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Research Paper: Effects of Pulmonary Rehabilitation Program on Patients With Chronic Obstructive Pulmonary Disease

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ABSTRACT

Introduction: Chronic Obstructive Pulmonary Disease (COPD) impairs patients` quality of life and clinical outcomes. Pulmonary rehabilitation (PR) program can improve the functional capacity in patients with chronic lung disease. Thus, the study aimed to evaluate the effect of the PR program on the quality of life, anxiety, depression, and pulmonary function of patients with COPD.

Materials and Methods: In this single-group before-and-after clinical trial, adult patients with COPD and recent history of exacerbation were recruited. The intervention was a PR program, including training of breathing exercises at home and aerobic exercise program, twice a week about 30 to 60 min for 8 weeks. The program was prepared according to the patient's tolerance by a sports medicine specialist in a pulmonary rehabilitation clinic. The primary outcome was quality of life measured by the St. George's Respiratory Questionnaire (SGRQ). Secondary outcomes were assessing anxiety, depression, pulmonary function, COPD status, the ability to walk, and shortness of breathing. All outcomes were measured before and one week after the program.

Results: Twenty-two eligible patients of both genders (68% male and 32% female) with a Mean±SD age of 65.09±9.72 years finished the program. Quality of life was improved significantly following the intervention (51.49 [16.68] vs 4275 [15.63]; P<0.001]. Anxiety and depression (P<0.001), pulmonary function parameters, such as forced expiratory volume in 1 second (FEV1) (P<0.001) and FEV1/ forced vital capacity (FVC) ratio (P=0.015), COPD status (P=0.001), the ability of walk1ing (P<0.05), and shortness of breath (P=0.001) were improved significantly after the intervention.

Conclusion: The PR program resulted in clinical improvement in patients with COPD. Thus, we recommend that it be used besides medical management.

Keywords: Pulmonary rehabilitation, Chronic obstructive pulmonary disease, Hospital anxiety and depression scale (HADS) questionnaire

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1. Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a common [1, 2], preventable, and treatable disease [3] with high and increasing prevalence, both in Iran and worldwide [4]. It is responsible for 5% of death worldwide and is predicted to be the fourth leading cause of death by the end of 2030 [5].

Patients with COPD suffer from three main symptoms of dyspnea, chronic cough, and sputum production [6]. Breathlessness/dyspnea, fatigue, cough and sputum production, physical functioning, social functioning, and exacerbations affect the patients with COPD [7, 8] and impair their quality of life that increases parallel to disease severity [9]. Recently, the therapeutic focus in COPD has shifted from lung function and mortality to health-related quality of life [10]. This index is used to assess the efficacy of medical management [11].

Pulmonary Rehabilitation (PR) is a multidisciplinary and comprehensive approach that can be integrated into the management of COPD patients to reduce their symptoms, optimize function, increase their participation in daily life, and lower health care resource utilization [12]. According to the Cochrane library review in 2015, PR improves the health-related quality of life of patients with COPD. It strongly supports the inclusion of PR as a part of their medical management [13, 14]. However, the systematic review of Rugbjerg et al. reported a clinically non-significant improvement in walking distance following PR in patients with COPD and mild symptoms [15].

COPD is an essential problem in the health system in Iran, and its prevalence has been increasing during recent decades. It also has adverse consequences on patients' health and results in the disability of the affected patients to adjust to everyday life [16]. Thus, the primary objective of the study was to evaluate the effect of the PR program on the quality of life of patients with COPD, and the secondary objective was to assess the impact of the PR program on anxiety and depression, COPD status, pulmonary function, the ability of walking, and shortness of breathing.

2. Materials and Methods

Study design

This research was a single-group before-and-after clinical trial. The study protocol was approved by the Institutional Review Board and Research Ethics Committee (Ref. No.: IR.TUMS.MEDICINE.REC.1395.637) of Tehran University of Medical Sciences (TUMS, Tehran, Iran). It was also registered at http://irct.ir (IRCT Id: IRCT20170210032476N2). The sampling method was convenient non-probability, and all eligible patients that came to the rehabilitation unit during the study and signed the informed consent form enrolled in the study.

Study participants

In this study, adult patients (age >18 years) with a confirmed diagnosis of COPD according to the global initiative for obstructive lung disease (GOLD) criteria (I to IV) and occurrence of exacerbation were included. The exclusion criteria were contraindication for pulmonary rehabilitation; non-compliance with the program; psychiatric disorders, such as dementia, uncontrolled cardiovascular diseases; disability for doing the program due to orthopedic issues; diabetes; uncontrolled liver disease, and no tendency to continue the study. Thus, eligibility criteria were assessed in patients referred to lung clinic or hospitalized in the lung/general internal medicine ward at Shariati Hospital affiliated to Tehran University of Medical Sciences from April 2016 to January 2017. Eligible patients were asked to refer to the PR clinic of the hospital to participate in the program.

Study intervention

In this trial, a PR program was implemented for eligible patients by a sports medicine specialist in the PR clinic of the hospital. This program was a combination of training of breathing exercises at home, and an aerobic exercise program, according to the American Association of Cardiovascular and Pulmonary Rehabilitation (AACPR), including respiratory muscle training with incentive spirometers, respiratory techniques, such as diaphragmatic breathing, and how to discharge lung secretion such as huffing. The program was conducted twice a week for about 30 to 60 minutes for 8 weeks, according to the patient's tolerance. Patients also received their usual care, including nutrition consultations, education on using prescribed medications, referring to the clinic in case of disease exacerbation, and treatment side effects.

Study outcomes

The primary objective of the study was to evaluate the effect of the PR program on the quality of life of patients with COPD, and the secondary objective was to assess the impact of the PR program on anxiety and depression, COPD status, pulmonary function, the ability of walking, and shortness of breathing.

Quality of life, anxiety and depression, pulmonary function, COPD status, the ability to walk, and shortness of breathing were the outcomes we evaluated before and 1 week after finishing the program. The St. George's Respiratory Questionnaire (SGRQ) is a disease-specific instrument that measures the disease impact on overall health, daily life, and perceived well-being in patients with obstructive airways disease. This questionnaire was composed of 50 items, 2 parts, and 3 components of symptoms, activities, and impact components (social functioning, psychological disturbances resulting from airways disease). The scores range from 0 to 100, and higher scores indicate more limitations [17]. Patients` anxiety and depression were measured by the Hospital Anxiety And Depression Scale (HADS). This scale comprises 14 questions (7 for anxiety and 7 for depression). The total score for each question was 0 to 21, and the total scores between 8 to 10, 11 to 14, and 15 to 21 were considered mild, moderate, and severe anxiety and depression, respectively [18].

To measure the pulmonary function, parameters of Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), and FEV1/FVC ratio were evaluated by spirometer (Ganshorn®). COPD assessment tool (CAT) that was used to assess and monitor COPD and measure the health status consisted of 8 items scored with a 5-point Likert-type from 0 to 5. The total score ranges between 0 and 40, and higher scores indicate a lower health status [19]. Shortness of breathing was measured by the medical research council (MRC) breathlessness scale according to the patient's self-report. This scale is made up of five statements that describe a range of respiratory disability from none (Grade 1) to complete incapacity (Grade 5) [20]. The ability to walk was assessed by a 6-min walk test (6MWT). Thus, patients were asked to walk for 30 m, and the parameters, such as peak oxygen consumption (peak VO2), metabolic equivalents (Mets), speed, and predicted 6MWT were measured.

Study variables

Study variables were as follows: demographic variables, including age, sex, Body Mass Index (BMI), marital status, and level of education; and clinical variables, including smoking, substance abuse, comorbidities, regular physician's visit, using the medication as prescribed, regular use of inhalers, oxygen therapy at home, and pneumococcal and influenza vaccination. They were collected by physical examination, examining patients` clinical records, and self-reports.

Data analysis

The obtained data were analyzed with SPSS software v. 16. Descriptive statistics such as Mean±SD and statistical tests such as paired t-test and McNemar's test were used to describe and analyze data. The significance level was set at less than 0.05.

3. Results

In this study, data of 100 patients were assessed, and based on the inclusion criteria, 22 were finally enrolled in the study (Figure 1).

Table 1 presents baseline characteristics, hospital readmission frequency (number), and length of stay in hospital (day). According to Table 1, most participants were male, married, with a high school diploma, and smokers. Ischemic heart disease was the most common comorbidity among them. In addition, regular physician's visits, using the medication as prescribed, and regular use of inhalers were seen among most of them (Table 1).

In this study, the Mean±SD hospital readmission frequency (number) and length of stay in hospital (day) were 3.22±4.11 and 8.40±3.99, respectively.

Table 2 compares the study outcomes before and after the program. According to Table 2, scores of quality of life, anxiety, and depression reduced significantly following the program. Parameters, such as FEV1 and FEV1/ FVC related to pulmonary function and COPD status, improved significantly after the program. 6MWT parameters and MRC breathlessness scale results showed significant improvement of patients` walking ability and shortness of breathing (Table 2).

4. Discussion

In this trial, the effect of the PR program on the patients with COPD was evaluated through a single-group before-and-after clinical trial, and results were improved following the PR program.

This study showed that patients' quality of life improved significantly after the PR program compared with before the program. Quality of life improvement has been reported in the previous studies, too [21-29]. PR program has improved clinical status, quality of life, especially on the physical aspect [30, 31], and patient's self-care [31]. Moreover, using bronchodilators, spirometer, respiratory physiotherapy, and exercise has led to the quality of life improvement [32].

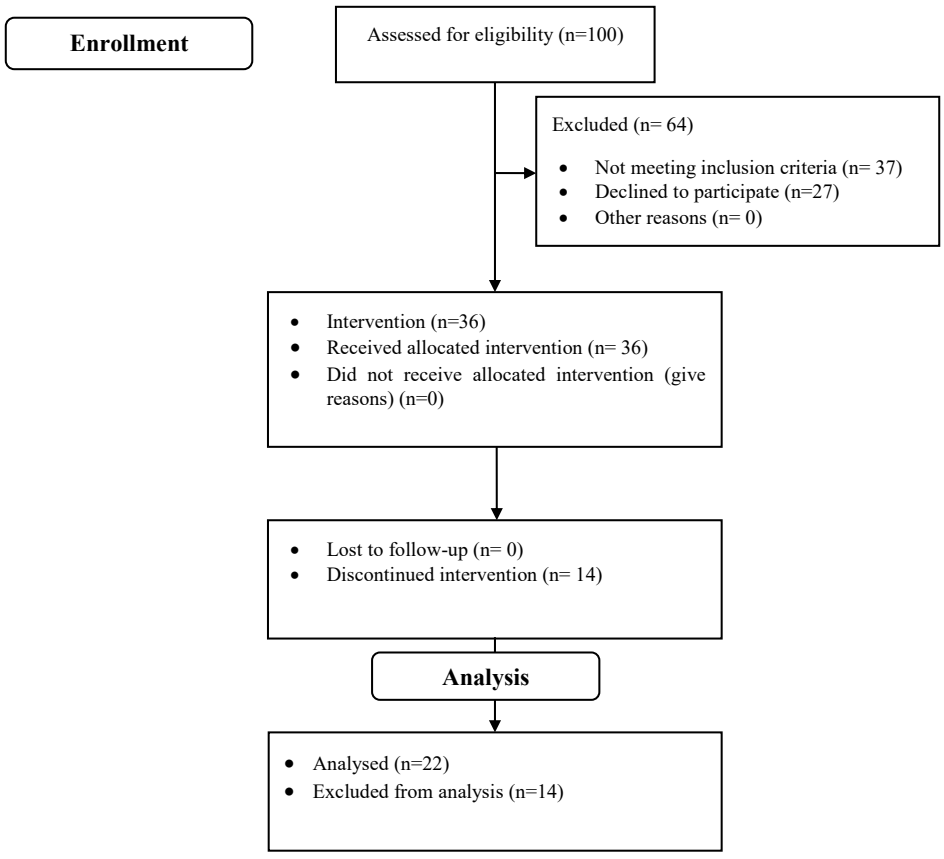

Figure 1. CONSORT (Consolidated Standards of Reporting Trials) 2010 flow chart

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In Jones et al. study, PR techniques reduced the oxygen consumption, and application of these techniques have been recommended to minimize the pulmonary, metabolic needs in patients with COPD [33]. In addition, pursed-lip breathing education improved lung function, arterial blood gas, and day-to-day activities. It can be considered part of the physiotherapy programs in patients with COPD to improve their quality of life [34].

In contrast, no significant effect of the PR program on the quality of life of patients with COPD has been shown in other studies [35, 36]. This discrepancy may be due to the difference between questionnaires used to assess the efficacy of PR programs applied in the previous studies. Also, 55% of our participants had a high level of education. As the relationship between quality of life and level of education has been shown [27], this improvement in the quality of life in our study may be due to the good educational level of the participants.

A considerable proportion of patients with COPD suffer from anxiety and depression reported among 32% and 27% of patients entering the PR program, respectively [37]. Although the PR program did not reduce anxiety and depression in patients with no symptoms ($P>0.05$), it caused a significant reduction of these symptoms among patients with "probable" or "presence" of symptoms ($P<0.001$) [38]. In our study, although patients had mild depression and anxiety before and after the PR program, the mean score of anxiety and depression reduced significantly following the intervention. An 8-week program of comprehensive PR and a combination of progressive muscle relaxation and PR program also reduced depression and anxiety significantly [39-41]. As anxiety and depression result in increased dyspnea, reduced functional performance, and quality of life in patients with COPD [42], PR may be an effective program for reducing symptoms of anxiety and depression [38].

The findings of our study showed that pulmonary functions of FEV1 and FEV1/FVC significantly improved following the PR program. While no significant difference was found in pulmonary function (FEV1 and FVC) following the PR program in other studies [24, 26, 28, 43].

CAT is a sensitive tool to changes in the health status of patients with COPD after exacerbation [44]. In the present study, the patients had a lower CAT score following the PR program, and improvement in their COPD status has been reported. In He et al. study, the safety and

Table 1. Baseline characteristics of studied patients (n=22)

Variables		Mean±SD/No.(%)
BMI		27.10±4.90
Age (y)		65.09±9.72
Sex	Male	15(68)
	Female	7(32)
Marital status	Single	1(5)
	Married	21(95)
Level of education	Illiterate	4(18)
	High school	6(27)
	High school diploma	9 (41)
	Academic	3(14)
Smoking		18(82)
Substance abuse		1(5)
Comorbidities	Hypertension	7(32)
	Hyperlipidemia	2(9)
	Ischemic heart disease	11(50)
	Chronic kidney disease	5(23)
	Diabetes	3(14)
	Psychiatric disorders	2(9)
	Other diseases	6(27)
Regular physician's visit		17(77)
Using medication as prescribed		21(95)
Regular use of inhalers		18(82)
Oxygen therapy at home		8(36)
Pneumococcal and influenza vaccination		13(59)
Length of stay in the hospital, day		3.22±4.11
Hospital readmission frequency		8.40±3.99

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feasibility of the PR program in patients with acute exacerbation of COPD has been shown, and the PR group had a lower CAT score [45], and this score improved in response to the PR [46]. In addition, the MRC breathless scale showed improvement of shortness of breath after the PR program, and this significant improvement in breathlessness has been reported in the previous studies, too [43]. Significant improvement in the ability to walk was found in our study by improvement in the parameters of the 6MWT following the PR program, which was consistent with the previous studies [22, 24, 35].

This research was the first study in Iran that evaluated the efficacy of the PR program on physical and psy-

Table 2. Comparing the study outcomes before and after the program

Outcomes		Mean±SD		P
		Before	After	
Quality of Life	Symptoms	54.55±21.16	49.31± 20.76	<0.001*
	Activities	71.57±17.71	58.99±14.46	<0.001*
	Impact components	39.91±20.09	32.32±18.27	<0.001*
	Total	51.49±16.68	42.75±15.63	<0.001*
Anxiety		5.86±4.50	4.45±3.94	<0.001*
Depression		6.59±3.58	5.54±3.27	<0.001*
Pulmonary function	FVC (%)	67.24±90.66	70.26±75.98	0.117
	FEV1 (%)	48.21±50.35	52.23±22.36	0.001*
	FEV1/ FVC	65.09±11.35	67.88±10.74	0.015*
COPD status		19.50±8.22	16.13± 7.56	<0.001*
Six-min walk test	VO2/kg (mL/kg/min)	7.99±3.02	8.70±3.15	0.002*
	Metabolic equivalents	2.28±0.87	2.48±0.90	0.002*
	Speed	1.61±0.47	1.83±0.57	0.001*
	Predicted	53.30±15.40	60.54±18.76	0.002*
Shortness of Breathing		3.00±0.92	2.40± 0.95	<0.001*

*Statistically significant.

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chological outcomes of patients with COPD. The small sample size of the study was its major limitation. Thus, large-scale multicenter studies are suggested to prove the efficacy of the PR program in different regions of Iran to implement PR in various clinical settings.

In conclusion, our study showed the positive effect of the PR program on the quality of life of patients with COPD. Furthermore, the PR program improved the depression, anxiety, COPD status, shortness of breathing, and walking ability of these patients. Thus, due to the positive effect of the PR program on physical and psychological aspects of a patient's health, the application of this program is recommended besides medical management of COPD.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article. The participants were informed of the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information. They were free to leave the study whenever they wished, and if desired, the research results would be available to them. Written consent has been obtained from the subjects. Principles of the Helsinki Convention were also observed.

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Authors' contributions

Conceptualization and supervision: Zeinab Naderpour and Mohammad Hossein Pourgharib Shahi; Methodology: Sima Borna; Data collection: Seyedeh Farnaz Mohammadnejad; Data analysis: Sayedeh Elham Sharafi and Keyvan Gohari Moghadam; Investigation, writing – original draft, and writing – review & editing: All authors.

Conflict of interest

The authors declared no conflict of interest.

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