Journal of Clinical and Nursing Research, 2025, Volume 9, Issue 6
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

The Rehabilitation Effect of Pulmonary Function Rehabilitation Training on Elderly Patients with Chronic Obstructive Pulmonary Disease During Hospitalization

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Abstract: *Objective*: To explore the rehabilitation effect of pulmonary rehabilitation training in elderly patients with chronic obstructive pulmonary disease (COPD). *Methods*: Elderly COPD patients hospitalized from June 2024 to December 2024 were selected as subjects for a quasi-experimental study. The study randomly assigned patients into two equal groups of 50 each. One group served as the control and received standard treatment and nursing care, while the other group, the intervention group, was given additional pulmonary rehabilitation exercises alongside the conventional care. The lung function indexes [forced expiratory volume in the first second (FEV1), forced vital capacity (FVC), FEV1/FVC], 6-minute walk distance (6MWD), Borg's Category Scale for perceived exertion (BCSS), COPD Assessment Test (CAT), Barthel Index for activities of daily living, blood oxygen saturation, and Modified Medical Research Council (MMRC) dyspnea scale were compared between the two groups before and after intervention. *Results*: Following the intervention, the intervention group demonstrated improved lung function compared to the control group ($P < 0.05$). However, no significant difference was observed in the 6-minute walk distance (6MWD) ($P > 0.05$). The intervention group had lower Bronchitis Severity Scale (BCSS) scores ($P < 0.05$) and better quality of life scores ($P < 0.05$) than the control group. No notable differences were found in activities of daily living scores or blood oxygen saturation ($P > 0.05$). Additionally, the intervention group exhibited a lower proportion of residual severe dyspnea ($P < 0.05$). *Conclusion*: Pulmonary rehabilitation can enhance respiratory function in individuals with COPD, leading to beneficial therapeutic outcomes and ultimately improving their overall quality of life.

Keywords: Elderly chronic obstructive pulmonary disease; Pulmonary rehabilitation training during hospitalization; Rehabilitation effect

Online publication: July 8, 2025

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a common chronic respiratory disorder characterized primarily

by persistent airflow obstruction [1]. In the treatment and rehabilitation of COPD patients, most international respiratory associations advocate the use of non-drug treatments and educational guidance for stable COPD patients. Pulmonary rehabilitation (PR) is a key non-drug treatment. Pulmonary rehabilitation was proposed by the American Thoracic Society and the European Respiratory Society in 2006, and its definition was later revised by the American Thoracic Society, which was accepted by more researchers [2, 3]. For elderly COPD patients, it is necessary not only to actively treat them based on the reason for admission, but also to find effective ways to improve lung function. In this study, 100 elderly COPD patients were selected to analyze the role of pulmonary rehabilitation training.

2. Materials and methods

2.1. General Information

From June to December 2024, patients are enrolled in a hospital-based quasi-experimental study. Using a random number table, they are assigned equally into two groups, with 50 participants in each. Demographic and clinical data, such as gender, age, BMI, and smoking history, are gathered via a general information questionnaire.

2.2. Inclusion criteria and exclusion criteria

2.2.1. Inclusion criteria

(1) Meet the diagnostic criteria for COPD in the "Guidelines for the Diagnosis and Treatment of Chronic Obstructive Pulmonary Disease (2021 Revision)" [4].

(2) Age ≥ 60 years old

(3) Stable condition and in remission phase.

(4) Willingly took part in the study and completed an informed consent agreement.

2.2.2. Exclusion criteria

(1) Combined with severe cardiac, liver, kidney, and other organ dysfunction.

(2) Suffering from mental illness or cognitive impairment.

(3) Had acute exacerbations or received lung surgery recently

(4) Unable to cooperate to complete pulmonary rehabilitation exercise training.

2.3. Methods

The control group is given standard medical care, which involved prescribed anti-infection therapy, supplemental oxygen, as well as mucus-clearing and cough-suppressing treatments as directed by physicians. Based on the type of disease, patients also received health education, psychological nursing, medication guidance, dietary nursing, and exercise guidance.

The intervention group received pulmonary function rehabilitation training in addition to the conventional treatment. This training included:

(1) Respiratory training, consisting of pursed-lip breathing and abdominal breathing. The training process, skills, and precautions are taught through graphics, videos, and live demonstrations to ensure that patients fully grasped the training knowledge and skills and could complete the training normally and smoothly. Pursed-lip breathing involved closing the mouth, inhaling through the nose, exhaling slowly through

pursed lips (like blowing a whistle), with exhalation time being 2–3 times longer than inhalation time. This is performed 2–3 times per day, for 10–15 minutes each time. Abdominal breathing is performed in a supine or semi-reclining position, as chosen by the patient for comfort and relaxation. During inhalation, the abdomen is gently raised while the chest remained stationary, and during exhalation, the abdomen is lowered while the chest remained stationary. This is also performed 2–3 times per day, for 10–15 minutes each time.

(2) Exercise training is based on the latest comprehensive assessment results, patient interests, and exercise habits. Patients are guided to train in the rehabilitation area of the hospital, using equipment such as dumbbells, sandbags, elastic bands, respiratory trainers, and sputum discharge devices. The target heart rate is determined by subtracting the patient's age from 220 to establish the maximum heart rate, with exercise intensity set at 60% to 80% of this value. The regimen consisted of one daily session lasting 10 to 15 minutes. To optimize outcomes and ensure safety, rehabilitation guidance included proper warm-up routines and exercise precautions.

2.4. Research tools

(1) Pulmonary function is evaluated with a spirometer, measuring forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and the FEV1/FVC ratio.

(2) Exercise capacity is evaluated through a 6-minute walk test, in which patients are asked to cover the maximum distance possible within six minutes.

(3) Exercise intensity is assessed using the Borg Category Scale for perceived exertion (BCSS), with scores ranging from 0 to 10, where lower scores indicate better exercise intensity [5].

(4) The Chronic Obstructive Pulmonary Disease Assessment Test (CAT) questionnaire is used to measure quality of life, which evaluates nine items with scores ranging from 0 to 5 for each item, where lower scores indicate better quality of life [6].

(5) The Barthel Index is used to evaluate daily living skills, with scores on a scale from 0 to 100. A higher score reflects greater independence in daily activities.

(6) Blood oxygen saturation is measured using a blood oxygen saturation detector.

(7) Dyspnea severity is evaluated using the Modified Medical Research Council (MMRC) scale, which categorizes breathlessness into five levels (0 to 4).

2.5. Statistical methods

The data are analyzed using SPSS 25.0 software. Categorical variables are presented as percentages (%) and analyzed with the chi-square test. Normally distributed continuous data are reported as mean ± standard deviation and compared using the t-test (or F-test). Statistical significance is set at $P < 0.05$.

3. Results

3.1. Comparison of general information between the two groups

No significant variations in demographic data were observed between the groups ($P > 0.05$). Results are shown in **Table 1**.

Table 1. General information of the two groups [n=50, n/($\bar{x} \pm s$)]

Variables	Control group (n = 50)	Experimental group (n = 50)	Statistic	P-value
Age (years), Mean ± SD	71.58 ± 7.11	69.08 ± 6.53	t = 1.831	0.070
BMI (kg/m²), Mean ± SD	22.11 ± 4.42	21.72 ± 3.65	t = 0.481	0.632
Gender, n(%)			χ^2 = 1.214	0.271
Male	33 (66.00)	38 (76.00)		
Female	17 (34.00)	12 (24.00)		
Smoking history, n(%)			χ^2 = 0.048	0.830
No	14 (28.00)	15 (30.00)		
Yes	36 (72.00)	35 (70.00)		

3.2. Comparison of lung function before and after intervention in two groups of COPD patients

The lung function in the intervention group was significantly improved relative to the control group following the intervention ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of lung function before and after intervention in two groups of COPD patients (n=50 cases)

Group	FEV1 (L)		FVC (L)	
	Pre- intervention	Post- intervention	Pre- intervention	Post- intervention
Intervention	2.98 ± 1.14	4.56 ± 0.89[a]	3.08 ± 1.45	4.89 ± 0.94[a]
Control	2.95 ± 1.21	4.02 ± 0.97[a]	3.01 ± 1.57	4.27 ± 0.79[a]
t-value	0.128	2.901	0.232	3.570
P-value	0.899	0.005	0.817	0.001
Group	**FEV1/FVC (%)**			
	Pre- intervention	**Post- intervention**		
Intervention	0.71 ± 0.14	0.85 ± 0.10[a]		
Control	0.69 ± 0.21	0.79 ± 0.12[a]		
t-value	0.560	2.716		
P-value	0.577	0.008		

Note: Compared with before intervention in the same group, aP < 0.05.

3.3. Comparison of exercise function and intensity before and after intervention in two groups of COPD patients

After intervention, the intervention group showed a lower BCSS score compared to the control group, ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of exercise function and intensity before and after intervention in two groups of COPD patients (n=50 cases)

Group	Exercise function (m)		BCSS score (points)	
	Pre- intervention	Post- intervention	Pre- intervention	Post- intervention
Intervention group	207.47 ± 89.63	265.79 ± 63.52a	6.46 ± 1.16	4.22 ± 1.59a
Control group	205.21 ± 95.05	250.65 ± 92.59a	6.55 ± 2.38	3.54 ± 1.62a
t-value	0.122	0.953	0.240	2.118
P-value	0.903	0.343	0.811	0.037

Note: Compared with before intervention in the same group, $^aP < 0.05$.

3.4. Comparison of quality of life, daily living ability, and blood oxygen saturation before and after intervention in two groups of COPD patients

After the intervention, the quality of life score in the intervention group was significantly lower compared to the control group ($P < 0.05$). However, no significant differences were observed between the two groups in terms of daily living ability scores and blood oxygen saturation levels ($P > 0.05$), as shown in **Table 4**.

Table 4. Comparison of quality of life, daily living ability, and blood oxygen saturation before and after intervention in two groups of COPD patients (n=50 cases)

Group	CAT (score)		Barthel Index (score)		Blood oxygen saturation (mmHg)	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Intervention Group	25.84 ± 6.55	15.66 ± 3.91a	89.30 ± 11.07	95.50 ± 6.00a	92.12 ± 6.83	94.96 ± 4.87a
Control Group	26.34 ± 5.61	22.66 ± 4.56a	90.20 ± 10.30	95.40 ± 9.19a	92.52 ± 3.11	95.54 ± 0.65a
t-value	0.410	8.240	0.420	-0.060	0.371	0.835
P-value	0.683	< 0.001	0.675	0.949	0.707	0.406

Note: Compared with before intervention in the same group, $^aP < 0.05$.

3.5. Comparison of dyspnea grading before and after intervention in two groups of COPD patients

After the intervention, the rate of remaining severe dyspnea was significantly reduced in the treatment group relative to the control group ($P < 0.05$), as shown in **Table 5**.

Table 5. Comparison of dyspnea grading before and after intervention in two groups of COPD patients

MMRC grade	Control group (n=50)		Z- value	P- value	Experimental group (n=50)		Z- value	P- value
	Pre- test	Post- test			Pre- test	Post- test		
Grade 0	5	5			6	8		
Grade 1	9	15			10	23		
Grade 2	15	14	3.023	0.003	16	10	4.124	< 0.001
Grade 3	12	10			10	6		
Grade 4	9	6			8	3		

Note: Before the experiment, the control group and the experimental group had Z=0.574, P=0.427. After the experiment, the control group and the experimental group had Z=5.181, $P < 0.001$.

4. Discussion

COPD is a common and highly prevalent disease, especially among the elderly. The disease progresses slowly and is prone to recurrent attacks [7]. Symptoms such as cough, shortness of breath, and dyspnea appear after lung function damage, affecting normal social interaction, work, and life, and increasing the burden on health and mental well-being. Drug therapy for this disease is limited and difficult to continuously improve lung function, with generally modest effects [8]. Therefore, it is necessary to combine other ideal solutions on the basis of routine COPD treatment and care to improve rehabilitation outcomes. Pulmonary function rehabilitation training is a non-drug intervention model that emphasizes patient-centeredness. It focuses on rehabilitation training that meets the needs of COPD patients. Active rehabilitation training can continuously improve lung function, enhance the effectiveness of COPD control, and prevent recurrent attacks of COPD [9].

4.1. Pulmonary rehabilitation can improve respiratory function in patients with chronic obstructive pulmonary disease (COPD)

Pulmonary function is the most intuitive indicator to evaluate the condition of elderly COPD patients, and it has a high correlation with patients' quality of life and symptoms of dyspnea [10, 11]. At present, there are many methods for respiratory function training in COPD, such as abdominal breathing, pursed-lip breathing, and respiratory training exercises based on the Five-Animal Plays [12, 13]. In this study, the intervention group had higher FEV1/FVC(%) and FEV1%pred measurements than the control group at various stages of the study, which is consistent with the meta-analysis results of Liu. This suggests that nursing workers should add richer and more targeted respiratory training exercises to basic respiratory training to improve respiratory function in COPD patients.

4.2. Pulmonary rehabilitation can improve patients' motor function

Relevant studies have shown that the six-minute walk test distance is negatively correlated with the severity of COPD [14, 15]. The study findings indicated that the intervention group achieved a greater distance in the 6MWT compared to the control group. This result fully demonstrates that pulmonary rehabilitation training can effectively improve patients' lower limb exercise endurance.

4.3. Pulmonary rehabilitation can improve the quality of life of COPD patients

This study assessed the quality of life in COPD patients using the CAT scale, a widely recognized tool in clinical research. Following the intervention, a notable improvement in patients' quality of life was observed. The intervention group demonstrated significantly lower CAT scores compared to the control group, suggesting that the pulmonary rehabilitation program implemented in this study effectively enhanced the well-being of COPD patients. This improvement may be attributed to the program's ability to enhance respiratory function, alleviating symptoms such as chest tightness and coughing. As these subjective symptoms diminished, patients experienced a corresponding improvement in their overall quality of life.

5. Conclusion

In summary, implementing pulmonary rehabilitation training for elderly COPD patients is beneficial for rapid improvement of pulmonary function and motor function, can reduce pain symptoms, improve patients' physical and mental health levels, and is conducive to disease control and prognosis improvement. It is suitable for

promotion and popularization.

Funding

Hohhot Health Science and Technology Program Project (Project No.: 2024-HHWK-041)

Disclosure statement

The authors declare no conflict of interest.

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