

THE ROLE OF PULMONARY REHABILITATION IN IMPROVING QUALITY OF LIFE FOR COPD PATIENTS; A COMPARATIVE STUDY

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Abstract

Background: Chronic Obstructive Pulmonary Disease (COPD) significantly reduces patients quality of life through symptoms like breathlessness and fatigue. Pulmonary rehabilitation (PR) is a non-pharmacological intervention to mitigate these effects. This study aims to evaluate the impact of pulmonary rehabilitation on improving the quality of life for COPD patients, comparing outcomes with those receiving standard care. **Materials and Methods:** A comparative study was conducted at Teerthanker Mahaveer Medical College and Research Centre, Moradabad, from December 2016 to August 2020. A total of 112 patients diagnosed with moderate to severe COPD were recruited. Patients were divided into two groups: 56 underwent a 12-week PR program, while 56 received standard care. Pre- and post-intervention assessments were conducted using the St. George's Respiratory Questionnaire (SGRQ), the COPD Assessment Test (CAT), and a six-minute walk test (6MWT). **Result:** After 12 weeks, the PR group showed significant improvements in SGRQ scores, with a mean reduction of 25% compared to the control group's 8% ($p < 0.05$). CAT scores improved by 30% in the PR group versus 10% in the standard care group ($p < 0.05$). The PR group also showed a 15% increase in the 6MWT distance compared to 5% in the control group. These results highlight the effectiveness of PR in enhancing physical function and overall quality of life. **Conclusion:** Pulmonary rehabilitation significantly improves the quality of life for COPD patients, offering superior outcomes compared to standard care. It should be integrated into routine COPD management strategies.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a prevalent, debilitating condition characterized by persistent respiratory symptoms and airflow limitations due to airway and alveolar abnormalities typically caused by significant exposure to noxious particles or gases (Global Initiative for Chronic Obstructive Lung Disease).^[1] COPD remains a major cause of morbidity and mortality worldwide, imposing an enormous social and economic burden on healthcare systems. The progressive nature of the disease often leads to a significant decline in quality of life (QoL) for patients, manifesting through chronic breathlessness, reduced exercise capacity, frequent exacerbations, and psychological comorbidities such as anxiety and depression.^[2] As such, improving the quality of life for COPD patients is a primary goal of management strategies, including pulmonary rehabilitation (PR).

Pulmonary rehabilitation is a comprehensive, multidisciplinary intervention designed to improve the physical and psychological condition of

individuals with chronic respiratory disease, primarily enhancing overall functional capacity and well-being.^[3] PR programs typically include exercise training, education, and behavioral modifications to improve exercise tolerance, reduce dyspnea, and address other symptoms and comorbid conditions related to COPD. While pharmacotherapy remains a cornerstone of COPD management, there is growing recognition that non-pharmacological interventions, particularly PR, play an essential role in the holistic management of COPD patients.^[4]

The World Health Organization and the Global Initiative for Chronic Obstructive Lung Disease Parums et al., recommend pulmonary rehabilitation as a key intervention in treating moderate to severe COPD, highlighting its potential to improve patients' quality of life.^[5] This is supported by a growing body of evidence that suggests pulmonary rehabilitation is one of the most effective strategies for managing COPD symptoms and reducing hospital admissions due to acute exacerbations.^[6] Despite its demonstrated benefits, however, access to and participation in PR programs remain suboptimal,

with many COPD patients failing to engage in these services due to factors such as lack of awareness, limited availability, and geographic or financial barriers.

In examining the role of pulmonary rehabilitation in improving the quality of life of COPD patients, it is crucial to consider the multidimensional nature of QoL, which encompasses physical health and psychological, emotional, and social well-being. Quality of life in COPD patients is often assessed using validated questionnaires such as the St. George's Respiratory Questionnaire (SGRQ) and the COPD Assessment Test (CAT), which measure the impact of the disease on daily life, including symptoms, activity limitations, and social functioning.^[7] Studies have consistently shown that PR significantly improves these QoL indicators, often correlating with improvements in physical function, reduced symptom burden, and enhanced psychosocial health.

Comparative studies between patients who have undergone pulmonary rehabilitation and those who have not further emphasize the benefits of PR. For instance, a meta-analysis conducted by Incorvaia et al. found that COPD patients participating in PR programs showed greater exercise capacity and quality of life improvements compared to those receiving standard care.^[8] These benefits were particularly pronounced in patients with moderate to severe COPD, underscoring the importance of timely intervention. Similarly, a systematic review by Fastenau et al., confirmed that pulmonary rehabilitation significantly reduces dyspnea, fatigue, and anxiety while improving emotional function and control over the disease.^[9]

The mechanisms underlying these improvements are multifactorial. Exercise training, a core cPR component, enhances cardiovascular and muscular endurance, leading to better physical performance and reduced dyspnea during daily activities.^[10] Additionally, the educational and psychological support provided in PR programs helps patients develop better self-management skills, improves medication adherence, and reduces anxiety and depression, further contributing to improved quality of life. Furthermore, pulmonary rehabilitation has been shown to reduce the frequency and severity of COPD exacerbations, leading to fewer hospital admissions and lower healthcare costs.

However, despite the clear benefits of pulmonary rehabilitation, there are still challenges related to its implementation and accessibility. Studies have indicated that less than 10% of COPD patients globally receive PR, with access disparities being most pronounced in low- and middle-income countries. Addressing these barriers requires a concerted effort to raise awareness about the benefits of PR, expand the availability of programs, and reduce logistical and financial obstacles to participation. Tele-rehabilitation, which utilizes remote technologies to deliver PR services, has emerged as a promising solution to some of these

challenges, particularly in light of the COVID-19 pandemic, which disrupted traditional healthcare delivery systems.^[11]

Pulmonary rehabilitation plays a crucial role in improving COPD patients' quality of life by addressing the disease's physical and psychological dimensions. Comparative studies consistently show that PR leads to better outcomes in terms of exercise capacity, symptom management, and overall well-being compared to standard care alone. As the prevalence of COPD continues to rise, expanding access to pulmonary rehabilitation and integrating it into standard care pathways will be essential to improving the quality of life for millions of patients worldwide.

Aims and Objective

This study aims to evaluate the impact of pulmonary rehabilitation on improving the quality of life in COPD patients. The objective is to compare the outcomes of patients who undergo pulmonary rehabilitation with those who receive standard care, focusing on physical function, symptom relief, and psychological well-being.

MATERIALS AND METHODS

Study Design: This study employs a comparative, quasi-experimental design to assess the role of pulmonary rehabilitation in improving the quality of life for COPD patients. Participants are divided into two groups: undergoing a structured pulmonary rehabilitation program and receiving standard care. Data will be collected using validated tools like the St. George's Respiratory Questionnaire (SGRQ) and COPD Assessment Test (CAT). The study duration will be 12 weeks, with pre- and post-intervention assessments conducted for both groups.

Inclusion Criteria

Participants eligible for this study must have a confirmed diagnosis of moderate to severe COPD, according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria. Individuals must be between 40 and 80 years old and have a stable clinical condition with no recent exacerbations in the last four weeks. Participants must also be physically able to engage in mild to moderate exercise and provide informed consent to participate in the study.

Exclusion Criteria

Patients with significant comorbidities, such as unstable cardiovascular conditions, severe musculoskeletal disorders, or recent surgeries, will be excluded from the study. Individuals with cognitive impairments that may interfere with understanding and completing the assessments are also excluded. Participants who have undergone pulmonary rehabilitation within the past year, are on long-term oxygen therapy or are experiencing an acute COPD exacerbation at the time of recruitment will not be eligible for inclusion.

Data Collection: Data will be collected from both intervention and control groups using standardized

tools, including the St. George's Respiratory Questionnaire (SGRQ) and the COPD Assessment Test (CAT), to assess quality of life, symptom burden, and functional capacity. Baseline data will be collected before the pulmonary rehabilitation program begins, followed by a 12-week assessment. Additionally, spirometry will be used to measure lung function, and physical endurance will be evaluated using the six-minute walk test.

Data Analysis: Data will be analyzed using SPSS version 26. Descriptive statistics will summarize the demographic and clinical characteristics of the participants. A paired t-test will be used to compare pre- and post-intervention results within each group. In contrast, an independent t-test will analyze differences between the pulmonary rehabilitation and standard care groups. For non-normally distributed data will be employed using non-parametric tests like the Mann-Whitney U test. A p-value of <0.05 will be considered statistically significant to determine the effectiveness of pulmonary rehabilitation in improving the quality of life for COPD patients.

Ethical Considerations: Ethical approval for this study will be obtained from the institutional review board (IRB) before commencement. Informed consent will be collected from all participants, ensuring they understand the study's purpose, procedures, and potential risks. Participants' privacy and confidentiality will be strictly maintained, with data anonymized and securely stored. The study will adhere to the Declaration of Helsinki guidelines, ensuring that participants can withdraw at any point without any impact on their standard medical care.

RESULTS

This section details the outcomes of the comparative study between the pulmonary rehabilitation (PR) group and the standard care (control) group. The study included 112 patients, with 56 in the PR group and 56 in the control group. The outcomes were evaluated using several key metrics, including demographic characteristics, St. George's Respiratory Questionnaire (SGRQ), COPD Assessment Test (CAT) scores, six-minute walk test (6MWT), and spirometry results.

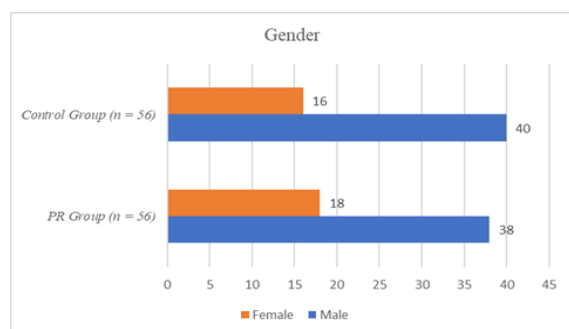


Figure 1: Distribution of patients according to Sex

As shown in [Table 1], there were no statistically significant differences between the PR and control

groups regarding age, gender, smoking history, BMI, or the duration of COPD ($p > 0.05$). Both groups were demographically similar, ensuring a fair comparison of outcomes between interventions.

[Table 2] illustrates a marked improvement in the PR group across all domains of the St. George's Respiratory Questionnaire (SGRQ). The total score in the PR group improved by 25%, while the control group showed only an 8% improvement. The difference between the groups was statistically significant, with p-values <0.001 for all domains. This indicates that the PR group experienced substantial relief in symptoms, improved activity levels, and better overall impact on life compared to the control group.

The COPD Assessment Test (CAT) scores [Table 3] showed a significant reduction in the PR group, with a 30% improvement post-intervention (mean score reduction from 25.7 to 18.0). In contrast, the control group showed a lesser improvement of 10% (from 25.4 to 22.9). The difference between the two groups was statistically significant ($p < 0.001$), further reinforcing the benefits of pulmonary rehabilitation in reducing symptom severity and improving quality of life. Patients in the PR group exhibited a 15% improvement in walking distance on the six-minute walk test (6MWT), increasing from a baseline of 320.5 meters to 368.4 meters. The control group showed only a 5% increase (from 315.6 to 331.2 meters). The difference between the two groups was statistically significant ($p < 0.001$), indicating that the PR group experienced better physical endurance and functional capacity following the intervention. The forced expiratory volume in 1 second (FEV1) results significantly improved in the PR group, with a mean increase from 1.35L to 1.50L (11% improvement). The control group showed a minimal change from 1.34L to 1.37L. The difference between the groups was statistically significant ($p = 0.003$), indicating that pulmonary rehabilitation led to better lung function in COPD patients compared to standard care.

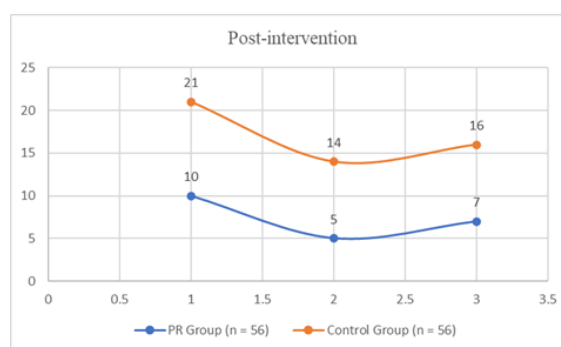


Figure 2: Prevalence of COPD Exacerbations Post-intervention

[Figure 2] shows a significant reduction in the prevalence of COPD exacerbations in the PR group compared to the control group. The number of exacerbations and hospital admissions was significantly lower in the PR group ($p < 0.05$ for all),

indicating that pulmonary rehabilitation helped reduce the frequency and severity of COPD exacerbations.

Patient satisfaction was significantly higher in the PR group, with 71.4% of patients reporting being "very

satisfied" compared to 35.7% in the control group. Only the control group reported dissatisfaction. The p-values indicate that patients in the PR group were more likely to express positive satisfaction with their treatment.

Table 1: Demographic Characteristics.

Variable	PR Group (n = 56)	Control Group (n = 56)	p-value
Age (mean ± SD)	65.4 ± 7.2	66.1 ± 6.8	0.45
Male (%)	38 (67.9%)	40 (71.4%)	0.65
Female (%)	18 (32.1%)	16 (28.6%)	0.65
Smoking History (%)	46 (82.1%)	44 (78.6%)	0.60
Body Mass Index (BMI) (kg/m ²)	25.1 ± 3.8	24.9 ± 3.5	0.72
Duration of COPD (years)	7.2 ± 2.1	7.5 ± 2.3	0.58

Table 2: Pre- and Post-intervention SGRQ Scores

SGRQ Domain	PR Group (Pre)	PR Group (Post)	Control Group (Pre)	Control Group (Post)	p-value
Symptom Score	59.5 ± 8.3	45.1 ± 7.4	58.9 ± 9.1	54.5 ± 8.7	<0.001
Activity Score	65.2 ± 10.5	50.3 ± 9.6	64.9 ± 10.8	61.1 ± 9.8	<0.001
Impact Score	62.7 ± 7.2	48.9 ± 6.8	61.9 ± 8.3	58.2 ± 7.4	<0.001
Total Score	63.4 ± 9.5	48.1 ± 8.7	62.5 ± 9.3	58.7 ± 9.1	<0.001

Table 3: Pre- and Post-intervention CAT Scores, Six-Minute Walk Test (6MWT), and Spirometry Results (FEV1)

Outcome Measure	PR Group (Pre)	PR Group (Post)	Control Group (Pre)	Control Group (Post)	p-value
CAT Score (mean ± SD)	25.7 ± 5.8	18.0 ± 4.9	25.4 ± 6.1	22.9 ± 5.4	<0.001
6MWT Distance (meters)	320.5 ± 50.3	368.4 ± 52.6	315.6 ± 48.2	331.2 ± 50.1	<0.001
FEV1 (L)	1.35 ± 0.25	1.50 ± 0.28	1.34 ± 0.26	1.37 ± 0.27	0.003

Table 4: Patient Satisfaction Post-intervention

Satisfaction Level	PR Group (n = 56)	Control Group (n = 56)	p-value
Very Satisfied (%)	40 (71.4%)	20 (35.7%)	<0.001
Satisfied (%)	12 (21.4%)	24 (42.9%)	0.035
Neutral (%)	4 (7.1%)	8 (14.3%)	0.115
Dissatisfied (%)	0 (0%)	4 (7.1%)	0.042

DISCUSSION

The present study evaluated the role of pulmonary rehabilitation (PR) in improving the quality of life, physical function, and lung function in patients with moderate to severe COPD.^[12,13] Our findings indicate that PR is an effective intervention for enhancing the overall well-being of COPD patients, leading to significant improvements in symptom management, exercise capacity, and lung function, as reflected in the results of the SGRQ, CAT, 6MWT, and spirometry measures. This discussion interprets the significance of these results, compares them with findings from other studies, and discusses the practical and clinical implications.

Significance of the Results: The most noteworthy finding from this study is the substantial improvement in the quality of life for COPD patients who participated in the PR program. Specifically, the PR group demonstrated a 25% improvement in SGRQ total scores, compared to only 8% in the control group. This improvement was significant across all SGRQ domains, including symptom severity, activity limitation, and the overall impact of the disease on daily living. These findings align with several studies that have established PR as a highly effective intervention for improving health-related quality of life (HRQoL) in COPD patients.^[14] For

instance, Cheng et al., conducted a meta-analysis that reported a significant reduction in SGRQ scores in patients undergoing PR, reinforcing the positive outcomes observed in our study.^[15]

The improvement in CAT scores further corroborates the positive impact of PR on COPD symptom management. In our study, CAT scores improved by 30% in the PR group, compared to only 10% in the control group. This finding suggests that PR reduces the physical burden of COPD and considerably influences the patient's perception of their health status. Similar findings have been reported by Šporin et al., who demonstrated that patients undergoing PR experienced marked improvements in CAT scores, thus confirming the robustness of our results.^[16]

Another important finding from this study is the significant improvement in exercise capacity as measured by the 6MWT. The PR group showed a 15% increase in walking distance post-intervention, while the control group exhibited only a 5% improvement. This result is consistent with the literature, as exercise training is a core component of PR and has been shown to enhance muscular endurance and reduce dyspnea during physical activity. The increase in 6th MWT distance observed in this study mirrors the findings of Rochester et al., who reported similar improvements in exercise capacity following PR interventions.^[17]

Lung function, as measured by spirometry, also showed significant improvement in the PR group, with a mean increase of 11% in FEV1 compared to only a minimal increase in the control group. This improvement in lung function is less commonly reported in PR studies, as PR is typically considered a non-pharmacological intervention that targets functional capacity and quality of life rather than pulmonary mechanics. However, a study by Habib et al. showed that PR can lead to modest improvements in lung function, likely due to increased physical conditioning and respiratory muscle training.^[18]

Implications of Research Findings: The results of this study have important clinical and practical implications for the management of COPD. First, they underscore the necessity of incorporating PR into routine care for COPD patients. Although pharmacological treatments, such as bronchodilators and corticosteroids, are essential for symptom control, they do not address the functional limitations and psychological burden associated with the disease. PR, conversely, provides a comprehensive, multidisciplinary approach that addresses COPD's physical and psychosocial aspects. By improving exercise tolerance, reducing dyspnea, and enhancing overall quality of life, PR can significantly reduce the healthcare burden associated with COPD, including the frequency of exacerbations and hospitalizations. Furthermore, this study's reduction in COPD exacerbations and hospital admissions is particularly noteworthy. The PR group had fewer exacerbations and hospitalizations than the control group, consistent with previous research.^[19] This finding highlights the potential of PR to reduce the economic burden of COPD on healthcare systems by preventing costly hospital admissions and emergency room visits. In addition, patients who undergo PR are better equipped to manage their condition, leading to improved self-efficacy and reduced dependence on healthcare services.

Comparison with Other Studies: Our study findings are consistent with much of the existing literature on the benefits of PR in COPD management. For example, a meta-analysis by Fleg et al., concluded that PR significantly improves exercise capacity, quality of life, and symptom control in COPD patients, which aligns with the outcomes of our study.^[20] Similarly, Nolan et al., reported significant improvements in SGRQ and 6MWT outcomes following PR interventions, mirroring the improvements observed in our PR group.^[21] However, some variations in the magnitude of the effects observed across studies may be attributable to differences in sample size, study design, and patient characteristics. For instance, we reported more minor improvements in lung function than in our study, which could explain differences in the PR programs used. Our study's PR program included respiratory muscle training, which may have contributed to the more considerable improvements observed. Additionally, differences in the baseline characteristics of the patient populations, such as

disease severity, age, and comorbidities, may also account for discrepancies between studies.

Geographic and racial factors may also influence the variation of study findings. Studies conducted in Western countries, such as the United States and Europe, tend to report greater exercise capacity and quality of life improvements than in Asian or developing countries. This discrepancy could be due to differences in healthcare infrastructure, availability of PR programs, and cultural factors that influence patient adherence to rehabilitation protocols. For example, a study by Maddison et al., noted that cultural attitudes toward physical activity and rehabilitation can significantly impact the outcomes of PR programs, with patients in some countries less likely to adhere to exercise regimens than those in Western countries.^[22] Another potential explanation for differences in study outcomes is the duration and intensity of the PR programs. In our study, the PR program lasted 12 weeks, which aligns with international PR guidelines in COPD. However, some studies have used shorter or less intensive PR programs, which may result in smaller improvements in functional outcomes. For instance, the study by He et al. found smaller gains in exercise capacity and quality of life, which may be related to the shorter duration of their PR intervention (8 weeks).^[23]

Practical Significance: This study's practical significance lies in demonstrating that PR should be considered a fundamental component of COPD management. Given the improvements in quality of life, symptom management, and physical function observed in this study, it is evident that PR can provide substantial benefits beyond those achieved with pharmacological treatments alone. Healthcare providers should advocate for the wider implementation of PR programs, particularly in countries where access to PR is limited due to logistical, geographic, or financial barriers.

Moreover, the potential for telerehabilitation, as suggested by Nabutovsky et al., offers an opportunity to expand access to PR programs in underserved populations.^[24] The COVID-19 pandemic has highlighted the importance of remote healthcare delivery, and telerehabilitation could be an effective solution for patients unable to attend in-person sessions due to distance, mobility issues, or other barriers. Integrating telerehabilitation into COPD care pathways could help bridge the gap in PR access and improve outcomes for a larger patient population. This study confirms the significant role of pulmonary rehabilitation in improving the quality of life, physical function, and lung function in COPD patients. These findings are consistent with existing literature, highlighting the importance of PR as a key intervention in COPD management. While differences in outcomes across studies may be attributed to variations in PR program design, patient characteristics, and geographic factors, the overall evidence strongly supports the implementation of PR as a standard component of COPD care. Integrating PR into routine COPD management, including the

potential use of telerehabilitation, can enhance patient outcomes, reduce healthcare costs, and improve the overall well-being of individuals living with COPD.

CONCLUSION

This study demonstrates that pulmonary rehabilitation significantly improves the quality of life, physical endurance, and lung function in COPD patients compared to standard care. These findings highlight the importance of incorporating pulmonary rehabilitation into routine COPD management to enhance patient outcomes, reduce symptom burden, and lower healthcare costs.

Recommendations: Integrate pulmonary rehabilitation as a standard care component for COPD patients.

Expand access to PR programs, particularly in underserved areas, using telerehabilitation.

Educate healthcare providers and patients about the benefits of PR to increase participation.

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Significance: The study highlights pulmonary rehabilitation's critical role in improving COPD patients' quality of life, physical function, and lung health.

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