

## EFFECT OF EIGHT WEEKS OF EXERCISE TRAINING ON LUNG FUNCTION IN PATIENTS WITH PULMONARY FIBROSIS

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**Aim.** The purpose of this study was to identify the effect of eight weeks of exercise training on lung function in PF patients. **Material and Methods.** Forty eight patients diagnosed with PF were participated in our training program which mainly consisted of a 8-week exercise training program. Pulmonary function tests, 6MWD, dyspnoea were evaluated at baseline and after the program. Our exercise training program involved thoracic expansion exercises, pursed-lips breathing, upper and lower extremity exercises combined with breathing control; exercises also included arm raising and knee extensions, diaphragmatic breathing exercises, and a walking program (15–30 min/day). **Results.** Our study showed that the 8-week-long exercise training program performed in PF patients significantly improved pulmonary function tests, 6MWD, and reduced dyspnea severity during daily life activities. Significant increase was showed in the exercise capacity of our patients after the exercise training program. **Conclusions.** The exercise training program may be beneficial to improve functional capacity of patients with PF by decreasing dyspnea and increasing exercise capacity. Thus, we recommend that exercise training programs, which are tailored to the individual needs of patients with PF, should be included in the treatment plan. Nevertheless, further studies, featuring larger patient and control groups, are needed to confirm the effectiveness of exercise training in PF patients.

**Keywords:** *exercise training, lung function, pulmonary fibrosis.*

### Introduction

Pulmonary fibrosis is a chronic and ultimately fatal disease considered a progressive lung disease causing dry, non-productive cough on exertion, progressive exertional dyspnea (shortness of breath with exercise), fatigue, dry, inspiratory bibasilar “velcro-like” crackles on auscultation (a crackling sound in the lungs during inhalation similar to Velcro being torn apart slowly, heard with a stethoscope), impaired gas exchange, and reduced exercise capacity and health related quality of life [2, 15, 16].

Impaired respiratory mechanics, musculoskeletal and hyperinflation dysfunction, ventilator insufficiency, and circulatory impairment that causes exercise induced gas exchange impairment results in limiting of exercise capacity in pulmonary fibrosis [1, 8], and to improve lung function in pulmonary fibrosis has to use rehabilitation programs which are shown to be active in improving exercise capacity, health-related quality of life and dyspnoea in PF patients, and are recommended in the recent treatment guideline [5]. Previous studies demonstrated that pulmonary rehabilitation has also been accepted among the non-pharmacological treatment options as a means to improve exercise capacity, reduce dyspnea severity, and quality of life of patients with PF

[7, 18]. However, no evidence has been reported for the efficacy of the program in PF patients. The present study investigated the effects of eight weeks of exercise training on lung function in patients with PF. Those effects were assessed in terms of pulmonary function, functional exercise capacity and dyspnea.

### Methodology

Forty eight PF patients repeatedly admitted to a pulmonary rehabilitation center were assessed. PF patients were enrolled according to the diagnostic criteria of the American Thoracic Society (ATS)/European Respiratory Society (ERS) consensus statement [1]. Patients were included if they were not having any pulmonary infections such as pneumonia at least in the last 6 weeks, being clinically stable, not receiving supplementary oxygen therapy, treatment with no more than 20 mg of prednisone per day, having no neurological, not having serious uncontrolled cardiovascular, being able to ambulate without assistance or assistive devices, and willingness to participate in this study. While the exclusion criteria involved the presence of any of the following: Asthma or chronic obstructive pulmonary disease (COPD), collagen vascular disease, cancer, acute coronary artery disease, nonparenchymal restrictive lung disease, and patients who did not com-

plete exercise training program on a regular basis. Moreover, the study protocol was approved by the local ethical committee and all patients gave their written informed agreement.

*Testing Procedures.* The researcher did number of tests as explained below.

*Outcome measures.* All patients were evaluated with the same gain parameters before and after the 8-week long exercise training program. Pulmonary function, exercise capacity, and baseline dyspnea were evaluated.

*Pulmonary Function.* Pulmonary function and reversibility tests were achieved with a spirometer (type German), according to the criteria set by the American Thoracic Society [1]. Values of FEV1 are stated in liters, in percentages of FVC, and as percentages of reference values.

*6MWD.* The researchers conducted the 6MWD according to American Thoracic Society guidelines [1], patients were instructed to walk, attempting to cover as much ground as possible within 6 min. A research assistant timed the walk, and standardized verbal encouragement was given to each patient, data were obtained for Spo<sub>2</sub>, heart rate, respiratory rate, Borg scale dyspnea score, and BP before and after the test. The distance covered was measured in meters.

*Exercise Training Program.* The participants were educated about the benefits and the importance of their adherence to the exercise training program over the 8-week course. So as to rise participants' adherence to the program, a booklet was organized and the instructions about the program were given to the participants with this booklet. Our exercise training program involved thoracic expansion exercises, pursed-lips breathing, upper and lower extremity exercises combined with breathing control (pectoral muscles stretch, trunk extension, bilateral shoulder elevation, sit-to-stand exercises using a chair), strength training for the limbs was conducted using elastic bands; exercises included arm raising and knee extensions, diaphragmatic breathing exercises, and a walking program (15–30 min/day). Breathing control training, coping strategies to deal with shortness of breath and relaxation training were given to the participants.

The participants were instructed to achieve all exercises four days a week, in four sessions per day with 12 repeats. They were recommended to have a break and rest in the case of excessive fatigue and shortness of breath and to continue the exercises according to their fatigue tolerance.

*Statistical analysis.* SPSS (version 10,0) was

used to analyze data. All values are shown as number, percentage or mean (standard deviation). Differences between assessment parameters before and after the exercise training program were compared using the T-test. A p value of 0,05 or less was considered statistically significant.

## Results and Discussion

*Baseline Characteristics of the Study Population.* Baseline characteristics of the forty eight PF patients tested are shown in Table 1. Of the 48 participants were men, and all were > 45 years of age and were enrolled according to the inclusion criteria during a six months period. A total of 48 patients completed the program. Among this group of participants, airflow obstruction was moderate and most of patients were receiving a short-acting. In all participants, the sensation of dyspnea on exertion was found to be light to moderate. The data analysis was performed on the 48 male patients who completed the program. All patients had not experienced any problem such as fatigue and dyspnea when performing their exercises. After the exercise training program, pulmonary function test results were changed (Table 2, p = 0,01, 0,003, and 0,000). However, a significant increase was found in 6MWD after the training program (p = 0,001). The perceived severity of dyspnea during daily life activities changed (p = 0,000).

**Table 1**  
Baseline Characteristics of the Study Population

Variables	Mean	SD
Age, yr	52,86	6,12
Weight, kg	72,31	10,27
FEV1, % of predicted	60,00	9,24
BMI, kg/m <sup>2</sup>	23,04	2,40
Cigarette consumption pack/years	14,16	1,06

**Table 2**  
Pulmonary function test results, 6MWD and Borg scale

Parameters	Before training		After training		P
	Mean	SD	Mean	SD	
FEV1	64,7	7,2	66,5	4,9	0,01
FVC	78,81	6,00	78,93	5,8	0,003
FEV1/FVC	68,75	5,56	86,06	1,23	0,000
6MWD	412,5	26,64	465,1	35,08	0,001
Borg Scale Dyspnea	2,68	2,33	0,31	0,47	0,000

Note. Borg S-6MWD – Borg scale dyspnea score at the end of the 6MWT. Significant if the P < 0,05.

Exercise training program has been recognized as an effective alternative to treat patients

[10]. Holland et al. [6] found that supervised exercise program for a period of 8 weeks results in a decline in functional parameters of patients with idiopathic lung disease. In previous studies of patients with COPD, improvements in exercise capacity, dyspnoea rating and health-related quality of life were demonstrated after pulmonary rehabilitation programs [9]. In the [14] study of IPF patients, significant improvements were observed in functional exercise capacity assessed by a 6-min walking test and in the health related quality of life score, but not in the BDI score. Although these results suggest that it is difficult to improve dyspnoea ratings in IPF patients, the improvement in the 6-min walking test seems comparable with that of patients with COPD as previously reported. Moreover, it is important to note that the total score for the health-related quality of life also significantly improved.

Exercise training has not been studied as extensively in PF as in other lung disease patients. However, a growing body of evidence has shown encouraging results with some health benefits following participation in these programs [17]. Garvey [4] demonstrated that exercise training interventions are safe and effective treatment for patients with PF and significant improvements in some outcomes after short-term exercise programs among same patients. There is only one study addressing the effects of a 12-week exercise training program on dyspnea severity and quality of life in idiopathic lung disease patients [19]. Hence we consider that current study is of importance since it examines the effects of an 8 week exercise training program on functional parameters, exercise capacity, and dyspnea in patients with PF. Nishiyama et al. [12] found that pulmonary rehabilitation program for a period of 10-week-long in PF patients did not have an effect on gas exchange and respiratory functions but improved exercise capacity and reduced dyspnea perception. While other study demonstrated that exercise training programs is safe and effective treatment for patients with PF [3]. Our study showed that the 8-week-long exercise training program performed in PF patients significantly improved pulmonary function tests, 6MWD, and reduced dyspnea severity during daily life activities, Ong et al. [13] reported that exercise capacity was increased significantly and effort dyspnea was reduced after the 6-week-long outpatient pulmonary rehabilitation program in 34 patients with idiopathic lung disease. Significant increase was

showed in the exercise capacity of our patients after the exercise training program. The 6MWD increase was 53 meters in our study and it is similar to the study results of Naji et al. [11]. Moreover, in our study, dyspnea was reduced in a statistically significant manner after the exercise training program.

According to these results, we considered that this increase in the 6MWD distance might be a result of the reduced disease symptoms and improve pulmonary function tests, especially FEV<sub>1</sub>, FVC, FEV<sub>1</sub>/FVC, and dyspnea. However, our study confirms that exercise training program is important to improve pulmonary function and reduce dyspnea and finally increase 6MWD.

### Conclusion

The results of this study show that an exercise training program may be beneficial to improve functional capacity of patients with PF by decreasing dyspnea and increasing exercise capacity. Thus, we recommend that exercise training programs, which are tailored to the individual needs of patients with PF, should be included in the treatment plan. Nevertheless, further studies, featuring larger patient and control groups, are needed to confirm the effectiveness of exercise training in PF patients.

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## ВОЗДЕЙСТВИЕ ВОСЬМИНЕДЕЛЬНОЙ ПРОГРАММЫ ФИЗИЧЕСКИХ УПРАЖНЕНИЙ НА ЛЕГОЧНУЮ ФУНКЦИЮ У ПАЦИЕНТОВ С ФИБРОЗОМ ЛЕГКИХ

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Целью исследования явилось изучение воздействия восьминедельной программы физических упражнений на легочную функцию у пациентов с фиброзом легких. **Материал и методы.** 48 пациентов с подтвержденным диагнозом «фиброз легких» приняли участие в программе тренировок, где основной упор делался на цикл физических упражнений, продолжительностью в 8 недель. Перед началом исследования и после завершения программы у пациентов оценивались следующие показатели: данные функциональной легочной пробы, результаты теста с шестиминутной ходьбой, выраженность одышки. Разработанная нами программа включала в себя упражнения для расширения грудной клетки, дыхание через сложенные трубочкой губы, упражнения для верхних и нижних конечностей с обязательным контролем дыхания; также в программу входили упражнения на подъем рук и разгибание коленей, упражнения на диафрагмальное дыхание и ходьба (15–30 минут в день). **Результаты.** Согласно полученным результатам, по завершении восьминедельной программы физических упражнений у пациентов с фиброзом легких отмечалось достоверное улучшение показателей функциональной легочной пробы и теста с шестиминутной ходьбой, а также снижение одышки во время повседневных занятий. Кроме того, после завершения программы у пациентов значительно возросла переносимость физических нагрузок. **Выводы.** Разработанная программа физических упражнений может иметь положительное влияние на функциональные возможности пациентов с фиброзом легких, поскольку уменьшает выраженность одышки и увеличивает переносимость физических нагрузок. Мы рекомендуем включать в план лечения больных фиброзом легких программу физических упражнений, разработанную с учетом индивидуальных потребностей конкретного пациента. Однако для окончательного подтверждения эффективности физических упражнений в улучшении состояния больных с фиброзом легких необходимо проведение дальнейших исследований с большим количеством испытуемых в экспериментальной и контрольной группе.

**Ключевые слова:** физические упражнения, легочная функция, фиброз легких.

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