ORIGINAL RESEARCH LETTER

Effects of pulmonary rehabilitation on daily life physical activity of fibrotic idiopathic interstitial pneumonia patients

To the Editor:

According to the international consensus statement of 2011, idiopathic pulmonary fibrosis (IPF) and idiopathic nonspecific interstitial pneumonia (NSIP) are classified as fibrotic idiopathic interstitial pneumonia (f-IIP) of unknown aetiology [1]. f-IIP patients display persistent and significant dyspnoea, exercise intolerance and poor health-related quality of life [2]. f-IIP is also associated with a marked reduction in daily life physical activity (DL_{PA}) [3], which is related to morbidity and mortality in many chronic diseases, including f-IIP [4–6].

Pulmonary rehabilitation (PR) is a validated and widely used method to improve exercise tolerance in patients with chronic respiratory diseases, including interstitial lung diseases (ILDs) [7]. In this patient population, improvements have been demonstrated in the distance covered during the 6-min walk test, peak oxygen uptake during exercise [7, 8], and associated dyspnoea and quality of life scores [7]. However, it is not known whether PR improves DL_{PA} of patients with f-IIP. To address this knowledge gap, we report here the results of an observational, retrospective, routine clinical practice study of home-based PR management of all f-IIP patients referred to us by their pulmonologists over a 4-year period.

Between December 2011 and December 2015, 176 Caucasian patients with a diagnosis of f-IIP were referred to our reference centre for rare pulmonary diseases for a diagnosis and medical decision based on multidisciplinary discussion with radiologists and pathologists. The inclusion criteria were 1) a diagnosis of IPF or NSIP according to the international consensus guidelines [9], and 2) no acute exacerbation in the 3 months preceding enrolment. Of the 176 patients, 86 (male:female ratio 2:3) gave written informed consent to participate in our home-based PR programme. Approval for the use of these data was provided by the Institutional Review Board of the French Learned Society for Pulmonology (CEPRO 2011-039).

Forced vital capacity (FVC) and forced expiratory volume in 1 s (FEV_1) were measured using spirometry with a Jaeger-Masterlab cabin (Vyaire medical, Hoechberg, Germany), and single-breath diffusing capacity of the lung for carbon monoxide (D_{LCO}; units of mL $CO \cdot min^{-1} \cdot mmHg^{-1}$) was measured and corrected for haemoglobin concentration. Values are expressed as percentages of the predicted normal values. Subjects were equipped with a physical activity monitor (SenseWear Pro Armband with SenseWear software version 6.1; BodyMedia Inc., Pittsburgh, PA, USA) and instructed to wear the device continuously (except while showering or bathing) for five consecutive days, of which two were to be weekend days, as previously described [3]. DL_{PA} was assessed by measuring four parameters: the number of steps per day, the time ($min \cdot day^{-1}$) spent in activities above an estimated energy expenditure of 2.5 metabolic equivalents (METs), the total energy expenditure above 2.5 METs ($kcal \cdot day^{-1}$), and the total daily energy expenditure ($kcal \cdot day^{-1}$). Exercise tolerance was evaluated at home using a 6-min stepper test (6MST), as previously reported [10]. During the 6MST, arterial oxygen saturation and heart rate were measured continuously and the total number of steps was recorded. The Hospital Anxiety and Depression Scale (HADS) questionnaire was administered to identify and quantify anxiety and depression. For both subscales, a score of ⩾8

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Fibrotic idiopathic interstitial pneumonia patients derived benefit from a pulmonary rehabilitation programme in terms of exercise tolerance, anxiety, depression and quality of life without increasing their daily life physical activity http://ow.ly/WV7U30kgNkU

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(scale 0–21) is indicative of clinically relevant symptoms. Quality of life was assessed using the Visual Simplified Respiratory Questionnaire (VSRQ).

Home-based PR was carried out for eight consecutive weeks, as previously described [11]. In brief, a qualified exercise specialist performed a training diagnostic assessment and initiated the programme in the patient's home to ensure full understanding. Thereafter, the specialist visited once a week for 8 weeks. The exercise training lasted for 30–45 min a day and included endurance training on a cycle ergometer (Domyos VM 630; Decathlon, Villeneuve d'Ascq, France) or stepper, muscle-strengthening exercises using weights and elastic resistance bands, activities of daily living, walking, and learning to climb stairs. A cycle ergometer or stepper was installed in the patients' homes for use during the PR programme. The patients learnt to recognise their dyspnoea threshold and were encouraged to perform this daily exercise programme independently. Therapeutic education, psychosocial support and motivational communication to encourage health-related behaviour changes and self-management were also implemented. Compliance with the PR programme was evaluated weekly by a team member by questioning the patient about DL_{PA}, adherence to treatments, independent exercises, nutrition, and other factors, and implementing exercise re-training, if required. The 6MST, DL_{PA}, VSRQ, and HADS scores were evaluated before and immediately after completion of the 8-week PR programme.

Statistical analysis was performed using the SAS statistical package, version 8 (SAS Institute Inc., Cary, NC, USA) and Prism 5 (GraphPad Software Inc., La Jolla, CA, USA). Normal distribution was verified with the Kolmogorov–Smirnov test. Quantitative variables are expressed as mean±SD, and differences between means were compared by Student's t-test. A p-value ⩽0.05 was considered statistically significant.

The PR programme was completed by 72 (84%) of the 86 patients. The remaining 14 patients were unable to perform exercise training because of a severe change in their condition (n=6), bronchial infection (n=4), lower back pain and joint pain (n=2), and non-acceptance of the armband (n=2). Of the final 72 patients (IPF n=35 and f-NSIP n=37), the mean±SD values were: age 64.3±10 years, body mass index 26.3±4.8 $kg \cdot m^{-2}$, FVC 71±19%, FEV_1 70.4±20.2%, and D_{LCO} 37±12%. As expected, exercise tolerance (6MST) and quality of life (VSRQ) improved significantly after PR, as did the HADS scores, particularly the anxiety score (table 1). However, the four parameters of DL_{PA} were not significantly different before and after PR.

The present study has three main findings: 1) PR significantly improved exercise tolerance and quality of life, as expected; 2) surprisingly, DL_{PA} measures were not changed after PR; and 3) interestingly, PR was associated with a decrease in both anxiety and depression. Our data are consistent with previous studies demonstrating that PR improves exercise tolerance, symptoms and quality of life in patients with chronic respiratory diseases, including ILDs such as f-IIP [7, 12]. However, this is the first investigation of the relationship between PR and DL_{PA}.

Objective gains in physical activity after PR has been studied in chronic obstructive pulmonary disease patients and did not show significant improvement, despite evidence of increased exercise tolerance [13, 14]. We previously reported that DL_{PA} was significantly impaired in f-IIP patients, as measured using a physical activity monitor [3]; however, to our knowledge, this is the first study evaluating the influence of PR on DL_{PA} using objective parameters obtained with a physical activity monitor. Previous studies that

TABLE 1 Effects of pulmonary rehabilitation (PR) on daily life physical activity, exercise tolerance, anxiety, depression and quality of life in fibrotic idiopathic interstitial pneumonia patients

	Before PR	After PR	p-value
Number of steps per day#	4203±3319	3854±2698	0.16
Duration of physical activity >2.5 METs min·day^{-1}#	103±98	84±83	0.06
Total energy expenditure kcal·day^{-1}#	2036±552	2040±440	0.9
Energy expenditure >2.5 METs kcal·day^{-1}#	357±375	299±283	0.11
6-minute stepper test steps¶	388±155	434±173	0.0001
HADS score (total)	14.6±6.6	12.5±6.3	0.0007
Anxiety score	8.3±4	7.1±3.6	0.0003
Depression score	6.3±7	5.4±3.5	0.023
VSRQ score	40.2±15	44±15	0.009

Data are presented as mean±SD, unless otherwise stated. n=72. METs: metabolic equivalents; HADS: Hospital Anxiety and Depression Scale; VSRQ: Visual Simplified Respiratory Questionnaire. #: Daily life physical activity was measured by the SenseWear Pro Armband; ¶: measure of exercise tolerance.

evaluated physical activity of f-IIP patients before and after PR used the International Physical Activity Questionnaire to estimate physical activity levels [12, 15]. Although the results suggested that small benefits had been obtained, questionnaires are not authentic measures of actual DL_{PA}. It is unclear why DL_{PA} did not change despite the improvement in exercise tolerance. One possibility is that the shorter duration of DL_{PA} >2.5 METs after PR was compensated by a longer duration of DL_{PA} <2.5 METs. Such a scenario would be consistent with the observed lack of significant change in total energy expenditure (kcal·day^{-1}). We also cannot exclude the possibility that the patients might have "rewarded" themselves by taking more leisure time at the end of PR programme; however, this is speculation. The PR programme included a personalised education programme geared towards helping and supporting the patients to adopt good health-related behaviour. Given that the patients' environment did not change at the end of the programme, except for removal of the weekly supervised session, we might have expected the patients to maintain the same level of physical activity immediately after completion of the PR programme. The fact that this was not observed suggests that simply increasing the patient's exercise capacity through a PR programme does not mean that they will subsequently take advantage of it in their daily life.

Anxiety and depression are higher in f-IIP patients than in the general population [16]. In a recent study, symptoms of depression and anxiety were present in 25.9% and 21.4%, respectively, of 112 patients with IPF [17]. The causes of psychological distress include dyspnoea, comorbidity, loss of independence, feelings of social isolation and inadequate sleep [2, 16]. Our results are in agreement with the findings of Harrison *et al.* [18] that PR is associated with a significant improvement of mood, despite the lack of effect on DL_{PA}.

In conclusion, patients with f-IIP derived benefit from a PR programme in terms of exercise tolerance, anxiety, depression and quality of life without increasing their physical activity. Future research should focus on developing PR programmes tailored to promote long-term changes in DL_{PA}.

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