

Home versus outpatient pulmonary rehabilitation in COPD: a propensity-matched cohort study

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ABSTRACT

Home-based exercise has been proposed as an equivalent treatment strategy to supervised outpatient pulmonary rehabilitation (PR) but it is not known whether its implementation into clinical practice produces similar benefits to those observed in trials. We compared the real-world responses of 154 patients with chronic obstructive pulmonary disease (COPD) undergoing home-based exercise with a matched group attending supervised PR. We observed smaller improvements in exercise capacity with home-based exercise compared with PR, but similar improvements in quality of life. We propose that supervised PR remains the standard of care, with home-based exercise a less effective alternative for those unable to attend PR.

INTRODUCTION

Pulmonary rehabilitation (PR) is an integral component of the management of chronic obstructive pulmonary disease (COPD).¹ Although the traditional model of PR typically comprises outpatient supervised exercise and multi-disciplinary education,¹ there are well-recognised problems with uptake and adherence. Consequently, there has been growing interest in alternative PR models with recent trials comparing home-based exercise to traditional PR.²⁻⁵ However, potential limitations of these trials include selective populations,⁴ lack of patient equipoise^{2,3} and lower than anticipated benefits in the PR arms,²⁻⁵ making non-inferiority analysis difficult to interpret. Furthermore, it is not known whether implementation of home-based exercise into clinical practice produces similar benefits to those observed in controlled trials.

The aim of our study was to observe the real-world responses of patients choosing to undergo home-based exercise to a matched control group choosing to undergo PR, in terms of exercise capacity, dyspnoea, health-related quality of life and programme completion.

METHODS

Participants were patients with a physician-diagnosis of COPD, who were consecutively referred to Harefield PR Unit between 2012 and 2015. Those with co-morbidities that would make exercise unsafe were excluded (e.g. unstable angina, severe aortic stenosis, abdominal aortic aneurysm >5.5cm, uncontrolled cardiac arrhythmias). The study was approved by

London-Camberwell St. Giles Research Ethics Committee (11/LO/1780) and participants provided informed consent.

All patients underwent a face-to-face assessment, and were allowed a free choice of either PR or home-based exercise. To balance baseline characteristics, we used 1:1 propensity score-matching (probability model)⁶ to match patients undergoing home-based exercise to those attending PR, accounting for age, gender, forced expiratory volume in one second %predicted, Medical Research Council (MRC) Dyspnoea score, body mass index, incremental shuttle walk (ISW) distance and Chronic Respiratory Questionnaire (CRQ)-total score. Gender was treated as a categorical variable and the others as continuous variables.

Home-based exercise was an eight-week structured programme with weekly telephone follow-up. It included individually tailored exercise which the patient was encouraged to perform at least three days per week, as well as educational material. The type of aerobic exercise was chosen by the patient and usually involved walking. Patients were encouraged to exercise to achieve a Borg Dyspnoea Scale score of 3 to 4 and progression included increasing the time to achieve 30 minutes of aerobic exercise three times per week. No specialist equipment was provided but upper and lower limb training was prescribed based on the American College of Sports Medicine (ACSM) endurance resistance training guidelines⁷ with resistance provided by body weight and home-made weights e.g. water bottles. Further information is provided in the online supplement. PR was an eight-week supervised outpatient programme delivered in a gymnasium or community hall according to the British Thoracic Society Quality Standards for PR.¹ The programme comprised two supervised sessions per week and at least one unsupervised home exercise session was encouraged per

week. Details of the aerobic and resistance training have been described in detail elsewhere⁹ as well as in the online supplement.

The primary outcome measure was exercise capacity (ISW). Secondary outcome measures were dyspnoea (CRQ-dyspnoea domain), health-related quality of life (CRQ-total score) and programme completion (participation in $\geq 50\%$ of weekly telephone calls or PR sessions and attendance at the post-intervention assessment). Following PR, patients completed a Global Rating of Change Questionnaire: *'How do you feel your condition has changed after rehabilitation?'*. Responses were rated on a five-point Likert scale ranging from *'much better'* to *'much worse'*.

A complete analysis was performed. For continuous data, within- and between-group differences were compared using Paired Samples t-test and Independent Samples t-test respectively. For categorical data, between-group differences were compared using Pearson Chi-squared test or Pearson Chi-squared test for trend.

RESULTS

In total, 154 patients (10% of eligible patients) chose home-based exercise and the baseline characteristics of the two groups are presented in table 1.

Table 1. Baseline characteristics (n=308).

Variable	PR (n=154)	Home (n=154)	p-value
Age (years)	71 (9)	71 (10)	0.76
Gender (male: %)	47	49	0.82
FEV ₁ (L)	1.04 (0.52)	1.08 (0.57)	0.54
FEV ₁ (% predicted)	45.3 (20.3)	45.7 (19.7)	0.87
FEV ₁ /FVC	0.46 (0.13)	0.47 (0.14)	0.39
MRC Dyspnoea score	3 (1)	3 (1)	1.0
BMI (kg/m ²)	27.9 (7.2)	28.3 (7.8)	0.97
Social deprivation index decile*	6 (2))	6 (2)	0.49
Smoking status (%) Current : Former : Never	19 : 71 : 11	21 : 68 : 11	0.85
LTOT (%)	8	11	0.33
ABOT (%)	10	11	0.85
4MGS (m/s)	0.76 (0.28)	0.76 (0.28)	0.29
ISW (m)	146 (132)	146 (135)	0.92
CRQ - Dyspnoea	13 (5.8)	13 (5.7)	0.45
CRQ - Fatigue	13 (5.2)	12 (5.4)	0.30
CRQ - Emotion	29 (10.1)	29 (9.8)	0.58
CRQ - Mastery	16 (5.7)	17 (5.8)	0.74
CRQ - Total	70 (22.2)	72 (22.3)	0.55

Data reported as mean (standard deviation) unless stated otherwise.

Abbreviations: 4MGS: Four Metre Gait Speed test; ABOT: Ambulatory Oxygen Therapy; BMI: Body Mass Index; CRQ: Chronic Respiratory Questionnaire; FEV₁: Forced Expiratory Volume in One Second; FVC: Forced Vital Capacity; Home: Home-Based Exercise Programme; ISW: Incremental Shuttle Walk test; LTOT: Long-Term Oxygen Therapy; MRC: Medical Research Council; PR: Pulmonary Rehabilitation.

**Lower values indicate greater deprivation.*

Following PR, both groups achieved significant improvements in exercise capacity, but the home-based group demonstrated smaller increases (table 2). Furthermore, 54% of the PR group achieved the minimum clinically important difference (MCID) of the ISW¹⁰, compared with 34% in the home-based group; p=0.008. Both programmes produced clinically and statistically significant improvements in the CRQ with no significant between-group differences (table 2).

Table 2. Response to the intervention.

Variable	Response to the intervention			
	PR (n=98)	Home (n=86)	Between group difference	p-value
ISW (m)	59 (45 to 73)	29.0 (16 to 42)	-30 (-49 to -11)	0.003
CRQ - Dyspnoea	5.0 (3.6 to 6.4)	3.8 (2.5 to 5.2)	-1.2 (-3.1 to 0.7)	0.23
CRQ - Fatigue	2.9 (2.1 to 3.8)	2.7 (1.8 to 3.6)	-0.3 (-1.5 to 1.0)	0.67
CRQ - Emotion	4.4 (2.8 to 6.0)	4.1 (2.4 to 5.8)	-0.3 (-2.6 to 2.0)	0.81
CRQ - Mastery	3.4 (2.3 to 4.4)	2.4 (1.3 to 3.6)	-0.9 (-2.5 to 0.6)	0.23
CRQ - Total	15.7 (11.9 to 19.5)	13.0 (9.2 to 16.9)	-2.7 (-8.1 to 2.7)	0.33

Data reported as mean (lower 95% confidence interval to upper 95% confidence interval) difference.

Abbreviations: CRQ: Chronic Respiratory Questionnaire; Home: Home-Based Exercise Programme; ISW: Incremental Shuttle Walk test; PR: Pulmonary Rehabilitation.

Regarding self-reported perception of the intervention effect, more positive responses favoured PR: 53% reported feeling '*much better*' in contrast to 37% of the home-based group; $p=0.03$. Further information is provided in the supplementary file. Nonetheless, 83% of the home-based group reported feeling '*much*' or '*a little better*'.

The programme completion rates were low in both groups (PR: 64%, Home: 56%; $p=0.16$).

The reasons for non-completion were broadly similar across the groups, with illness cited as the most common reason (PR: 39%, Home: 34%).

DISCUSSION

To our knowledge, this is the first study to compare the real-world responses of COPD patients choosing to undergo PR or home-based exercise. A distinct finding was the significantly greater mean improvements in exercise capacity with PR (59m) compared to home-based exercise (29m), with the former comparable to data reported in national PR datasets.¹¹ In contrast, recent trials comparing home-based exercise with PR have demonstrated lower than expected improvements in exercise outcomes in the PR arms,^{2 5} which may have been driven by participant bias or design. For example, Bourne *et al.*, reported the effects of home-based exercise conducted through an online platform.⁴ Although the comparator arm was supervised and took place in an outpatient setting, the participants did not undergo traditional PR but followed a programme of ten exercise stations that was identical to that in the online programme, with minimal aerobic exercise.

A potential advantage of our study was that we compared patients who chose to undergo home-based exercise with a matched group of patients who chose to attend PR. As such, our results may be generalizable and were not affected by a lack of equipoise. In contrast, a limitation of previous studies is selective trial populations, where significant proportions of eligible participants were not randomised as they wanted to participate in traditional PR.^{2,3} Furthermore, it is plausible that these trials may have lacked equipoise; for example, the majority of participants questioned by Horton *et al.*, '*would have chosen the home programme*'.³ In contrast, out of the 1,593 patients eligible for our study, only 154 (10%) chose home-based exercise. This may have reflected referral bias or bias of the clinical team when offering treatment options, but we suspect that patients choosing home-based exercise were primarily those who did not wish to exercise in a group setting, or those with mobility or transport difficulties who were unable to travel to PR sessions.

A novel finding from our study is that the majority of patients in the home-based group (83%) reported feeling '*much*' or '*a little better*' following intervention. We also observed significant improvements in health-related quality of life following home-based exercise, corroborating recent meta-analysis data.¹² However, we only evaluated the short-term effects and exploration of the long-term impact may be relevant.

In conclusion, traditional PR remains the standard of care and first-line option, with home-based exercise a less effective alternative for COPD patients unable to attend PR.

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COMPETING INTERESTS

CN; DK; SJ; SP; RB; JW; SW have no competing interests to report. WM reports grants from National Institute for Health Research during the conduct of the study; grants from Pfizer, non-financial support from GSK, personal fees from Mundipharma, personal fees from Novartis, outside the submitted work.

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