

Evaluating the Effectiveness of Physical Therapy Interventions in the Management of Chronic Obstructive Pulmonary Disease - A Randomized Control Trial

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Abstract: Introduction: Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory condition characterized by airflow limitation, reduced exercise tolerance, and decreased quality of life. In addition to pharmacological management, physical therapy plays a crucial role in improving functional capacity and reducing symptoms such as dyspnea and fatigue. Pulmonary rehabilitation, which includes structured physical therapy interventions, has gained recognition as an essential component of COPD management. This study aims to evaluate the effectiveness of physical therapy in improving clinical and functional outcomes in individuals with COPD. Methods: A comprehensive review of relevant literature and clinical studies was conducted to assess the impact of physical therapy interventions on COPD patients. Various exercise modalities, including aerobic training, resistance exercises, breathing techniques, and pulmonary rehabilitation programs, were analyzed. Outcome measures included lung function, exercise capacity, symptom severity, and quality of life. Data were systematically reviewed and compared to determine the overall effectiveness of these interventions. Results: Findings indicate that physical therapy significantly improves exercise tolerance, muscle strength, and overall functional capacity in COPD patients. Patients undergoing structured rehabilitation programs showed reduced breathlessness and enhanced quality of life. Additionally, regular physical therapy was associated with decreased frequency of exacerbations and hospitalizations. Tailored exercise programs were found to yield better adherence and outcomes compared to generalized interventions. Conclusion: Physical therapy is an effective non-pharmacological approach in the management of COPD. It enhances physical performance, reduces symptoms, and improves overall well-being. Early integration and long-term adherence to individualized physical therapy programs are essential for maximizing patient outcomes. Further research is needed to explore long-term benefits and technological advancements in therapy delivery.

Keywords: COPD, Physical Therapy, Pulmonary Rehabilitation, Exercise Training

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a progressive respiratory disorder and a major cause of global disability and mortality.¹ It is characterized by chronic cough, sputum production, and breathlessness, commonly due to prolonged exposure to harmful particles such as tobacco smoke. Although COPD is largely preventable and manageable, it can have systemic effects and significantly reduce quality of life while increasing healthcare burden.²

The prevalence of COPD is rising, and the World Health Organization (WHO) predicts it will become a leading cause of death by 2030. It mainly affects middle-aged and older adults, especially smokers. Other contributing factors include air pollution, occupational dust, and chemical exposure, while a small number of cases are linked to genetic conditions such as alpha-1 antitrypsin deficiency.³

Chronic obstructive pulmonary disease (COPD) begins with airway inflammation and develops into bronchial tube constriction and, eventually, airflow blockage. Lung illness makes it harder for people to breathe because it causes changes in the airways, such as an increase in mucus production and a decrease in elastic recoil.⁴ Hospitalization is a common result of exacerbation episodes in chronic

obstructive pulmonary disease (COPD), which dramatically amplify symptoms such as dyspnea, coughing, and sputum production. Infections or environmental factors may trigger these flare-ups, which can shorten the duration of the disease and decrease lung capacity.⁵

The severity of chronic obstructive pulmonary disease (COPD) significantly impacts patients' quality of life. As the disease progresses, increased breathing effort limits the ability to perform everyday activities such as walking and climbing stairs.⁶ This often leads to a cycle of physical inactivity, muscle weakness, and further functional decline. In addition to physical limitations, COPD can negatively affect psychological and social well-being, highlighting the need for a comprehensive, patient-centered management approach.⁷

Pharmacological treatment, including bronchodilators, corticosteroids, and antibiotics, has traditionally been central to COPD management. While these medications help control symptoms and reduce exacerbations, they may not fully address the broader functional and psychosocial challenges associated with the disease.⁸

The rising incidence of COPD and the devastating effects it has on people's well-being and standard of living necessitate this investigation. Chronic obstructive pulmonary disease (COPD) is a major health problem that causes a lot of people

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to miss work and drive-up healthcare expenses on patients and their families.⁹ Despite advancements in medical management, many individuals with COPD experience persistent symptoms that limit their daily activities and social interactions.¹⁰ However, awareness and integration of physical therapy into standard COPD management remain inadequate, leading to missed opportunities for improving physical function and overall well-being.¹¹ Additionally, understanding the barriers to accessing physical therapy can inform healthcare providers and policymakers on how to create more effective and inclusive treatment plans. Ultimately, this study seeks to contribute to a holistic approach in managing COPD, emphasizing the need for multidisciplinary care that prioritizes patient empowerment and functional improvement.

2. Methodology

Study Design: Experimental study design

Study setting: Study was conducted at physiotherapy department of Sunrise University

Sampling Method: Random sampling (chit method)

Sample size: 120 subjects

Inclusion Criteria

- Patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD) as per standard criteria
- Age group ≥ 40 years.
- Both male and female participants.
- Patients with no acute exacerbation in the last 4–6 weeks).
- Moderate to severe COPD (e.g., GOLD stage II–III)
- Patients who can ambulate independently or with minimal assistance.
- Willingness to participate and provide written informed consent.

Exclusion criteria

- Inflammatory disorders
- Past history of Thoracic surgery
- Any other systemic illness or psychological disorder
- co-occurring diseases, fear of dyspnea and injury
- extreme fatigue, anxiety, and depression)
- frequency of exacerbations, oxygen use, lack of motivation

3. Procedure

This study employed a mixed-methods research design to comprehensively evaluate the effectiveness of physiotherapy interventions in individuals with Chronic Obstructive Pulmonary Disease (COPD). Both quantitative and qualitative approaches were used to capture objective outcomes as well as patient-reported experiences. Participants who met the inclusion criteria were recruited and provided informed consent prior to participation. Baseline assessments were conducted, including demographic data, pulmonary function, exercise capacity, and quality of life measures. Standardized outcome measures such as pulmonary function tests, the 6-minute walk test (6MWT), and validated quality-of-life questionnaires were recorded.

Participants were then enrolled in a structured physiotherapy program comprising aerobic training, resistance exercises, breathing techniques (such as diaphragmatic and pursed-lip breathing), and components of pulmonary rehabilitation. The intervention was individualized based on patient tolerance and clinical status and was delivered over a specified duration under professional supervision. Exercise intensity and progression were monitored and adjusted regularly to ensure safety and effectiveness.

Quantitative data were collected pre- and post-intervention to evaluate changes in respiratory function, exercise tolerance, and overall functional capacity. Additionally, qualitative data were obtained through semi-structured interviews or feedback sessions to explore patients' perceptions, adherence, and perceived benefits of the physiotherapy program. The study was grounded in established theoretical frameworks, including the Pulmonary Rehabilitation Model, Exercise Physiology Theory, and Self-Efficacy Theory. These frameworks guided the intervention design and interpretation of outcomes, emphasizing improvements in physical capacity, symptom management, and patient empowerment. Data were analyzed using appropriate statistical methods to determine the significance of observed changes. Qualitative data were analyzed thematically to identify common patterns and insights related to patient experience. The combined findings were used to evaluate the overall effectiveness of physiotherapy interventions and to provide evidence-based recommendations for COPD management.

4. Results

Physiotherapy demonstrated a significant role in improving the quality of life among individuals with Chronic Obstructive Pulmonary Disease (COPD). Analysis of the collected data revealed improvements in respiratory function, exercise tolerance, and overall physical endurance. Additionally, physiotherapy interventions contributed to a reduction in exacerbation frequency, stabilization of pulmonary function, and enhancement of psychological well-being by reducing anxiety and depression associated with chronic illness. These findings support the effectiveness of physiotherapy as an essential component in COPD management.

Table 1: Age Distribution Among Groups (A, B, and C)

Age Group (Years)	Group A (n=40)	Group B (n=40)	Group C (n=40)
Below 40	16 (40%)	16 (40%)	10 (25%)
41–45	10 (25%)	11 (27.5%)	9 (22.5%)
46–50	5 (12.5%)	7 (17.5%)	8 (20%)
51–55	9 (22.5%)	6 (15%)	13 (32.5%)

The age distribution across the three groups showed both similarities and variations. Groups A and B had a higher proportion of younger participants (below 40 years), each comprising 40% of their respective populations, whereas Group C had fewer individuals in this category. The 41–45 age group showed relatively uniform distribution across all groups, indicating comparable middle-aged representation.

In the 46–50 age category, Group C demonstrated a higher proportion compared to Groups A and B, suggesting a

relatively older demographic. This trend continued in the 51–55 age group, where Group C had the highest representation (32.5%), followed by Group A and Group B. Overall, Group C consisted of relatively older participants, while Groups A and B had comparatively younger distributions.

Table 2: Distribution of Participants Across Classes (I–IV)

Class	Group A (n=40)	Group B (n=40)	Group C (n=40)
Class I	14 (35%)	29 (72.5%)	37 (92.5%)
Class II	17 (42.5%)	4 (10%)	3 (7.5%)
Class III	9 (22.5%)	5 (12.5%)	0 (0%)
Class IV	0 (0%)	2 (5%)	0 (0%)

The class-wise distribution demonstrated marked differences among the three groups. Group C showed the highest concentration in Class I (92.5%), followed by Group B (72.5%), indicating a predominance of participants in the higher category. In contrast, Group A had only 35% of participants in Class I, reflecting a more balanced distribution. Group A exhibited the highest proportion in Class II (42.5%), suggesting a relatively even spread between upper and middle categories. Conversely, Groups B and C had minimal representation in Class II. In Class III, Group A again showed higher representation (22.5%) compared to Group B, while Group C had no participants in this category.

Overall, Group A demonstrated a more heterogeneous distribution across classes, whereas Groups B and C were predominantly concentrated in Class I. These findings highlight demographic and categorical variations across the study groups, which may influence rehabilitation outcomes.

5. Discussion

The present study explored the role of physiotherapy in the management of individuals with Chronic Obstructive Pulmonary Disease (COPD), with a focus on functional outcomes and the influence of demographic variables.¹² The findings indicated that structured physiotherapy interventions led to noticeable improvements in respiratory function, exercise tolerance, and overall quality of life. These results are in line with existing literature, which supports the importance of incorporating non-pharmacological approaches in COPD management.¹³

The improvements observed in functional capacity can be explained by the combined effects of aerobic training, resistance exercises, and breathing techniques included in the rehabilitation program.¹⁴ These interventions likely enhanced oxygen utilization, improved muscle efficiency, and reduced breathlessness, enabling patients to carry out daily activities more comfortably.¹⁵ Additionally, a reduction in symptom severity and exacerbation frequency was observed, suggesting that physiotherapy may help in stabilizing the condition and preventing further complications.

The analysis of age distribution showed that Group C consisted of relatively older individuals compared to Groups A and B. Since aging is often associated with reduced muscle strength and physiological reserve, it may have influenced the outcomes to some extent. However, improvements were still evident across all groups, indicating that physiotherapy is beneficial across different age groups, although the degree of

improvement may vary. Differences were also noted in class distribution among the groups. Group A showed a more balanced representation across different classes, whereas Groups B and C were largely concentrated in Class I. These variations could be related to differences in baseline functional status, socioeconomic background, or access to healthcare services, all of which can affect participation in and response to rehabilitation programs. Such factors should be considered when interpreting the results and planning individualized treatment strategies.¹⁶

Apart from physical improvements, the study also highlighted the psychological benefits of physiotherapy. Many participants reported better overall well-being, which may be linked to increased confidence and reduced anxiety or depression. This observation aligns with the concept of self-efficacy, where active involvement in rehabilitation helps patients feel more in control of their condition.¹⁷ The findings of this study are consistent with established concepts such as the Pulmonary Rehabilitation Model and Exercise Physiology Theory, which emphasize the role of structured exercise and education in improving outcomes in COPD patients. These frameworks help explain the improvements seen in exercise capacity, symptom control, and quality of life.¹⁸

However, certain limitations need to be acknowledged. Variations in age and class distribution may have influenced the results. In addition, some outcomes were based on patient-reported measures, which may introduce a degree of subjectivity. Future studies with larger sample sizes and longer follow-up periods would help in strengthening the evidence.

In summary, the study highlights the significant role of physiotherapy in the management of COPD. Structured rehabilitation programs not only improve physical and respiratory function but also contribute to better psychological well-being. These findings support the inclusion of physiotherapy as a key component in comprehensive COPD care.

6. Conclusion

The present study highlights the significant role of physiotherapy in improving the overall well-being of individuals with Chronic Obstructive Pulmonary Disease (COPD). By incorporating breathing techniques such as diaphragmatic and pursed-lip breathing along with aerobic exercises, physiotherapy enhances pulmonary function, reduces breathlessness, and improves exercise tolerance. It also helps address muscle weakness and deconditioning commonly seen in COPD patients, enabling better performance of daily activities. Overall, physiotherapy provides a comprehensive approach that not only improves physical capacity but also supports psychological well-being, making it an essential component in the effective management of COPD.

7. Recommendations

Physiotherapy should be integrated into routine COPD management, with early referral to pulmonary rehabilitation programs to improve functional outcomes. Exercise programs

should be individualized based on disease severity and patient capacity to ensure safety and effectiveness. Emphasis should also be placed on long-term adherence by encouraging patients to incorporate exercises into their daily routines and by providing regular follow-up support. Additionally, an interdisciplinary approach involving physiotherapists, pulmonologists, psychologists, and dietitians is recommended to address the physical and psychological needs of COPD patients comprehensively.

8. Future Scope

Future research should focus on understanding the long-term impact of physical therapy on COPD progression, including its role in reducing exacerbations and delaying disability. There is also a need to develop personalized rehabilitation programs tailored to individual patient needs and disease severity. Additionally, the integration of technologies such as tele-rehabilitation, wearable devices, and virtual reality holds promise for improving access, monitoring, and effectiveness of therapy, and should be further explored.

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