ORIGINAL ARTICLE *UDK: 616.24-002.2-085.816.2*

www.doi.org/10.55302/MJA259461a

IMPACT OF THE ECONOMIC AVAILABILITY OF LONG-TERM OXYGEN THERAPY ON THE HEALTH STATUS OF PATIENTS WITH COPD: A CROSS-SECTIONAL STUDY

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Abstract

Background: Chronic obstructive pulmonary disease (COPD) is a progressive respiratory condition characterized by persistent airflow limitation, chronic inflammation, and represents a significant burden globally. Long-term oxygen therapy (LTOT) improves survival, reduces exacerbations, and enhances health-related quality of life (HRQoL) among patients with severe hypoxemia. However, economic constraints in many health systems restrict access to LTOT, potentially exacerbating symptom burden and the overall functional decline. This study evaluates whether economic inaccessibility to LTOT is associated with differences in symptoms and perceived health status among COPD patients who meet clinical criteria for LTOT.

Material and methods: A cross-sectional study was conducted involving 60 adults with COPD who met physiological criteria for LTOT. Participants were divided into two groups: LTOT users (n = 30) and LTOT non-users (n = 30) who could not obtain therapy due to financial limitations. Symptoms and health status were assessed using the COPD Assessment Test (CAT). Statistical analyses included t-tests, Mann–Whitney U tests, chi-square tests, and Cohen's d.

Results: Patients without access to LTOT demonstrated higher CAT scores, indicating worse symptom burden and lower health status. Although the mean difference did not reach statistical significance, the effect size suggested a small-to-moderate clinically meaningful trend favoring LTOT users. A higher proportion of LTOT non-users fell into the very high impact CAT severity band.

Conclusion: Economic barriers to LTOT access may contribute to poorer symptom control and diminished quality of life in COPD patients who meet established criteria for oxygen therapy. Addressing financial constraints through policy reforms may improve equity in COPD care and reduce disease burden.

Keywords: *Chronic obstructive pulmonary disease; Long-term oxygen therapy; Chronic obstructive pulmonary disease Assessment Test.*

Introduction

Chronic obstructive pulmonary disease (COPD) is a progressive disease characterized by airflow limitation, airway inflammation, and structural lung changes (1). Globally, COPD remains a leading cause of morbidity and mortality, driven largely by tobacco exposure, environmental pollutants, and population aging (2,3). The disease is associated with reduced functional capacity, increased healthcare utilization, and substantial economic cost.

Patients in advanced COPD stages frequently develop chronic hypoxemia, a condition linked to higher mortality, cognitive deficits, reduced exercise capacity, and poorer HRQoL (4). Long-term oxygen therapy (LTOT) is an evidence-based intervention recommended for patients with severe resting hypoxemia, demonstrating improvements in survival, physiological stability, and daily functioning (5,6). International guidelines emphasize LTOT as a cornerstone treatment for advanced COPD (7).

Despite its benefits, LTOT access varies widely across socioeconomic groups. Financial constraints, partial reimbursement, or out-of-pocket expenses often prevent eligible patients from obtaining home oxygen equipment (8,9). Socioeconomic disadvantage—including low income, limited education, and inadequate social support—further reduces the likelihood of LTOT initiation or adherence (10-12).

The COPD Assessment Test (CAT) is a validated patient-reported outcome measure widely used to quantify symptom burden and health status. Higher CAT scores correlate with worse HRQoL, increased exacerbation risk, and greater mortality (13-15).

Given the important role of LTOT in symptom control and functional stability, understanding whether economic inaccessibility affects symptom burden among clinically eligible patients is an urgent research priority. This study compares CAT-measured symptom severity between LTOT users and financially constrained non-users to evaluate the impact of economic barriers on COPD health status.

Material and methods

Study Design

A cross-sectional comparative design was employed to assess differences in symptom severity between COPD patients receiving LTOT and those unable to access LTOT due to financial limitations.

Study Population

Sixty adults with confirmed COPD were consecutively recruited from an outpatient pulmonary clinic.

Inclusion Criteria

- Age ≥ 40 years
- Spirometry-confirmed COPD (post-bronchodilator $FEV_1/FVC < 0.70$)
- Documented LTOT indication per international guidelines (PaO_2 <7,3 kPa or $SaO_2 \leq$ 88%, or PaO_2 8 kPa with cor pulmonale/polycythemia) (7,16)
- Clinical stability for ≥4 weeks

Exclusion Criteria

- Recent exacerbation (<4 weeks)
- Cognitive impairment
- Other chronic lung diseases
- Declined consent

Group Allocation

- Group A: LTOT users (n = 30)
- Group B: LTOT non-users (n = 30) unable to afford oxygen equipment

Data Collection

Primary outcome:

- Symptom burden measured by CAT (0–40 scale) (13)

Secondary variables:

- Age, gender
- Economic status (low/middle/high)
- Smoking history (pack-years)
- Comorbidities

CAT severity categories:

- 0–9 low impact
- 10–20 medium
- 21–30 high
- 31–40 very high (14)

Statistical Analysis

- Descriptive statistics: mean ± SD, frequencies
- Group comparisons: independent t-test, Mann–Whitney U, chi-square
- Normality testing: Shapiro–Wilk
- Effect size: Cohen's d
- Significance: $p < 0.05$
- Software: SPSS v26

Results

Demographic Characteristics

Table 1. Demographic Characteristics

Variable	LTOT Yes (n = 30)	LTOT No (n = 30)
Age (years)		
– Mean ± SD	67.3 ± 10.2	68.2 ± 9.5
– Age range	51–69	56–73

Variable	LTOT Yes (n = 30)	LTOT No (n = 30)
Gender, n (%)		
– Male	18 (60.0%)	22 (73.3%)
– Female	12 (40.0%)	8 (26.7%)
Economic status, n (%)		
– Low	17 (56.7%)	19 (63.3%)
– Middle	11 (36.7%)	10 (33.3%)
– High	2 (6.7%)	1 (3.3%)
Smoking history, median (IQR)**	44 (35–55)	46 (38–58)
Comorbidities, n (%)		
– Cardiovascular disease	13 (43.3%)	16 (53.3%)
– Anxiety/Depression	9 (30.0%)	11 (36.7%)
– Osteoporosis	6 (20.0%)	5 (16.7%)
– Chronic kidney disease	5 (16.7%)	4 (13.3%)
– Hypertension	14 (46.7%)	15 (50.0%)
– GERD	7 (23.3%)	6 (20.0%)

Sixty COPD patients were analyzed. Age and gender distributions were similar between groups. Most participants reported low-to-middle economic status. Smoking exposure and comorbidity patterns did not differ meaningfully.

CAT Scores

LTOT users reported lower symptom burden (CAT mean 24.2 ± 8.5) than non-users (27.8± 9.1). Although the p-value (0.11) did not reach statistical significance, the effect size (Cohen's d = 0.41) suggested a small-to-moderate clinically relevant difference.

Non-users were overrepresented in the very high impact band (46.7% vs. 30%).

Table 2. CAT Scores in LTOT Users and Non-Users

CAT Variable	LTOT Yes (n = 30)	LTOT No (n = 30)
CAT total score, mean ± SD	24.2 ± 8.5	27.8 ± 9.1
Range (min–max)	10–39	12–40
CAT severity categories, n (%)		
– Low impact (0–9)	1 (3.3%)	0 (0%)
– Medium impact (10–20)	7 (23.3%)	5 (16.7%)
– High impact (21–30)	13 (43.3%)	11 (36.7%)
– Very high impact (31–40)	9 (30.0%)	14 (46.7%)

Table 2 summarizes the distribution of CAT scores among patients who use LTOT and those who do not. LTOT users demonstrated a slightly lower mean CAT total score (24.2 ± 8.5) compared with non-users (27.8 ± 9.1), suggesting a trend toward a less severe symptom burden in

the LTOT group. The score ranges were comparable between groups, with LTOT users scoring between 10 and 39 and non-users between 12 and 40.

Table 3. Between-group comparison of CAT scores in LTOT users and non-users

Variable	LTOT Yes (n = 30) Mean ± SD	LTOT No (n = 30) Mean ± SD	Mean difference (No − Yes)	95% CI for mean difference	Statistical test	p-value	Cohen's d
CAT total score	24.2 ± 8.5	27.8 ± 9.1	3.6	−0.9 to 8.1	Independent samples t-test	0.11	0.41

Table 3 presents the comparison of total CAT scores between patients who use long-term oxygen therapy (LTOT Yes) and those who do not use LTOT despite having indications (LTOT No). The mean CAT score was lower in the LTOT group (24.2 ± 8.5) compared with the non-LTOT group (27.8 ± 9.1), indicating a trend toward less severe symptom burden among LTOT users.

Discussion

This study found that COPD patients using LTOT reported lower symptom burden and better perceived health status compared with those who could not obtain LTOT due to financial constraints. Although the difference in mean CAT scores was not statistically significant, the effect size and severity distribution suggest that the lack of LTOT access may contribute to clinically meaningful impairment.

These findings are consistent with extensive literature showing that LTOT improves survival, HRQoL, exercise tolerance, and dyspnea in patients with chronic hypoxemia (1-4). Studies by Ringbaek et al. and Jones et al. further demonstrate improvements in patient-reported outcomes when oxygen therapy is appropriately used (17,18).

The present results highlight the impact of socioeconomic inequalities in COPD management. Numerous investigations have shown that socioeconomic deprivation reduces the likelihood of LTOT initiation or adherence, even among clinically eligible patients (10-12). Economic barriers appear to shape disease burden beyond physiological severity.

International studies reveal that limited access to essential COPD treatments—including medication and oxygen therapy—is associated with higher CAT and SGRQ scores, worse functional outcomes, and increased psychological distress (19-21).

Higher CAT scores also predict exacerbations, hospitalizations, and mortality (15,22). Thus, the greater symptom burden among LTOT non-users may have long-term prognostic implications.

Improving financial accessibility to LTOT—through reimbursement reforms, equipment subsidies, or national oxygen programs—may substantially improve HRQoL and reduce disease progression among vulnerable COPD populations (7,23).

Limitations of the Study

This study has several limitations that should be considered when interpreting the results. First, the cross-sectional design does not allow for establishing causal relationships between LTOT

use and symptom burden. Although differences in CAT scores were observed, the temporal direction of these associations cannot be confirmed.

Second, the sample size was relatively small (n = 60), which may limit the statistical power to detect modest but clinically relevant differences between groups. The non-significant p-value in the CAT comparison may partially reflect limited statistical power rather than the absence of a true effect.

Third, the study relied on a single symptom-related measure (CAT) without including additional validated HRQoL tools such as the SGRQ or mMRC dyspnea scale. The use of multiple instruments might have provided a more comprehensive assessment of health status.

Fourth, although key demographic and clinical variables were comparable between groups, the lack of detailed physiological measurements (e.g., PaO_2, $PaCO_2$, spirometric severity, oxygen saturation profiles) limits the ability to adjust for potential clinical confounders that could influence symptom scores independently of LTOT use.

Fifth, the group of patients not receiving LTOT consisted of individuals who lacked access due to financial constraints, which introduces possible socioeconomic confounding. Economic hardship is known to correlate with worse health outcomes, reduced access to other treatments, poorer nutrition, and lower adherence to medical advice, all of which may have influenced CAT results independently of LTOT status.

Sixth, the study did not evaluate exacerbation frequency, hospitalization history, or treatment adherence, variables that are strongly associated with CAT scores and overall disease burden. Their absence limits the depth of interpretation regarding disease control.

Finally, the study was conducted at a single center, which may affect generalizability. COPD populations in other regions may differ in demographic characteristics, access to care, or patterns of LTOT use.

Recommendations for Future Research

Future studies should build upon these findings through more robust and comprehensive research designs. First, longitudinal or prospective cohort studies are needed to clarify the temporal relationship between LTOT use and changes in symptom burden, functional capacity, and health-related quality of life. Tracking patients over time would allow for stronger inferences regarding the causal effect of LTOT.

Second, future research should include larger and more diverse samples, enabling improved statistical power and greater generalizability across different healthcare settings. Multi-center studies would help validate these results in broader COPD populations, including patients from different socioeconomic backgrounds and healthcare systems.

Third, forthcoming investigations should integrate detailed physiological and clinical parameters, such as arterial blood gases, oxygen saturation trends, spirometry (including FEV_1 decline), and desaturation during exertion. Adding these measures would enable a more comprehensive assessment of disease severity and help disentangle the independent contribution of LTOT from other clinical determinants.

Fourth, the inclusion of multiple validated patient-reported outcome measures (e.g., SGRQ, EQ-5D, mMRC) would provide a more nuanced understanding of how LTOT affects dyspnea, activity limitation, psychosocial functioning, and overall quality of life. Combining patient-reported outcomes with objective measurements such as 6-minute walk distance or actigraphy could further enrich the evidence.

Fifth, it would be valuable to examine exacerbation frequency, hospitalization rates, and healthcare utilization in relation to LTOT accessibility. Understanding whether economic limitations contribute to higher exacerbation risk or increased clinical burden could have important health policy implications.

Sixth, future studies should investigate adherence patterns to LTOT, including barriers related not only to economic limitations but also to stigma, device characteristics, mobility restrictions, and patient perceptions. Qualitative or mixed-methods research could provide insight into patient experiences and identify practical strategies to improve adherence and acceptance of LTOT.

Lastly, given the significant role of economic barriers identified in this study, future research should incorporate health economics analyses, including cost-effectiveness evaluations, modeling of long-term outcomes and healthcare savings, and assessment of reimbursement strategies that could improve equitable access to LTOT.

Conclusion

COPD patients with an established indication for LTOT who lack access to therapy due to financial constraints exhibit a higher symptom burden and poorer perceived health status. Although statistical significance was not reached, clinically relevant differences suggest that economic inaccessibility may contribute to worsened HRQoL. Strengthening health policies aimed at equitable access to LTOT may significantly improve outcomes in this high-risk population.

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