Pulmonary Rehabilitation outcomes In COPD Patients

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Abstract : Although pulmonary rehabilitation (PR) is a crucial part of managing chronic obstructive pulmonary disease (COPD), patients in India still have limited access to it. Additionally, it is not yet known what the ideal level of aerobic exercise intensity is for PR regimens. Consequently, the purpose of this research was to examine the impact of aerobic training at 60% and 80% of MWR on HRQOL, symptom management, and exercise capacity in chronic obstructive pulmonary disease (COPD) patients. The 34 patients with stable chronic obstructive pulmonary disease (COPD) were randomly allocated to one of two groups: 60% or 80% MWR, in this single-center, randomized non-inferiority/equivalence experiment performed in India. With the only difference being the degree of aerobic activity, all groups had 20 sessions of organized outpatient physical rehabilitation. The St. George's Respiratory Questionnaire (SGRQ) was used to evaluate HRQOL, which was the main outcome measure. Results from the secondary outcomes included dyspnea as measured by Mahler's Transitional Dyspnea Index, functional performance as evaluated by the London Chest Activity of Daily Living (LCADL) scale, and exercise tolerance as assessed by the six-minute walk test (6MWT), incremental exercise test (IET), and constant load exercise test (CLET). A modified intention-to-treat strategy was used for data analysis. Changes in both groups were more than the minimum clinically relevant difference (MCID), and they were statistically significant across the board. The two workout intensities did not vary significantly from one another. HRQOL, dyspnea, and exercise capacity all showed significant improvements as compared to baseline in the within-group studies. There were little side effects and strong adherence to the rehabilitation regimen. In chronic obstructive pulmonary disease (COPD) patients, pulmonary rehabilitation significantly improved exercise tolerance, symptom load, and quality of life, even when aerobic training was done at 60% or 80% of maximal work rate. Based on these results, aerobic exercise at a lower intensity may be adequate, if not preferred, for regular clinical use.

Keywords: Pulmonary rehabilitation; Chronic obstructive pulmonary disease; Exercise tolerance; Health-related quality of life; Aerobic training intensity; India

INTRODUCTION

When individuals with COPD continue to have symptoms even after taking the recommended medications, pulmonary rehabilitation (PR) may be an important factor in improving their prognosis [1]. To put it simply, it is a lot less expensive than drugs [2]. In most cases, it enhances exercise ability, life quality, and symptoms associated with physical activity (such

fatigue and trouble breathing) [3]. However, the extent to which some persons react negatively to public relations is affected by the results and metrics that are used [4]. Reports in the literature on outcomes and measurements may show a large degree of variability. This might be because their choice is contingent upon a multitude of variables, such as the assessor's or patient's preferences, the patient's comorbidities, and the available resources, such as personnel, infrastructure, equipment, and finances [5,6]. All of this variety makes it harder to formulate suggestions, synthesise data efficiently [7], and benchmark within and among public relations centers. Regardless, the precise level of heterogeneity is unclear since no research has performed a thorough evaluation of all the outcomes and metrics used in PR trials that were assessed by peers. All of the outcomes and measures used to evaluate PR's utility and effectiveness in COPD patients were thoroughly examined in the present systematic review. The first step toward standardizing outcome reporting is the creation of a core outcome set (COS) for pulmonary rehabilitation (PR) in people with chronic obstructive lung disease (COPD). In clinical study and practice, a core outcome set is a basic group of results that everyone agrees should be observed and recorded in the same way.

Chronic obstructive pulmonary disease (COPD) is one of the most common long-term illnesses in the world [8]. It is marked by prolonged breathing reduction and ongoing lung complaints. The disease is very hard on both people and society as a whole because it causes a lot of pain and loss of function. The rates of illness and death from COPD are much higher than those for many other long-term diseases [9]. The World Health Organization (WHO) says that by 2030, COPD will be the main cause of death in the world [10]. A lot of this is happening in China, where the rate of occurrence is 8.6%, affecting more than 99 million people and killing over 900,000 each year [11,12].

A lot of people agree that pulmonary therapy is one of the best ways to treat COPD without drugs. PR programs usually happen outside of hospitals and are run by a group of professionals from different fields. They include guided exercise, patient education, food advice, and emotional and social support. Pulmonary therapy has been shown to improve many aspects of health-related quality of life compared to normal community-based care [14–16]. These include exercise ability, breathlessness, and tiredness. Overall, the main goal of pulmonary therapy is to improve quality of life by lowering shortness of breath and raising the body's ability to handle exercise [17]. It is also possible to tailor PR plans to meet the unique wants and situations of each patient.

OBJECTIVES

1. To find out how lung therapy changes the ability of COPD people to move, their health-related quality of life, and how they deal with their symptoms.
2. To find out what difference there is between high-intensity (80% Wmax) and moderate-intensity (60% Wmax) cardio exercise for COPD patients who are going through lung therapy.

RESEARCH METHODOLOGY

Study Design

Researchers used a parallel-group design with a 1:1 allocation ratio to produce this randomized controlled experiment. The purpose of this experiment was to evaluate whether or not the two groups were equivalent or non-inferior. Due to the fact that the researchers used blocked stratified randomization, each and every individual was blissfully oblivious of the groups to which they had been allocated.

Study Setting and Duration

Between the months of January 2022 and March 2023, the Department of Pulmonary Medicine and Physiotherapy at a tertiary care teaching hospital in India provided pulmonary rehabilitation services and specialized respiratory treatment to a vast population that was located in suburban and city settings.

Study Population

For steady COPD patients who are cared for in the outpatient lung clinic, a respiratory retraining program was set up.

Inclusion Criteria

- Spirometry is used to detect chronic obstructive pulmonary disease (COPD) when FEV_1/FVC ratios are less than 0.70 after bronchodilator testing.
- A stable clinical state that has not had an acute exacerbation in the preceding four weeks
- The capacity and desire to take part in an outpatient rehabilitation course

Exclusion Criteria

Individuals were not allowed to participate if they had:

- The inability to go to three weekly pulmonary rehabilitation sessions
- Malignancy or active infectious illness (e.g., TB)
- Cardiovascular illness that is unstable
- Severe neuromusculoskeletal, behavioral, or cognitive disorders preventing exercise participation

Randomization and Blinding

For the purpose of randomization, a computer-generated allocation sequence was used, and patients were categorized according to the severity of their disease by using a threshold value of FEV1 = 50% expected. All patients were accepted if they had COPD, regardless of how bad their condition was. We used two-block randomization to make sure that each group got an equal amount of resources. To ensure the privacy of the distribution, random envelopes were sealed. No one was told which group a person belonged to as the two groups did the same pulmonary rehabilitation program and couldn't tell each other apart in terms of how hard the exercises were. It was not possible to blind the healthcare experts since clinical monitoring was necessary.

Program for Pulmonary Rehabilitation as an Intervention

Everyone who took part in the study finished an outpatient lung therapy program with twenty sessions. They were closely watched by trained respiratory doctors and trainers the whole time.

Exercise Training Components

1. Aerobic Training

- Frequency: Three sessions per week
- Duration: 30 minutes per session
- Mode: Treadmill or stationary cycle ergometer, based on patient preference and availability

- Intensity:
    - Group A: 60% of Wmax, the maximum work rate
    - Group B: 80% of Wmax, the maximum work rate
- The intensity of the exercise was assessed with the use of a first incremental exercise test.

2. Strength Training

- Frequency: Two sessions per week
- Strength training for the lower and upper body (pressing the legs, raising the calves, rowing while sitting, crunching the abdominals, pressing the chest)
- Recommended exercise: three sets of eight reps at 50% of the maximum allowed per set

3. Flexibility Training

- Frequency: Three sessions per week
- Protocol: Stretching of major muscle groups with each stretch held for 5 seconds

Education and Skills Training

We had five instructional sessions with small groups, and we covered:

- Understanding chronic obstructive pulmonary disease—a basic level
- Inhalation device and drug usage
- Methods for clearing the airway and breathing exercises
- Methods for reducing energy consumption
- Why changing one's lifestyle and engaging in regular physical exercise are so important

Outcome Measures

Primary Outcome:

In order to measure HRQOL, the St. George's Respiratory Questionnaire (SGRQ) was administered.

- On a scale from zero to one hundred, the questionnaire is graded.
- An inferior health condition and worse quality of life are indicated by higher scores.
- The MCID, or minimal clinically meaningful difference, is a four-point change.

Secondary Outcomes:

Severity of dyspnea, measured using:

- Mahler's Transitional Dyspnea Index (TDI) (MCID: 1 point)
- One way to measure how dyspnea affects your ability to go about your everyday life is using the London Chest Activity of everyday Living (LCADL) scale.

The capacity to work out, as measured by: Miles to Conquer Injury (6MWT)

- Peak aerobic capacity as measured by the incremental exercise test
- The maximum heart rate index (MCID) test, which measures endurance capability, lasts 100 seconds.

Baseline and post-pulmonary rehabilitation assessments were done. After the ninth therapy session, an intention-to-treat interim analysis was done.

Sample Size Calculation

Based on the following factors, 34 subjects were thought to be a good sample size to find a 12-point difference in St. George's Respiratory Questionnaire (SGRQ) scores:

- A 3.3% standard deviation
- 80% Power
- A level of significance of 5%

- A 10% attrition rate

Statistical Analysis

When doing the statistical analysis, we made use of the SPSS program. Those individuals who were able to complete all ten sessions of the treatment program were included in a modified version of the intention-to-treat analysis.

An improved and updated version of your material is this:

- Parametric tests, such as the Student's t-test and the Satterthwaite-adjusted t-test, were used to assess variables that followed a normal distribution.
- The Mann-Whitney U test, a non-parametric approach, was used to assess data that did not follow a normal distribution, or was skewed.
- Depending on the situation, we used Pearson's or Spearman's correlation coefficients to look for relationships between the variables.

For statistical significance, a p-value below 0.05 was used.

RESULT

From January to December of 2022, 56 patients were enrolled in the research; 22 of them were later withdrawn, as shown in Figure 1. Once the intended sample size was reached (n = 34), the experiment was ended, and the findings may be seen in the image. From February 2022 to March of the following year, we were involved in the intervention phase. Table 1 shows the general and clinical information about the subjects at the start of the study. The lung rehabilitation program had 20 sessions. Group 1 finished it in 8.2 ± 1.8 weeks on average, while Group 2 finished it in 7.9 ± 2.9 weeks.

Group 1 had an average aerobic exercise intensity of 4.3 ± 0.9 metabolic equivalents (METs), whereas Group 2 experienced an average of 5.5 ± 1.8 METs. Equations suggested by the American College of Sports Medicine were used to standardize and represent exercise intensities in METs. Groups 1 and 2 achieved 92% and 82% efficiency, respectively, out of a total training efficiency of 87.1%. There were no statistically significant differences between the two groups in terms of the participants' preferred training format, where 94% used a constant-load strategy and 6% used interval training, or exercise modality, with 76% choosing treadmill-based training and 24% choosing cycle ergometer exercise. People who took part

worked out or trained to get stronger at 100% efficiency, which means they used 50% of their maximum effort for each repeat. They also went to the planned group sessions with the goal of learning and growing.

Out of the 34 randomly assigned patients, Figure 1 shows that 31 had a changed intention to treat because three dropped out of the lung rehabilitation program before the tenth session for a variety of reasons, such as chest infections, trouble at work, and pain in their lower limbs. In the secondary investigation, 28 participants were administered the 6-minute walk test, LCADL scale, and Mahler's breathlessness score. One person did not finish the total assessment and could not be found when the lung rehabilitation program reached its thirteenth session. There were twenty-eight more participants that were tested using the gradual exercise and constant-load exercise protocols. Six individuals were not followed up with; they included the four already mentioned as well as two more who were either not driven or who had intestinal surgery that they opted out of.

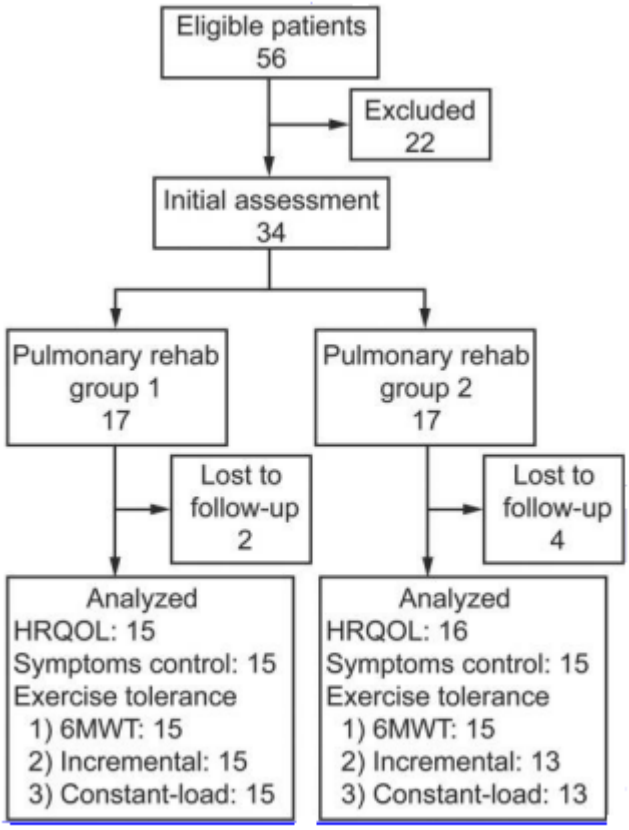

Figure. 1. Flow chart.

Table 1. Baseline clinical profile and participant demographics

Variable	Group 1: 60% Wmax (n = 17)	Group 2: 80% Wmax (n = 17)
Sex, n (%)		
Male	12 (70.5)	15 (88.1)
Female	5 (29.3)	2 (11.7)
Age (years), mean ± SD	66.9 ± 11.4	67.3 ± 10.4
Educational status, n (%)		
Primary education	5 (29.4)	4 (23.5)
Secondary education	9 (52.9)	10 (58.8)
Higher education	3 (17.6)	3 (17.6)
Occupational status, n (%)		
Unemployed	1 (5.9)	1 (5.9)
Employed/Active	3 (17.6)	1 (5.9)
Retired	13 (76.5)	15 (88.2)
Pulmonary function, mean ± SD		
FVC (L)	3.0 ± 1.0	3.5 ± 0.9
FVC (% predicted)	87.8 ± 20.3	96.4 ± 19.3
FEV_1 (L)	1.4 ± 0.4	1.6 ± 0.5
FEV_1 (% predicted)	54.1 ± 15.6	55.7 ± 16.4
FEV_1/FVC ratio	0.48 ± 0.12	0.45 ± 0.10
Supplemental oxygen use, n (%)	0 (0.0)	2 (11.8)

Risk factors, n (%)		
Hypertension	10 (58.8)	10 (58.8)
Dyslipidaemia	3 (17.6)	2 (11.8)
Diabetes mellitus	2 (11.8)	0 (0.0)
Alcohol consumption	2 (11.8)	0 (0.0)
History of substance use	1 (5.9)	1 (5.9)
Obesity	1 (5.9)	0 (0.0)
Comorbidities, n (%)		
Post-tuberculosis lung sequelae	4 (23.5)	2 (11.8)
Obstructive sleep apnea syndrome	3 (17.6)	1 (5.9)
Chronic sinusitis/rhinitis	3 (17.6)	1 (5.9)
History of myocardial infarction	3 (17.6)	1 (5.9)
Benign prostatic hyperplasia	1 (5.9)	3 (17.6)
Hypoxic respiratory failure	2 (11.8)	1 (5.9)
Bronchiectasis	1 (5.9)	1 (5.9)
Gastroesophageal reflux disease (GERD)	1 (5.9)	1 (5.9)
Osteoporosis	1 (5.9)	0 (0.0)

Both groups showed significant improvements on all end measures, as shown in Table 2, with changes beyond the threshold clinically significant differences that were previously established. Despite increases in incremental exercise test performance and LCADL scores, the little variations between the groups were not clinically significant. Participants' constant-load exercise test length increased by around 100 seconds, and their Transitional Dyspnea

Index score more than tripled the minimal clinically significant difference (MCID: 1 point) [18–20]. The established MCID of 25 meters was almost quadrupled by advancements in the six-minute walk distance (6MWD) [21].

The two intervention groups did not vary statistically significantly in their mean improvements in health-related quality of life (HRQOL). The observed improvements fell short of the 12-point effect size indicated in the research design, despite the fact that every category of the St. George's Respiratory Questionnaire (SGRQ) exceeded the 4-point threshold deemed clinically relevant. Similarly, after aerobic training at 60% or 80% of Wmax, secondary analyses revealed no significant differences between groups in terms of improvements in HRQOL, symptom severity, or exercise capacity.

The association between exercise performance and age was investigated using exploratory analysis. Age and the length of the constant-load exercise test were shown to be inversely correlated, with significant associations both at baseline ($r = 0.48$, $p < 0.01$) and during rehabilitation ($r = 0.62$, $p < 0.001$). Age and six-minute walk distance did not, however, significantly correlate either at baseline ($r = 0.07$, $p = 0.71$) or after the intervention ($r = 0.27$, $p = 0.16$). One participant with a history of heart disease in the 60% Wmax group had angina, arrhythmia, and tachycardia during the eleventh session of the rehabilitation program.

This was one of the five adverse events that occurred throughout the trial. After the emergency department determined that the patient did not have acute cardiac ischemia, the patient began their pulmonary rehabilitation program, and the program was completed successfully. One individual in group 2 was suffering from lower-limb discomfort as a result of a lumbar hernia; two individuals in group 2 were experiencing symptoms related to the gastrointestinal tract; one individual in group 2 was experiencing thyroid dysfunction associated with atrial fibrillation; and one individual in group 1 was suffering from a respiratory infection. Not a single one of these unfavorable occurrences was connected to exercises.

Table 2. Pulmonary Rehabilitation's Effects on Exercise Persistence, Symptom Control, and Health-Related Well-Being

Result	Group 1: Moderate-intensity training (60% Wmax) (n = 17)	Group 2: High-intensity training (80% Wmax) (n = 17)	Size of Effect	p-value	95% Confidence Interval
Health-related Quality of Life (HRQOL)					
Change in SGRQ Total Score (%)	14.7 ± 13.0	10.6 ± 7.4	0.31	0.12	−12.0 to 3.9
Change in SGRQ Symptoms score (%)	15.7 ± 19.2	13.5 ± 15.0	0.72	0.72	−14.8 to 10.4
Change in SGRQ Activity score (%)	17.4 ± 14.6	11.0 ± 13.7	0.21	0.21	−16.8 to 4.0
Change in SGRQ Impact score (%)	12.7 ± 16.2	9.5 ± 7.9	0.50	0.50	−12.8 to 6.5
Management of Symptoms					
Difference in Mahler's Dyspnea Index Score	3.0 ± 2.8	3.5 ± 3.5	0.38	0.38	—
Difference in LCADL Score	2.3 ± 2.5	1.5 ± 3.5	0.42	0.42	—

Exercise Tolerance					
Change in 6-Minute Walk Distance (m)	98.9 ± 109.0	95.4 ± 67.0	0.92	0.92	−64.2 to 71.1
Mean Change in METs (IET)	1.3 ± 1.1	1.7 ± 0.9	0.12	0.12	—
Change in CLET Duration (s)	135.7 ± 433.8	118.0 ± 151.1	0.50	0.50	—

DISCUSSION

This research looked at how well two different levels of physical exercise—60% and 80% of maximum work rate—worked in an organized lung therapy program for people with (COPD). The test took place at an Indian primary care hospital. The results showed that lung therapy made a big difference in the ability to exercise, the control of symptoms, and the quality of life linked to health. The fact that these benefits were seen in both groups shows that the good results of recovery were the same no matter how hard the training was.

Primary and secondary outcomes, including SGRQ scores, Mahler's dyspnea index, 6-minute walk distance, and constant-load exercise endurance, demonstrated improvements in both groups that exceeded the smallest clinically detectable differences. Because both groups showed gains, it may be concluded that there were improvements. Pulmonary rehabilitation is a crucial part of total chronic obstructive pulmonary disease (COPD) treatment, as these results confirm. There were no statistically significant differences found between the two training intensities. This means that moderate-intensity physical exercise may be just as good for you as higher-intensity training if you do it as part of a well-structured and supervised recovery program. Hence, it seems that there is no extra therapeutic benefit to raising the intensity of exercise in this context.

Significant improvements in daily functioning and well-being are associated with decreases in SGRQ scores of four points or more. Because of this, the fact that both groups' health-related quality of life got better is practically important. The fact that both groups did better on the

SGRQ shows that lung therapy has benefits that go far beyond just making patients' physical conditions better. Exercise tolerance and dyspnea get better when functional ability and symptom awareness get better. These are two important signs of freedom in people with chronic obstructive lung disease (COPD).

Given the constraints imposed on India's healthcare system by underfunding, patient comorbidities, and accessibility issues, the results have important real-world implications. Not every patient will have the means to engage in vigorous physical activity. There may be a greater push to expand pulmonary rehabilitation programs to community health centers and public hospitals if similar benefits are shown with moderate-intensity exercise. While earlier in the trial there was a negative link between age and exercise ability, no such relationship was seen for the amount of improvement that happened following rehabilitation. Pulmonary rehabilitation may benefit patients of all ages, not only younger ones, and thus provides additional proof that age alone is not enough to justify its referral.

Guided lung therapy seemed to be a safe treatment for people with COPD, even those who had other health problems at the same time. Most of the small adverse events that were mentioned during the study had nothing to do with exercising. The high level of obedience seen further says that the recovery program was well received by the people who took part in it. There are some problems with the study, but there are also some very good things about it. The results can't be applied to a wide population because the sample size was small and the follow-up time was short. It's also not possible to say for sure if the effects will last in the long term. To get a better idea of long-term effects, upkeep methods, and how cost-effective lung rehabilitation programs are, future studies in India should include bigger groups of participants and longer follow-up periods.

CONCLUSION

The findings of this research indicate that patients with chronic obstructive lung disease who undergo pulmonary rehabilitation have significant enhancements in their health-related quality of life, exercise tolerance, and symptom management. Aerobic exercise at a moderate level (60 percent of one's maximum work capacity) and high intensity (80 percent of one's maximum work capacity) both produced clinically significant benefits, and there were no significant differences found between the two intensities. Based on these data, it seems that aerobic exercise of a moderate intensity, when performed as part of a pulmonary rehabilitation

program that is both organized and supervised, is adequate to provide the best possible therapeutic effects. Moderate-intensity training may be a more viable and accessible technique for everyday clinical practice, especially in areas with limited resources, due to the fact that it is safe, has a high patient adherence rate, and is equivalent in terms of efficacy. In order to enhance functional ability and quality of life in people who have chronic obstructive lung disease (COPD), the findings provide support to the more widespread deployment of pulmonary rehabilitation programs in India as an efficient and low-risk technique.

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