Journal Pre-proof

Home versus outpatient pulmonary rehabilitation in people with chronic obstructive pulmonary disease: an unselected and propensity-matched real-life study

Sarah Gephine Gaelle Terce Gilles Brulois Cécile Chenivesse
Olivier Le Rouzic Jean-Marie Grosbois

PII: S0300-2896(25)00028-6

DOI: https://doi.org/doi:10.1016/j.arbres.2025.01.007

Reference: ARBRES 3728

To appear in: *Archivos de Bronconeumologia*

Received Date: 12 November 2024

Accepted Date: 13 January 2025

Please cite this article as: Gephine S, Terce G, Brulois G, Chenivesse C, Rouzic OL, Grosbois J-Marie, Home versus outpatient pulmonary rehabilitation in people with chronic obstructive pulmonary disease: an unselected and propensity-matched real-life study, *Archivos de Bronconeumología* (2025), doi: https://doi.org/10.1016/j.arbres.2025.01.007

Type of article: Scientific letter

Title: Home versus outpatient pulmonary rehabilitation in people with chronic obstructive pulmonary disease: an unselected and propensity-matched real-life study.

Authors: Sarah Gephine[1,2], Gaelle Terce[3], Gilles Brulois[4], Cécile Chenivesse[4], Olivier Le Rouzic[4], Jean-Marie Grosbois[1-3].

[1]FormAction Santé, Pérenchies, France, [2]Univ. Lille, Univ. Artois, Univ. Littoral Côte d'Opale, EA 7369 - URePSSS - Unité de Recherche Pluridisciplinaire Sport Santé Société, F-59000 Lille, France. [3]Centre Hospitalier de Béthune, Pneumologie et de Réhabilitation Respiratoire, Beuvry F-62660, France; [4]Univ. Lille, CHU Lille, CNRS, Inserm, Institut Pasteur de Lille, U1019 - UMR 9017- CIIL - Center for Infection and Immunity of Lille, Lille, France

Corresponding author: Sarah Gephine

Address: Zone d'Activité du Bois, Rue de Pietralunga, Pérenchies F-59840, France

Email: sgephine@formactionsante.com

Title: Home versus outpatient pulmonary rehabilitation in people with chronic obstructive pulmonary disease: an unselected and propensity-matched real-life study.

About 5 to 10% of people with chronic obstructive pulmonary disease (COPD) have access to a centre-based pulmonary rehabilitation (PR) programme (1). Evidences support the feasibility, safety and effectiveness of home-based PR programmes, which have been recommended as an alternative to conventional PR to improve access and uptake (2). However, the results of the randomised controlled trials are inconsistent, particularly with regard to exercise capacity (3-5). The wide variety of home-based PR models, which often include telerehabilitation using telephone follow-up or videoconferencing, may account for this inconsistency. A propensity matched study conducted on real-life data reported a greater improvement in exercise capacity after an 8-week outpatient PR programme compared to unsupervised home exercise sessions with weekly telephone follow-up (6). Face-to-face supervised PR home sessions (included exercise training + education + psychosocial support) conducted by a specifically trained professional may prove to be the key to similar benefits. The aim of this retrospective real-life study was to compare the effectiveness of a home vs outpatient PR programme conducted in the north of France in people with COPD, in terms of health-related quality of life, exercise capacity and anxiety and depressive symptoms.

Participants were referred to either the home (FormAction Santé) or outpatient (Bethune hospital) PR programme by their respective respiratory physician who was responsible for the diagnosis of COPD and for validating the absence of contraindications to exercise training. An ethics committee (CEPRO 2021-054) approved this study and the participants provided informed consent. Exclusion criteria were similar between home- and centre-based PR, including unstable cardiovascular disease, dementia or poorly controlled psychiatric illness, neurological sequelae, or bone and joint diseases preventing physical activity training. Home PR consisted of a weekly face-to-face 90-minute home session, during 8 weeks (total of 8 supervised sessions) (7). Personalised physical training, education, motivational and self-management plans were designed and implemented through a collaborative process between the care manager (i.e. the professional who delivered the entire home PR), the participant and their caregiver (if present). Participants were encouraged to perform at least 3 unsupervised exercise sessions per week. A cycle ergometer, a stepper or a mini bike were provided at home. Exercise intensity was adjusted to achieve a Borg Dyspnœa Scale score of 3-4 (moderate to somewhat severe); endurance training was performed with continuous intensity or with intervals depending on the participants' needs and capacities. Physical training was completed with limb muscle strengthening exercises using dumbbells, elastic bands and/or body weight. PR assessments were also conducted at home for this group. Outpatient-based programme consisted of 4 supervised 180-minutes sessions a week, during 6 weeks (total of 24 supervised sessions). Personalised physical training and education sessions were performed in a group of 6 to 8 people and were delivered according to the French PR guidelines (8). Quality of life (Visual Simplified Respiratory Questionnaire, VSRQ), exercise tolerance (6-minute Stepper Test, 6MST) and anxiety and depressive symptoms (HAD) were assessed. The data was retrospectively analysed in two steps: first we compared the data of all participants who enrolled in both programmes from January 2010 to December 2021 (unselected data); then to balance baseline characteristics, we used 1:1 propensity score matching (nearest neighbor) (9) accounting for baseline age, gender, BMI, FEV_1%, VSRQ, 6MST, anxiety and depressive symptoms (matched data). One-way ANOVAs and linear mixed models were used.

Of the 1192 (70.2%) and 507 (29.8%) participants enrolled in the home and outpatient interventions respectively, 1048 (87.9%) and 385 (75.9%) participants completed PR ($p<0.001$). We matched 144 participants in each group, amongst which 103 participants completed the outpatient programme. Baseline characteristics of the unselected and matched completers are presented in Table 1 (see the online supplementary file for the non-completers data).

Table 1. Baseline characteristics of the completers

Variable	Home	Outpatient	p-value

Unselected participants	***n=1048***	***n=385***	
Age, years	65.0 ± 10.1	70.7 ± 10.0	<0.001
Males, n (%)	684 (65.3)	267 (69.3)	0.147
BMI, kg/m^2	26.9 ± 7.6	28.2 ± 7.2	0.005
FEV_1, % of predicted value	39.3 ± 18.5	52.3 ± 20.0	<0.001
FEV_1/FVC % of predicted value	50.0 ± 13.4	56.8 ± 11.3	<0.001
VSRQ, score (0-80)	31.4 ± 15.8	39.5 ± 14.2	<0.001
6MST, strokes	304 ± 154	479 ± 153	<0.001
Anxiety, score (0-21)	9.4 ± 4.6	8.8 ± 4.3	0.027
Depression, score (0-21)	7.8 ± 4.1	6.1 ± 3.6	<0.001
Matched participants	***n=103***	***n=103***	
Age, years	66.9 ± 11.8	67.0 ± 9.9	0.764
Males, n (%)	71 (68.9)	71 (68.9)	0.919
BMI, kg/m^2	27.1 ± 6.5	27.5 ± 7.3	0.728
FEV_1, % of predicted value	48.3 ± 19.9	44.8 ± 18.6	0.195
FEV_1/FVC % of predicted value	53.0 ± 14.0	54.5 ± 11.5	0.439
VSRQ, score (0-80)	37.1 ± 16.8	35.9 ± 14.4	0.605
6MST, strokes	396 ± 157	400 ± 131	0.873
Anxiety, score (0-21)	9.5 ± 4.6	9.2 ± 4.4	0.704
Depression, score (0-21)	7.4 ± 4.0	7.2 ± 4.0	0.682

Abbreviations. BMI, body mass index; FEV_1, forced expiratory volume in 1 second; FVC, forced vital capacity; VSRQ, visual simplified respiratory questionnaire; 6MST, 6-minute stepper test.

Both groups of unselected participants significantly responded to PR (Table 2). The VSRQ and depressive symptoms improvements were higher in the home group (23% vs 11%, and 20% vs 10%, respectively). When matched, the 6MST improvement was higher in the outpatient group (25% vs 13%) and 75% vs 51% of the participants reached the minimum clinically important difference (MCID) (10), while the depressive symptoms score difference remains higher in the home group (18% vs 2%) and 51% vs 29% of the participants reached the MCID (11)) (Table 2, + online supplementary file). These results were consistent in a subgroup of patients with severe to very severe airflow obstruction (online supplementary file).

Table 2. Response to the home vs outpatient PR programmes

	Response to the intervention			
Variable	**Home**	**Outpatient**	**Between-group difference**	**p-value**
Unselected participants	***n=1048***	***n=385***		
VSRQ, score (0-80)	7.2 [6.0 to 8.5]	4.2 [2.7 to 5.7]	3.0 [1.1 to 5.0]	0.002
6MST, strokes	67 [60 to 75]	78 [66 to 89]	-10 [-24 to 3]	0.133
Anxiety, score (0-21)	-1.2 [-1.4 to -1.0]	-0.8 [-1.2 to -0.5]	0.4 [-0.05 to 0.7]	0.086
Depression, score (0-21)	-1.6 [-1.8 to -1.4]	-0.4 [-0.7 to -0.05]	1.2 [-0.8 to 1.6]	<0.001
Matched participants	***n=103***	***n=103***		
VSRQ, score (0-80)	5.4 [3.0 to 7.8]	5.1 [2.7 to 7.6]	0.3 [-3.7 to 3.1]	0.858
6MST, strokes	52 [32 to 72]	97 [78 to 117]	-45 [-73 to -17]	0.002
Anxiety, score (0-21)	-1.5 [-2.2 to -0.9]	-0.6 [-1.2 to 0.1]	0.9 [-0.0 to 1.8]	0.050
Depression, score (0-21)	-1.4 [-1.9 to -0.8]	-0.1 [-0.5 to 0.7]	1.2 [0.4 to 2.1]	0.004

Abbreviations. VSRQ, visual simplified respiratory questionnaire; 6MST, 6-minute stepper test.

This real-life study firstly demonstrated that home and outpatient PR may not be offered to the same typology of people with COPD: airway obstruction was more severe in the home group (65% and 36% of the participants were requiring long-term oxygen therapy and non-invasive ventilation, respectively; data unknown for the centre group). In relation to the severity of COPD or to the employment status, these individuals were also younger and had poorer health-related quality of life and exercise tolerance, and higher symptoms of anxiety and depression than participants enrolled in the outpatient PR. This suggests that frail patients with COPD are more likely to choose home-based PR. Nevertheless, we cannot say with certainty that all participants had a free choice between the two models of PR since 211 respiratory physicians have prescribed the home or outpatient PR programmes according to their knowledge and beliefs. This bias would have been eliminated in a randomised controlled design and could have implications for the success of PR, as the choice of modality appears to be a significant factor affecting adherence and attendance (12). Despite the aforementioned limitations, which will be partially offset by the propensity-matched analysis, both groups of unselected participants significantly improved all the outcomes following PR. This finding is in accordance with the literature (4, 13).

The propensity-matched sample size was considerably reduced due to missing data and significant differences in initial characteristics between groups. However, a total of 288 participants were matched, a sample size which appears adequate when compared to literature (4, 6). The 103 matched completers of the home group had a significant and clinically smaller improvement in exercise tolerance (-45 strokes, $p=0.002$) in comparison to their centre-based counterparts. Despite the recommendation that participants undertake a minimum of three additional unsupervised exercise sessions per week, the absence of a diary or weekly phone follow-up precludes any commentary on the number and intensity of unsupervised home exercise. Therefore, the lack of adherence to exercise training in the home group is also a limitation of this real-world study. Moreover, despite both groups following the physical training recommendations (14), the centre group benefited from a greater number of supervised sessions, higher-performance equipment and higher exercise intensity training; probably explaining the superior result observed in this group. However, standardising home physical training to match that offered in the centre might not be the most effective approach, since the home option attracted the frailest people with COPD. Nevertheless, PR benefits cannot be quantified solely in terms of exercise tolerance. A noteworthy finding is that when matched, the centre group did not demonstrate a reduction in anxiety and depressive symptoms, whereas the home group exhibited a significant and clinically meaningful improvement. The home-based programme was conducted on an individually tailored basis (or with the caregiver if present) with a greater focus on listening to the specific needs and problems of the individual, which may account for this result. Moreover, PR completion was higher in the home group (88% vs 76%, $p<0.001$) as previously reported (4). Home-based PR addresses patient-related barriers to uptake (transport, fatigue, inconvenient timing, fear of

the group…), while the use of a unique care manager throughout the entire home programme may have facilitated the therapeutic alliance.

To conclude, despite the apparent discrepancy in patient profile between home and outpatient PR, both groups benefited from their respective programmes. While the outpatient group demonstrated greater improvement in exercise tolerance, home-based PR should be considered as an alternative in people with severe COPD, as it allows them to respond to PR on PROMs other than exercise capacity. These findings should be complemented with randomized controlled trials and real-life studies exploring the long-term effectiveness of home vs center PR programmes given that benefits typically fade away (4).

Funding

The delivery of the home-based PR programme was financially supported by Adair, Aeris Santé, Elivie, France Oxygène, Homeperf, LVL, Médopale, NorOx, Santélys, Santéo, SOS Oxygène, Sysmed, VentilHome, VitalAire and ARS Hauts-de-France. The funders played no role in the design, conduct or reporting of this study.

Author contribution

SG and JMG: conceptualization, execution, acquisition of data, formal analysis and interpretation, writing the original draft. GT: execution, acquisition of data, review and editing. GB, CC, OLR: writing – review and editing. All authors gave final approval of the version to be published.

Declaration of interest

SG, GT and GB declare not to have any conflicts of interest that may be considered to influence directly or indirectly the content of the manuscript. **CC** reports personal fees and non-financial support unrelated to the submitted work from ALK-Abello, AstraZeneca, Boehringer Ingelheim, Chiesi, GlaxoSmithKlein, MEDA Pharma, Medexact, Novartis, Pierre Fabre, Pfizer, Roche, Sanofi, Santélys, and TEVA. **OLR** reports personal fees and non-financial support unrelated to the submitted work from AstraZeneca, Boehringer Ingelheim, Chiesi, CSL Behring, GlaxoSmithKline, MSD France, Vertex and Vitalaire. OLR is principal investigator in studies for Vertex and CSL Behring. **JMG** reports personal fees and non-financial support unrelated to the submitted work from AstraZeneca, Boehringer Ingelheim, Chiesi, CSL Behring, GlaxoSmithKlein, Menarini.

Artificial intelligence involvement.

No part of this study has been partially or totally produced with the help of any artificial intelligence software or tool.

Acknowledgments

We would like to thank the patients who participated in this research and the staff of both the home and centre-based pulmonary rehabilitation programmes for their role in delivering the interventions and help with data collection. We would like to express our gratitude to Claire Nolan for her help with the propensity score matching technique.

References

1. Spruit MA, Pitta F, Garvey C, ZuWallack RL, Roberts CM, Collins EG, et al. Differences in content and organisational aspects of pulmonary rehabilitation programmes. Eur Respir J. 2014;43:1326-37.

2. Alison JA, McKeough ZJ, Johnston K, McNamara RJ, Spencer LM, Jenkins SC, et al. Australian and New Zealand Pulmonary Rehabilitation Guidelines. Respirology. 2017;22:800-19.

3. Horton EJ, Mitchell KE, Johnson-Warrington V, Apps LD, Sewell L, Morgan M, et al. Comparison of a structured home-based rehabilitation programme with conventional supervised pulmonary rehabilitation: a randomised non-inferiority trial. Thorax. 2018;73:29-36.

4. Holland AE, Mahal A, Hill CJ, Lee AL, Burge AT, Cox NS, et al. Home-based rehabilitation for COPD using minimal resources: a randomised, controlled equivalence trial. Thorax. 2017;72:57-65.

5. Bourne S, DeVos R, North M, Chauhan A, Green B, Brown T, et al. Online versus face-to-face pulmonary rehabilitation for patients with chronic obstructive pulmonary disease: randomised controlled trial. BMJ Open. 2017;7:e014580.

6. Nolan CM, Kaliaraju D, Jones SE, Patel S, Barker R, Walsh JA, et al. Home versus outpatient pulmonary rehabilitation in COPD: a propensity-matched cohort study. Thorax. 2019;74:996-8.

7. Grosbois JM, Gicquello A, Langlois C, Le Rouzic O, Bart F, Wallaert B, et al. Long-term evaluation of home-based pulmonary rehabilitation in patients with COPD. Int J Chron Obstruct Pulmon Dis. 2015;10:2037-44.

8. SPLF R. Réhabilitation du patient atteint de BPCO. Revue des maladies respiratoires. 2010;27:S36-69.

9. Austin PC. An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies. Multivariate Behav Res. 2011;46:399-424.

10. Pichon R, Couturaud F, Mialon P, Le Ber-Moy C, Peran L, Lochon C, et al. Responsiveness and Minimally Important Difference of the 6-Minute Stepper Test in Patients with Chronic Obstructive Pulmonary Disease. Respiration. 2016;91:367-73.

11. Puhan MA, Frey M, Buchi S, Schunemann HJ. The minimal important difference of the hospital anxiety and depression scale in patients with chronic obstructive pulmonary disease. Health Qual Life Outcomes. 2008;6:46.

12. Wan ES, Decherd J, Stella C, Venne JR, McKeon B, Robinson SA, et al. A Two-way Audiovisual Teleconferenced Pulmonary Rehabilitation Program Is Safe, Feasible, and Expands Geographic Catchment. Chest Pulmonary. 2024.

13. Uzzaman MN, Agarwal D, Chan SC, Patrick Engkasan J, Habib GMM, Hanafi NS, et al. Effectiveness of home-based pulmonary rehabilitation: systematic review and meta-analysis. Eur Respir Rev. 2022;31.

14. Andrianopoulos V, Klijn P, Franssen FM, Spruit MA. Exercise training in pulmonary rehabilitation. Clin Chest Med. 2014;35:313-22.