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Original Article

Comparison of Compliance Rates and Treatment Efficiency in Home-Based with Hospital-Based Pulmonary Rehabilitation in COPD

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Abstract

OBJECTIVES: The aim of the present study was to compare the home-based pulmonary rehabilitation (PR) with the hospital-based PR with respect to exercise compliance rates and efficiency of therapy in stable chronic obstructive pulmonary disease (COPD).

MATERIALS AND METHODS: Patients with stable severe and very severe COPD who were admitted consequently to our PR clinic were prospectively included in the study. Patients who completed the home-based PR for at least 4 days/week for 2 months as recommended were classified as the study group. Patients who completed the hospital-based PR in our clinic before the present study were classified as the control group.

RESULTS: Thirty-five patients were included in the home-based PR, but 10 patients were incompatible with the exercise training, and four patients were out of follow-up. Twenty-one patients successfully completed the home-based PR (study group), and compliance rate was 60%. Thirty-seven patients previously underwent the hospital-based PR, and 25 patients completed the exercise program (control group); thus, their compliance rate was 67%. There was no difference between the two groups with respect to treatment compliance rates. The significant improvement in six-minute walking distance, modified Medical Research Council dyspnea, and COPD Assessment Test scores were observed after PR in both groups, and there was no difference with respect to the levels of improvement.

CONCLUSION: The present study showed that approximately two-thirds of patients with COPD successfully completed the home-based PR, and that this program also provided similar benefits with respect to the quality of life and exercise capacity compared with the hospital-based PR.

KEYWORDS: Chronic obstructive pulmonary disease, dyspnea, exercise capacity, pulmonary rehabilitation, walk test

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INTRODUCTION

Pulmonary rehabilitation (PR) is defined as a comprehensive intervention based on a thorough patient assessment, followed by patient-tailored therapies, and includes exercise training, education, and behavior change, and it is designed to improve the physical and psychological conditions of people with chronic respiratory disease and to promote the long-term adherence to health-enhancing behaviors [1]. It is integrated into lifelong care and management of chronic respiratory illness and requires active collaboration between the patient, their family, and the PR team [2]. Owing to the complex nature of respiratory diseases, many disciplines must be involved in co-treatment [3].

Pulmonary rehabilitation is a useful treatment modality for almost all patients with chronic respiratory disease, especially in chronic obstructive pulmonary disease (COPD) [2]. Recent studies have shown that PR decreases the number of exacerbations and frequency of hospitalization in patients with COPD [4-6].

There are many PR organizational types, such as hospital-based [7], telephone-mentoring with home-based [8], or tele-monitorizational programs [9]. Hospital-based supervised programs are time-consuming and costly practices [10]. There are few studies comparing home-based PR and hospital-based PR [11-13]. Adherence to home care may vary according to societies and cultures. In our country, to the best of our knowledge, this is the first study that compared hospital-based and home-based PR in patients with COPD and examined the effect of PR on the COPD Assessment Test (CAT) score, which is an important assessment of disease outcomes. For this reason, there is a need for further studies on the effectiveness and benefits of unsupervised programs.

In the present study, we compared outpatient unsupervised home-based PR and outpatient supervised hospital-based PR with respect to compliance and effectiveness.

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Hypothesis of the study,

H1: Outpatient home-based PR is as effective as outpatient hospital-based PR.

H2: Exercise compliance of home-based PR is as good as hospital-based PR.

MATERIALS AND METHODS

This was a combined prospective and retrospective cohort study. The Global Initiative for Chronic Obstructive Lung Disease (GOLD) stage 3–4 (forced expiratory volume in 1 second (FEV_1) <50%) patients with stable COPD with shortness of breath and exercise intolerance applying to subsequently our PR polyclinic were included in the present study. Inclusion criteria were as follows: aged ≥40 years, at least a 1-year diagnosis of COPD according to the GOLD with post-bronchodilator FEV_1/forced vital capacity ratio of ≤0.7 [14], and ≥10 pack-year smoking history. Exclusion criteria were as follows: having COPD exacerbation within the past 6 weeks prior to enrolment, respiratory disease other than COPD, decompensated heart failure, uncontrolled hypertension (systolic blood pressure >200 mmHg and diastolic blood pressure >110 mmHg), and comorbidities (orthopedic or psychiatric) preventing exercise.

Patients with stable COPD who were admitted to the PR clinic were prospectively recruited in the study between May 2017 and October 2017 and classified as the study group. The multidisciplinary PR program was designed as the outpatient home-based PR. Each patient was evaluated by cardiologists and dieticians at the beginning of the program, and necessary interventions were made. The patients and their families were taught in hospital once in detail the exercises they would do at home. Home program included breathing exercises, upper and lower extremity strengthening exercises with free weights, and free walking for 5 days in a week for 2 months. Patients were asked to perform upper and lower extremity strengthening exercises with free weights, three times a week, 10 times repeated at home. For the exercises to be remembered by the patient, the exercise form was given to the patient. The patients were asked to walk daily in their own homes, taking the calculated distance based on the walking distance obtained from the six-minute walk test. It was taught how safe the heart rate, blood pressure, and oxygen saturation intervals, and how they should behave when possible. They were told that they could get oxygen support and take a break if necessary. It was requested that the walking time be increased by 15 min, increasing by tolerance every 30 min. The method of calculating the number of free walking laps based on the six-minute walk test is given below:

(6-minute walking distance/6) × Exercise time = Distance to walk

Distance to walk × 80%

If the distance to the corridor to be walked is known:

Distance to walk / Corridor length = Number of laps.

An exercise follow-up form was given to the patients to record their daily exercises. A similar form was filled out by the physiotherapist once a week during phone call. It was recorded whether the patient performed the exercises, and whether any problems existed. In this way, two schedules were evaluated together, and patients who were regularly performing all the exercises for 4 days/week were accepted as compatible with the rehabilitation program and were classified as the study group.

Between October 2015 and May 2017, patients with COPD who had previously completed the outpatient hospital-based supervised PR for 2 days under supervision in our PR clinic and 3 days/week at home during 2 months and had inclusion criteria were classified as the control group, and their data were analyzed retrospectively. The supervised exercise sessions had included breathing exercises, treadmill walking (15 s), cycle training (15 s), arm ergometer training (15 s), peripheral muscle training, and stretching exercises with free weights. The aerobic exercise program was administered based on the heart rate determined according to the target heart rate (HR) method (HR target = rest HR + (% Aerobic intensity × HR reserve). Exercise intensity was 60%–80% target HR. Oxygen saturation, HR, Borg fatigue, dyspnea scores, and distance covered were recorded during the exercises. The patient started strength training with 20% of the calculated one-repetition maximum weight and progressively increased to 40%. The dumbbells and lead weight bags were used in supervised exercise sessions. The study flowchart is shown in Figure 1.

The study was carried out under the supervision of the Haseki Training and Research Hospital Ethics Committee (Protocol Number: 517, 21.06.2017). It was conducted in accordance with the Helsinki Declaration. A written informed consent was obtained from each patient.

Outcome Measurements

Dyspnea was assessed based on the modiŞed Medical Research Council (mMRC) dyspnea scale [15], and the disease control status was measured by the CAT for each patient [16]. Exercise capacity was also assessed by Six-Minute Walking Test (6MWT) based on the American Thoracic Society standards [17]. The six-minute walk test is a submaximal exercise test used to assess aerobic capacity and endurance. Patients were asked to walk as far as possible in 6 min along a flat corridor. The distance in meters was recorded (6MWD). Standardized instructions and encouragement were commonly provided during the test. The 6MWT was performed twice for each patient. The overall outcome measurements were applied before and after the PR.

Statistical Analysis

Statistical analyses of the study were performed using Statistical Package for Social Sciences (SPSS) IBM Statistic version 15.0 (SPSS Inc.; Chicago, IL, USA). Shapiro–Wilk test was used for normality of data. Wilcoxon test was used for intragroup comparisons, and Mann–Whitney U test was used for intergroup changes in data with no normal distribution. Variables were expressed as median, minimum, and maximum. A p value <0.05 was considered statistically significant. The sample size estimation was performed in "G*Power," a statis-

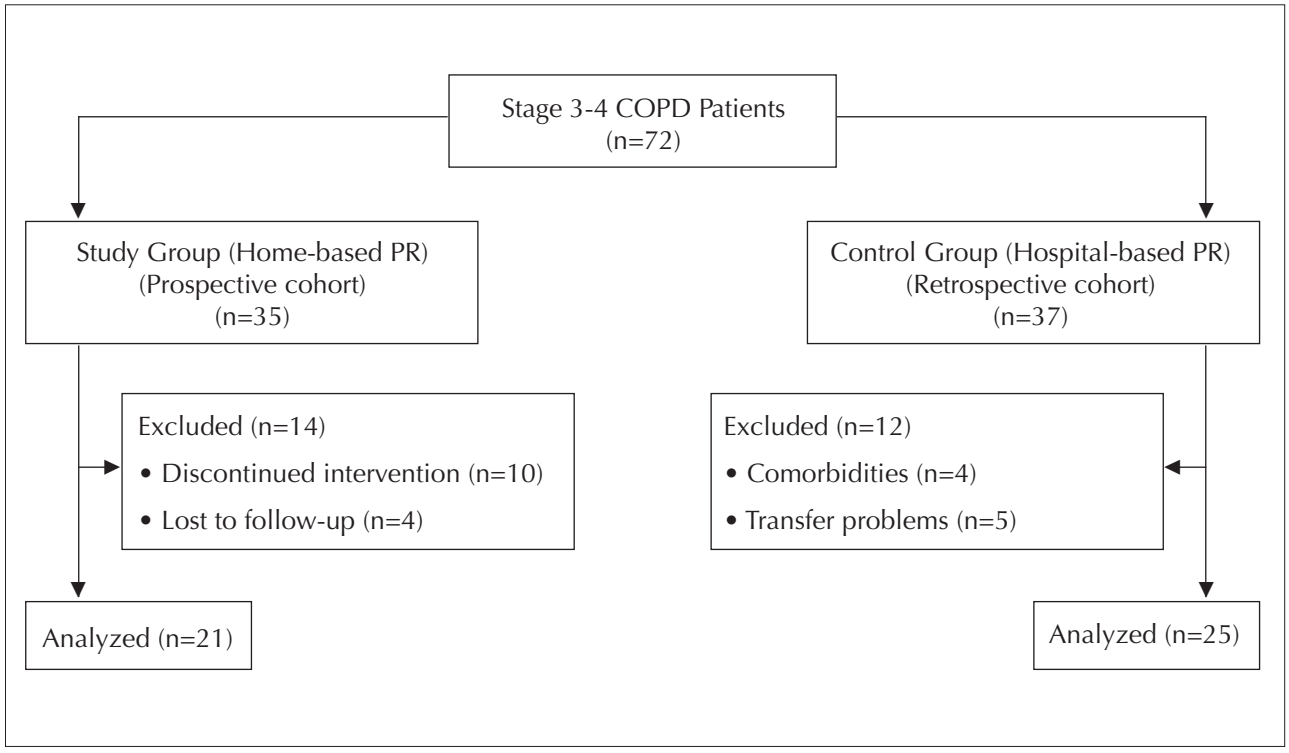

Figure 1. The study flow chart
COPD: chronic obstructive pulmonary disease; PR: pulmonary rehabilitation

Table 1. Comparison of baseline demographic and clinical feature changes between the two groups before pulmonary rehabilitation

Variables	Study group n=21	Control group n=25	z	p*
Male/female (n, %)	20/1 (95.2/4.8)	22/3 (88/12)	–0.858	0.39
Age (year)	65.14 (50–80)	61.24 (53–75)	–1.954	0.05
BMI (kg/m^2)	25.09 (18.29–35.99)	25.73 (17.04–32.77)	–0.761	0.44
Smoking (pack/year)	64.52 (13–160)	47.6 (0–200)	–1.429	0.15
6MWD (m)	337 (133–464)	388 (228–489)	–1.832	0.06
mMRC (0–4)	2.71 (1–4)	2.48 (1–4)	–0.731	0.46
CAT	21.52 (4–36)	17 (2–30)	–1.934	0.05
FVC (L)	1.87 (0.94–3.08)	2.09 (1.04–3.80)	–1.125	0.26
FVC, %	49.92 (22–92)	57.75 (5–126)	–1.467	0.14
FEV_1 (L)	1.02 (0.56–1.98)	1.08 (0.50–2.50)	–0.762	0.44
FEV_1, %	34.90 (19–77)	39.75 (20–89)	–0.871	0.38
FEV_1/FVC	53.94 (32.24–70)	51.12 (32.47–69.60)	–1.269	0.20

Study group: home-based pulmonary rehabilitation group. Control group: hospital-based pulmonary rehabilitation group. $p<0.05$. Data are expressed as median (min–max) or %
BMI: body mass index; 6MWD: six-minute walking distance; mMRC: modified medical research council dyspnea score; CAT: COPD assessment test; FVC: forced vital capacity; FEV_1: forced expiration volume in 1 second
*Mann–Whitney U test

tical software program with 80% power with 5% type 1 error level to detect a minimum clinically significant difference of 54 m [18] of the 6-minute walk test [19] with the highest standard deviation of the study parameters.

RESULTS

Twenty-five patients were prospectively included in the home-based PR, but 10 patients were incompatible with the exercise training, and four patients were out of follow-up. Twenty-one patients successfully completed the home-based PR (study group). Thus, compliance rate was calculated as 60% (21/35). Age- and sex-matched 37 patients with COPD were selected from the outpatient hospital-based PR retrospective cohort. Twelve out of 37 patients failed to complete the hospital-based PR for various reasons, such as four patients due to comorbid problems, five patients transfer problems,

Table 2. Comparison of PR efficiency with respect to exercise capacity, dyspnea, and disease control level between the two groups

	Study group n=21				Control group n=25				Difference analysis between groups			
Variables	**Before PR**	**After PR**	**z**	**p***	**Before PR**	**After PR**	**z**	**p***	**ΔGroup1**	**ΔGroup2**	**z**	**p****
6MWD (m)	337 (133–464)	382 (171–589)	–2.364	0.01	388 (228–489)	455 (268–550)	–4.130	<0.0001	44.19 (–87–138)	66.56 (–28–192)	–0.717	0.47
mMRC (0–4)	2.71 (1–4)	1.95 (0–4)	–2.344	0.01	2.48 (1–4)	1.48 (0–4)	–3.898	<0.0001	0.76 (–2–3)	1.48 (0–4)	–1.053	0.29
CAT	21.52 (4–36)	14.85 (3–27)	–3.475	0.001	17 (2–30)	11.52 (1–27)	–4.240	<0.0001	6.66 (–4–23)	5.48 (–1–14)	–0.299	0.76

Study group: home-based pulmonary rehabilitation group. Control group: hospital-based pulmonary rehabilitation group. p<0.05. Data are expressed as median (min–max). Results are shown as change between post-pulmonary rehabilitation and baseline levels

PR: pulmonary rehabilitation; 6MWD: six-minute walking distance; mMRC: modified medical research council dyspnea score; CAT: COPD assessment test

*Wilcoxon rank test; **Mann–Whitney U test

and three patients follow-up problems. Thus, 25 patients who had previously underwent the hospital-based PR completed the exercise program (control group), and their compliance rate was 67% (25/37). There was no difference with respect to compliance rate between the two groups (p=0.504). When the initial values were compared, the study group had higher age and higher CAT score than the control group but did not reach statistical significance (p=0.05). The comparison of the clinical and laboratory features of the groups is given in Table 1.

Significant improvement in mMRC, CAT scores, and 6MWD was observed in both groups after PR (p<0.05), and there was no difference between the groups with respect to the level of improvement (p>0.05). These results are given in Table 2.

DISCUSSION

Pulmonary rehabilitation is a non-pharmacologic treatment that is effective on the clinical outcomes of COPD, and it is also a very cost-effective approach [20]. However, in our country, although the prevalence of COPD is very high [21], the number of PR centers is very limited. Thus, an alternative PR program is needed for more patients to benefit. In this regard, our study is important because it showed that home-based PR improved dyspnea, exercise capacity, and quality of life, and this improvement is also similar to hospital-based PR.

Dyspnea is the main symptom perceived by patients with COPD, and one of the most important goals of treatment is the reduction of dyspnea [22]. The present study demonstrated that dyspnea perception decreased with home-based rehabilitation, and that the level of improvement is similar to hospital-based PR. In a randomized controlled trial in which 58 patients with COPD were included, the study group underwent home-based PR, whereas the control group was given only standard medical treatment and nursing counseling session. At the end of 12 weeks, a significant recovery was determined with dyspnea perception in the PR group [23]. Another study compared home-based and central-based PR with respect to treatment effectiveness. Dyspnea perception was assessed by the Chronic Respiratory Questionnaire Self-Report scale different from our study. They observed that after PR, similar improvement of the dyspnea score in both groups was seen [24]. We have not found any report that home- or hospital-based PR is ineffective on dyspnea perception in the literature.

Six-minute walking test is widely used to evaluate the exercise capacities and therapeutic interventions effectiveness in patients with COPD [25]. The present study showed that home-based PR improves 6MWD, and that this improvement is also similar to hospital-based PR. In Designed as a daily life study, 6MWD was increased 65 m at the end of the 5 weeks home-based PR similar to our study. In another study, patients with COPD underwent the home-based PR program that was composed of aerobic exercise (walking) and limb muscle and respiratory muscle training during 12 weeks. They had given each patient a metronome that beeped at preset intervals, individualized to the patient's target intensity to guarantee

walking speed. Similar to our results, the patient's exercise capacity was increased (6MWD = 48 m), and the quality of life was improved at the end of the study [26].

The CAT is a practical alternative to longer-established health status questionnaires [27]. The present study demonstrates that there is a significant recovery in CAT score in patients with severe and very severe COPD with home-based PR. We encountered only one study that had investigated the effect of home- and hospital-based PR on CAT score in the literature [28]. This study detected that improvement in exercise capacity (6MWD) and CAT score in both groups was similar to our results.

The compliance rates for PR programs vary from 10% to 50%. Holland et al. clarified that the compliance rates of home-based and center-based PR are 70% and 49%, respectively [29]. Similarly, Morgan et al. reported a general compliance rate of 70%, but the compliance rate is higher in home-based PR than in central-based PR [30]. In our study, the compliance rates of home-based and hospital-based PR were 60% and 67%, respectively. The reason for dropping out the home program was mainly follow-up problems, whereas the reasons for discontinuing the hospital-based PR were transfer problems and comorbidities in our study. In light of the results of the present study, we think that patients who can continue their exercises together with their relatives at home, who have more transfer problems, and who do not want to wait in the waiting list of direct supervised program can be taken to home-based programs. Recently, some methods have been developed to increase the compliance of the exercise program, such as web-based exercise, activity monitors, tele coach applications, videos, and phone mentoring. Future studies are needed in this regard.

It is investigated in which patients the PR is more successful. In a study examining the baseline demographic and clinical characteristics of the PR, it was demonstrated that the outcomes were independent of age, sex, and chronic hypoxemic respiratory failure, and patients with better respiratory function and lower BODE scores (body mass index, airflow obstruction, dyspnea, and exercise capacity index) gave more successful results [31]. In another study, the researchers found that PR results in significant improvement in the quality of life, dyspnea, and functional capacity independent of baseline disease burden [32]. There are also some studies suggesting that depressive mood is effective on PR success [33]. The baseline characters of the groups were similar in our study. Anyway, the purpose of our study was not to answer the question of which patient might have more PR gain. Our study shows that home-based and hospital-based PR programs have similar gains and are caused by factors other than baseline characteristics.

In conclusion, the present study showed that patients who underwent home-based PR had achieved similar benefits to hospital-based PR with respect to exercise capacity, dyspnea perception, and quality of life. The similarities obtained from both programs can be attributed to the fact that the patients in the hospital-based program may not have regular home exercise programs. On the other hand, patients who were given home-based PR had regular exercise for at least 4 days. At the same time, we think that once a week phone calls can increase home patients' motivation. We believe that future studies on home-based PR involving more patients and more comprehensive evaluation may alter daily practice.

The important limitation of the present study is the small number of patients included, especially female gender. Another limitation is that data of the hospital-based group were obtained from retrospective cohort.

Ethics Committee Approval: Ethics committee approval was received for this study from the Haseki Training and Research Hospital Ethics Committee (Protocol Number: 517, 21.06.2017).

Informed Consent: Written informed consent was obtained from patient who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – E.P., E.Y.; Design – E.P., E.Y.; Supervision – E.Y., L.K.; Materials – E.Y., L.K.; Data Collection and/or Processing – E.P., A.B.; Analysis and/or Interpretation – E.P.; Literature Search – E.P.; Writing Manuscript – E.P., E.Y.; Critical Review – E.Y.

Conflict of Interest: The authors have no conflicts of interest to declare.

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