused to be included in the studies.

A positive impact of all these complementary therapies was observed on lung function similarly to studies on asthmatic patients [26] but contrarily to a previous systematic review on CF patients [27]. Moreover, the improvement on FEV1 was clinically relevant (higher than 100 mL [28]) at 6 months in four (out of 10) studies [15–18]. In two of them, the benefit was even dramatically greater (higher than 200 mL) [17,18]. These results were obtained mostly in studies with a long duration of the training program (6 months). The benefit on vital capacity was systematically found. It could be explained by the increased muscle strength as demonstrated in relationship to yoga [29].

Dyspnea improved after practicing one of the complementary therapies, which is important due to the clinical relevance of this symptom in COPD patients [2]. Moreover, the improvement on dyspnea reached the MCID (1 pts) in one study using Borg scale [11]. This benefit on dyspnea is higher than in the control group [11,19] but similar to the improvement obtained with some exercise program [13,20] and as it was already suggested in a previous partial meta-analysis [5].

The investigated complementary therapies promote long term quality of life improvement in COPD patients [11,15,16,18–20,23,24,30,31] despite they achieved low intensity exercices [32]. For example, the intensity of tai chi and qi gong was shown to be 3 or less metabolic equivalents and approximated 50% of the maximum oxygen uptake [32]. This low intensity can explain the good acceptability of these exercises observed in the review. This benefit on quality of life was clinically relevant in some of the retrieved studies [15,19,31] and was similarly found in other chronic diseases [33–35]. However, the benefit on quality of life is poorly clinically relevant as found in a previous systematic review [25]. A benefit was sometimes observed when anxiety or depression was specifically analysed [11,19,30] but it was not systematic. This is in accordance with previous systematic reviews specifically designed to evaluate the relationship between yoga and anxiety or depression [36,37].

Unsurprisingly, the main outcome concerning functional exercise capacity was the 6MWT. If the walked distance improved systematically in all studies, the clinical relevance of the improvement was only observed in one-third of them [11,17,24,30]. A similar result was found in a previous systematic review investigating only studies on tai chi [25]. Interestingly, a clinical benefit was maintained for 6 months [15,24]. The lack of clinical benefit on walking distance in some studies could be related to the physical intensity of these therapies. High intensity training demonstrated a better improvement than low to moderate intensity training in COPD [38] and, as previously mentioned, the intensity of these complementary therapies are low [39]. However, yoga satisfied the criteria for moderate-intensity physical activity [40] which is recommended in the international guidelines [41]. Moreover, the energy expenditure in yoga sessions is significantly lower compared to heart rate matched walking session [40]. In one study, the authors used the both versions of the shuttle test and they demonstrated a clinically relevant improvement in the endurance shuttle walk test (ESWT) but not in the incremental shuttle walk test (ISWT) [19]. Even if all exercise measures are responsive to rehabilitation with limited evidence [42], ESWT seems more sensitive to detect and quantify changes in exercise capacity [43]. Despite the lack of clinically relevant improvement in the ISWT, it was similar to other studies on pulmonary rehabilitation [44].

This systematic review highlighted a great disparity in the choice of the therapies and in the programs proposed to the patients. Based on our results, we cannot conclude neither about the superiority of one of these complementary therapies nor about the length of an optimal program. It can be explained by this disparity. First, different styles of tai chi or qi gong were analyzed and the exercises of yoga were not standardized. Secondly, training frequency was from 2 to 7 sessions a week and session duration lasted 1 h. We can postulate that the more frequent and longer the sessions and the program, the greater the benefits.

The strengths of this systematic review were that more articles and patients were included than in the previous reviews and that we bring together all the therapies in one review. The methodological quality of the studies can be discussed. Indeed, the concealed allocation and the blinding of therapists and subjects have never or rarely been verified.

Some limits need to be addressed regarding the results of this systematic review. First, the generalization of the results to each complementary therapy is difficult due to the heterogeneity of the protocols used in the studies and no statistical analysis was performed. This is a limitation of this systematic review as discussed previously, even if the benefits appeared in the majority of the studies independently on the investigated therapy. Secondly, the studies included mainly patients from Asian countries. The use of these exercises could be different in European people as illustrated by a twice-higher prevalence of traditional, complementary and alternative medicine in Asia compared to Europe [3]. It is also illustrated by the six studies excluded because they were written in Chinese and the greater proportion of Asian studies about tai chi (62%) whatever the condition. Thirdly, some other outcomes related to COPD such as balance impairment should be investigated. In deed, a benefit was related to these outcomes in other conditions [45–47] and it seems a promising way for patients with COPD.

In conclusion, this systematic review highlights the benefit of the complementary therapies on lung function and functional exercise capacity. Their effects on quality of life and dyspnea are less convincing. It highlights the potential of complementary therapies as complementary therapeutic approach in COPD patients.

Funding source

Gregory Reychler received a grant from the Institut de Recherche Expérimentale et Clinique (Université catholique de Louvain–Brussels–Belgium). William Poncin received funding from Vaincre la Mucoviscidose (France).

Disclosure of interest

The authors declare that they have no competing interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.resmer.2019.04.002.

References

[1] Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380:2197–223.
[2] Tsiligianni I, Kocks J, Tzanakis N, Siafakas N, van der Molen T. Factors that influence disease-specific quality of life or health status in patients with COPD: a review and meta-analysis of Pearson correlations. Prim Care Respir J 2011;20(3):257–68.
[3] Peltzer K, Pengpid S. Prevalence and determinants of traditional, complementary and alternative medicine provider use among adults from 32 countries. Chin J Integr Med 2016.
[4] Wang YT, Huang G, Duke G, Yang Y. Tai Chi. Yoga, and Qigong as Mind-Body Exercises. Evid Based Complement Alternat Med 2017;2017 [8763915].
[5] Ding M, Zhang W, Li K, Chen X. Effectiveness of t'ai chi and qigong on chronic obstructive pulmonary disease: a systematic review and meta-analysis. J Altern Complement Med 2014;20(2):79–86.
[6] Wu LL, Lin ZK, Weng HD, Qi QF, Lu J, Liu KX. Effectiveness of meditative movement on COPD: a systematic review and meta-analysis. Int J Chron Obstruct Pulmon Dis 2018;13:1239–50.
[7] Moher D, Shamseer L, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev 2015;4 [1].
[8] O'Connor SR, Tully MA, Ryan B, Bradley JM, Baxter GD, McDonough SM. Failure of a numerical quality assessment scale to identify potential risk of bias in a systematic review: a comparison study. BMC Res Notes 2015;8 [224].
[9] Kulpati DD, Kamath RK, Chauhan MR. The influence of physical conditioning by yogasanas and breathing exercises in patients of chronic obstructive lung disease. J Assoc Physicians India 1982;30:865–8.
[10] Ranjita R, Hankey A, Nagendra HR, Mohanty S. Yoga-based pulmonary rehabilitation for the management of dyspnea in coal miners with chronic obstructive pulmonary disease: a randomized controlled trial. J Ayurveda Integr Med 2016;7(3):158–66.
[11] Ranjita R, Badhai S, Hankey A, Nagendra HR. A randomized controlled study on assessment of health status, depression, and anxiety in coal miners with chronic obstructive pulmonary disease following yoga training. Int J Yoga 2016;9:137–44.
[12] Chan AW, Lee A, Suen LK, Tam WW. Effectiveness of a Tai chi Qigong program in promoting health-related quality of life and perceived social support in chronic obstructive pulmonary disease clients. Qual Life Res 2010;19:653–64.
[13] Chan AW, Lee A, Suen LK, Tam WW. Tai chi Qigong improves lung functions and activity tolerance in COPD clients: a single blind, randomized controlled trial. Complement Ther Med 2011;19:3–11.
[14] Ng BH, Tsang HW, Ng BF, So CT. Traditional Chinese exercises for pulmonary rehabilitation: evidence from a systematic review. J Cardiopulm Rehabil Prev 2014;34:367–77.
[15] Ng L, Chiang L, Tang R, Siu C, Fung L, Lee A, et al. Effectiveness of incorporating Tai Chi in a pulmonary rehabilitation program for Chronic Obstructive Pulmonary Disease (COPD) in primary care-A pilot randomized controlled trial. Journal of Integrative Medicine 2014;6:248–58.
[16] Chan AW, Lee A, Lee DT, Suen LK, Tam WW, Chair SY, et al. The sustaining effects of Tai chi Qigong on physiological health for COPD patients: a randomized controlled trial. Complement Ther Med 2013;21:585–94.
[17] Niu R, He R, Luo BL, Hu C. The effect of tai chi on chronic obstructive pulmonary disease: a pilot randomised study of lung function, exercise capacity and diaphragm strength. Heart Lung Circ 2014;23:347–52.
[18] Zhang M, Xv G, Luo C, Meng D, Ji Y. Qigong yi jinjing promotes pulmonary function, physical activity. Quality of life and emotion regulation self-efficacy in patients with chronic obstructive pulmonary disease: a pilot study. J Altern Complement Med 2016;22:810–7.
[19] Leung RW, McKeough ZJ, Peters MJ, Alison JA. Short-form Sun-style t'ai chi as an exercise training modality in people with COPD. Eur Respir J 2013;41:1051–7.

[20] Xiao CM, Zhuang YC. Efficacy of liuzijue qigong in individuals with chronic obstructive pulmonary disease in remission. J Am Geriatr Soc 2015;63:1420–5.
[21] Donesky-Cuenco D, Nguyen HQ, Paul S, Carrieri-Kohlman V. Yoga therapy decreases dyspnea-related distress and improves functional performance in people with chronic obstructive pulmonary disease: a pilot study. J Altern Complement Med 2009;15:225–34.
[22] Ng BH, Tsang HW, Jones AY, So CT, Mok TY. Functional and psychosocial effects of health qigong in patients with COPD: a randomized controlled trial. J Altern Complement Med 2011;17:243–51.
[23] Gupta A, Gupta R, Sood S, Arkham M. Pranayam for treatment of chronic obstructive pulmonary disease: results from a randomized. Controlled Trial. Integr Med (Encinitas) 2014;13:26–31.
[24] Chan AW, Lee A, Lee DT, Sit JW, Chair SY. Evaluation of the sustaining effects of Tai Chi Qigong in the sixth month in promoting psychosocial health in COPD patients: a single-blind, randomized controlled trial. Scientific World Journal 2013;2013 [425082].
[25] Guo JB, Chen BL, Lu YM, Zhang WY, Zhu ZJ, Yang YJ, et al. Tai Chi for improving cardiopulmonary function and quality of life in patients with chronic obstructive pulmonary disease: a systematic review and meta-analysis. Clin Rehabil 2016;30:750–64.
[26] Saxena T, Saxena M. The effect of various breathing exercises (pranayama) in patients with bronchial asthma of mild to moderate severity. Int J Yoga 2009;2:22–5.
[27] Lorenc AB, Wang Y, Madge SL, Hu X, Mian AM, Robinson N. Meditative movement for respiratory function: a systematic review. Respir Care 2014;59(3):427–40.
[28] Donohue JF. Minimal clinically important differences in COPD lung function. COPD 2005;2:111–24.
[29] Mandanmohan, Jatiya L, Udupa K, Bhavanani AB. Effect of yoga training on handgrip, respiratory pressures and pulmonary function. Indian J Physiol Pharmacol 2003;47:387–92.
[30] Liu XC, Pan L, Hu Q, Dong WP, Yan JH, Dong L. Effects of yoga training in patients with chronic obstructive pulmonary disease: a systematic review and meta-analysis. J Thorac Dis 2014;6:795–802.
[31] Yeh GY, Roberts DH, Wayne PM, Davis RB, Quilty MT, Phillips RS. Tai chi exercise for patients with chronic obstructive pulmonary disease: a pilot study. Respir Care 2010;55:1475–82.
[32] Chao YF, Chen SY, Lan C, Lai JS. The cardiorespiratory response and energy expenditure of Tai-Chi-Qui-Gong. Am J Chin Med 2002;30:451–61.
[33] McDermott KA, Rao MR, Nagarathna R, Murphy EJ, Burke A, Nagendra RH, et al. A yoga intervention for type 2 diabetes risk reduction: a pilot randomized controlled trial. BMC Complement Altern Med 2014;14 [212].
[34] Rao RM, Raghuram N, Nagendra HR, Usharani MR, Gopinath KS, Diwakar RB, et al. Effects of an integrated Yoga Program on Self-reported Depression Scores in Breast Cancer Patients Undergoing Conventional Treatment: A Randomized Controlled Trial. Indian J Palliat Care 2015;21:174–81.
[35] Tekur P, Nagarathna R, Chametcha S, Hankey A, Nagendra HR. A comprehensive yoga programs improves pain, anxiety and depression in chronic low back pain patients more than exercise: an RCT. Complement Ther Med 2012;20:107–18.
[36] Kirkwood G, Rampes H, Tuffrey V, Richardson J, Pilkington K. Yoga for anxiety: a systematic review of the research evidence. Br J Sports Med 2005;39: 884–91.
[37] Pilkington K, Kirkwood G, Rampes H, Richardson J. Yoga for depression: the research evidence. J Affect Disord 2005;89:13–24.
[38] Toohey K, Pumpa KL, Arnolda L, Cooke J, Yip D, Craft PS, et al. A pilot study examining the effects of low-volume high-intensity interval training and continuous low to moderate intensity training on quality of life, functional capacity and cardiovascular risk factors in cancer survivors. PeerJ 2016; 4 [e2613].
[39] Lan C, Chen SY, Lai JS, Wong MK. Heart rate responses and oxygen consumption during Tai Chi Chuan practice. Am J Chin Med 2001;29:403–10.
[40] Sherman SA, Rogers RJ, Davis KK, Minster RL, Creasy SA, Mullarkey NC, et al. Energy Expenditure in Vinyasa Yoga versus Walking. J Phys Act Health 2017:1–29.
[41] Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, et al. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. Med Sci Sports Exerc 2011;43:1334–59.
[42] Puente-Maestu L, Palange P, Casaburi R, Laveneziana P, Maltais F, Neder JA, et al. Use of exercise testing in the evaluation of interventional efficacy: an official ERS statement. Eur Respir J 2016;47:429–60.
[43] Borel B, Provencher S, Saey D, Maltais F. Responsiveness of various exercise-testing protocols to therapeutic interventions in COPD. Pulm Med 2013;2013 [410748].
[44] Mador MJ, Modi K. Comparing various exercise tests for assessing the response to pulmonary rehabilitation in patients with COPD. J Cardiopulm Rehabil Prev 2016;36:132–9.
[45] Youkhana S, Dean CM, Wolff M, Sherrington C, Tiedemann A. Yoga-based exercise improves balance and mobility in people aged 60 and over: a systematic review and meta-analysis. Age Ageing 2016;45:21–9.
[46] Sumec R, Filip P, Sheardova K, Bares M. Psychological benefits of nonpharmacological methods aimed for improving balance in parkinson's disease: a systematic review. Behav Neurol 2015;2015, 620674.
[47] Jeter PE, Nkodo AF, Moonaz SH, Dagnelie G. A systematic review of yoga for balance in a healthy population. J Altern Complement Med 2014;20:221–32.
[48] Fulambarker A, Farooki B, Kheir F, Copur AS, Srinivasan L, Schultz S. Effect of yoga in chronic obstructive pulmonary disease. Am J Ther 2012;19:96–100.