Generic, symptom based, exercise rehabilitation; integrating patients with COPD and heart failure

R.A. Evans a,*, S.J. Singh a, R. Collier a, I. Loke b, M.C. Steiner a, M.D.L. Morgan a

a Dept. of Respiratory Medicine, Allergy and Thoracic Surgery, University Hospitals of Leicester NHS trust, Glenfield Hospital, Groby Road, Leicester LE3 9QP, United Kingdom
b Dept. of Cardiology, University Hospitals of Leicester NHS trust, Glenfield Hospital, Groby Road, Leicester LE3 9QP, United Kingdom

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Chronic obstructive pulmonary disease; Chronic heart failure; Pulmonary rehabilitation; Exercise; Dyspnea

Summary
Background: Patients with Chronic Heart Failure (CHF) develop similar symptoms of exertional breathlessness and fatigue as patients with COPD. Although pulmonary (exercise based) rehabilitation (PR) is an integral part of the management of COPD, the potential for exercise rehabilitation (ER) to assist patients with CHF may not be as readily appreciated. We investigated whether combined ER for patients with CHF and COPD was feasible and effective using the model of PR.

Methods: 57 patients with CHF were randomized 2:1 to 7 weeks ER (CHF-ER) or 7 weeks of usual care (CHF-UC). As a comparator 55 patients with COPD were simultaneously recruited to the same ER program (COPD-ER). The primary outcome measure was the Incremental Shuttle Walk Test (ISWT) and the secondary outcome measures were the Endurance Shuttle Walk Test (ESWT), isometric quadriceps strength and health status.

Results: 27 CHF and 44 COPD patients completed ER and 17 patients with CHF completed UC. The CHF-ER group made significant improvements, compared to CHF-UC, in the mean (95%CI) ISWT distance: 62(35–89)m vs 60(30 to 11)m p < 0.001. The CHF-ER group also made statistically significant improvements in health status. The improvements in exercise performance and health status were similar between patients with CHF and COPD, treated with ER.

Conclusion: Patients with CHF who undergo ER improve similarly in their exercise performance and health status to COPD. Combined training programs for COPD and CHF are effective and feasible, such that service provision could be targeted around common disability rather than the primary organ disease.

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* Corresponding author. Tel.: +44 0116 2871471.
E-mail address: rach27evans@hotmail.com (R.A. Evans).
Introduction

Chronic respiratory disease and cardiovascular disease are two of the four priority non-communicable diseases for the World Health Organisation. Cardiovascular disease and Chronic Obstructive Pulmonary Disease are the first and fifth leading causes of death worldwide and are in the ten leading causes of burden of disease for all countries.1

Exertional breathlessness and fatigue are frequent symptoms common to COPD and chronic heart failure (CHF), which result in marked activity limitation (disability).

In COPD and in CHF the degree of primary organ impairment, as assessed by the FEV1 and left ventricular ejection fraction (LVEF), respectively, correlates poorly with exercise capacity.2,3 Both conditions also have in common secondary impairments such as skeletal muscle dysfunction4,5 which contribute substantially to exercise intolerance6,7 and mortality.8–10 Deconditioning, systemic inflammation and nutritional status have all been implicated in the development of skeletal muscle dysfunction.5

In both conditions, skeletal muscle dysfunction is at least partially reversible with exercise training.11,12 The service of pulmonary rehabilitation (with exercise training as a key component) is an integral part of the management of patients with COPD.13 The model of pulmonary rehabilitation is symptom directed towards exertional dyspnea and includes exercise training (individually prescribed lower limb endurance training), multi-disciplinary education (e.g. exercise, energy conservation, relaxation, nutrition) psychological support and self management.13–15 It is *designed to reduce symptoms, optimize functional status, increase participation and reduce health care costs through stabilizing or reversing the systemic manifestations of the disease*14 and has a strong evidence base demonstrating improvements in exercise performance and health status.15,16

There is a substantial literature on the beneficial effects of exercise training in CHF, including improvements in exercise capacity,17 health status,18,19 and morbidity and mortality.20 However, a practical exercise rehabilitation service has not been integrated into the long-term management of CHF, nearly to the extent that it has been for COPD. Few studies have evaluated the influence of exercise rehabilitation for CHF in a practical rehabilitation setting.21 A large multicentre trial of exercise training in CHF only resulted in modest short-term improvements in exercise performance.22 This training intervention was not part of a broader rehabilitation service, containing key components of exercise, education, psychological support and self management.

The traditional focus of cardiac rehabilitation (CR) is aimed at the secondary prevention of cardiovascular disease events, predominantly for patients after either a myocardial infarction or cardiac surgery and currently may exclude patients with CHF.23,24 The target population for CR are frequently asymptomatic (NYHA class I) with preserved exercise tolerance.25 Many patients with CHF would be unable to adhere to the absolute exercise prescription set for CR. The symptoms and disability of patients with CHF have more in common with COPD than the traditional CR population4,25,26 and the pulmonary rehabilitation team are experienced in dealing with patients with a reduced functional status. A symptom directed programme (for both the exercise training and education component) may be more suitable for patients with CHF, and in practice these patients are increasingly referred to pulmonary rehabilitation. In the US, recent guidelines regarding outcome measures for CR excluded patients with CHF,21 and a national audit in the UK concluded that only a tiny fraction of patients with heart failure receive rehabilitation.24

We hypothesized that a program of exercise rehabilitation, supported by symptom based specific education, could be successfully applied to patients with CHF in the same setting as COPD. If successful this would provide a generic, symptom based exercise rehabilitation program for exertional dyspnea.

We therefore designed a randomized controlled trial of supervised exercise rehabilitation compared to usual care in patients with CHF and a comparative observational study of the same exercise rehabilitation program between CHF and COPD. The aim was to investigate whether patients with CHF could improve their exercise performance and health related quality of life with pulmonary rehabilitation compared to usual care and whether the changes were comparable to patients with COPD.

Methods

The study protocol was approved by the Leicestershire Research Ethics Council (National Research Registry N0123134233 - www.nrr.nhs.uk).

Participants

Chronic obstructive pulmonary disease (COPD)

Patients with a clinical diagnosis COPD, supporting spirometry of an FEV1/FVC <70% and an FEV1 <80% predicted and MRC dyspnea scale 2–5 were eligible to participate. Patients with COPD were consecutively recruited from physician referrals to PR. Patients with known co-morbid CHF were excluded.

Chronic heart failure (CHF)

Patients with a clinical diagnosis of CHF,27 New York Heart Association (NYHA) class II–IV and evidence of left ventricular dysfunction (LVEF) on echocardiography, were eligible to participate. Patients were recruited from community chronic heart failure nurses and had originally been diagnosed by a cardiologist. Patients with known COPD, FEV1/FVC <70% and FEV1 <80% and other respiratory conditions were excluded.

All participants

Any medications relating to COPD or CHF were unchanged during the trial. Patients with a predominant neurological, locomotor or peripheral vascular limitation to exercise were excluded. Patients within three months of an acute myocardial infarction or with significant aortic stenosis were excluded. All patients completed an incremental cardiopulmonary exercise test to exclude any significant...
arrhythmias or ischaemia, as per the American College of Sports Medicine guidelines. Written consent was obtained.

Randomization and intervention

Exercise rehabilitation

We used an existing outpatient pulmonary (exercise) rehabilitation (ER) program designed for patients with COPD and previously described. This seven week program involved supervised physical training twice weekly for 2 h, which combined endurance training and patient education by a multi-disciplinary team, with unsupervised daily home training. Walking was the main training modality and was individually prescribed at a speed equivalent to 85% VO2 peak derived from the Incremental Shuttle Walk Test (ISWT). The initial duration of the walk was set from the distance achieved on the ESWT. The duration of the walk was increased throughout the seven weeks based on the symptom of dyspnea, aiming for a Borg Scale breathlessness score of 3-6 at the end of exercise.

Peripheral muscle exercises were performed three times a week using free weights for the upper limbs, and conditioning exercises for the lower limbs; once at hospital and twice at home. Four different exercises of ten repetitions each were performed for both the upper and lower limbs. Patients from both groups trained together and were supervised by the same therapists. Completers were defined as having attended twelve sessions. The education component of the program was delivered identically to both groups.

At least one of the rehabilitation team members present in the exercise classes were trained in Advanced Life Support and all were educated about the symptoms and signs associated with the decompensation of heart failure similar to understanding an exacerbation of COPD.

Usual care

The usual care group received only their usual care for seven weeks.

Assignment

Patients with CHF were randomized to receive exercise rehabilitation (CHF-ER) or usual care (CHF-UC) in a ratio of 2:1 ER to UC after completion of all baseline measurements. This was to allow for a likely higher dropout among the exercising group. The randomization was undertaken by an outside institute and performed in blocks of four. Treatment allocation was concealed by an outside researcher. All patients with COPD were allocated to receive the exercise rehabilitation program (COPD-ER).

Outcomes measures

The following outcome measures were performed at baseline and after the intervention in all subjects and included those used practically to assess the service.

Primary outcome measure

The primary outcome measure was the ISWT distance. The ISWT is a maximal, externally paced, symptom limited test conducted along a 10m course. The ISWT has been validated both in patients with CHF and with COPD. It is reproducible after one practice test. A familiarization test was performed for both the ISWT and Endurance Shuttle Walk Test (ESWT). The patients allocated to ER had serial ISWTs at sessions 1, 4, 7, 11, and 14.

Secondary outcome measures

The Endurance Shuttle Walk Test (ESWT) is a measure of submaximal exercise capacity. It has been validated in COPD and is reproducible after familiarization. Isometric quadriceps strength was measured using a Cybex II dynamometer at 70°. Six maximal voluntary contractions (MVC) were performed and the peak torque (PT) taken as the highest of the six. Body composition was measured by bioelectrical impedance (Biostat 1500®). The disease specific questionnaires, used were the Chronic Heart Questionnaire (CHQ) for CHF and the Chronic Respiratory Questionnaire (CRQ) for COPD. These two questionnaires comprise of the same four domains (dyspnea, fatigue, emotional function and mastery) and were designed by the same research group. The test operator was blinded to the diagnostic category (COPD or CHF) and for the CHF population, the operator was unaware of the group allocation (study or control) for the ISWT and ESWT.

Sample size calculation for the randomized controlled trial

In order to show a 50 m difference in the change in ISWT performance between the two groups and assuming a standard deviation (SD) of the change in ISWT of 50 m with 80% power at the 5% level of significance 17 patients were needed for each group. Patients with COPD and patients with CHF were recruited simultaneously, so that training of both groups could occur at the same time.

Statistical analysis

Appropriate parametric and non-parametric tests were performed for the baseline intergroup differences. An intention to treat (ITT) analysis was applied for the primary outcome measure for the RCT and thereafter an efficacy subset analysis (ESA) for completers was performed to allow a direct comparison with the COPD group. Effect size was calculated by (μ1 − μ2) / σ where μ1 and μ2 = mean of each group and σ the SD of the mean of the two groups. ANCOVA was performed to compare the change in outcome measures between COPD-ER and CHF-ER accounting for any difference in baseline variables. A MANOVA with Pillai’s trace was performed for a comparison between COPD-ER and CHF-ER for the serial ISWTs. Significance was set at p < 0.05. Analyses were performed using SPSS version 14.0.

Results

Fig. 1 demonstrates the patient flow through the trial. 57 patients with CHF were randomized; 37 to exercise rehabilitation (ER) and 20 to usual care (UC). The majority of patients with CHF had ischaemic cardiomyopathy (79%), 55 patients with COPD were recruited. There were no baseline
demographic differences between diagnostic groups or between the CHF patients randomized to the intervention or usual care groups (Table 1). All groups showed a similar exercise performance and quadriceps muscle strength. There were no significant adverse events during the exercise tests. Baseline disease specific health status was similar between the two CHF groups. The COPD subjects had worse dyspnea and mastery scores, than those with CHF (Table 1).

Results of exercise rehabilitation vs. usual care in CHF

27 patients completed exercise rehabilitation and 17 patients completed usual care. Of the ten CHF-ER dropouts, six attended only the first session of ER. These patients and the three dropouts from the UC group were assigned a zero score for the change in ISWT. The four dropouts during ER at session four were assigned their last ISWT as their final measurement. The CHF-ER group made a significant mean (95%CI) improvement in ISWT of 45 (23–66) m \( p < 0.001 \) while the ISWT in the CHF-UC group remained the same (–5 (–9 to 19) m \( p = 0.460 \). The intergroup mean (95%CI) difference in the change in ISWT was also statistically significant 50 (25–76) m \( p < 0.001 \) \( d = 0.51 \) (moderate effect size). There was no statistically significant change in any auxiliary measurement at the end of the ISWT performance, with ER or UC.

Table 2 and Fig. 2 show the efficacy subset analysis for all outcome measures and exercise performance respectively. The CHF-ER group made significant improvements in ESWT time compared to CHF-UC. The CHF-ER group made statistically significant improvements in all four domains of the CHQ compared to no change in any domain for the CHF-UC group, but the between group difference did not reach significance (Table 2). However, there was a between group difference in the change in functional status (NYHA class) between the CHF-ER and CHF-UC groups (Table 2). There were a higher proportion of dropouts in the CHF-ER group than the CHF-UC group 27% vs 15% respectively (\( p = 0.30 \)). The number due to decompensation of heart failure was similar; 2/37 for ER vs. 2/20 for UC. There were more non-medical reasons for dropping out in the CHF-ER group.

Results of exercise rehabilitation- COPD vs. CHF

44 patients with COPD completed ER. A similar proportion of COPD patients (20%) dropped out compared to CHF (27%) \( (p = 0.43) \); 8 had medical reasons and 3 had non-medical reasons.

The statistically significant improvements in ISWT and ESWT for the CHF-ER group were similar to those with COPD who underwent rehabilitation (Table 3). An ANCOVA for the change in ISWT performance between COPD and CHF was performed including baseline ISWT, FEV1% predicted and BMI and there remained no difference between the two groups \( (p = 0.72) \). Patients with COPD could easily train together with patients with CHF.

All patients had serial ISWT every 3rd or 4th session throughout the seven weeks. 22/27 CHF and 36/44 COPD had complete data sets for all five time points (Fig. 3). There was no significant difference in the overall rate of improvement between the two groups \( (p = 0.07) \), although patients with COPD experienced significant improvements by session four \( (33m \ p < 0.001) \) whereas those with CHF did not reach significance \( (16m \ p = 0.19) \) at that stage. There were no statistical differences in the ISWT performance between the two groups at any session number.

Both exercise-trained groups made statistically significant improvements in all four domains of the disease specific questionnaire (Table 3). After an ANCOVA was performed, accounting for the baseline scores, there was no between group difference between the scores except for a greater improvement in the fatigue score for COPD (Table 3).

Discussion

This trial confirms that symptom-directed, exercise training programs are feasible and effective for COPD and CHF and that training can be progressed similarly for both categories, based on symptoms rather than diagnosis. Moreover, there is a practical benefit to knowing that both groups could train together, at the same time and location, supervised by the same therapists.

Patients with CHF undergoing rehabilitation made highly statistically significant improvements in exercise tolerance, functional status and health status. This randomized study
of pragmatic rehabilitation supports the benefit of exercise training for CHF and adds to the current literature by providing a successful model of rehabilitation for CHF. Programs in pulmonary rehabilitation are able to also serve a population of patients with CHF who may not otherwise be referred or have access to rehabilitation.

There is a growing appreciation of the similarity in the systemic manifestations and disability between CHF and COPD. Table 1 summarizes the baseline demographics, exercise performance, and health status in CHF-UC, CHF-ER, and COPD-ER groups.

**Table 1** Baseline demographics, exercise performance and health status in CHF-UC, CHF-ER and COPD-ER groups.

<table>
<thead>
<tr>
<th>Metric</th>
<th>CHF-UC n = 20</th>
<th>CHF-ER n = 37</th>
<th>COPD-ER n = 55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>73.2 (8.9)</td>
<td>69.8 (10.7)</td>
<td>69.1 (8.3)</td>
</tr>
<tr>
<td>Gender (% male)</td>
<td>70.0%</td>
<td>67.6%</td>
<td>54.5%</td>
</tr>
<tr>
<td>LVEF %</td>
<td>30.7 (12.7)</td>
<td>31.2 (8.4)</td>
<td>N/A</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>76.1 (4.7)</td>
<td>77.1 (4.7)</td>
<td>50.0 (8.7) c</td>
</tr>
<tr>
<td>FEV1% predicted</td>
<td>82.2 (18.1)</td>
<td>81.2 (22.2)</td>
<td>42.9 (14.6) c</td>
</tr>
<tr>
<td>Medication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACE inhibitor/ATII antagonist</td>
<td>97%</td>
<td>90%</td>
<td>N/A</td>
</tr>
<tr>
<td>Beta Blocker</td>
<td>81%</td>
<td>60%</td>
<td></td>
</tr>
<tr>
<td>NYHA Class for CHF or MRC</td>
<td>2 (25%)</td>
<td>2 (46%)</td>
<td>2 (11%)</td>
</tr>
<tr>
<td>dyspnea grade for COPD</td>
<td>3 (65%)</td>
<td>3 (38%)</td>
<td>3 (48%)</td>
</tr>
<tr>
<td>ISWT (m)</td>
<td>213 (91)</td>
<td>242 (154)</td>
<td>225 (114)</td>
</tr>
<tr>
<td>End heart rate (bpm)</td>
<td>94 (3)</td>
<td>93 (6)</td>
<td>88 (8) b</td>
</tr>
<tr>
<td>End BS^c</td>
<td>4.0 (3.0–6.0)</td>
<td>5.0 (3.5–5.0)</td>
<td>5.0 (4.0–7.0)</td>
</tr>
<tr>
<td>End PE^c</td>
<td>15.0 (13.0–17.0)</td>
<td>15.0 (13.0–16.0)</td>
<td>15.0 (13.0–17.0)</td>
</tr>
<tr>
<td>ESWT (secs)</td>
<td>226 (93)</td>
<td>215 (83)</td>
<td>247 (154)</td>
</tr>
<tr>
<td>Quadriceps PT (Nm)</td>
<td>109 (39)</td>
<td>119 (53)</td>
<td>115 (44)</td>
</tr>
<tr>
<td>HRQL; CHQ or CRQ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyspnea (D)</td>
<td>3.73 (1.19)</td>
<td>3.57 (1.21)</td>
<td>2.43 (0.84) c</td>
</tr>
<tr>
<td>Fatigue</td>
<td>3.25 (1.14)</td>
<td>3.40 (1.16)</td>
<td>3.25 (1.25)</td>
</tr>
<tr>
<td>Emotional Function (EF)</td>
<td>4.17 (1.29)</td>
<td>4.73 (1.32)</td>
<td>4.28 (1.20)</td>
</tr>
<tr>
<td>Mastery</td>
<td>4.42 (1.18)</td>
<td>4.84 (1.17)</td>
<td>4.13 (1.18) b</td>
</tr>
</tbody>
</table>

**Mean (SD) or % male.**
LVEF — left ventricular ejection fraction, ACE — angiotensin converting enzyme inhibitor, ATII — angiotensin-II receptor antagonists, NYHA — New York Heart Association, MRC — Medical Research Council, BMI — Body mass index, FFMI — fat free mass index, ISWT — Incremental Shuttle Walk Test, ESWT — Endurance Shuttle Walk Test, PT — peak torque, HRQL — Health related quality of life, CHQ — Chronic Heart Questionnaire, CRQ — Chronic Respiratory Questionnaire.

<table>
<thead>
<tr>
<th>Metric</th>
<th>CHF-ER p value^b</th>
<th>CHF-UC p value^b</th>
<th>CHF-ER and CHF-UC p value^c</th>
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<tr>
<td>ISWT (m)</td>
<td>0.000</td>
<td>0.47</td>
<td>&lt;0.001 Effect size 0.57</td>
</tr>
<tr>
<td>ESWT (secs)</td>
<td>0.001</td>
<td>0.08</td>
<td>&lt;0.001 Effect size 0.95</td>
</tr>
<tr>
<td>Quadriceps PT (Nm)</td>
<td>0.09</td>
<td>0.75</td>
<td>0.19</td>
</tr>
<tr>
<td>HRQL (CHQ)</td>
<td>0.01</td>
<td>0.19</td>
<td></td>
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<tr>
<td>Dyspnea and CRQ</td>
<td>0.01</td>
<td>0.19</td>
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</tr>
<tr>
<td>Fatigue</td>
<td>0.02</td>
<td>0.37</td>
<td></td>
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<tr>
<td>Emotional Function (EF)</td>
<td>0.05</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Mastery</td>
<td>0.03</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>NYHA class ^a</td>
<td>0.01</td>
<td>0.32</td>
<td></td>
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**Mean (95% CI).**
ISWT — Incremental Shuttle Walk Test, ESWT — Endurance Shuttle Walk Test, PT — peak torque, HRQL — Health related quality of life, CHQ — Chronic Heart Questionnaire NYHA— New York Heart Association.

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**Mean (95% CI).**
ISWT — Incremental Shuttle Walk Test, ESWT — Endurance Shuttle Walk Test, PT — peak torque, HRQL — Health related quality of life, CHQ — Chronic Heart Questionnaire NYHA— New York Heart Association.

^a Median.
^b Intragroup difference before and after the intervention.
^c Intergroup difference between CHF-ER and CHF-UC.
COPD. Our study populations also had similar measures of exercise performance, health status and quadriceps strength. The peak heart rate on the ISWT was lower in CHF than in COPD, possibly because of beta blockade therapy in CHF. Although treated as separate populations for the purpose of this study, the two conditions often coexist (20–39%). A recent report noted heart failure in greater than 10% of patients with COPD undergoing pulmonary rehabilitation and coexisting COPD in 18% of patients post coronary artery bypass grafting (CABG) undergoing cardiac rehabilitation. Although it is relatively easy to exclude COPD from the CHF group, by spirometry, CHF may be harder to exclude among patients with COPD as standard tests, such as echocardiography, are technically difficult in COPD and more invasive tests were not justifiable for this trial. Co-existent disease has implications for the current separate services of pulmonary and cardiac rehabilitation.

We noted that training as a combined group did not adversely affect the improvements for patients with COPD, which remained similar to those previously reported. Although much of the literature for pulmonary rehabilitation is for COPD there is an expanding group of other chronic respiratory patients who may also gain benefit e.g. pulmonary fibrosis, bronchiectasis, cystic fibrosis, asthma and pulmonary hypertension, and are being referred. The PR population is becoming more heterogenous and therefore, a symptom based approach to exercise training (rather than disease based) for patients with dyspnea, would seem logical.

The pulmonary rehabilitation program was delivered identically and simultaneously to both groups. This included the assessment, outcome measures and the specific training program. The improvements in exercise performance for COPD and CHF were similar. Whereas there is no consensus on the optimal training prescription for CHF, the exercise rehabilitation program adhered to the international recommendations for COPD. Physical training was individually prescribed, aiming for high intensity from the outset 85% predicted peak VO2, which the patients with CHF achieved. Improvements in exercise performance occurred in the first two weeks and were statistically significant by session seven (halfway). There were no significant differences in the training profile between the two groups. The program was predominantly endurance training, which likely accounts for the very modest changes in quadriceps strength post exercise.

<table>
<thead>
<tr>
<th>Change in:</th>
<th>CHF-ER</th>
<th>p valueb</th>
<th>COPD-ER</th>
<th>p valueb</th>
<th>COPD-ER and CHF-ERC</th>
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</thead>
<tbody>
<tr>
<td>ISWT (m)</td>
<td>62 (35–89)</td>
<td>&lt;0.001</td>
<td>68 (50–85)</td>
<td>&lt;0.001</td>
<td>0.69</td>
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<tr>
<td>ESWT (secs)</td>
<td>351 (203–498)</td>
<td>&lt;0.001</td>
<td>348 (249–447)</td>
<td>&lt;0.001</td>
<td>1.0</td>
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<tr>
<td>Quadriceps PT (Nm)</td>
<td>7 (0–13)</td>
<td>0.09</td>
<td>2 (–6 to 10)</td>
<td>0.62</td>
<td>0.46</td>
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<tr>
<td>Dyspnea</td>
<td>0.65 (0.21–1.09)</td>
<td>0.01</td>
<td>0.94 (0.57–1.31)</td>
<td>&lt;0.001</td>
<td>0.32</td>
</tr>
<tr>
<td>ANCOVA</td>
<td>0.94</td>
<td>0.72</td>
<td>0.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue</td>
<td>0.39 (0.06–0.72)</td>
<td>0.02</td>
<td>1.24 (0.85–1.64)</td>
<td>&lt;0.001</td>
<td>0.001</td>
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<tr>
<td>ANCOVA</td>
<td>0.46</td>
<td>1.17</td>
<td>0.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional Function</td>
<td>0.38 (0.01–0.75)</td>
<td>0.049</td>
<td>0.92 (0.56–1.30)</td>
<td>&lt;0.001</td>
<td>0.047</td>
</tr>
<tr>
<td>ANCOVA</td>
<td>0.50</td>
<td>0.82</td>
<td>0.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mastery</td>
<td>0.36 (0.04–0.67)</td>
<td>0.03</td>
<td>0.78 (0.44–1.12)</td>
<td>&lt;0.001</td>
<td>0.84</td>
</tr>
<tr>
<td>ANCOVA</td>
<td>0.55</td>
<td>0.66</td>
<td>0.63</td>
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Mean (95% CI). ISWT — Incremental Shuttle Walk Test, ESWT — Endurance Shuttle Walk Test, PT — peak torque, HRQL — Health related quality of life, CHQ — Chronic Heart Questionnaire.

a minimum important difference 0.5 units.
b Intragroup difference before and after ER.
c Intergroup difference between CHF-ER and COPD-ER.
The improvements in health related quality of life, as measured by a disease specific questionnaire, were comparable between the groups although there were slightly lower scores among those with CHF. The education part of the pulmonary rehabilitation course was primarily designed for COPD and was not adapted for the trial. Both groups attended the lectures, and at least half were generic. This aspect of the program could be modified further and may enhance the effect on health status. The more specific aspects of disease management were addressed predominantly outside of the training program (all the patients with chronic heart failure were under a community specialist nurse).

The safety of physical training for patients with CHF has been a concern and may have limited its practical development. In keeping with recent reports, we did not identify any adverse effects with training. The number of patients with CHF who withdrew for clinical reasons was similar in both the exercise training and the usual care groups. The only adaptation for the assessment of CHF patients for exercise rehabilitation was the need to exclude arrhythmias. For this purpose a full cardiopulmonary exercise test was performed under laboratory conditions (telemetry during field testing could be used). During the rehabilitation program cardiac monitoring during exercise training was not required by either group. This is usual practice for COPD rehabilitation and has been reported as a safe approach despite the co-existence of CHF in this population.

There were limitations to the study. There was no sham training in the CHF usual care group. However, no improvement in exercise performance are seen if exercise training is excluded from PR in COPD. After three baseline tests, the patients in the CHF-ER group performed three further ISWTs during the program. As these were not performed by the CHF-UC group, a bias for the CHF-ER group cannot be completely excluded. However, Lewis et al. have reported that the mean ISWT distance does not change with serial tests under controlled conditions. The study was performed in a single centre, hospital outpatient setting, which limits their generalizability. Confirmation of effectiveness from other centers is required. Only the short-term effects are described and strategies for long-term adherence needs further evaluation for both groups. This study was conducted to see if combined training was feasible and effective, further studies would need to be done to investigate whether combined rehabilitation provides economies of scale for both populations.

In conclusion, patients with CHF can make significant improvements in exercise performance and health status from an existing pulmonary rehabilitation program and the results are comparable with COPD. Combined training is feasible without any negative interaction between the groups. The provision of exercise rehabilitation needs to be increased for CHF and for an increasing number of other respiratory diseases, therefore developing generic symptom based exercise rehabilitation for exertional dyspnea could be a successful strategy. This study highlights the possibility of organising services for chronic disease around a common disability rather than the primary organ disease.

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Conflict of interest statement

There are no conflicts of interests for any of the authors for this work.

References


