Effectiveness of Pulmonary Rehabilitation in Patients with COPD

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Keywords: COPD, pulmonary rehabilitation, pulmonary function test

doi: 10.5281/zenodo.3612992

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Submitted: November 12, 2019
Accepted: December 04, 2019
Published Online: December 10, 2019

How to cite this: Fatima, Z., Iftikhar, A. and Yousaf, M.I. 2020. Effectiveness of Pulmonary Rehabilitation in Patients with COPD. Int J Front Sci, 4(1), 13-19.

Significance:

Chronic obstructive pulmonary disease (COPD) is a preventable and treatable disease state characterized by airflow limitation that is not completely reversible. Pulmonary rehabilitation has been well established and increasingly recommended in COPD and other chronic diseases management plans. Appropriate candidates are symptomatic patients with chronic lung disease who are aware of their disability and still motivated to actively participate in their own health care activity and program.

ABSTRACT

Background: Pulmonary rehabilitation (PR) is beneficial for patients with COPD, with improvement in exercise capacity and health-related quality of life. Despite these overall benefits, the responses to PR vary significantly among different individuals. It is not clear if PR is beneficial for patients with COPD and normal exercise capacity. Although it is believed that longer pulmonary rehabilitation programs can provide better results, most of the evidence comes from short-term programs.

Objective: The objective of this analysis was to determine the effectiveness of respiratory services provided in the hospital or community by respiratory therapists (RTs) in reducing health care utilization and improving patient outcomes. The aim was to evaluate the outcomes of a comprehensive pulmonary rehabilitation (PR) in chronic obstructive pulmonary disease.

Methodology: All 65 Pakistani patients who met the inclusion criteria with ages between 40 to 65 years, including both male and female, with mild to severe COPD were enrolled in the study on the basis of convenient sampling. Informed consent was taken from each patient starting about the study and their rights to withdraw from study. A demographics detail (name, age, sex) was noted along with the necessary medical history. A questionnaire was made to see the effects of pulmonary rehabilitation in patients with COPD. All necessary tests were performed to evaluate the patient betterment completely.

Results: The mean FEV1 in the subjects was 1.29 ± 0.47 L/min, 64.8 ± 23.0% of predicted. Clinically there is a little effect on CXR pattern, FEV1 and FEV1/FVC after pulmonary rehabilitation. But overall quality of life improved after pulmonary rehabilitation. Mainly improvement occurs in peak expiratory flow rate, BORG dyspnea scale, 6 mint walk test distance (meters) and Oxygen saturation after rehabilitation.

Conclusion: These results showed that patients with COPD had benefited from a comprehensive PR program in an out-patient setting regardless of disease severity. Exercise training can result in significant improvement in health-related quality of life, exercise capacity, respiratory muscle strength, and exertional dyspnea in subjects with COPD and normal exercise capacity.

Introduction

Chronic obstructive pulmonary disease (COPD) is a preventable and treatable disease state characterized by airflow limitation that is not completely reversible. The airflow limitation is usually progressive and is associated with an abnormal inflammatory response of the lungs to noxious gaseous particles mainly caused by cigarette smoking. Although COPD affects the lungs and produces significant systemic consequences. (1) The most common symptoms of COPD are excessive sputum, SOB and a productive cough. (2) The pursed lip breathing, barrel chest, paradoxical movement of chest (Hoovers sign) are also common. (3)

Globally tobacco smoking is primary and most important risk factor for COPD. (2) In non-smokers, passive smoke is responsible for about 20% of COPD cases. (3) The prevalence of COPD was modeled in 12 South-east Asian countries and estimated to be 6.3%, with highest prevalence in China (6.5%) and in Vietnam (6.7%). COPD has been estimated from 3.2% in France to 5.4% in the Netherlands. COPD is a major health problem across the world with its prevalence inversely proportionate to socioeconomic status. (4)

Poorly ventilated cooking fires, often fueled by coal or biomass fuels such as wood and animal dung, lead to indoor air pollution and are one of the most common causes of COPD in developing countries. (5) Currently, the only inherited risk factor is alpha 1-antitrypsin deficiency (AAT). (6) COPD is the 4th leading cause of death in the world, and there are further increases in the prevalence, morbidity and mortality of the disease. (7)

Diagnosis of COPD primarily rely on a reduction of FEV1 and FVC ratio decrease <70% post bronchodilators therapy. (8) Assessment of COPD is based on the patient's age, level of symptoms, exacerbation history, the severity of the spirometry report abnormality, and the related co-morbidities. Spirometry is now required to make a confident diagnosis of COPD. (2) Management included smoking cessation, influenza and pneumococcal vaccines, workplace health strategies, pulmonary rehabilitation, bronchodilators, corticosteroids, long term oxygen, surgery and stem cell therapy. (9)

Pulmonary rehabilitation is an evidence-based, multidisciplinary, and comprehensive intervention for patients with chronic respiratory diseases who are symptomatic and often have decreased daily life activities. Focused onto the individualized treatment of the patient, pulmonary rehabilitation is designed to reduce patient symptoms, optimize functional status, increase participation, and reduce health care utilization through stabilizing or reversing systemic manifestations of the disease. The aim of pulmonary rehabilitation is to break this vicious cycle and help the COPD patients to take part in daily activities. (10)

Pulmonary rehabilitation has been well established and increasingly recommended in COPD and other chronic diseases management plans. Main elements included a multidisciplinary team, focus on the individual patient, and attention to emotional, psychological, social and physical aspects of health care. Appropriate candidates are symptomatic patients with chronic lung disease who are aware of their disability and still motivated to actively participate in their own health care activity and program. Pulmonary rehabilitation program has also been recommended and useful for patients with other types of chronic lung diseases. (11)

Pulmonary rehabilitation may be beneficial for all patients in whom respiratory symptoms are associated with decreased/diminished functional capacity or reduced health related quality of life (HRQL). (12) It has been known to improve exercise capacity, dyspnea and health related quality of life in COPD following COPD. (13) Pulmonary rehabilitation induces important changes on depression and anxiety independent of changes in dyspnea and health-related quality-of-life. (14)

Morbidity measures traditionally include physician visits, emergency department visits, and hospitalizations time duration. Although COPD databases for these outcome parameters are less readily available and usually less authentic than mortality databases, the limited data available indicate that morbidity due to COPD increases with age and is greater in men than in women. (15)

Improved air quality can prevent COPD or slow down the worsening of existing disease. Annual influenza vaccinations in COPD reduce exacerbations, hospitalizations and death. (16) Keeping away people from starting smoking is a key aspect of preventing COPD as well as use of medications such as nicotine replacement therapy, bupropion (17). The rationale of this research was to see the effectiveness of pulmonary rehabilitation in stable COPD patients. The research was aimed to reduce disability and handicap in people with chronic lung disease and to improve their quality of life.

Materials and Methods

Study Design: It was a Randomized clinical trial.

Setting: The data was collected from Gulab Devi Hospital Lahore

Duration: The study was conducted in 4 months from November 2015 to February 2016

Sample Size: We included 70 patients of COPD. Sample size was calculated based on COPD prevalence i.e., 11.8%. Samples were divided in two groups A and B. Group A comprised of patients with conventional treatment while Group B patients comprised of patients taking pulmonary rehabilitation in addition to conventional treatment.

Sampling Technique: Convenient sampling

Inclusion Criteria: COPD patients with mild to severe COPD, stable patients with age 40-65, FEV1 40-80%, FEV1/FVC >65%, FCV 35-70%, paO2 >55% were included in this study.

Exclusion criteria: Exclusion criteria include significant orthopedic or neurologic problems that reduce mobility or cooperation with physical training. In addition, poorly controlled coexisting medical conditions, especially psychiatric or unstable cardiac disease, may limit participation, thereby making the patient an unsuitable candidate. Patients with very severe COPD and Cor-pulmonale were also excluded.

Statistical Analysis: Both descriptive and inferential statistics were done in Statistical Package for Social Sciences (SPSS) version 16.00.

Results

Mean age of patients was 53.96 + 6.471 with maximum age of 66 and minimum age of 45 years. In our study 32 (45.71%) patients were male; 3 (4.29%) patients were female in group A; 33(47.14%) patients were male and 2 (2.86%) patients were female in group B as shown in Figure 1.

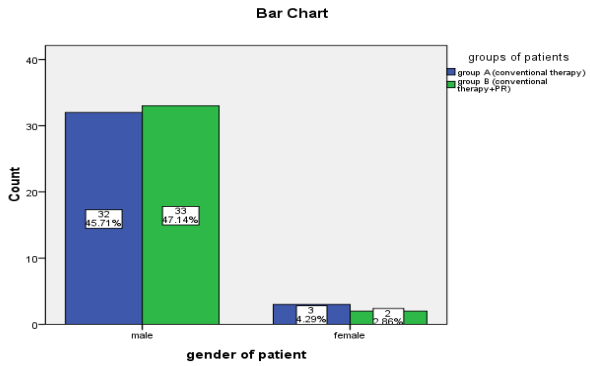

Figure 1. Descriptive Statistics of gender of group A (conventional treatment) and group B (conventional treatment + PR)

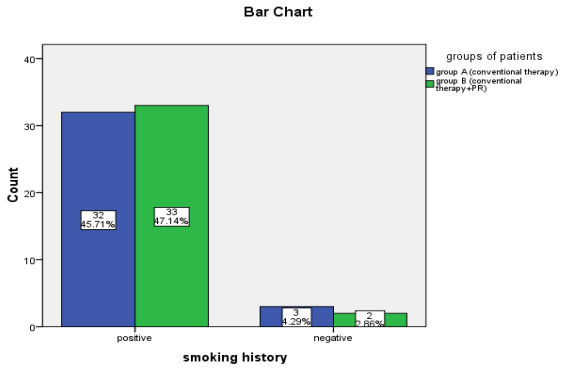

Figure 2. Descriptive Statistics of smoking history of group A (conventional treatment) and group B

In our study, 32 (45.71%) were smoker in group A, and 33 (47.14%) were smoker in group B. 3 (4.29%) were non-smoker in group A and 2(2.86%) were non-smoker in group B as shown in Figure 2.

Table 1 showing chi-square value at baseline is 2.132 and P-value 0.545. Chi-Square value after 10 days is 1.701 and P-value is 0.129. Chi-square value after 20 days in 0.058 and P-value is 0.810.

This study also showed baseline CXR of group A had 17 (24.29%) patients with hyperinflation, 8 (11.43%) hyper translucency, 6 (3.57%) patchy shadows, 4 (5.71%) other abnormalities. While baseline CXR of group B had 20 (28.57%) hyperinflation, 10 (14.29%) hyper translucency, 3 (4.29%) patchy shadows, 2 (2.86%) other abnormality. After 10 days, CXR improvement of group A was 8 (11.43%) and group B CXR improvement was 13 (18.57%). After 20 days, group A improvement was 19 (27.14%) and improvement in group B CXR was 20 (28.57%).

Table 1. Comparison of chest X-Ray of group A (conventional treatment) and group B (conventional treatment + PR)

		Group A	Group B	Chi-square	P Value
CXR baseline	hyperinflation	17	20	2.132	0.545
	Hyper-translucency	8	10		
	Patchy Shadows	6	3		
	Other abnormalities	4	2		
CXR after 10 days	Improved	8	13	1.701	0.129
	Not improved	27	22		
CXR after 20 days	Improved	19	20	0.058	0.810
	Not Improved	16	15		

Table 2. Comparison of FEV1/FVC of group A (conventional treatment) and group B (conventional treatment + PR)

	Severity	Group A	Group B	Chi-square	P-value
FEV1/FVC Baseline	Mild	8	8	0.076	0.963
	Moderate	15	16		
	Severe	12	11		
FEV1/FVC After 10 days	Mild	7	10	1.289	0.525
	Moderate	15	16		
	Severe	13	9		
FEV1/FVC After 20 days	Mild	4	11	4.933	0.085
	Moderate	17	16		
	Severe	14	8		

Table 2 showing chi-square value at baseline is 0.076 and P-value is 0.963. Chi-square value after 10 days is 1.289 and P-value is 0.525. Chi-square value after 20 days is 4.933 and P-value is 0.085. Baseline Group A FEV1/FVC was mild in 8 (11.43%), moderate 15 (21.43%) and severe was 12 (17.14%), while group B FEV1/FVC was mild in 8 (11.43%), moderate 16 (22.86%) and severe 11 (15.17%). After 10 days, Group A FEV1/FVC was mild in 7 (14.29%), moderate 15 (2.43%) and severe was 13 (18.57%), while group B FEV1/FVC was mild in 10 (14.29%), moderate 16 (22.86%) and severe 9 (12.86%). After 20 days, group A

Table 3. Comparison of PEFR of group A (conventional treatment) and group B (conventional treatment + PR)

		Group A	Group B	Chi-square	P-value
PEFR Baseline	Normal	0	1	1.465	0.690
	Mild limitation	17	14		
	Moderate limitation	15	16		
	Severe limitation	3	4		
PEFR after 10 days	Normal	0	3	5.921	0.116
	Mild limitation	12	17		
	Moderate limitation	20	14		
	Severe limitation	3	1		
PEFR after 20 days	Normal	0	10	14.396	0.002
	Mild limitation	12	13		
	Moderate limitation	18	11		
	Severe limitation	5	1		

FEV1/FVC was mild 4 (5.71%), moderate 17 (24.29%) and severe was 14 (20%), while group B FEV1/FVC was mild in 11 (15.71%), moderate 16 (22.86%) and severe 8 (11.43%).

Table 3 explained PEFR: chi-square value at baseline is 1.465 and P-value is 0.690. Chi-square value after 10 days is 5.921 and P-value is 0.116. Chi-square value after 20 days is 14.396 and P-value is 0.002. None of baseline Group A patients had normal PEFR while mild limitation was found in 17 (24.29%), moderate limitation 15 (21.43%), severe limitation was 3 (4.29%). Group B found normal PEFR in 1 (1.43%) patient, mild limitation 14 (20%), moderate limitation 16 (22.86%) and severe limitation in 4 (5.71%). None of group A Patients had normal PEFR after 10 days while mild limitation in 12 (17.14%), moderate limitation in 20 (28.57%), severe limitation in 3 (4.29%). Group B had normal PEFR in 3 (4.29%) patients after 10 days, mild limitation 17 (24.29%), moderate limitation 14 (20%) and severe limitation was 1 (1.43%). Baseline Group A Patients didn't have any patient with normal PEFR, mild limitation in 12 (17.14%) patients, moderate limitation in 18 (25.71%), severe limitation in 5 (7.14%) while group B had normal PEFR in 10 (14.29%), mild limitation in 13 (18.57%), moderate limitation in 11 (15.71%) and severe limitation was in only 1 (1.43%).

Chi-square value at baseline is 8.090 and P-value is 0.044. Chi-square value after 10 days is 5.118 and P-value is 0.163, Chi-square value after 20 days is 17.249 and P-value is 0.001. (Table 4) Mild FEV1 limitation in 1 baseline group A patient was reported, moderate limitation was in 17 patients, severe limitation was in 15 patients and very severe limitation in 2 patients while FEV1 group B reported mild limitation in 8 patients, moderate limitation in 16 patients and severe limitation in 11 patients. After 10 days, group A patients reported mild FEV1 in 2, moderate limitation in 20, severe limitation in 12 and very severe limitation in 1 while group B patients reported mild FEV1 in 7, moderate limitation in 21 and severe limitation in 7. After 20 days, group A patients reported FEV1 with mild limitation in 1, moderate limitation was in 17, severe limitation was in 15 and very severe limitation in 2 while group B mild limitation in 14, moderate limitation in 15 and severe limitation was in 6.

Table 4. Comparison of FEV1 of group A (conventional treatment) and group B (conventional treatment + PR)

	Severity	Group A	Group B	Chi-square	P-value
FEV1 baseline	Mild	1	8	8.090	0.044
	Moderate	17	16		
	Severe	15	11		
	Very severe	2	0		
FEV1 after 10 days	Mild	2	7	5.118	0.163
	Moderate	20	21		
	Severe	12	7		
	Very severe	1	0		
FEV1 after 20 days	Mild	1	14	17.249	0.001
	Moderate	17	15		
	Severe	15	6		
	Very severe	2	0		

As described in table 5, chi-square value at baseline is 2.819 and P-value is 0.420, chi-square value after 10 days is 12.65 and P-value is 0.005 and chi-square value after 20 days is 16.389 and P-value is 0.00. Baseline group A had normal spO2 in 4 (5.71%), mild hypoxia 16 (22.86%) moderate hypoxia was in 15 (21.43%) while group B had normal spO2 in 3 (4.29%), mild hypoxia in 21 (30%), moderate hypoxia in 10 (14.29%) and severe hypoxia was 1 (0.43%). After 10 days group A had normal spO2 in 2 (2.86%), mild hypoxia in 17 (24.29%) moderate hypoxia in 14 (20%) and severe was in 2 (2.86%) while group B had normal spO2 in 9 (12.86%), mild hypoxia in 22 (31.43%), moderate hypoxia in 4 (5.71%) and severe hypoxia was not present. After 20 days group A had normal spO2 in 2 (2.86%), mild hypoxia 18 (25.71%) moderate hypoxia was 15 (21.43%), while group B had normal spO2 in 16

(22.86%), mild hypoxia in 14 (20%), moderate hypoxia in 5 (7.14%).

Table 5. Comparison of SpO2 of group A (conventional treatment) and group B (conventional treatment + PR)

		Group A	Group B	Chi-square	P-value
spO2 baseline	Normal	4	3	2.819	0.420
	Mild hypoxia	16	21		
	Moderate Hypoxia	15	10		
	Severe Hypoxia	0	1		
SpO2 after 10 days	Normal	2	9	12.65	0.005
	Mild hypoxia	17	22		
	Moderate hypoxia	14	4		
	Severe hypoxia	2	0		
SpO2 after 20 days	Normal	2	16	16.389	.000
	Mild hypoxia	18	14		
	Moderate Hypoxia	15	5		
	Severe hypoxia	0	0		

Chi-square value at baseline is 4.597 and P-value is 0.467, chi-square value after 10 days is 20.897 and P-value is 0.002, chi-square value after 20 days is 20.010 and P-value is 0.003 as showed in Table 6. Baseline BORG dyspnea scale of group A had very slight 0%, slight 2 (2.86%), moderate SOB 4 (5.71%), somewhat severe 8 (11.43%), severe 11 (15.71%), very severe 2 (2.86%) while group B had slight 1 (1.43%), moderate SOB 9 (12.86%), somewhat severe SOB 11 (15.71%), severe 9 (12.86), and severe 1 (1.43%). After 10 days BORG dyspnea scale of Group A had very slight 0%, slight 0%, moderate SOB 6 (8.571%), somewhat severe 6 (3.57%), severe 13 (18.57%) and very severe 1 (1.43%) while group B had slight 5 (7.14%), moderate SOB 11 (15.71%), somewhat severe SOB 11 (15.71%), severe 5 (7.41%) and severe 0. After 20 days BORG dyspnea scale of group A had very slight 0%, slight 0%, moderate SOB 6 (8.57%), somewhat severe 8 (11.43%), severe 13 (18.57%), very severe 1 (1.43%) while group B had slight 6 (8.57%), moderate SOB 13 (18.57%), somewhat severe SOB 13 (18.57%), severe 2 (2.86%), and severe 0.

Group A 6 minutes-walk test baseline t-value is -0.595 and P-value is 0.554 with mean 53.63±7.276. Group B 6 minutes-walk baseline t-value is -0.595 and P-value is 0.554 with mean 54.8571±9.81938 described in table 7. Group A 6 minutes-walk after 10 days t-value is -0.636 and P-value is 0.509, and mean was 54.0571±8.45383. Group B 6 minutes-walk after 10 days t-value is -0.636 and P-value is 0.509 and mean is 55.5143±9.87085. Group A 6 minutes-walk after 20 days t-value is -2.709 and P-value 0.009 is with mean was 51.3714±63674. Group B 6 minutes-walk after 20 days t-value is -2.709 and P-value is 0.009 with mean was 57.4857±10.18468.

Table 6. Comparison of BORG dyspnea scale of group A (conventional treatment) and group B (conventional treatment + PR)

	Severity	Group A	Group B	Chi-square	P-value
Borg Dyspnea scale baseline	Very slight	0	0	4.597	0.467
	Slight	2	1		
	Moderate	4	9		
	Somewhat severe	8	11		
	Severe	19	13		
	V severe	2	1		
Borg Dyspnea scale after 10 days	Very slight	0	2	20.897	0.002
	Slight	0	5		
	Moderate	6	11		
	Somewhat severe	6	11		
	Severe	22	6		
	V severe	1	0		
Borg Dyspnea scale after 20 days	Very slight	0	2	20.010	0.003
	Slight	0	6		
	Moderate	6	13		
	Somewhat severe	7	8		
	Severe	21	6		
	V severe	1	0		

Discussion

The results of the study suggested small but statistically and clinically significant improvements of health-related quality of life in patients with COPD and immediately after participation. Mainly improvement occurs in Peak expiratory flow rate, BORG dyspnea scale, 6 mint walk test distance (meters) and Oxygen saturation after rehabilitation. Walking distance also improved in 6MWT, but the effect was too small to be considered clinically relevant. Clinically there is a little effect on CXR pattern, FEV1 and FEV1/FVC after pulmonary rehabilitation. But overall quality of life improved after pulmonary rehabilitation.

Group A 6 minutes-walk test baseline t-value is -0.595 and P-value is 0.554 with mean 53.63±7.276. Group B 6 minutes-walk baseline t-value is -0.595 and P-value is 0.554 with mean 54.8571±9.81938. Group A 6 minutes-

Table 7. Comparison of 6 minutes walk test of group A (conventional treatment) and group B (conventional treatment + PR)

	groups of patients	Mean	Std. Deviation	T	P-value
6 mint walk test baseline (meters)	group A	53.6286	7.27642	- 0.595	0.554
	group B	54.8571	9.81938	- 0.595	0.554
6 mint walk test after 10 days (meters)	group A	54.0571	8.45383	- 0.636	0.509
	group B	55.5143	9.87085	- 0.636	0.509
6 mint walk test after 20 days (meters)	group A	51.3714	8.63674	- 2.709	0.009
	group B	57.4857	10.18468	- 2.709	0.009

walk after 20 days t-value is -2.709 and P-value 0.009 is with mean was 51.3714±63674. Group B 6 minutes-walk after 20 days t-value is -2.709 and P-value is 0.009 with mean was 57.4857±10.18468. So, there is increase in 6MWD after PR as compared to group A. As compared to other research We also found a statistically significant improvement of 25.71 m (95% CI: [15.76-35.65]) in the 6-minute walk test with PR (18).

In our study P-value for FEV1/FVC at baseline is 0.96, and P-value after 20 days is 0.085 so there is little improvement in FEV1/FVC and FEV1 after PR. As compared to other research there were also no significant changes in pulmonary function test results (FEV1, FVC, and FEV1/FVC), minute ventilation, breathing frequency, or tidal volume at rest or exercise after pulmonary rehabilitation. After PR there was significant improvement in maximal oxygen uptake and work rate improvements of exercise capacity, respiratory muscle strength, maximum oxygen pulse, and exertional dyspnea scores (all P < .05) (19).

In our study BORG dyspnea scale was also improved significantly after pulmonary rehabilitation. at baseline P-value for BORG dyspnea scale is 0.467, but P-value is 0.003 after 20 days of PR. Baseline BORG dyspnea scale of group B had slight1 (1.43%), moderate SOB 9(12.86%), somewhat severe SOB 11(15.71%), severe 9(12.86), and severe 1(1.43%) After 20 days BORG dyspnea scale of group B had slight 6(8.57%), moderate SOB 13(18.57%), somewhat severe SOB 13(18.57%), severe 2(2.86%), and severe (0%) As compared to other study the dyspnea scores evaluated with MRC showed significant improvements (P < 0.001). HRQoL and exercise capacity were significantly improved for the two groups (P < 0.001) (20)

As compared to another research Exercise capacity, muscle force, quality of life, and functional status improved significantly after 3 months of pulmonary rehabilitation (all p < 0.05), Movement intensity during walking improved significantly after 3 months (p = 0.046) with further improvements after 6 months (p = 0.0002). Walking time in daily life did not improve significantly at 3 months (mean improvement, 7 ± 35%; p = 0.21), but only after 6 months (mean improvement, 20 ± 36%; p = 0.008). No significant changes occurred in other activities or in the pattern of the time spent walking in daily life. Changes in dyspnea after the program were significantly related to changes in walking time in daily life (r = 0.43; p = 0.02) (21).

As compared to another research Overall, patient health-related quality of life (HRQoL) and Exercise capacity assessed by a 6-min walking distance test (6MWD) was similarly significantly improved. However, there was some fall-off in terms of the distance walked 12 months after pulmonary rehabilitation. The improvements in exercise capacity, dyspnoea, and HRQoL did not differ between the two groups, with the exception that the 6MWD (P < 0.01) at 3 months post-pulmonary rehabilitation were significantly higher in the old-elderly group (22) while in our study P value after PR for 6MWD is 0.009 and for dyspnea scale P value is 0.003.

Education of workers about the risks, smoking cessation, checking workers for early signs of COPD, use of respirators, and dust control (23). A number of measures have been taken to reduce the incidence that workers in at-risk industries such as coal mining, construction and stonemasonry will develop COPD.

Conclusions

Pulmonary rehabilitation proposed where patients who feel a loss of control as their disease advances may find that pulmonary rehabilitation offers them the opportunity to regain control. These results showed that patients with COPD had benefited from a comprehensive PR program in an out-patient setting regardless of disease severity. Even patients with earlier

stage of disease should be referred and encouraged to participate in a PR program Exercise training can result in significant improvement in health-related quality of life, exercise capacity, respiratory muscle strength, and exertional dyspnea in subjects with COPD and normal exercise capacity.

Conflict of Interest: This study has no conflict of interest to declare by any author.
Disclosure: None
Human and Animal Rights: No rights violated

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