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Evaluation of psychosocial benefits of pulmonary rehabilitation in chronic obstructive pulmonary disease patients

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Ethics approval and consent to participate: the study protocol was reviewed and approved by the Institutional Ethics Committee of JLN Medical College, Ajmer in the letter No. 742/Acad-III/MCA/2019 Dated 08/04/2019. All procedures followed were in accordance with the ethical standards of the institutional and/or national research committee and with the Helsinki Declaration of 1975, as revised in 2013.

Informed consent: written informed consent was obtained from all individual participants included in the study. Confidentiality of patient data was strictly maintained throughout the study.

Patient consent for publication: appropriate consent was taken from all for publication.

Availability of data and materials: the datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Abstract

Chronic obstructive pulmonary disease (COPD) is associated with significant symptom burden, impaired quality of life, and psychosocial morbidity. Pulmonary rehabilitation (PR) is a recommended non-pharmacological intervention, but evidence focusing on its psychosocial benefits remains limited. The objective of this study was to assess the effect of hospital-based outpatient PR on psychosocial parameters and health-related quality of life in patients with COPD receiving standard pharmacotherapy. This before-after interventional study included 50 male patients with stable COPD who underwent a structured outpatient PR program for 24 weeks in addition to standard medical therapy. Assessments were performed at baseline, 12 weeks, and 24 weeks. Psychosocial outcomes were evaluated using the Hospital Anxiety and Depression Scale (HADS), and quality of life was assessed using the COPD Assessment Test (CAT) and the St. George's Respiratory Questionnaire-COPD-specific version (SGRQ-C). Statistical analysis was performed with significance set at $p < 0.05$. PR led to significant improvements in psychosocial and quality-of-life outcomes. Mean HADS anxiety and depression scores showed significant reductions at 12 and 24 weeks compared to baseline ($p < 0.001$). Quality-of-life scores improved significantly, with reductions in CAT and SGRQ-C scores at follow-up ($p < 0.001$). A marked reduction in COPD exacerbations and hospital admissions was also observed during the study period. Hospital-based outpatient PR significantly improves psychosocial well-being and health-related quality of life while reducing morbidity in patients with COPD, supporting its routine integration into comprehensive COPD care.

Key words: COPD, pulmonary rehabilitation, psychosocial benefits.

Introduction

Chronic obstructive pulmonary disease (COPD) is a heterogeneous lung condition characterized by chronic respiratory symptoms—including dyspnoea, cough, sputum production, and/or exacerbations—caused by abnormalities of the airways and/or alveoli that produce persistent, often progressive airflow obstruction [1]. COPD is a major global public-health problem: an estimated 10.3% of adults aged 30–79 years, approximately 391.9 million people, were living with COPD worldwide in 2019 [2]. Its burden extends beyond airflow limitation to exercise intolerance, loss of independence, recurrent exacerbations, impaired health-related quality of life (HRQoL), anxiety, depression, and increased healthcare use.

Pulmonary rehabilitation (PR) is a comprehensive, multidisciplinary intervention based on individual assessment and followed by patient-tailored therapies that include exercise training, education, and behaviour change [3,4]. PR was selected for the present study because optimized pharmacotherapy improves symptoms and reduces exacerbation risk but does not fully address peripheral muscle dysfunction, physical deconditioning, activity avoidance, dyspnea-related fear, poor self-efficacy, or social isolation. By combining supervised exercise, breathing and inspiratory-muscle training, education, and risk-factor modification, PR directly targets these modifiable extrapulmonary consequences of COPD.

Multiple studies demonstrate that structured outpatient PR programs result in significant improvements in COPD patients' quality of life, as measured by disease-specific health status tools such as the St George's Respiratory Questionnaire (SGRQ) and COPD Assessment Test (CAT) [5]. These outcomes reflect not only symptom reduction and enhanced daily functioning, but also improvements in overall well-being that are clinically meaningful [6].

Aside from physical and functional benefits, COPD is frequently accompanied by psychological comorbidities, especially anxiety and depression, which negatively impact disease perception and quality of life [7,8]. Several studies have reported that PR programs can decrease anxiety and depression scores in COPD patients, suggesting that psychosocial components should be considered important outcome domains in PR effectiveness research [7-9]. In addition, evidence shows that PR not only improves physical outcomes but also reduces healthcare utilization such as emergency admissions, indirectly reflecting improvements in patient confidence, disease self-management, and psychological adjustment [10]. Evidence from aerobic and remotely delivered exercise programs further supports the feasibility and psychophysiological value of rehabilitation in stable COPD [8,9].

However, psychosocial outcomes are less consistently evaluated than exercise capacity, particularly within prolonged hospital-based outpatient programs delivered alongside usual pharmacotherapy. The present study was therefore undertaken to determine whether a structured 24-week PR program could produce sustained improvements in anxiety, depression, and HRQoL and reduce morbidity in patients with stable COPD. Evaluating these patient-centred outcomes together provides a clinically relevant assessment of benefit beyond spirometric change and may inform the routine integration of PR into COPD services. Therefore, evaluating both health-related quality of life and psychosocial parameters before and after hospital-based outpatient PR provides a holistic understanding of the benefits of PR in COPD, beyond traditional clinical endpoints.

Aim and objectives

This study aimed to evaluate the psychosocial benefits of pulmonary rehabilitation in patients with chronic obstructive pulmonary disease by assessing changes in quality of life and psychological well-being before and after hospital-based outpatient pulmonary rehabilitation given alongside standard pharmacotherapy, using the St George's Respiratory Questionnaire for COPD, the COPD Assessment Test, and the Hospital Anxiety and Depression Scale.

Materials and Methods

This was a single-centre, single-arm prospective before–after interventional study conducted over one year among patients attending respiratory medicine outpatient services. Consecutive eligible participants were enrolled and followed at baseline, 12 weeks, and 24 weeks. The study protocol was approved by the Institutional Ethics Committee before recruitment. Written informed consent was obtained from every participant, confidentiality was maintained, and all study procedures conformed to the principles of the Declaration of Helsinki and applicable institutional ethical standards.

Fifty patients with COPD were included. COPD was diagnosed from a compatible clinical history and post-bronchodilator spirometry showing persistent airflow obstruction, in accordance with Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidance [1]. All participants were receiving stable, optimized pharmacological treatment. Patients with modified Medical Research Council (mMRC) dyspnea grades 1–3, stable cardiovascular status, and willingness and ability to participate in exercise training were eligible. PR referral and selection were guided by NICE and British Thoracic Society recommendations [11,12]. PR

was chosen as an adjunct because these symptomatic patients continued to have dyspnea and functional limitation despite appropriate medication and had no contraindication to supervised exercise. Patients with established asthma, mMRC grade 4 dyspnoea, myocardial infarction within the preceding four weeks, severe aortic stenosis, or significant musculoskeletal or cognitive impairment limiting exercise participation, as well as those unwilling to participate, were excluded.

Eligible and clinically stable patients underwent a hospital-based outpatient pulmonary rehabilitation program in addition to standard pharmacotherapy for a total duration of 24 weeks. Rehabilitation sessions were conducted two to three times per week, each lasting 20–30 minutes. The program included supervised lower- and upper-limb endurance and strength training using treadmill walking, cycle ergometry, and arm ergometry, along with chest wall stretching, breathing retraining, inspiratory muscle training, and chest physiotherapy. Exercise intensity was individualized, symptom-limited, and progressively increased. Health education, smoking cessation counselling, and advice regarding influenza and pneumococcal vaccination were provided throughout the program, in accordance with pulmonary rehabilitation standards [12].

Outcome assessments were performed at baseline (0 weeks), 12 weeks, and 24 weeks. HRQoL was assessed using the COPD Assessment Test (CAT) [8] and the St George's Respiratory Questionnaire–COPD-specific version (SGRQ-C) [13]. Psychosocial status was evaluated using the Hospital Anxiety and Depression Scale (HADS), including its anxiety (HADS-A) and depression (HADS-D) subscales [14,15]. All questionnaires were administered in a quiet, distraction-free environment. When required, trained study personnel provided standardized assistance in the participant's local language without influencing responses, and questionnaires were checked for completeness at each visit.

Data were entered into Microsoft Excel and analysed using SPSS version 25. Quantitative variables were expressed as mean $\pm$ standard deviation or median, and qualitative variables as percentages. Categorical variables were compared using the chi-square test or Fisher's exact test as appropriate. Pearson or Spearman correlation coefficients were used to assess associations between quantitative variables. A p-value <0.05 was considered statistically significant.

Results

A total of 50 male patients with chronic obstructive pulmonary disease (COPD) were included in the study. The baseline demographic and clinical characteristics of the study population are summarized in Table 1. The mean age of the participants was 59.68 ± 9.29 years, with the majority of patients belonging to the 61–70-year age group (50%), followed by the 51–60-year group (28%). Most participants belonged to the upper-lower socioeconomic class (60%) as per the Modified Kuppuswamy scale. With respect to disease duration, nearly two-thirds of patients (64%) had COPD for less than five years, while only 4% had a disease duration exceeding ten years. A high prevalence of smoking exposure was observed, with 62% of participants being current smokers at baseline; however, 12% of patients quit smoking during the study period following repeated counselling as part of the pulmonary rehabilitation program.

The clinical profile and morbidity-related outcomes of the study subjects are presented in Table 2. Dyspnea was the most common symptom and was present in all patients (100%), followed by cough with or without expectoration (98%) and wheezing (90%). Constitutional symptoms such as weight loss (76%) and generalized weakness (64%) were also frequently reported, whereas chest pain, pedal edema, and fever were less common. Regarding disease morbidity, 70% of patients had experienced at least one COPD exacerbation in the six months preceding enrolment. During the six-month pulmonary rehabilitation period, the proportion of patients experiencing exacerbations declined significantly to 10% ($p < 0.001$). Similarly, hospital admissions due to COPD decreased from 18% before the study to 8% during follow-up ($p < 0.01$), indicating a significant reduction in morbidity following pulmonary rehabilitation.

The effect of pulmonary rehabilitation on quality of life and psychosocial parameters is detailed in Table 3. A significant and sustained improvement was observed across all assessed domains. The mean HADS anxiety score decreased from 7.68 ± 1.33 at baseline to 6.06 ± 1.31 at three months and further to 5.32 ± 1.27 at six months ($p < 0.001$). Similarly, the mean HADS depression score showed a significant reduction from 5.12 ± 1.25 at baseline to 4.14 ± 1.22 at three months and 3.42 ± 1.35 at six months ($p < 0.001$). Health-related quality of life also improved significantly following pulmonary rehabilitation, with the mean CAT score decreasing from 16.26 ± 4.81 at baseline to 14.74 ± 4.40 at three months and 13.42 ± 3.87 at six months ($p < 0.001$). A marked improvement was also noted in the SGRQ-C score, which decreased from 39.42 ± 7.77 at baseline to 28.22 ± 6.64 at three months and further to 19.80

± 5.34 at six months ($p < 0.001$), reflecting clinically meaningful improvement in symptom burden and daily functioning.

Changes in symptom burden and disease impact were further reflected in the redistribution of GOLD groups over time, as shown in Figure 1. At baseline, the majority of patients were classified under GOLD group B, followed by groups A and D. At three months, most patients had shifted to GOLD group A, with a corresponding reduction in GOLD group B and D categories. By six months, 68% of patients were classified as GOLD group A, while the proportion of patients in GOLD group D declined substantially, indicating overall improvement in disease impact following pulmonary rehabilitation.

The association between disease severity and psychosocial as well as quality-of-life parameters is summarized in Table 4. Increasing GOLD spirometric stage was associated with significantly higher HADS anxiety and depression scores, CAT scores, and SGRQ-C scores. Patients in GOLD stage IV demonstrated the greatest psychosocial burden and poorest quality of life compared to those in GOLD stages II and III ($p < 0.05$ for all), underscoring the close relationship between disease severity, psychological distress, and impaired health-related quality of life in COPD.

Discussion

This study demonstrates that a structured, hospital-based outpatient pulmonary rehabilitation (PR) program delivered alongside standard pharmacotherapy results in significant improvements in psychosocial well-being, health-related quality of life (HRQoL), and morbidity outcomes in patients with chronic obstructive pulmonary disease (COPD). Pulmonary rehabilitation is strongly recommended by international guidelines as a core non-pharmacological intervention for symptomatic COPD, targeting not only physical deconditioning but also psychological distress and disease impact [3].

The baseline profile of the study population reflects the typical demographic and clinical characteristics of COPD, with a predominance of older patients, high symptom burden, and substantial smoking exposure. Universal dyspnoea and the high prevalence of cough and wheeze underline the functional limitation experienced by this cohort and justify eligibility for PR as per guideline criteria [11,16]. The observed association between increasing disease severity and poorer psychosocial and HRQoL scores is consistent with previous evidence linking airflow limitation and symptom burden with anxiety, depression, and impaired daily functioning [17].

A key finding of this study is the significant reduction in COPD exacerbations and hospital admissions following pulmonary rehabilitation. The proportion of patients experiencing exacerbations declined markedly during the study period, accompanied by a reduction in hospitalization rates. Although the absence of a parallel control group limits causal inference, these findings are consistent with published evidence showing that PR improves disease self-management, exercise tolerance, and symptom awareness, thereby reducing morbidity and healthcare utilization [10,18]. Improved inhaler adherence, smoking cessation support, and patient education integrated within PR programs may further contribute to these benefits [4,10].

Pulmonary rehabilitation was associated with clinically meaningful improvements in HRQoL, as evidenced by significant reductions in CAT and SGRQ-C scores. The magnitude of CAT score improvement exceeded the established minimum clinically important difference, indicating perceptible benefit from the patient's perspective [12,19]. Similarly, the substantial reduction in SGRQ-C scores far exceeded the accepted clinically important threshold, reflecting marked improvement across symptom, activity, and impact domains [20,21]. These findings align with systematic reviews and guideline statements identifying PR as one of the most effective interventions for improving HRQoL in COPD [16,18].

Importantly, this study also demonstrates significant psychosocial benefits of PR. Both anxiety and depression scores, measured using the Hospital Anxiety and Depression Scale (HADS), showed sustained improvement over the 24-week period. Psychological comorbidities are highly prevalent in COPD and are associated with worse symptom perception, reduced physical activity, poor treatment adherence, and increased mortality [1,21]. The observed improvement in HADS scores supports existing evidence that PR can alleviate psychological distress, likely through reductions in dyspnea-related fear, improved self-efficacy, structured social interaction, and the antidepressant effects of regular exercise [4,22]. While HADS is primarily a screening tool rather than a diagnostic instrument, its responsiveness makes it suitable for tracking psychosocial change over time in COPD populations [23].

The favourable redistribution of GOLD groups observed during follow-up further reinforces the impact of PR on symptom burden and disease impact. The shift toward GOLD group A reflects improvement in patient-reported outcomes rather than spirometric reversal, consistent with the GOLD framework that emphasizes symptom control and exacerbation reduction as key treatment goals [1]. This finding underscores the importance of incorporating PR into routine COPD management, particularly for symptomatic patients.

Smoking cessation observed in a subset of participants during the study period, although not a primary outcome, highlights an additional benefit of structured rehabilitation programs. PR provides repeated opportunities for counselling and behavioural reinforcement, potentially enhancing cessation success and contributing indirectly to improved outcomes [4,11].

Clinical relevance and future implications

The observed reductions in CAT and SGRQ-C scores indicate that the benefits were not merely statistically significant but perceptible in patients' daily symptoms, activity, and disease impact. For clinicians, these findings support offering PR to symptomatic, clinically stable patients despite optimized inhaled therapy and monitoring psychological outcomes alongside conventional respiratory measures. A program that combines aerobic and resistance exercise, breathing retraining, inspiratory-muscle training, education, and behavioural support may address several treatable traits simultaneously. The wider rehabilitation literature also shows that structured respiratory or inspiratory-muscle training can improve functional or quality-of-life outcomes across chronic respiratory and systemic conditions, although evidence from familial Mediterranean fever, obstructive sleep apnoea, and intensive-care-unit-acquired weakness should be considered supportive rather than directly generalizable to COPD [8,24]. Future studies should use multicentre randomized controlled designs with larger, sex-inclusive samples; document adherence and adverse events; and include objective exercise-capacity and respiratory-muscle measures. Longer follow-up is needed to determine whether psychosocial and morbidity benefits persist after supervised rehabilitation. Comparative evaluation of hospital-, home-, and tele-rehabilitation models, together with cost-effectiveness and implementation analyses, could identify scalable approaches for settings where access to conventional PR remains limited.

Limitations

The study has certain limitations. The sample size was modest and included only male participants, limiting generalizability. The before–after design without a control group introduces the possibility of confounding factors, including improved medication adherence and reporting bias. Exacerbation data were partly based on patient recall. Nevertheless, the consistent and statistically robust improvements across multiple validated outcome measures strengthen the credibility of the findings.

Conclusions

A structured 24-week hospital-based outpatient pulmonary rehabilitation program added to optimized pharmacotherapy produced sustained, clinically meaningful improvements in anxiety, depression, and health-related quality of life in patients with stable COPD and was associated with fewer exacerbations and hospital admissions. PR should therefore be regarded not as an optional exercise add-on, but as an integral component of comprehensive COPD care that addresses physical limitation, psychological distress, and self-management together. Early referral of suitable symptomatic patients and routine assessment of psychosocial outcomes may translate into better daily functioning and lower morbidity. These promising findings warrant confirmation in larger randomized, sex-inclusive multicentre studies with longer follow-up and evaluation of accessible home-based and tele-rehabilitation pathways.

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Table 1. Baseline demographic and clinical characteristics of study subjects (n=50).

Variable	Category	Number of Subjects	Percentage (%)
Age (years)	40–50	9	18.0
	51–60	14	28.0
	61–70	25	50.0
	71–80	2	4.0
Socioeconomic status	Upper middle	1	2.0
	Lower middle	10	20.0
	Upper lower	30	60.0
	Lower	9	18.0
Duration of COPD	< 5 years	32	64.0
	5–10 years	16	32.0
	> 10 years	2	4.0
Smoking status	Current smoker	31	62.0
	Ex-smoker	10	20.0
	Quit during study	6	12.0
	Never smoker	3	6.0

Table 2. Clinical profile and morbidity outcomes in study subjects (n=50).

Parameter	Category	Before study/presence	During Study	p
Clinical manifestations	Dyspnea	50 (100%)	—	—
	Cough±expectoration	49 (98%)	—	—
	Wheeze	45 (90%)	—	—
	Weight loss	38 (76%)	—	—
	Weakness	32 (64%)	—	—
	Chest pain	11 (22%)	—	—
	Pedal edema	10 (20%)	—	—
	Fever	4 (8%)	—	—
COPD exacerbations	None	15 (30%)	45 (90%)	<0.01
	≥1 episode	35 (70%)	5 (10%)	<0.001
Hospital admissions	Yes	9 (18%)	4 (8%)	<0.01
Evidence of Emphysema on Chest X-ray/CT	Present	68	—	—
	Absent	32	—	—

Table 3. Effect of pulmonary rehabilitation on quality of life and psychosocial outcomes (n=50).

Parameter	Baseline (0 weeks) Mean ± SD	3 months Mean ± SD	p	6 months Mean ± SD	p
HADS – Anxiety	7.68 ± 1.33	6.06 ± 1.31	<0.001	5.32 ± 1.27	<0.001
HADS – Depression	5.12 ± 1.25	4.14 ± 1.22	<0.001	3.42 ± 1.35	<0.001
CAT score	16.26 ± 4.81	14.74 ± 4.40	<0.001	13.42 ± 3.87	<0.001
SGRQ-C score	39.42 ± 7.77	28.22 ± 6.64	<0.001	19.80 ± 5.34	<0.001

Table 4. Association of disease severity (GOLD Stage) with psychosocial and quality-of-life parameters,

Parameter	GOLD II	GOLD III	GOLD IV	p
HADS – Anxiety	6.80 ± 1.15	7.96 ± 1.02	9.29 ± 0.76	<0.001
HADS – Depression	4.40 ± 0.96	5.26 ± 1.09	6.71 ± 0.95	<0.001
CAT score	14.55 ± 3.47	16.65 ± 5.30	19.86 ± 6.78	0.019
SGRQ-C score	36.65 ± 4.98	39.83 ± 8.16	46.00 ± 9.68	0.04

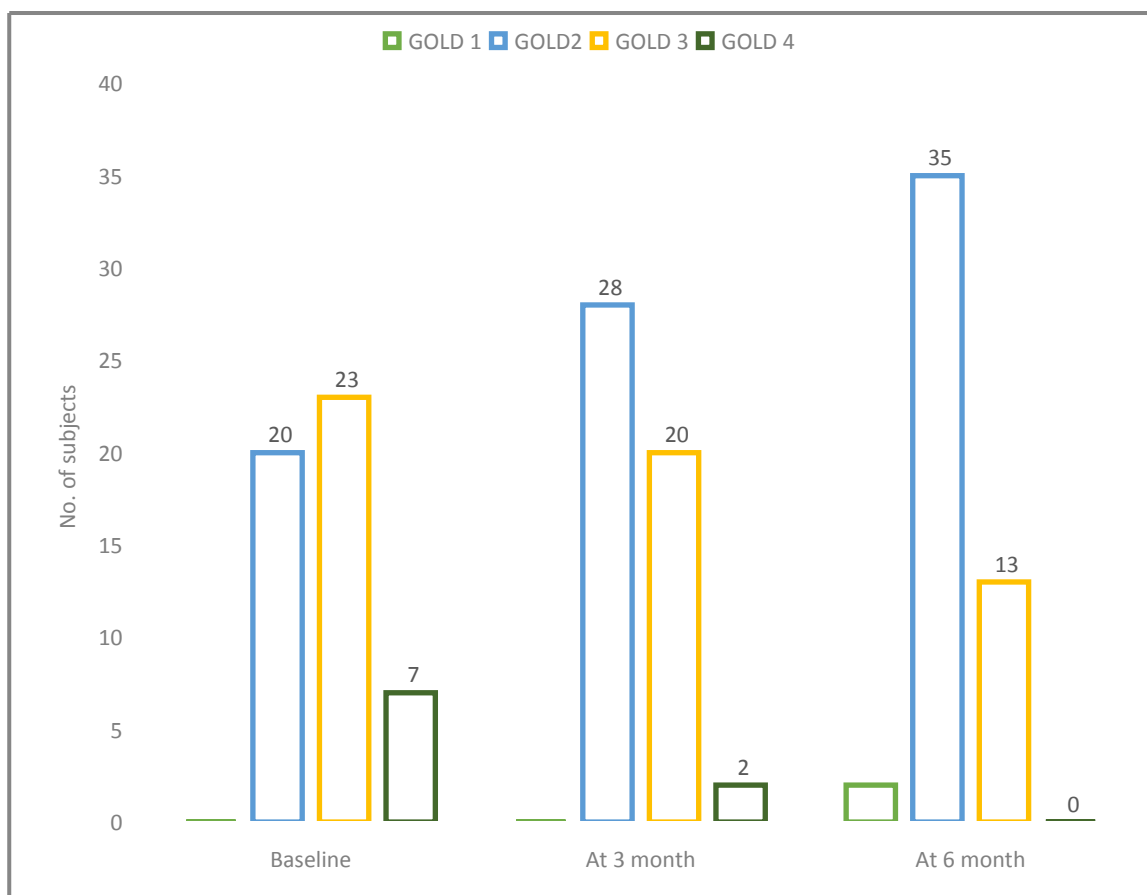


Figure 1. Distribution of GOLD Groups at Different Follow-up Intervals (n=50).