

The Efficacy of Supervised Home-based Pulmonary Rehabilitation in Patients with Chronic Respiratory Disorders

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Abstract

Objective: Pulmonary rehabilitation (PR) programs can be carried out in hospital or home basis with a different organizational aspect and program content. This study aimed to evaluate the efficacy of a multidisciplinary supervised home-based PR program in patients with chronic respiratory disorders.

Methods: Forty patients with chronic respiratory disorders who admitted to our center between September 2007 and May 2012 were enrolled. In all patients before and after PR, dyspnea was assessed with Medical Research Council (MRC) dyspnea scale, exercise capacity with Incremental Shuttle Walk Test (ISWT) and Endurance Shuttle Walk Test (ESWT), health related quality of life with St. George Respiratory Questionnaire (SGRQ), psychosocial evaluation with hospital anxiety and depression scale (HAD), the body composition with bioelectrical impedance method. Ten patients did not complete home-based PR for various reasons.

Results: In patients with Chronic Obstructive Pulmonary Disease (COPD), dyspnea sensation ($p=0.026$), exercise capacity ($p=0.001$), quality of life ($p=0.001$), body composition ($p=0.012$), anxiety and depression score ($p=0.001$) improvements were statistically significant. In all patients with COPD and non-COPD perception of dyspnea, exercise capacity, quality of life, anxiety and depression score improvements were above minimal clinically important differences.

Conclusion: In this study supervised home-based pulmonary rehabilitation has been shown as an effective and safe modality when applied by an experienced and multidisciplinary team in selected severe COPD or non-COPD patients.

Keywords: Chronic respiratory disorders, exercise capacity, quality of life, supervised home-based pulmonary rehabilitation

INTRODUCTION

Chronic pulmonary disease is an important cause of mortality and morbidity, and chronic obstructive pulmonary disease (COPD) is among the most common causes of death. It has been proven that there is an improvement in the quality of life, exercise capacity, and perception of dyspnea in COPD patients with pulmonary rehabilitation (PR), and this is recommended by the guidelines as a non-pharmacological treatment method.

Pulmonary rehabilitation programs are structured at the hospital (as an inpatient or outpatient) and at home (supervised home-based, remotely supervised home-based, or unsupervised home-based). Hospital-centered PR programs with the supervision of outpatients are the most widely accepted applications in stable cases. It was shown in studies that have been conducted that home-based PR (remotely supervised or without supervision) could be an alternative to hospital-centered supervision of outpatients, and there were similar levels of gains in the quality of life and exercise capacity (1). There are a limited number of studies about supervised home-based PR programs. Supervised home-based PR programs can be applied on a hospital-centered basis in ventilator-dependent cases and in patients who have severe disease, are out of condition, or have immobilization or transfer problems in hospitals where there are medical teams to provide home service.



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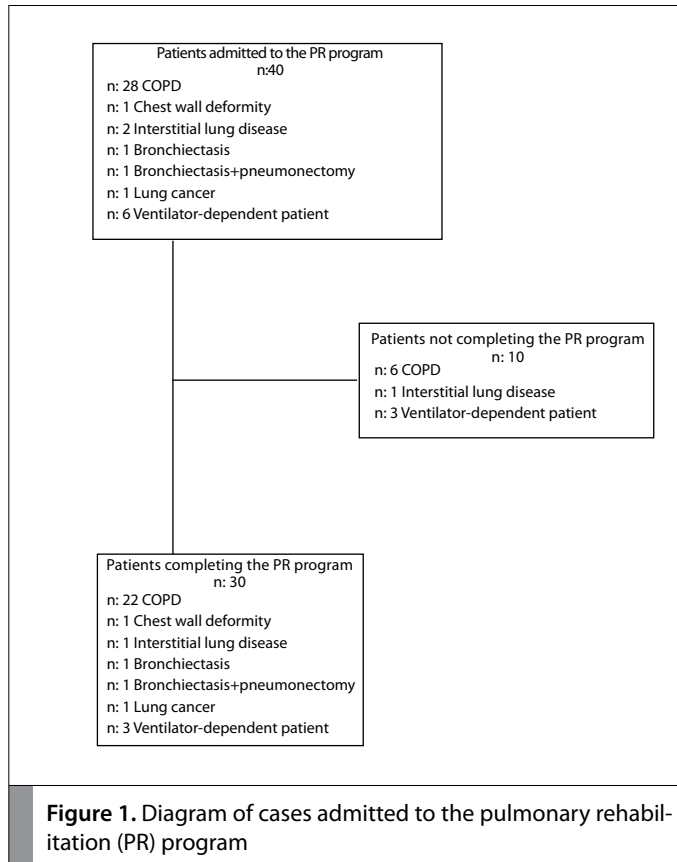
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It was aimed in this study to evaluate the effectiveness of multidisciplinary supervised home-based PR programs in cases that were admitted to our center having chronic respiration problems.



METHODS

Forty patients having chronic respiration problems who underwent PR with direct observation by our center were evaluated between September 2007 and May 2012. Information on the patients included in the retrospective study was recorded after obtaining the consent of the patients and their relatives. Ten of the patients included in the study could not complete their home PR program because of several reasons (noncompliance, cerebrovascular accident, and acute COPD attack). A diagram of all cases included in the PR program is shown in Figure 1.

Evaluation of the cases before and after PR was performed at our center. The instruments used for evaluation were the Medical Research Council (MRC) dyspnea scale for perception of dyspnea; the incremental shuttle walk test (ISWT) and endurance shuttle walk test (ESWT) for exercise capacity; the St. George’s Respiratory Questionnaire (SGRQ) for health-related quality of life; and the Hospital Anxiety and Depression Scale (HAD) for psychosocial evaluation. The severity of dyspnea before and after exercise was determined using the Borg dyspnea scale. Changes of 1 point on the MRC dyspnea scale (2), 47.5 m in the ISWT, 45–85 s in the ESWT (4), 4 units on the SGRQ, 10 units on the Chronic Respiratory Diseases Questionnaire (CRDQ) (5), and above 10 on both subscores of the HAD scale were regarded as abnormal, and a change of 1.5 units (6) on the HAD scale was regarded as of minimal clinical significance.

The body composition was determined via bioelectrical impedance. The body mass index (BMI) was calculated by dividing the body weight (kg) by the height (cm) squared. The body weight without fat was used to calculate the fat-free mass index (FFMI). A supervised home-based PR program was structured in line with the requirements of the cases.

Table 1. Recorded parameters in patients with COPD

	n	Time of measurement				z	p
		Before PR		After PR			
		Median (Min; Max)	M±SD	Median (Min; Max)	M±SD		
BMI	22	20.2 (14.0; 34.5)	21.4±4.9	21.7 (16.0; 30.5)	22.2±4.4	2.504	0.012
FFM	22	18.2 (13.1; 21.5)	16.9±2.1	18.5 (15.0; 23.8)	17.4±2.2	1.719	0.086
MRC	22	4 (2; 5)	4.3±0.7	3 (2; 5)	3.4±0.8	3.827	<0.001
Borg (rest)	17	0.5 (0.0; 3.0)	0.9±1.1	0.0 (0.0; 3.0)	0.5±0.8	2.226	0.026
Borg (exercise)	16	3.5 (1.0; 5.0)	3.4±1.2	3.0 (1.0; 7.0)	3.2±1.4	0.933	0.351
ISWT (m)	22	25.0 (0.0; 280.0)	54.1±72.6	120.0 (11.0; 290.0)	137.3±83.9	4.114	<0.001
ESWT (min)	22	0.0 (0.0; 13.0)	2.1±3.6	2.4 (0.0; 20.0)	5.4±6.4	4.075	<0.001
SGRQ total	20	77.7 (59.8; 91.1)	77.0±8.9	37.7 (22.8; 78.6)	42.8±15.0	3.702	<0.001
CRDQ total	18	62.0 (45.0; 76.0)	60.7±8.2	98.5 (59.0; 115.0)	95.3±15.2	3.681	<0.001
Anxiety	20	9.0 (6.0; 12.0)	9.3±2.0	6.0 (2.0; 14.0)	6.2±3.0	3.297	0.001
Depression	19	10.0 (5.0; 13.0)	9.8±2.0	6.0 (3.0; 13.0)	7.1±2.7	3.480	0.001
FEV ₁ , % of expected	11	26.0 (17.0; 77.0)	35.0±14.2	30.0 (16.0; 94.0)	40.6±27.8	0.490	0.624

BMI: Body mass index; CRDQ: Chronic Respiratory Diseases Questionnaire; ESWT: endurance shuttle walk test; FFM: fat-free body mass; ISWT: incremental shuttle walk test; M: mean; Max: maximum; Min: minimum; MRC: Medical Research Council; PR: pulmonary rehabilitation; SD: standard deviation; SGRQ: St. George’s Respiratory Questionnaire

The PR program involved the following: 1. Exercise training: endurance and strengthening training for the muscles of the lower and upper extremities, respiratory exercises, and training in methods of coping with shortness of breath; 2. Determination of body composition and supporting treatment; 3. Psychosocial evaluation and supporting treatment; and 4. Training of the patient and patient's relatives.

The exercise training, involving lower and upper-extremity neuromuscular electrical stimulation (NMES) (Uniphy; Myaction Med, Bilzen, Belgium) and active strengthening, bronchial hygiene techniques, methods of coping with shortness of breath, and respiratory exercises, was structured for the person and performed twice a week under the supervision of a physiotherapist and a physician for a minimum of 10 weeks.

Statistical Analysis

Concordance of the variables to a normal distribution was assessed graphically and with the Shapiro–Wilk test. Median (minimum; maximum) values and mean±standard deviation were used to demonstrate the descriptive statistics of the variables. The Wilcoxon signed-rank test was employed to compare values before and after PR.

The Statistical Package for the Social Sciences (SPSS) (released in 2012. For Windows, version 21.0. Armonk, NY: IBM Corp.) and MS Excel 2007 programs were used for statistical analyses and calculations. The level of statistical significance was accepted as p≤0.05.

RESULTS

The study included 22 patients with COPD, 1 patient with kyphoscoliosis, 1 patient with bronchiectasis, 1 patient with bronchiectasis+left pneumonectomy, 1 patient with lung cancer, 1 patient with

chronic hypersensitivity pneumonia, and 3 cases followed up using a household-type mechanical ventilator who completed the PR program. The mean age of the cases diagnosed with COPD was found to be 68±9 years, and the mean parameters that were measured are shown in Table 1. The patients who had a mean FEV₁ of 35.0±14.2%

Table 3. Exercise parameters in cases diagnosed with non-COPD pulmonary diseases

	Patient with bronchiectasis+ left pneumonectomy		Patient with bronchiectasis	
	Before PR	After PR	Before PR	After PR
BMI	27.8	29.1	28.1	29.2
FFM	16	17	17.3	17.6
MRC	5	4	5	4
Borg (rest)	7	2	2	1
Borg (exercise)	7	3	4	3
ISWT (m)	Immobile	70	60	120
ESWT (min)	0	9.5	1.2	2.4
SGRQ total	96.0	40.8	72.1	30.6
CRDQ total	58	101	47	71
Anxiety	12	7	9	8
Depression	11	7	8	6

BMI: Body mass index; COPD: chronic obstructive pulmonary disease; CRDQ: Chronic Respiratory Diseases Questionnaire; ESWT: endurance shuttle walk test; FFM: fat-free body mass; ISWT: incremental shuttle walk test; MRC: Medical Research Council; PR: pulmonary rehabilitation; SGRQ: St. George's Respiratory Questionnaire

Table 2. Exercise parameters in cases diagnosed with non-COPD pulmonary diseases

	Patient diagnosed with ILD		Patient diagnosed with lung cancer		Patient with kyphoscoliosis	
	Before PR	After PR	Before PR	After PR	Before PR	After PR
BMI	20.1	20.0	20	24	18.3	19.6
FFM	15.1	15.7	16.3	18.2	16.6	17
MRC	5	4	4	3	5	4
Borg (rest)	1	0.5	1	0	0	0
Borg (exercise)	5	1	2	3	3	0
ISWT (m)	160	160	280	290	130	195
ESWT (min)	2.5	4.8	3.1	5.2	1.2	2.7
SGRQ total	94.0	36.2	82.8	69.4	80.3	35.6
CRDQ total	48	105	66	59	76	89
Anxiety	12	9	14	9	10	4
Depression	14	10	17	7	10	6

BMI: Body mass index; COPD: chronic obstructive pulmonary disease; CRDQ: Chronic Respiratory Diseases Questionnaire; ESWT: endurance shuttle walk test; FFM: fat-free body mass; ILD: interstitial lung disease; ISWT: incremental shuttle walk test; MRC: Medical Research Council; PR: pulmonary rehabilitation; SGRQ: St. George's Respiratory Questionnaire

Table 4. Exercise parameters in patients followed up using invasive household-type ventilator

	Case 1		Case 2		Case 3	
	Before PR	After PR	Before PR	After PR	Before PR	After PR
BMI	28.5	29.9	16.6	16.6	19.4	20.8
FFM	16.6	17.6	15.3	15.3	14.1	15
MRC	5	3	5	4	4	3
Borg (rest)	5	3	7	3	5	3
Borg (exercise)	10	4	10	5	7	3
ISWT (m)	Immobile	80	Immobile	40	Immobile	220
SGRQ total	94.9	41.6	82.6	45.5	77.7	35.3
CRDQ total	56	98	47	74	64	76
Anxiety	10	8	10	8	10	5
Depression	9	6	9	7	7	4

BMI: Body mass index; CRDQ: Chronic Respiratory Diseases Questionnaire; ESWT: endurance shuttle walk test; FFM: fat-free body mass; ISWT: incremental shuttle walk test; MRC: Medical Research Council; PR: pulmonary rehabilitation; SGRQ: St. George's Respiratory Questionnaire

of the expected value were Stage 3–4 according to Global Initiative for Chronic Obstructive Lung Disease (GOLD) post-bronchodilator spirometric evaluation. Eleven cases were Group D and four cases were Group B according to the combined evaluation. Seven cases who had a performance status of Eastern Cooperative Oncology Group (ECOG) 4 could not take part in spirometric evaluation, and FEV₁ values were not recorded. Exercise tests could not be applied in these cases and ISWT distances were recorded as 0. The mean ISWT distance in COPD cases was calculated to be 54.1±72.6 m. Statistically significant changes were observed in MRC (p=0.001), Borg resting scale (p=0.026), ISWT (p=0.001), ESWT (p=0.001), BMI (p=0.012), SGRQ total (p=0.001), CRDQ total (p=0.001), and HAD (p=0.001) scores after PR (Table 1).

An increase that was greater than the clinically significant change was observed in the MRC, Borg scale after exercise, ESWT, SGRQ, CRDQ, and HAD scores of the case diagnosed with chronic hypersensitivity pneumonia and in the MRC, Borg scale, ISWT, ESWT, SGRQ, CRDQ, and depression scores of the case diagnosed with bronchiectasis. For the three patients with improved body composition and with diagnoses of bronchiectasis+left pneumonectomy, kyphoscoliosis, and lung cancer, all gains were found to be above the minimum clinically significant values (Tables 2, 3).

An improvement that was more than the clinically significant level was seen after supervised home-based PR in the MRC, Borg scale, SGRQ, CRDQ, and HAD scores, and ISWT distance of the cases with COPD (Cases 1, 3) and the case with kyphoscoliosis (Case 2), among the cases followed up using a household-type mechanical ventilator (Table 4).

DISCUSSION

Currently, PR has an important place in the management of cases with chronic respiration problems. The attainment of individual independence, social participation, and skills at the highest level and their continuation are the targets of PR programs (7). Despite its many proven effects, it was reported in the literature that the rate of participation in PR fell to 50% and the discontinuation rate was 23–31% (8-10). In the studies conducted, transportation, work conditions, a level of increased shortness of breath, and low social support were observed to be among the reasons for noncompliance and nonattendance in PR programs (8, 9, 11-13). Those who have transportation and work problems or a high level of perception of shortness of breath as well as advanced-stage and bedbound cases also benefit from PR by means of supervised home-based, remotely supervised, and unsupervised programs. In this study, it was demonstrated that supervised home-based PR is a method that is structured by experienced teams and could be applied not only in COPD cases but also in all cases with chronic problems, even at advanced stages.

Most of the studies were conducted with cases diagnosed with COPD, and a few studies were structured as supervised home-based PR programs. In a meta-analysis published in 2014, 18 studies that involved cases with a diagnosis of COPD to whom supervised home-based/unsupervised PR programs were applied and cases with a diagnosis of COPD who did not receive PR were examined. Although there were gains in the perception of dyspnea [Borg, basal dyspnea index (BDI)], quality of life (CRDQ, SGRQ), exercise capacity (6 min walk test), and respiratory functions (FEV₁/FVC) in the group receiving PR, there

was no significant difference between the two groups in admission to hospital, mortality, or maximum workload (14).

In a review comprising 12 studies that included cases who were stable clinically and over 60 years of age with GOLD spirometric Stage 3–4 COPD, both statistically and clinically significant improvements in the quality of life and a statistically significant improvement in exercise capacity were observed. Moreover, when outpatient hospital-based and remotely supervised home-based/unsupervised structured PR programs were compared, it was seen that the gains in the quality of life and exercise capacity were similar, and the differences between them were not statistically significant (1). When the perception of PR was examined, although a decrease was observed in both groups in one of the studies that were compared (15), a decrease was found only in the group receiving PR in the other study (16). The Borg scale after exercise was used in five studies (15, 17-20), and a decrease was observed in the Borg scale in remotely supervised home-based PR in four studies (17-20). In this study, there were gains in the perception of dyspnea, exercise capacity, and quality of life in all cases, with and without a diagnosis of COPD, after a supervised home-based PR program.

In a study conducted on patients with a diagnosis of interstitial lung disease (21) and in two studies performed on patients diagnosed with idiopathic pulmonary fibrosis (22, 23), a decline was observed in exercise capacity and perception of dyspnea with remotely supervised home-based PR; however, no change was seen in respiratory functions. In a study in which 286 cases with chronic respiration problems were included, remotely supervised home-based PR and outpatient hospital-based PR programs were compared; similar gains were observed in the quality of life and exercise capacity in both groups. In the same study, although a significant improvement was not observed in the HAD score of the outpatient hospital-based group, a significant improvement was observed in the group that received remotely supervised home-based PR (24). In this study, a clinically significant improvement was observed in the two subscores of the HAD scale in all patients undergoing PR. This improvement in the HAD scale was statistically significant in COPD patients. Furthermore, gains were observed in body composition, quality of life, perception of dyspnea, and exercise capacity in the cases, except for COPD.

One of the limitations of this study is the insufficient number of non-COPD patients and that the distribution of diagnoses is heterogeneous. However, it was found to be a valuable reflection of the first experiences in Turkey of the application of hospital-centered supervised home-based multidisciplinary PR.

CONCLUSION

Supervised home-based PR is an effective, safe method that results in gains in the quality of life, perception of dyspnea, exercise capacity, and psychological state in ventilator-dependent cases and patients with COPD or non-COPD chronic respiratory disorders who have serious disease, are out of condition, or have immobilization or transfer problems. This procedure is performed in hospitals that have experienced medical home teams with adequate equipment.

Ethics Committee Approval: Ethics committee approval was not received because the study was observational, not experimental.

Informed Consent: Written informed consent was obtained from patients and the parents of the patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - İ.C., P.E.; Design - P.E., D.K.; Supervision - D.K., İ.C.; Materials - D.K., P.E.; Data Collection and/or Processing - D.K., N.D., İ.C., F.C.T., N.E., F.Ş.; Analysis and/or Interpretation - İ.C., P.E.; Literature Review - İ.C.; Writer - İ.C., D.K.; Critical Review - P.E., İ.C.

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