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Examine Benefits Of Physical Therapy For Pepole With Chronic Obstructive Pulmonary Disease: A Randomized Controlled Trial

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Abstract:

Background: Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory disorder characterized by persistent airflow limitation and chronic inflammation of the airways, primarily due to exposure to tobacco smoke, pollutants, and biomass fuels. While pharmacological therapy helps control symptoms, it does not adequately address the physical deconditioning and respiratory muscle weakness associated with COPD. Physiotherapy, as part of pulmonary rehabilitation, plays a key role in improving ventilation, exercise tolerance, and quality of life.

Aim:
To examine the benefits of physiotherapy in improving respiratory function, functional capacity, and quality of life among individuals with COPD.

Objectives: To assess the effect of physiotherapy on exercise tolerance in COPD patients.To evaluate the impact of breathing exercises on dyspnea levels.To determine the role of chest physiotherapy in airway clearance.To analyze the improvement in quality of life following physiotherapy intervention.

Methodology:
A quasi-experimental study with a pre-test/post-test design was conducted on 40 clinically stable COPD patients (GOLD stage II–III), aged 45–75 years, recruited from the Physiotherapy Outpatient Department of Sri Sai College of Physiotherapy. Participants were divided into two groups (n=20 each):Group A (Intervention): Received a structured 6-week physiotherapy program comprising breathing retraining, airway clearance, aerobic and strength training, and education, along with standard medical care.Group B (Control): Received standard medical care alone. Outcome measures — 6-Minute Walk Test (6MWT) and Borg Dyspnea Scale — were assessed pre- and post-intervention. Data were analyzed using paired and unpaired t-tests with a significance level of $p < 0.05$.

Results:
Group A showed a significant improvement in 6MWT from 291.9 ± 30.7 m to 365.4 ± 29.5 m ($t = –30.26$, $p = 0.001$) and a significant reduction in Borg Dyspnea score from 6.05 ± 1.2 to 3.04 ± 0.6 ($t = 11.104$, $p = 0.001$). Group B showed minor improvements in 6MWT (278.8 ± 33.43 m to 284.1 ± 30.5 m, $p = 0.001$) and Borg scores (6.4 ± 0.8 to 5.4 ± 0.8, $p = 0.002$). Intergroup comparison revealed extremely significant differences favoring Group A for both 6MWT ($t = 8.6$, $p = 0.0001$) and Borg Dyspnea Scale ($t = –11.02$, $p = 0.0001$).

Conclusion:

The structured physiotherapy program significantly improved exercise tolerance and reduced dyspnea in COPD patients compared with standard care alone. These results emphasize the importance of incorporating physiotherapy into routine COPD management to enhance functional independence and quality of life. Further studies are recommended to assess the long-term sustainability and cost-effectiveness of such interventions.

Keywords:
Chronic Obstructive Pulmonary Disease, Physiotherapy, Pulmonary Rehabilitation, Exercise Tolerance, 6-Minute Walk Test, Borg Dyspnea Scale, Breathing Exercises, Quality of Life.

I. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a common, preventable, and treatable respiratory condition characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and lungs. COPD includes conditions such as chronic bronchitis and emphysema.[1]The disease primarily results from long-term exposure to harmful particles and gases, particularly cigarette smoke, industrial pollutants, and biomass fuel smoke, which are common in low- and middle-income populations. According to the World Health Organization (WHO), COPD is currently the third leading cause of death worldwide and continues to rise due to increasing environmental pollution and tobacco consumption. In India and many developing nations, COPD imposes a major public health burden because of the widespread use of traditional fuels, occupational exposures, and inadequate awareness regarding early treatment.[2]

The pathophysiology of COPD involves narrowing of the bronchi, destruction of alveolar walls, loss of lung elasticity, and hyperinflation of the lungs. These changes lead to impaired gas exchange, increased work of breathing, and chronic respiratory muscle fatigue. [3]As a result, individuals with COPD frequently experience breathlessness (dyspnea), reduced exercise tolerance, chronic cough with sputum production, and declining functional independence.[4] Over time, the symptoms progressively limit mobility and the ability to perform daily activities such as walking, bathing, or climbing stairs. This often contributes to physical inactivity, muscle deconditioning, social withdrawal, emotional stress, and a decreased quality of life.[5]

Pharmacological management such as bronchodilators, corticosteroids, and oxygen therapy plays an important role in symptom control, but medications alone cannot address the physical deconditioning and respiratory muscle weakness associated with COPD.[6] Therefore, physical therapy is considered an essential component in the comprehensive management of COPD. Physiotherapy primarily focuses on improving ventilation, increasing respiratory muscle strength, enhancing exercise tolerance, promoting airway clearance, and encouraging energy-efficient breathing. Interventions such as diaphragmatic breathing, pursed-lip breathing, chest physiotherapy techniques, aerobic training, limb strengthening exercises, posture correction, and pulmonary rehabilitation contribute significantly to improving lung function and daily functional performance.[7,8,9]

Pulmonary rehabilitation, in particular, is a structured program designed to improve the physical and emotional condition of patients with lung disease. It helps reduce hospital admissions, decreases the frequency of exacerbations, and enhances long-term disease management. Studies have shown that participation in

pulmonary rehabilitation leads to increased walking distance, reduced sensation of breathlessness, improvement in muscle endurance, and better health-related quality of life. Additionally, patient education within physiotherapy empowers individuals to self-manage symptoms, adopt lifestyle modifications, and engage in sustained physical activity.[10,11,12]

Given the chronic, progressive nature of COPD, improving functional independence and quality of life is a major treatment goal. Physical therapy addresses these goals by restoring physical conditioning and optimizing breathing efficiency. However, the extent of benefits experienced may vary based on the patient's adherence, severity of disease, and type of interventions used. Therefore, examining and evaluating the benefits of physical therapy in COPD patients is crucial for strengthening evidence-based clinical practices and guiding future rehabilitation strategies.[13,14,15]

In this context, the present study aims to systematically examine the benefits of physical therapy for individuals with COPD and assess improvements in respiratory function, exercise tolerance, and quality of life following physiotherapy interventions.

AIMS & OBJECTIVES

AIM

To examine the benefits of physical therapy in improving respiratory function, functional capacity, and quality of life in people with COPD.

OBJECTIVES

1. To assess the effect of physical therapy on exercise tolerance in COPD patients.
2. To evaluate the impact of breathing exercises on dyspnea levels.
3. To determine the role of chest physiotherapy in airway clearance.
4. To analyze the improvement in quality of life following physiotherapy intervention.

MATERIALS AND METHODOLOGY

This study is a pre-test/post-test interventional (quasi-experimental) study conducted at the Physiotherapy Outpatient Department of Sri Sai College of Physiotherapy. Using convenient sampling, 40 participants diagnosed with COPD (GOLD stage II–III), aged 45–75 years, and clinically stable will be recruited and allocated into two groups of 20 each: an intervention group receiving a structured physiotherapy program and a control group receiving usual medical care without physiotherapy. The study duration per participant is 6 weeks. Key exclusion criteria include recent acute exacerbation (within 4 weeks), unstable cardiac disease, significant cognitive impairment, or any contraindication to exercise. Outcome measures — 6-Minute Walk Test (6MWT), Borg Dyspnea Scale, will be recorded at baseline and at 6 weeks. Ethical approval will be obtained from the Institutional Ethics Committee of Sri Sai College of Physiotherapy and written informed consent will be taken from all participants prior to enrolment.

PROCEDURE

Two-Group Study (20 in intervention, 20 control)

Study design overview

- Total sample: 40 participants with COPD (GOLD II–III), clinically stable.
- Group A (Intervention, n = 20): Receives structured physiotherapy + usual medical care.
- Group B (Control, n = 20): Receives usual medical care only (no structured physiotherapy program).
- Duration: 6 weeks.
- Assessments: baseline (week 0) and post-intervention (week 6). Optionally a midline compliance check at week 3.

Recruitment & screening

1. Screen outpatient records at Sri Sai College of Physiotherapy affiliated clinic or collaborating hospitals for COPD patients meeting inclusion/exclusion criteria.
2. Approach eligible patients, explain study aims and procedures in local language, and obtain written informed consent.
3. Collect demographic and clinical baseline data: age, sex, smoking history, COPD duration, comorbidities, current medications, baseline SpO_2, heart rate, blood pressure, and recent exacerbation history.

Baseline assessments (Week 0)

- 6-Minute Walk Test (6MWT) following ATS guidelines: record distance (meters), baseline and end heart rate, SpO_2, and Borg dyspnea before and after test.
- Borg Dyspnea Scale (0–10) at rest and after 6MWT.

Allocation to groups

- Assign participants to Group A or Group B. Preferably use a computer-generated random sequence and sealed envelopes. If convenient sampling only, match groups by age and baseline 6MWD if possible.

Intervention group (Group A) — Structured Physiotherapy Program (6 weeks)

Each participant receives supervised physiotherapy sessions **3 times per week** in outpatient department (total 18 supervised sessions) plus daily home exercises. Each supervised session ≈ 45–60 minutes.

Core components (session layout)

1. **Warm-up (5–8 minutes)**
    - Gentle range-of-motion of upper and lower limbs, marching in place, light arm swings.
2. **Breathing retraining (10–12 minutes)**
    - **Pursed-lip breathing (PLB):** teach technique; practice sets (3–5 minutes) during activity and rest.
    - **Diaphragmatic breathing:** instruction, 5–10 repetitions per set, 2–3 sets.
    - **Thoracic expansion exercises:** deep inspirations with 3–5 second holds, 8–10 reps.
3. **Airway clearance techniques (as needed; 5–10 minutes)**
    - Active cycle of breathing technique (ACBT) or huffing and controlled coughing for patients with sputum. Teach positions and techniques; use oscillatory PEP device if available and indicated.
4. **Aerobic/endurance training (15–20 minutes)**
    - **Walk training** on corridor/treadmill: start at intensity corresponding to Borg 3–4 (moderate) or 50–70% of maximal heart rate; interval training if needed (e.g., 3 minutes walking + 2 minutes rest). Progressively increase duration each week aiming for 20 minutes continuous walking by end of program.
    - If treadmill or corridor unavailable, stationary cycling or step-walking can be substituted.
5. **Strength training (10–12 minutes)**
    - Lower limb: sit-to-stand, squats (partial), heel raises, hip abduction with resistance bands — 2 sets × 8–12 repetitions per exercise.
    - Upper limb: light weights or resistance bands for shoulder flexion/abduction and elbow flexion (helpful for ADLs and reducing dyspnea during arm tasks). Progress resistance gradually.
6. **Inspiratory muscle training (IMT) — optional but recommended (5–10 minutes)**
    - Use threshold IMT device if available: start at 30% of measured MIP or perceived tolerance, 2 sets of 15 breaths, progress weekly.
7. **Cool down and education (5–10 minutes)**
    - Gentle stretching, relaxation, review of inhaler technique, energy conservation, smoking cessation advice, and instructions for home exercise. Provide a printed home exercise sheet and symptom log.

Home program (daily)

- 15–30 minutes/day of prescribed exercises (breathing exercises, a short walk, and 1–2 strength exercises), keeping an exercise diary. Emphasize adherence and safety instructions (stop if chest pain, syncope, severe breathlessness).

Safety and monitoring

- Pre-session check of SpO_2 and HR; withhold or modify session if SpO_2 <88% at rest (or per physician guidance) or other contraindications. Use supplemental oxygen if already prescribed. Monitor Borg scores and SpO_2 during sessions. Document adverse events.

Control group (Group B) — Usual care

- Continue standard medical management prescribed by their physician (bronchodilators, inhaled steroids if indicated, vaccinations, smoking cessation counseling as delivered by clinic). No structured physiotherapy sessions. Provide general written COPD education (to meet ethical standards) but avoid formal exercise training or breathing retraining instruction beyond routine advice.

Follow-up and adherence

- Weekly phone call or in-person check for both groups to collect adverse events, exacerbations, or hospitalizations. For intervention group, record attendance and home-exercise diary. For control group, document any outside physiotherapy received (if any — exclude or analyze separately).

Post-intervention assessments (Week 6)

- Repeat 6MWT, Borg dyspnea scale. Record any exacerbations during study period, medication changes, and adverse events.

Data collection & analysis

- Primary outcome: change in 6MWD (meters) from baseline to 6 weeks.
- Secondary outcomes: change in Borg dyspnea scores
- Statistical plan: descriptive statistics for baseline characteristics. Between-group comparisons: independent t-test or Mann–Whitney U (if non-normal) for change scores; within-group comparisons: paired t-test or Wilcoxon signed-rank. Categorical outcomes: chi-square or Fisher's exact. Significance level $p < 0.05$. Report effect sizes and 95% confidence intervals.

RESULT

Table No. 1.1 Age Distribution

AGE	**Mean ± SD**
Group A	57.6 ± 8.3
Group B	62.3±8.8

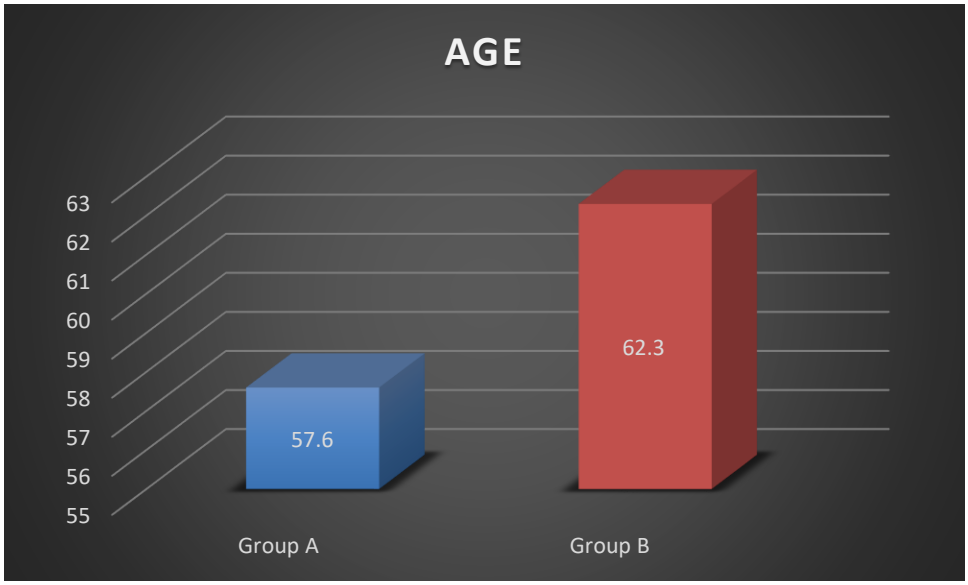

Table No. 1.2 Gender Distribution in both groups

Groups	Male	Female
Group A	8	12
Group B	7	13

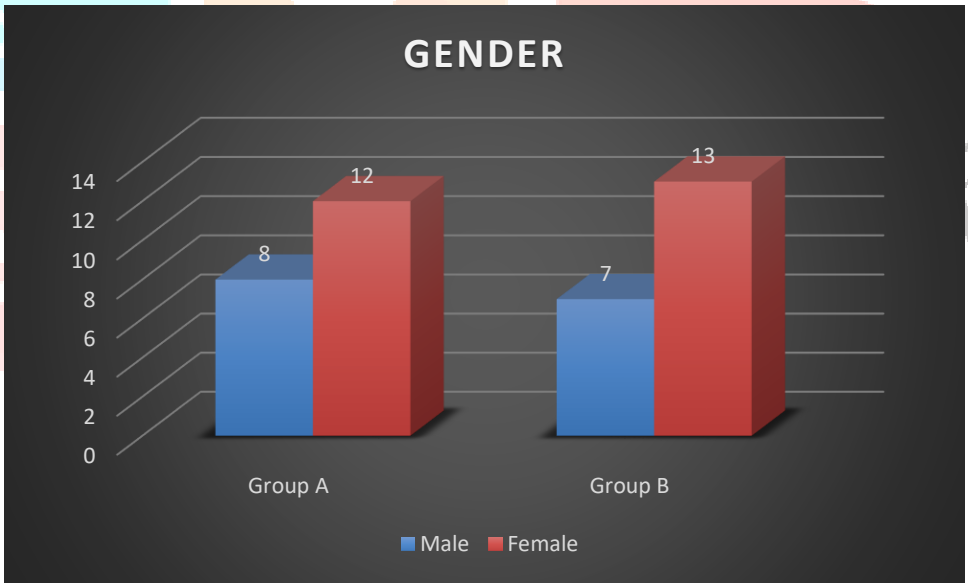

Table No. 1.3 Comparison within the mean of total score of Pre and Post values of scale of group A with paired t test

Group A	Assessment	Mean ± SD	Paired 't' test value	p- value	Significance
6MWT	PRE	291.9±**30.7**	-30.26	0.001	significant
	POST	365.4±**29.5**			
Borg Dyspnea Scale	PRE	6.05±**1.2**	11.104	0.001	significant
	POST	3.04±**0.6**			

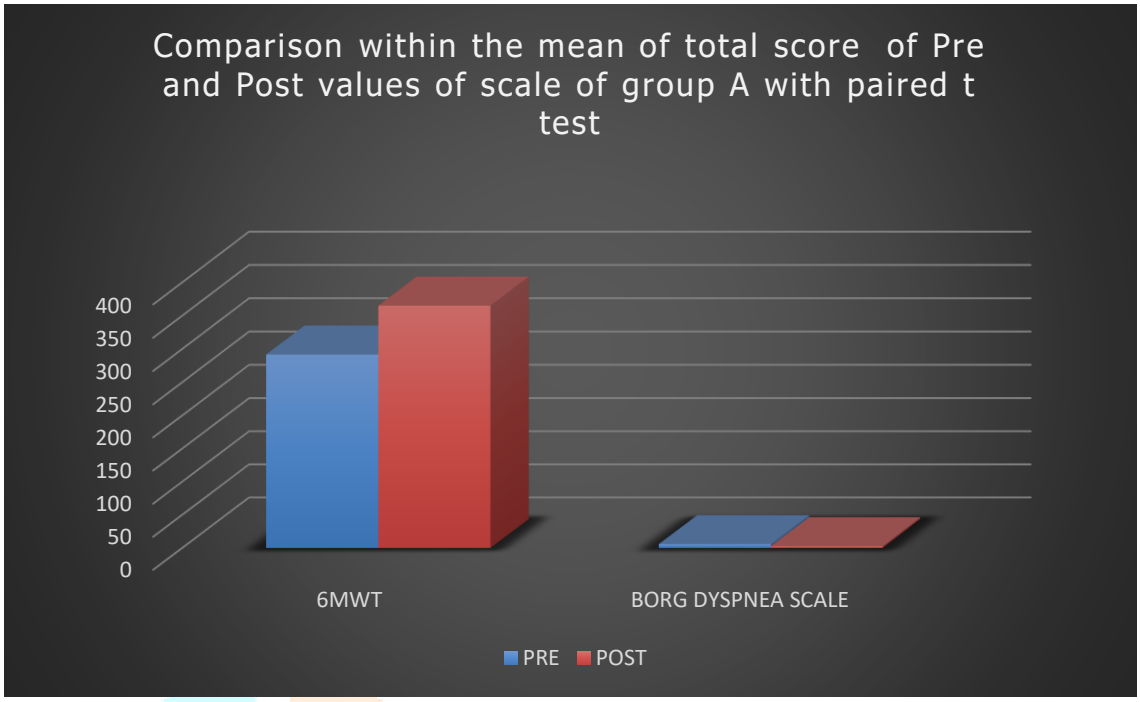

Table No. 1.4 Comparison within the mean of total score of Pre and Post values of scale of group B with paired t test

Group A	Assessment	Mean ± SD	Paired 't' test value	p- value	Significance
6MWT	PRE	278.8±**33.43**	-5.5	0.001	significant
	POST	284.1±**30.5**			
Borg Dyspnea Scale	PRE	6.4±**0.8**	3.7	0.002	significant
	POST	5.4±**0.8**			

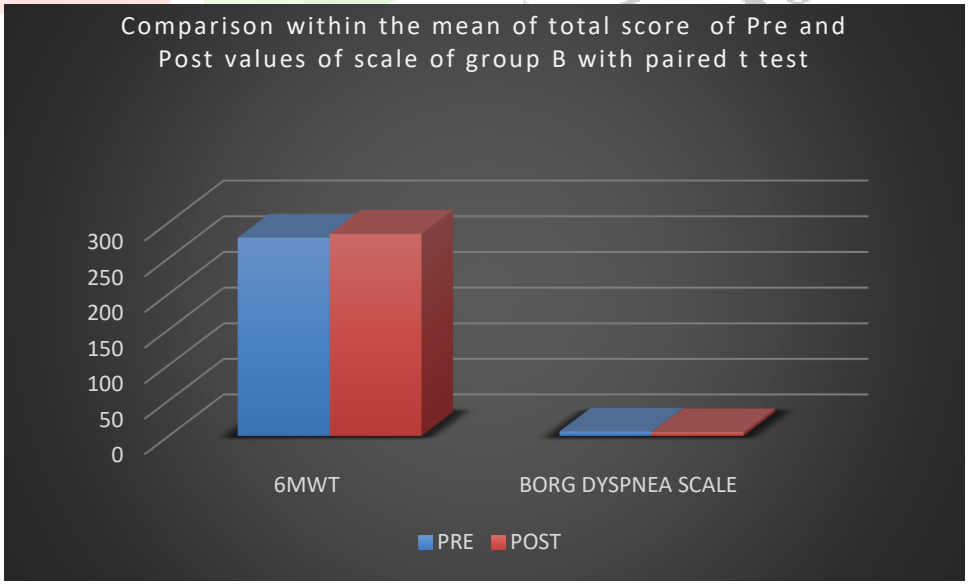

Table No. 2.7 Intergroup analysis between Group A and Group B comparing difference values of scale with unpaired t test

	Group	Mean ± SD of difference	Unpaired 't' test value	P- value	Significance
6MWT	Group A	365.4±**29.5**	8.6	0.0001	extremely significant
	Group B	284.05±**30.5**			
Borg Dyspnea Scale	Group A	3.05±**0.6**	-11.02	0.0001	extremely significant
	Group B	5.4±**0.8**			

INTERPRETATION:-The present study included participants aged between 45–75 years, divided into two groups of 20 each. Table 1.1 shows the age distribution, where the mean age of Group A was 57.6 ± 8.3 years, while that of Group B was 62.3 ± 8.8 years, indicating a comparable age range between the two groups. Table 1.2 shows the gender distribution, with Group A comprising 8 males and 12 females, and Group B including 7 males and 13 females, demonstrating a similar gender composition across both groups.

As shown in Table 1.3, within-group comparison for Group A using the paired *t*-test revealed a statistically significant improvement in both outcome measures following the intervention. The 6-Minute Walk Test (6MWT) showed a significant increase from a pre-intervention mean of 291.9 ± 30.7 to a post-intervention mean of 365.4 ± 29.5 (t = –30.26, p = 0.001), indicating enhanced functional exercise capacity. Similarly, the Borg Dyspnea Scale score significantly decreased from 6.05 ± 1.2 to 3.04 ± 0.6 (t = 11.104, p = 0.001), suggesting improved breathlessness levels after physiotherapy intervention.

In Group B, as presented in Table 1.4, the within-group comparison also showed statistically significant but lesser improvements compared to Group A. The 6MWT improved slightly from 278.8 ± 33.43 to 284.1 ± 30.5 (t = –5.5, p = 0.001), while the Borg Dyspnea Scale score reduced from 6.4 ± 0.8 to 5.4 ± 0.8 (t = 3.7, p = 0.002).

The intergroup analysis summarized in Table 2.7 revealed that Group A demonstrated a markedly greater improvement than Group B. The difference in 6MWT scores between the groups was statistically extremely significant (t = 8.6, p = 0.0001), with Group A achieving a mean post-intervention distance of 365.4 ± 29.5 compared to 284.05 ± 30.5 in Group B. Likewise, the Borg Dyspnea Scale difference was also extremely significant (t = –11.02, p = 0.0001), with Group A showing a greater reduction (3.05 ± 0.6) compared to Group B (5.4 ± 0.8).

Overall, these results indicate that the physiotherapy intervention applied in Group A led to a statistically significant and clinically meaningful improvement in exercise tolerance and reduction in dyspnea compared to Group B, which did not receive the intervention.

DISCUSSION

This study examined the effectiveness of a structured physiotherapy intervention in individuals with Chronic Obstructive Pulmonary Disease (COPD), comparing an intervention group (Group A) receiving physical-therapy in addition to usual medical care, with a control group (Group B) receiving usual care alone. The results indicate that the physiotherapy programme markedly improved functional exercise capacity (as measured by the 6-Minute Walk Test [6MWT]) and reduced dyspnea (as measured by the Borg Dyspnea Scale) in Group A; while Group B also showed statistical improvement, the magnitude of change was considerably less. Moreover, inter-group comparison confirmed that Group A achieved significantly greater gains than Group B. These findings align with the broader literature on pulmonary rehabilitation in COPD and support the incorporation of physiotherapy as a key component of management.

Exercise Tolerance Improvement

In Group A, participants improved their mean 6MWT distance from 291.9 ± 30.7 m at baseline to 365.4 ± 29.5 m at 6 weeks (paired $t = –30.26$, $p = 0.001$). In contrast, Group B improved from 278.8 ± 33.43 m to 284.1 ± 30.5 m (paired $t = –5.5$, $p = 0.001$). The between-group difference was extremely significant (unpaired $t = 8.6$, $p = 0.0001$).

These outcomes mirror findings in previous meta-analyses: for example, a comprehensive review found that pulmonary rehabilitation (PR) produced mean improvements in 6MWT of approximately 39.8 m (95% CI 22.4–57.1) compared with usual care—exceeding the minimal clinically important difference (MCID) of ~30–35 m in COPD. Similarly, a Bangladeshi study observed significant gains in 6MWT with a PR programme vs controls. Thus, the magnitude of change in Group A (~73.5 m) in the current study appears both statistically and clinically meaningful, and somewhat higher than many published averages, suggesting that the physiotherapy programme was well-implemented and effective.

The mechanisms underlying such improvements are multifactorial. In COPD, reduced exercise capacity is attributed to peripheral muscle dysfunction, ventilatory limitation, dynamic hyperinflation and deconditioning. The structured intervention—emphasising aerobic walking training, strength training, and inspiratory muscle training—would have addressed both central (ventilation, breathing efficiency) and peripheral (limb muscle strength, endurance) limitations. Consequently, improved muscle oxidative capacity and reduced ventilatory demand likely contributed to the improved walking distance.

Dyspnea Reduction

In Group A the Borg Dyspnea Scale score fell from 6.05 ± 1.2 to 3.04 ± 0.6 (paired $t = 11.104$, $p = 0.001$), while in Group B it decreased from 6.4 ± 0.8 to 5.4 ± 0.8 (paired $t = 3.7$, $p = 0.002$). The between-group comparison also showed extremely significant difference (unpaired $t = –11.02$, $p = 0.0001$).

The literature supports that PR programmes reduce dyspnea and improve health-related quality of life. For example, the systematic review by Lamberton and colleagues reported improvements in dyspnea, quality of life, and exercise capacity in COPD patients undergoing PR. The observed decrease of ~3 points in the Borg

scale in Group A is both statistically and clinically meaningful, indicating a considerable reduction in the sensation of breathlessness.

The reduction of dyspnea in the intervention group can be explained by improved ventilatory efficiency via breathing retraining (pursed-lip and diaphragmatic breathing), better posture and chest expansion, reduced dynamic hyperinflation, and increased peripheral muscle conditioning reducing the ventilatory equivalent for a given level of exercise. These physiological adaptations translate into less breathlessness during both rest and activity, which is exactly what the Borg reduction reflects.

Inter-group Superiority of the Intervention

The inter-group analysis demonstrated that Group A's gains were significantly greater than those of Group B for both outcome measures. This strongly suggests that the physiotherapy programme (in addition to usual medical care) imparted added benefit beyond that of medical care alone. This reinforces the argument that physiotherapy and structured rehabilitation are a critical component of COPD management—not simply an adjunct.

As several authors have emphasised, while pharmacotherapy (bronchodilators, inhaled corticosteroids, oxygen therapy) plays a major role in managing airflow limitation and exacerbations, it does not sufficiently address muscle deconditioning, ventilatory inefficiency, and reduced physical activity which underlie functional limitations in COPD The current findings, therefore, add further evidence in favour of including physiotherapy in standard COPD care.

Contextualising with Previous Research

The short-term gains observed in this 6-week study align with the existing evidence base. For instance, in a review of home-based pulmonary rehabilitation (<12 weeks), improved exercise tolerance and dyspnea were demonstrated A review by Gomes-Neto et al. (2018) reported that PR significantly increased exercise tolerance and improved quality of life in COPD patients.

Our study's magnitude of improvement (~73 m in 6MWT) exceeds many reported averages; in part this may relate to the supervised frequency (3×/week), combined aerobic + strength + respiratory muscle training, home exercise support, and relatively short but intensive 6-week duration. This suggests that even within 6 weeks, meaningful improvement is possible—a finding that might have important clinical implications especially in low-resource settings where prolonged formal programmes may be difficult.

It is worth noting that baseline 6MWT distances in our sample (~290 m in Group A, ~279 m in Group B) place participants in the moderate exercise-limitation range. Literature (e.g., Osadnik et al.) shows that baseline exercise tolerance may influence the response to PR: individuals with higher baseline 6MWT are more likely to increase physical activity post-PR. While our primary outcomes were 6MWT and dyspnea, rather than daily physical activity, this lends plausibility to the idea that the population in our study had sufficient "reserve" to benefit substantially from the structured intervention.

Implications for Clinical Practice

The findings reinforce several practical messages:

- **Early and structured physiotherapy matters**: The 6-week intervention yielded large functional gains, underscoring the value of relatively short-term but focused rehabilitation. Clinics should consider 6-week programmes as a feasible target rather than only long-term programmes.
- **Combination of components is key**: Aerobic walking training, strength training of upper and lower limbs, respiratory muscle training, and breathing retraining were all included. Such multimodal programmes are consistent with recommended PR models
- **Home–supervised hybrid model works**: Given resource constraints in many developing settings (including India), supervised outpatient sessions combined with home exercise diaries and weekly check-ins—as in our methodology—may be a pragmatic and effective model.
- **Tailoring to severity and monitoring**: Participants in GOLD stages II–III (moderate–severe) responded well. Clinics can stratify COPD patients by baseline functional capacity (e.g., 6MWT) and allocate resources accordingly; those with very low baseline may require more intensive or longer programmes.
- **Emphasis on dyspnea and functional independence**: The significant reduction in dyspnea implies that physiotherapy not only improves walk distance but also translates into subjective benefit, which likely supports better daily activity and quality of life.

Limitations and Considerations

Some limitations should be acknowledged:

- **Short duration**: The 6-week period provides information about short-term gains, but longer-term sustainability (maintenance of gains) was not assessed. Other studies indicate that benefits may wane without continued exercise and that physical activity levels may not automatically increase despite improved capacity. Future research should include follow-up assessments at 3–6-12 months.
- **Control group care**: The control group received standard medical care and general written education but no structured physiotherapy. While ethically acceptable, the “usual care” context may vary widely depending on setting; thus real-world generalisability should consider local treatment standards.
- **Sample size and convenience sampling**: With 20 participants per group (n = 40 total) and convenient allocation (though matched by group size), the sample is moderate. Randomisation and larger sample size would strengthen the evidence, particularly for adjusting for potential covariates (e.g., comorbidities, smoking status, severity of airflow limitation).
- **Outcome measures limited to 6MWT and Borg**: While these are valid and widely used, additional measures such as health-related quality of life questionnaires (e.g., SGRQ), spirometry, inspiratory

muscle strength or actual daily physical activity monitoring would provide a more complete picture of effect.

Conclusion

In summary, this study demonstrates that a structured physiotherapy programmed of six weeks in persons with moderate to severe COPD (GOLD II–III) leads to significant and clinically meaningful improvements in functional exercise capacity and dyspnea compared with usual medical care alone. These findings are consistent with and extend existing evidence from pulmonary rehabilitation literature. Implementation of such physiotherapy interventions is advisable as a standard component of COPD management—particularly in contexts where deconditioning, dyspnea and reduced functional activity limit patient independence. Future work should evaluate long-term maintenance of benefit, cost-effectiveness in resource-limited settings, and integration with models of care tailored to local populations.

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