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# Is longer really better? Results of a retrospective real-life cohort study evaluating the benefit of adding a weekly educational session to a traditional 8-week home-based pulmonary rehabilitation programme in people with COPD

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## ABSTRACT

**Objectives** To evaluate the short-term and long-term benefits of adding a weekly educational session to a traditional 8-week home-based pulmonary rehabilitation (PR) programme in people with chronic obstructive pulmonary disease (COPD). Primary hypothesis was that 8 home-based supervised sessions will be equivalent to 16 home-based supervised sessions at both short- and long-term after PR.

**Design** Retrospective cohort study conducted on prospectively collected real-life data, from January 2010 to December 2021.

**Setting** FormAction Santé, Pérenchies France.

**Participants** Eligible individuals were aged >18 years with a diagnosis of COPD and referred to the home-based PR programme by their respiratory physician. Participants were retrospectively divided into two groups (Gr 1, 8 PR sessions, n=759,and Gr 2, 8 PR sessions+8 educational sessions, n=262).

**Intervention** All participants received an 8-week personalised home PR programme. A subgroup of participants received one additional supervised home session per week, including education and motivational support for daily physical activities and walking.

**Outcomes** Health-related quality of life, dyspnoea, anxiety and depressive symptoms, fatigue and exercise tolerance were assessed at baseline (M0), at the end of PR (M2), and 14 months (M14) after M0.

**Results** Baseline characteristics and assessments were similar between groups with an exception for long-term oxygen therapy (Gr1: 69.8% vs Gr2 53.0%, p<0.001) and noninvasive ventilation (Gr1: 38.6% vs Gr2: 29.8%, p=0.015). At M2 and M14, all the assessments were improved in both groups (p<0.01). At M2, the improvement in health status and exercise tolerance was higher in Gr 2 compared with Gr 1 (p<0.05). From M0 to M14, 90 (11.9%) participants and 29 (11.1%) participants died in Gr 1 and Gr 2, respectively (p=0.794).

**Conclusion** People with COPD benefited, at short and long terms, from both 8 or 16 supervised home-based PR sessions. Once-weekly home-based supervised sessions during 8 weeks, combined with unsupervised physical training sessions and self-management plan for the other health behaviours, might be the best compromise between patients, health professionals and policy makers.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This real-life study included more than a thousand of people with severe chronic obstructive pulmonary disease over a decade of home-based pulmonary rehabilitation practice.
⇒ The design of the home-based pulmonary rehabilitation (PR) programme was person-centred and started with an evaluation of the patient's needs (and caregiver's needs if present), health beliefs and expectations leading to the formulation of personalised objectives.
⇒ Although the study was not randomised and uncontrolled, group allocation was not selected by either the participant or the PR team.
⇒ Multicentric and randomised controlled trials are needed to confirm the generalisability of these findings.

## INTRODUCTION

Pulmonary rehabilitation (PR), including education, motivational support to behaviour changes and exercise training, is a well-recognised interdisciplinary intervention that is highly effective at improving dyspnoea, health-related quality of life (HRQoL) and exercise tolerance in people with moderate to severe chronic obstructive pulmonary disease (COPD).[1 2] PR programmes are commonly

outpatient based, delivered in twice or thrice once-weekly supervised sessions during 6–12 weeks for a total of 16–36 sessions.[3 4] French PR programmes are following the European guidelines, and 20 sessions are recommended for maximum benefits.[5] A minority of patients have access to centre-based PR, and although home-based PR accounts for less than 5% of delivered interventions,[3] this setting could provide increased capacity by eliminating barriers that affect outpatient PR attendance such as travelling distance or long-term oxygen therapy.[6] In COPD, home-based PR is feasible and conducts to the same benefits at short and long terms, as the inpatient or outpatient programme.[7–9] The number of home-based supervised PR sessions is often lower than the one in centre-based PR, and patients need to be rapidly empowered to perform on their own additional unsupervised weekly exercise training to achieve national recommendations.

Despite scientific and clinical consensus on duration of outpatient programme (8–12 weeks),[3 4] the optimal number of supervised PR sessions remains debated as the available evidences are still insufficient.[1 10] A few randomised controlled trials (RCTs) published 20 years ago have addressed this topic as the primary study outcome[11–13] and were computed in a systematic review.[10] However, due to heterogeneity in PR programme duration and outcomes assessed, the authors were not able to perform a meta-analysis; therefore, no recommendation was made. While the overall conclusion indicated that longer programmes (20–72 weeks), therefore those with more supervised PR sessions, may have slightly better improvements in health-related quality of life than shorter interventions (8–12 weeks), two trials showed that whether it was once-weekly (6 sessions) compared with twice weekly (12 sessions)[13] or 4 weeks (8 sessions) compared with 7 weeks (14 sessions),[11] the shortest setting showed similar benefits on health-related quality of life and exercise capacity than longer programmes. Beyond the number of supervised sessions, these trials[10] highlighted the importance of unsupervised but structured home-based training sessions tailored and adjusted by healthcare professionals. However, short-term benefits were not always maintained 6 months after both short and long programmes,[11 12] highlighting the crucial role of a meaningful motivational support from the outset of PR and questioning PR maintenance strategies. Given these results and the consensus that needs to be made between patients, health professionals and policy makers, it is important to establish whether less-frequent supervised home-based PR sessions could achieve the well-known benefits of PR.

Therefore, the objective of this real-life retrospective study was to evaluate the short and long term benefits of adding one educational home-based session per week (8 PR sessions+8 educational sessions) to a traditional 8-week home-based PR programme, on health-related quality of life, dyspnoea, anxiety and depressive symptoms, fatigue, exercise tolerance and functional capacity in people with COPD. Primary hypothesis was that 8 home-based supervised sessions will be equivalent to 16 home-based supervised sessions at both short and long term after PR.

## METHODS

### Study design and participants

This was a retrospective study conducted on prospectively collected data, from January 2010 to December 2021. Eligible individuals, aged >18 years were referred to the home-based PR programme (*FormAction Santé*, Pérenchies, France) by their pulmonologist who was responsible for documenting the presence of COPD according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) classification system (inclusion criteria) and validating that the participants were absent of cardiovascular contraindications (unstable and uncontrolled cardiovascular comorbidities despite treatment) to exercise training (exclusion criteria). All participants received an 8-week personalised home PR programme, including a weekly 90-min supervised session as previously described (8 supervised sessions in total).[14] A subgroup of participants received one additional supervised home session per week (8 PR sessions+8 educational sessions), offered by another healthcare company (*Santélys*, France), which cares for people with COPD requiring home-based hospitalisation. These eight additional supervised home sessions included education and motivational support for daily physical activities and walking. Therefore, participants were retrospectively divided into two groups: group 1 receiving 8 supervised sessions (once-weekly) and group 2 receiving 16 supervised sessions (twice-weekly). Retrospective exclusion criteria were $FEV_1$>80% of predicted value, spirometry missing data or a second PR programme performed less than a year after the first one. Human Research Ethics approval was provided by the observational research protocol evaluation committee of the French Language Society of Pulmonology (CEPRO 2021–054), who approved the retrospective analysis. All participants signed a written informed consent before the start of the programme.

### Home-based PR programme

The programme started with an evaluation of the patient's needs and expectations leading to the formulation of a personalised plan (learning needs assessment). Physical training, educational, motivational and self-management plans were designed and implemented through a collaborative process between the PR team, the patient and his/her caregiver. Apart from the weekly visit of the team member who supervised the sessions during the first 8 weeks, participants were expected to perform, on their own, personalised physical training and self-management plan the rest of the week and during the 1-year follow-up period, during which there was no supervised maintenance strategy by the PR team.

All the PR healthcare professionals received training in the principles of behaviour change and motivational communication skills which were used to encourage

health-promoting behaviour change.[15] Education and self-management interventions were adapted to respond to individual's needs, barriers and personal goals. Education topics covered pathophysiology of lung disease and comorbidities, medication and its use (bronchodilator, oxygen and noninvasive ventilation), breathing techniques, prevention and recognition of exacerbations, physical exercise, stress management and emotional responses related to the disease. Other topics could be addressed according to participant's needs: nutrition and weight control, smoking cessation, airway clearance strategies, mindfulness meditation and end-of-life planning.

A cycle ergometer (Domyos 120, Decathlon, Villeneuve-d'Ascq, France)and/or a stepper (Go Sport, Grenoble, France) were available at home to perform exercise training during the 8-week PR programme. Cardiorespiratory training was initially performed by 10-min bouts (or sometimes shorter if the participant was unable to exercise for 10 min), at least 5 days per week, trying to achieve 30–45 min of exercise, in one or several sessions, per day. Exercise intensity was adjusted to maintain a Borg dyspnoea score between 3 and 4 on the Borg 0–10 scale. Physical training was completed with upper and lower limb muscle strengthening exercises using dumbbells, elastic and/or body weight on the same daily basis than cardiorespiratory training. Intensity was gradually adjusted (increasing the number of repetitions and/or resistance) according to participant's dyspnoea or fatigue. They were also encouraged to increase the amount of time spend in daily life physical activities such as gardening, housekeeping and groceries to encourage the integration of physical activities that can be pursued over the long term.

## Patient and public involvement

With the exception of the outcome measures, the participants were involved in the design and implementation of the study. As the home-based PR programme was designed with a person-centric approach, participants were encouraged to select the physical activity, educational and self-management programme that aligned with their individuals needs and capacities. However, the participants were unable to select their group allocation, and no participants were asked to advise on the interpretation or writing up of results. The results of this study will be accessible to participants online via a dedicated website (www.formactionsante.com).

## Data collection

Lung function according to standard guidelines,[16] medication and comorbidity data were collected from the individual's medical record provided by the respiratory specialist. Epices multidimensional questionnaire was used to assess social deprivation on a quantitative and continuous scale ranging from 0 (no deprivation) to 100 (maximum deprivation). A cutoff score of >30.17 suggests social deprivation.[17] Participants were evaluated at home, at the beginning (M0), at the end of the 8-week programme (M2, short term) and at 14 months (M14, long term) after M0 to conclude a full year of follow-up. No home visits or telephone calls were performed between M2 and M14, with the exception of one home visit 6 months after the end of PR in which motivational support was provided.

The Hospital Anxiety and Depression (HAD) scale (14 items: seven each for anxiety and depression with minimum and maximum subscores of 0 and 21; lower is better)[18] and the Fatigue Assessment Scale (FAS) (10 items: five reflecting physical fatigue and 5 reflecting mental fatigue with a test score ranging from 10 to 50; lower is better)[19] were assessed. An anxiety or depressive symptoms score >11 indicates a probable clinical diagnosis of anxiety or depression, and a FAS score ≥22 suggests abnormal fatigue. The minimal clinically important difference (MCID) of the HAD and FAS is considered to be a change of 1.5 units[20] and 4 points,[21] respectively.

Health-related quality of life was evaluated from January 2010 to December 2016 with the Visual Simplified Respiratory Questionnaire (VSRQ) (8 questions on a scale from 0 to 10 with a total score ranging from 0 to 80; higher is better)[22] and then from January 2017 to December 2021 with the COPD Assessment Test (CAT) (8 items with a total test score ranging from 0 to 40; lower is better).[23] In COPD, the MCID of the VSRQ and CAT is considered to be a change of 3.4 and 2 points, respectively.[22 24]

The mMRC breathlessness scale was also used to evaluate the physical dimension of dyspnoea.[25] The 6-min stepper test (6MST) and the timed-up and go (TUG) test were used to evaluate exercise capacity and functional capacity at home, as previously described.[26 27] The MCID of the 6MST is considered to be a change of 40 steps in COPD,[28] and a change of 0.9–1.4 s in TUG performance was identified as clinically important.[27] A cutoff of 1 s was selected for the present study.

## Statistical analyses

Statistical analyses were performed using SPSS 29.0 (IBM SPSS Statistics 29.0), and statistical significance threshold was considered at 0.05. Quantitative variables are expressed as mean and SD or median and IQR in case of non-Gaussian distribution and qualitative variables as number and frequency. Normality of distribution was verified graphically and using Kolmogorov–Smirnov tests. Data were normally distributed. Comparisons of the baseline characteristics and assessments between groups were performed using one-way ANOVAs. Linear mixed models with a random intercept to account for the correlation between samples obtained within the same individuals were used to evaluate the changes in study outcomes over time (M2 and M14). Normality of the model residuals was checked for each outcome using graphs of conditional residuals.

Table 1 Baseline characteristics of the participants according to pulmonary rehabilitation sessions number

| Characteristics | N | Total group n=1021 | Gr 1 8 sessions n=759 | Gr 2 16 sessions n=262 | P value |
|---|---|---|---|---|---|
| Age, years | 1021 | 65.1±10.0 | 65.2±10.2 | 64.9±9.5 | 0.659 |
| Males, n (%) | 1021 | 682 (66.8) | 503 (66.3) | 179 (68.3) | 0.406 |
| BMI, kg/m$^2$ | 1021 | 26.5±7.5 | 26.5±7.5 | 26.6±7.7 | 0.886 |
| Epices score | 943 | 39.7±18.6 | 39.4±18.5 | 40.7±18.8 | 0.343 |
| Smoking status, n (%) | 1021 | | | | 0.077 |
| Current smokers | | 171 (16.7) | 124 (16.3) | 47 (17.9) | |
| Former smokers | | 788 (77.2) | 597 (78.7) | 191 (72.9) | |
| Never smokers | | 83 (8.1) | 56 (7.4) | 27 (10.3) | |
| Pulmonary function test* | | | | | |
| $FEV_1$, % of predicted value | 1021 | 38.4±17.6 | 38.1±17.9 | 39.3±16.9 | 0.337 |
| $FEV_1$/FVC % of predicted value | 857 | 49.5±13.4 | 49.8±13.5 | 48.6±12.9 | 0.267 |
| Long-term oxygen therapy, n (%) | 1021 | 669 (65.5) | 530 (69.8) | 139 (53.0) | <0.001 |
| Noninvasive ventilation, n (%) | 1021 | 371 (36.3) | 293 (38.6) | 78 (29.8) | 0.015 |
| Mean comorbidities number | 1021 | 4.4±2.2 | 4.4±2.2 | 4.5±2.2 | 0.557 |

*Collected from the medical record provided by the respiratory specialist.
BMI, body mass index; $FEV_1$, forced expiratory volume in 1 second; FVC, forced vital capacity.

## RESULTS

From January 2010 to December 2021, 1255 people with COPD diagnosed by their lung specialist were enrolled in PR programme and 21 (1.7%) people did not enrolled into PR programme after the learning needs assessment visit (lack of motivation, n=5; death, n=3; hospitalisation, n=3; no reason, n=10). Among them, 152 (12.3%) participants were removed from the analysis due to spirometry missing data and 61 (4.9%) because it was not the first PR programme. Among the 1021 participants included in the retrospective analysis (mean age of 65.1±10.0 years and mean $FEV_1$ of 38.4±17.6% of predicted), 759 (74.3%) participants and 262 (25.7%) participants performed 8 (Gr 1) and 16 home-based sessions (Gr 2), respectively. At baseline, compared with Gr 2, participants in Gr 1 were more often receiving long-term oxygen therapy (69.8% vs 53.0%, p<0.001) and noninvasive ventilation (38.6% vs 29.8%, p=0.015) (table 1). All the other baseline characteristics and assessments were similar between groups (tables 1 and 2). The baseline characteristics of the participants including in the sensitivity analysis are presented in supplements (online supplemental table S1 and table S2). In the analysis of the completers at

Table 2 Baseline assessments according to pulmonary rehabilitation session number

| Assessments | N | Total group n=1021 | Gr 1 n=759 | Gr 2 n=262 | P value |
|---|---|---|---|---|---|
| VSRQ (0–80) | 430 | 30.9±15.6 | 30.9±15.6 | 30.7±15.9 | 0.880 |
| CAT (0–40) | 577 | 22.4±7.6 | 22.1±7.4 | 23.0±8.0 | 0.220 |
| FAS (10-50) | 745 | 28.0±8.3 | 27.8±8.3 | 28.4±8.1 | 0.399 |
| HAD (0–42) | 1014 | | | | |
| Anxiety symptoms | | 9.5±4.6 | 9.6±4.6 | 9.2±4.5 | 0.241 |
| Depression symptoms | | 7.9±4.2 | 7.9±4.1 | 7.8±4.3 | 0.752 |
| Total score | | 17.4±7.6 | 17.5±7.6 | 17.0±7.7 | 0.378 |
| mMRC (0–4) | 738 | 3.14±1.02 | 3.17±1.02 | 3.07±1.03 | 0.269 |
| 6MST, strokes | 828 | 299±152 | 305±152 | 282±150 | 0.052 |
| TUG, seconds | 926 | 10.6±6.0 | 10.5±5.8 | 10.9±6.3 | 0.372 |

CAT, COPD assessment test; FAS, Fatigue Assessment Scale; HAD, Hospital Anxiety and Depression scale; mMRC, modified Medical Research Council scale; 6MST, 6-minute stepper test; TUG, timed-up and go; VSRQ, visual simplified respiratory questionnaire.

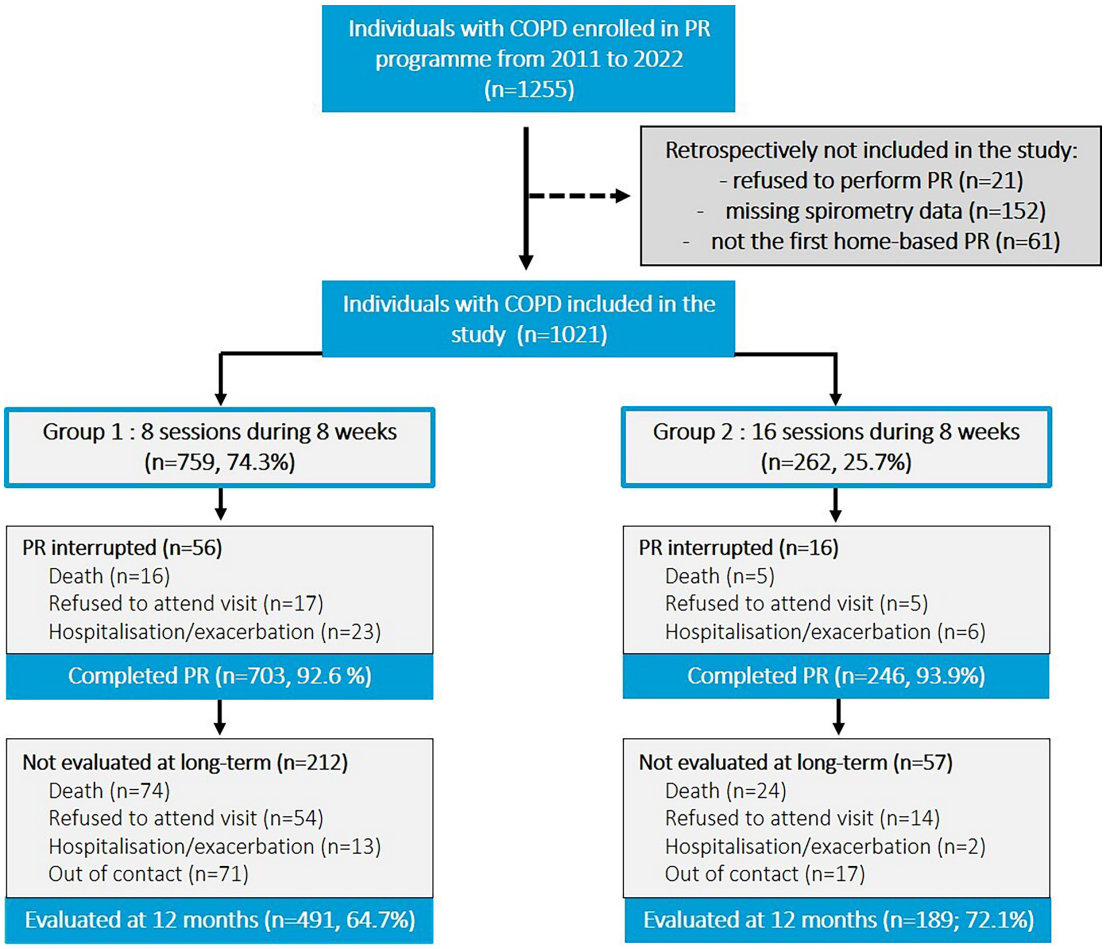


**Figure 1** Flowchart of study participants.

M0 and M2, only the baseline 6MST test was higher in Gr 1 compared with the Gr 2 (320 vs 292 strokes, p=0.024).

A flowchart of the study participants is presented in figure 1. Among the 1021 included patients, 72 (7.1%) participants did not complete PR (56 (7.4%) in Gr 1 and 16 (6.1%) in Gr 2), and 680 (66.6%) participants performed the 12-month follow-up visit (491 (64.7%) and 189 (72.1%), respectively, p=0.028). From M0 to M14, 90 (11.9%) participants and 29 (11.1%) participants died in Gr 1 and Gr 2, respectively (p=0.794).

In both groups, all the assessments were significantly and clinically improved at the end of PR (p<0.005) (table 3). At short term, VSRQ and 6MST improvements were higher in Gr 2 compared with Gr 1 (VSRQ, +9.4 vs +6.9 points, p=0.039 and 6MST, 80 vs 61 strokes, p=0.023) (table 3). With an exception for the TUG, all the assessments were also improved at M14 compared with M0 (p<0.005) (table 4). These improvements were similar between groups at long term (table 4). Figure 2 shows a box plot of the 6MST delta improvements at M2 and M14 in both groups. Diagrams show the large intersubject variability of the 6MST improvement and especially in Gr 1 at the end of PR with outsiders ranging from a decrease of 362 strokes to an increase of 560 strokes.

## DISCUSSION

Despite that PR is widely recognised as an essential component of the integrated care of people with COPD, the optimal number of physical training and educational sessions remains a topic of ongoing debate. This real-life retrospective cohort study demonstrated that whether participants performed 8 supervised PR sessions (Gr 1) or 8 supervised PR sessions+8 supervised educational sessions (Gr 2) during 8 weeks, they significantly improved health-related quality of life, dyspnoea, anxiety and depressive symptoms, fatigue and exercise tolerance at both short and long terms. At the end of PR, Gr 2 showed a greater improvement in health-related quality of life (VSRQ only) and exercise tolerance than Gr 1. However, 1 year after the end of PR, the benefits were similar between groups. These results suggest that a PR programme of once-weekly home-based supervised sessions during 8 weeks, combined with unsupervised home physical training sessions and self-management plan for the other health behaviours, might be the best compromise between patients, health professionals and policy makers.

At the end of the 2-month supervised intervention, both groups significantly improved health-related quality of life, fatigue symptom, anxiety and depressive symptoms,

Table 3 Short-term pulmonary rehabilitation benefits according to the number of sessions performed

| | Gr 1 8 sessions | | | Gr 2 16 sessions | | | |
|---|---|---|---|---|---|---|---|
| **Characteristics** | **n** | **M2** | ΔM2 – M0 | **n** | **M2** | ΔM2 – M0 | **Group*time effect** |
| VSRQ | 299 | 37.9±15.5 | 6.9 [5.4 to 8.4] | 104 | 40.4±17.7 | 9.4 [8.2 to 10.6] | 0.039 |
| CAT | 391 | 18.5±7.4 | −3.4 [-4.0 to -2.8] | 133 | 18.1±7.7 | −4.6 [-5.6 to -3.5] | 0.059 |
| FAS | 497 | 24.2±7.7 | −3.3 [-3.9 to -2.8] | 173 | 24.2±7.5 | −4.2 [-5.2 to -3.3] | 0.135 |
| HAD | | | | | | | |
| Anxiety symptoms | 696 | 8.4±4.2 | −1.1 [-1.4 to -0.9] | 239 | 7.5±4.1 | −1.6 [-2.0 to -1.1] | 0.113 |
| Depression symptoms | 696 | 6.2±4.0 | −1.5 [-1.8 to -1.3] | 239 | 5.7±3.9 | −1.9 [-2.4 to -1.5] | 0.150 |
| Total score | 696 | 14.7±7.2 | −2.7 [-3.1 to -2.2] | 239 | 13.3±6.9 | −3.5 [-4.2 to -2.7] | 0.073 |
| mMRC | 494 | 2.74±1.13 | −0.39 [-0.47 to -0.31] | 172 | 2.51±1.19 | −0.52 [-0.65 to -0.39] | 0.081 |
| 6-min stepper test | 504 | 380±158 | 61 [53 to 70] | 185 | 372±166 | 80 [66 to 94] | 0.023 |
| Timed-up and go | 595 | 8.8±4.5 | −1.3 [-1.5 to -1.0] | 215 | 9.0±4.9 | −1.8 [-2.2 to -1.3] | 0.068 |

Abbreviations VSRQ, Visual Simplified Respiratory Questionnaire; CAT, COPD Assessment Test; FAS, Fatigue Assessment Scale; HAD, Hospital Anxiety and Depression scale; mMRC, modified Medical Research Council scale.

dyspnoea, exercise tolerance and functional capacity. While all the improvements also reached the clinical threshold in Gr 2, Gr 1 did not reach the MCID of the fatigue and anxiety symptom scores. Moreover, the benefits on health-related quality of life (VSRQ) and exercise tolerance were significantly greater in the group that received more supervised sessions. As shown in figure 2, we chose to keep the outsiders in the 6MST analyses, as they reflect the variations in physical capacity that people with COPD experience over the course of the disease progression.[29] For example, the outsiders who showed a 6MST decrease >300 strokes after PR all reported a COPD-related recent exacerbation and/or hospitalisation. Therefore, the large intrasubject variability and the higher number of outsiders in Gr 1 compared with Gr 2 may have influenced the results. As the majority of participants did not fill a physical training diary, we cannot rule out that the number of unsupervised physical training sessions could have also contribute to the 6MST short-term difference between group.

The short-term results are consistent with the conclusion of the only review on this topic,[10] that longer duration PR programmes (20–72 weeks), therefore those offering more supervised sessions (54–216 sessions), may have more favourable effects on health-related quality of life in people with COPD, with the exception that the participants of the present study benefited from a maximum of 16 supervised sessions. Recent RCTs have

Table 4 Long-term pulmonary rehabilitation benefits according to the number of sessions performed

| | Gr 1 8 sessions | | | Gr 2 16 sessions | | | |
|---|---|---|---|---|---|---|---|
| **Characteristics** | **n** | **M14** | ΔM14 – M0 | **n** | **M14** | ΔM14 – M0 | **Group*time effect** |
| VSRQ | 209 | 37.9±16.9 | 6.5 [4.4 to 8.6] | 77 | 39.0±14.7 | 6.7 [3.3 to 10.1] | 0.926 |
| CAT | 247 | 17.7±8.0 | −3.5 [-4.4 to -2.6] | 91 | 18.6±7.7 | −4.1 [-5.6 to -2.7] | 0.452 |
| FAS | 318 | 23.7±8.3 | −3.2 [-4.0 to -2.4] | 120 | 23.9±8.1 | −4.1 [-5.3 to -2.8] | 0.250 |
| HAD | | | | | | | |
| Anxiety symptoms | 460 | 7.7±4.5 | −1.8 [-2.2 to -1.5] | 171 | 7.1±4.5 | −1.7 [-2.3 to -1.1] | 0.795 |
| Depression symptoms | 460 | 5.7±4.2 | −1.9 [-2.3 to -1.5] | 171 | 5.4±4.1 | −1.9 [-2.6 to -1.3] | 0.926 |
| Total score | 460 | 13.4±7.4 | −3.7 [-4.4 to -3.1] | 171 | 12.5±7.5 | −3.7 [-4.7 to -2.7] | 0.921 |
| mMRC | 316 | 2.83±1.17 | −0.20 [-0.31 to -0.09] | 118 | 2.76±1.16 | −0.21 [-0.39 to -0.03] | 0.906 |
| 6-min stepper test | 259 | 392±176 | 44 [29 to 59] | 87 | 378±167 | 52 [26 to 78] | 0.601 |
| Timed-up and go | 357 | 9.1±5.3 | −0.30 [-0.73 to 0.14] | 137 | 10.0±5.1 | −0.11 [-0.80 to 0.59] | 0.649 |

Abbreviations VSRQ, Visual Simplified Respiratory Questionnaire; CAT, COPD Assessment Test; FAS, Fatigue Assessment Scale; HAD, Hospital Anxiety and Depression scale; mMRC, modified Medical Research Council scale.

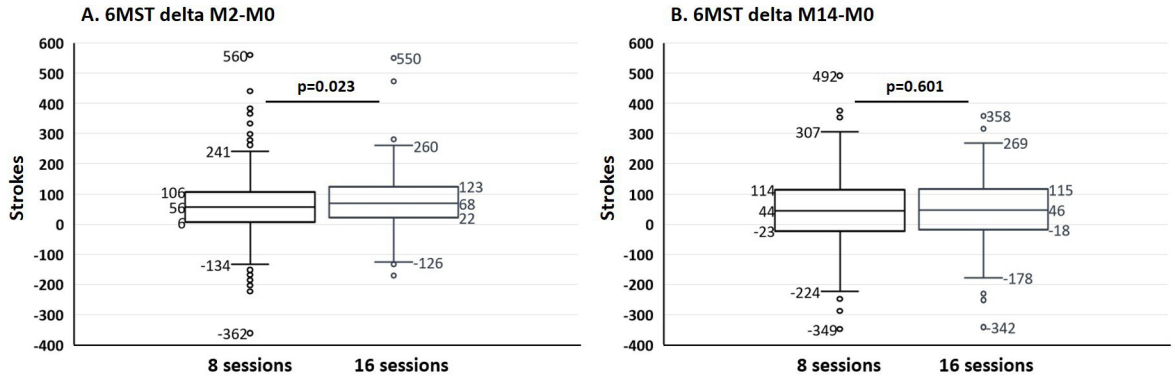


**Figure 2** Box plot showing delta improvements of the 6-min stepper test (6MST) at the end of pulmonary rehabilitation (A) and the end of the 1-year follow-up (B) in people who received 8 sessions (GR 1, black box plot) and people who received 16 sessions (Gr 2, grey box plot). Values are expressed in median and range. The minimal clinically important difference of the 6MST is considered to be a change of 40 strokes.

validated that exercise tolerance, health-related quality of life and dyspnoea can be improved by 8–14 remote supervised home sessions (weekly phone calls) in people with COPD[8 30 31] but with divergent results regarding long-term maintenance. Moreover, the review of Beauchamp *et al*[10] included five RCTs (published from 1990 to 2006) in which only two studies offered education combined with exercise training. One of this trial showed that health-related quality of life and exercise capacity were similarly improved by both the short and long interventions (4 weeks, 8 sessions vs 7 weeks, 14 sessions).[11] Over the past 20 years, PR programmes content have evolved, giving a more substantial role to education and psychosocial support through motivational communication and self-management plan to encourage patients to adapt healthier behaviours.[32 33]

The most important result of this real-life study is that, with the exception of the timed-up and go test, all outcomes were significantly improved 12 months after the end of the home-based PR programme, without a difference between the number of sessions performed. No maintenance strategy (such as phone calls, telerehabilitation or home visits) was delivered by the PR team after the end of PR. However, the design of the home-based PR was patient-centred; it started with an evaluation of the patient's needs, health beliefs and expectations leading to the formulation of personalised objectives. Physical training, education, motivational and self-management plans were implemented using appropriate strategies and readjusted during the 8 sessions to achieve patient's objectives. A collaborative process between the PR team, the person with COPD and his/her caregiver (if present) was implemented throughout the 8-week programme to negotiate the self-maintenance of exercise training/daily life physical activity and positive health behaviours. This design may explain the similar significant benefits between groups 1 year after the end of PR. When designing a PR programme, a balanced compromise must be reached between (1) the needs, availability, capacity and commitment of the patients; (2) healthcare professionals to provide optimal long-term benefits for a majority of participants and (3) at a reasonable cost for the funders and policy makers. To reach such a compromise, flexibility and diversity among PR settings should be offered to patients with respiratory chronic diseases.[4 10 11]

In light of the guidelines' recommendation of an 8-week programme duration, future trials should focus on providing robust evidence on the optimal number of sessions during this duration for people with COPD. It would be beneficial to consider the implementation of tailored programmes, in which the conventional number of PR session can be extended or shortened as required to align with the evolving needs of the individual as well as temporal constraints. This would be particularly relevant to patients who are referred to PR in preparation for thoracic surgery or for lung transplant or those entering an aggressive treatment for bronchopulmonary cancer.

## Methodological considerations

One of the strengths of the study was to include more than a thousand of people with severe COPD over a decade of real-life home-based PR practice. By improving external validity and establishment in usual care, real-life studies are useful to complement the results of traditional randomised controlled trial.[34] Nevertheless, the monocentric, non-randomised and uncontrolled nature of this study may limit the scope of the present results that should be confirmed by more robustly designed trials. Although the group allocation was not randomly assigned, it was not selected by either the patient or the PR team. Participants received 16 supervised sessions if, in addition to PR (*FormAction Santé*), they were also requiring a home-based hospitalisation (*Santélys*), which limits the selection bias for this study. Despite that education is an essential component of PR and that both healthcare teams received the same initial standardised therapeutic education from the same licensed instructor, we recognised that 8 educational sessions are not equivalent of 8 PR sessions. Therefore, our study is not comparable with others trials that have evaluated the effectiveness of short versus long PR programmes. Since using a diary was optional, the adherence to physical training session cannot be report and

we cannot rule out that the higher improvement of exercise tolerance in Gr 2 at short term is related to a higher amount of physical exercise training during PR. Tracking unsupervised physical training is a challenge for real-life home-based studies that has yet to be addressed. Finally, given the real-life study design, health-related quality of life was evaluated using two questionnaires over the 10-year period of PR practice. As the comparisons were intragroup, it can be presumed that it did not impact the study results.

## Conclusion

This real-life study showed that people with COPD benefit from both 8 or 16 supervised home-based PR sessions. Participants who received more supervised sessions showed a significant but not clinically greater short-term improvement in health-related quality of life and exercise tolerance. However, benefits were similar between groups 1 year after the end of PR. Once-weekly home-based supervised sessions during 8 weeks, combined with unsupervised physical training sessions and self-management plan for the other health behaviours, might be the best compromise between patients, health professionals and policy makers.

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