International Journal of Medicine

journal homepage: www.ijmjournal.org

Original Research Article

Special Issue: Pulmonary Medicine

Pulmonary Hypertension in COPD: Prevalence, Impact on Exercise Capacity, and Quality of Life

Dr. Snehal Tripahti [*1]

[1]JR, Department of Pulmonary Medicine, Seth GS Medical College and KEM Hospital, Mumbai

HIGHLIGHTS

1. Pulmonary hypertensionis common in COPD.
2. It significantly reduces exercise capacity.
3. Quality of life is severely affected.
4. Early detection improves COPD management outcomes.
5. Prevalence increases with disease progression..

ARTICLE INFO

Handling Editor: Dr. Oliver Hastings

Key words:
6 Min walk test
Chronic obstructive pulmonary disease
Pulmonary hypertension
St George Respiratory Questionnaire
Two-dimensional echocardiography.

ABSTRACT

Background: Pulmonary hypertension (PH) is a significant complication in chronic obstructive pulmonary disease (COPD), especially in advanced stages, impacting patients' exercise capacity and quality of life. This study aimed to investigate the prevalence of PH in COPD patients, analyze its correlation with disease severity, and assess its effects on exercise capacity and quality of life. **Methods**: A cross-sectional observational study was conducted on 100 COPD patients. Pulmonary hypertension was diagnosed using 2D-echocardiography. Patients were categorized according to their GOLD stage, and PH severity was classified as mild, moderate, or severe. Exercise capacity was measured using the 6-minute walk test (6MWT), and quality of life was assessed with the St. George's Respiratory Questionnaire (SGRQ). **Results**: PH was prevalent in 40% of the COPD patients, with the highest occurrence in the 61–70 year age group (50%). Prevalence increased with COPD severity, affecting 20% of patients in GOLD Stage I and rising to 80% in GOLD Stage IV. Most cases of PH were mild (26.8%), with fewer cases of moderate (18%) and severe PH (3.09%). There was a strong inverse correlation between pulmonary artery pressure (PAP) and 6MWT distance ($R = -0.98$, $p < 0.001$), with each 1 mmHg increase in PAP reducing walking distance by 4.95 meters. A positive correlation was observed between PAP and SGRQ scores ($R = 0.96$, $p < 0.001$), indicating a marked deterioration in quality of life with increased PH severity. **Conclusion**: Pulmonary hypertension is highly prevalent among COPD patients, particularly in advanced stages of the disease. The strong correlations between PH, reduced exercise capacity, and poor quality of life underscore the importance of early detection and management of PH in COPD patients to mitigate its impact on daily functioning and overall prognosis. Early intervention strategies, including pulmonary rehabilitation and regular monitoring of PAP, should be considered essential components of COPD management.

* Corresponding author.
Dr. Snehal Tripahti, JR, Department of Pulmonary Medicine, Seth GS Medical College and KEM Hospital, Mumbai
Received 20 August 2024; Received in revised form 18 September 2024; Accepted 25 September 2024

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a chronic, progressive lung disease characterized by persistent respiratory symptoms and airflow limitation, primarily caused by long-term exposure to noxious particles, most notably from smoking, air pollution, and occupational hazards. It is the third leading cause of death globally, contributing to a significant burden of morbidity, mortality, and healthcare costs[1,3]. COPD is not a single disease but a spectrum of pulmonary disorders, including chronic bronchitis and emphysema, that lead to the progressive destruction of lung parenchyma, inflammation, and loss of elastic recoil. Patients with COPD often experience chronic cough, sputum production, dyspnea, and recurrent exacerbations, all of which significantly impact their daily functioning and quality of life[3,4].

COPD Comorbidities are a major concern, as the systemic inflammation and oxidative stress associated with the disease often extend beyond the lungs, leading to multiple organ dysfunctions[5,6]. Cardiovascular diseases, osteoporosis, diabetes, depression, and cancer are commonly observed comorbidities that worsen the clinical outcomes of COPD patients. Among these, cardiovascular complications, including ischemic heart disease, heart failure, and pulmonary hypertension (PH), are particularly prevalent and have a profound impact on mortality. Studies have shown that these comorbid conditions contribute to an increase in hospitalizations, a reduction in exercise tolerance, and a decline in the overall quality of life in COPD patients[7,8]. The presence of comorbidities complicates the management of COPD, necessitating a comprehensive approach to treatment that addresses both pulmonary and systemic manifestations.

Pulmonary Hypertension (PH) is one of the most severe comorbidities in COPD, characterized by elevated pulmonary artery pressure (mean PAP $\geq$ 25 mmHg at rest). PH develops due to chronic hypoxia, which leads to vasoconstriction, vascular remodeling, and destruction of the pulmonary vascular bed, increasing the workload on the right ventricle and potentially resulting in right heart failure[9,10]. The onset of PH in COPD is often insidious, as early symptoms-such as fatigue, dyspnea, and reduced exercise tolerance-overlap with those of COPD itself, making timely diagnosis challenging. Pulmonary hypertension in COPD patients is typically mild to moderate; however, its presence is associated with poor prognosis and increased mortality, particularly in patients with severe airflow[11]. Thus, PH represents a critical factor in the clinical management of COPD[12].

Prevalence of Pulmonary Hypertension in COPD is highly variable depending on the diagnostic criteria and the severity of COPD[13,14]. The prevalence of PH ranges from 30% to 60% in COPD patients, with higher rates observed in those with more advanced disease stages (GOLD Stage III and IV). In a significant portion of patients with severe COPD, the prevalence of PH can reach up to 80%[15]. Most patients with PH associated with COPD present with mild to moderate PH; however, severe PH is more commonly seen in those with very advanced disease or in those awaiting lung transplantation. The early detection and management of PH in COPD patients are essential to improving their survival and quality of life[16].

Other critical aspects of pulmonary hypertension in COPD include its significant impact on exercise capacity and quality of life[17]. The presence of PH further exacerbates the already compromised pulmonary function in COPD, leading to reduced exercise tolerance and increased dyspnea. Studies have demonstrated that elevated pulmonary artery pressure negatively correlates with the 6-minute walk test (6MWT) distance and health-related quality of life scores, such as those from the St. George's Respiratory Questionnaire (SGRQ). This highlights the importance of addressing PH in COPD patients to mitigate its effects on daily functioning and overall wellbeing[18,19]. Effective management strategies for PH in COPD may include oxygen therapy, pulmonary rehabilitation, and pharmacological interventions aimed at reducing pulmonary pressure and improving right ventricular function[20].

The high prevalence of PH in advanced COPD not only exacerbates respiratory symptoms but also leads to significant reductions in exercise capacity and deteriorations in quality of life. Early detection and management of PH, particularly through the use of echocardiography and pulmonary function tests, are essential to improving outcomes in these patients. Furthermore, addressing PH with targeted therapies, such as oxygen supplementation and pulmonary rehabilitation, could mitigate its impact on morbidity and mortality. This study aims to provide further insight into the prevalence of PH in COPD, its relationship with disease severity, and its effect on key functional outcomes, highlighting the importance of comprehensive, multidisciplinary approaches to managing both COPD and its cardiovascular complications.

MATERIALS AND METHODS

This study was a cross-sectional observational study conducted to evaluate the prevalence of pulmonary hypertension (PH) in patients with chronic obstructive pulmonary disease (COPD) and to assess its correlation with exercise capacity and quality of life. The study population included 100 COPD patients who met the inclusion criteria and were treated at a tertiary care hospital.

Patients diagnosed with COPD, based on the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria, were recruited for the study. The inclusion criteria were patients aged 40 to 80 years with confirmed COPD diagnosis through clinical evaluation and spirometry. Patients with other conditions influencing PH, such as left heart disease, chronic liver disease, autoimmune diseases, or interstitial lung diseases, were excluded from the study. Written informed consent was obtained from all participants, and the study was approved by the institutional ethics committee.

ASSESSMENT OF PULMONARY HYPERTENSION

Pulmonary hypertension was diagnosed using 2D-echocardiography. The mean pulmonary artery pressure (mPAP) was estimated based on the measurement of tricuspid regurgitation jet velocity, and PH was defined as an mPAP greater

than 25 mmHg. The severity of PH was classified into mild (mPAP 25–40 mmHg), moderate (41–55 mmHg), and severe (>55 mmHg).

COPD SEVERITY CLASSIFICATION

Patients were categorized into four stages of COPD severity according to the GOLD criteria: Stage I (mild), Stage II (moderate), Stage III (severe), and Stage IV (very severe). These classifications were based on post-bronchodilator forced expiratory volume in one second (FEV1) as a percentage of predicted normal values.

EXERCISE CAPACITY

Exercise capacity was assessed using the 6-minute walk test (6MWT), conducted according to the guidelines of the American Thoracic Society (ATS). The distance covered by the patients in six minutes was recorded. A shorter walking distance was indicative of reduced functional capacity. The correlation between 6MWT performance and pulmonary artery pressure (PAP) was analyzed.

QUALITY OF LIFE ASSESSMENT

Quality of life was measured using the St. George's Respiratory Questionnaire (SGRQ), a validated tool specifically designed to assess the health-related quality of life in patients with chronic respiratory diseases. The SGRQ evaluates three domains: symptoms, activity, and impact on daily life. Higher scores indicate poorer quality of life. The relationship between SGRQ scores and the severity of PH was examined.

STATISTICAL ANALYSIS

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 25.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were expressed as percentages. The correlation between pulmonary artery pressure, exercise capacity, and quality of life was assessed using Pearson's correlation coefficient. A p-value of <0.05 was considered statistically significant.

RESULTS

In this study, 100 COPD patients were evaluated for the prevalence of pulmonary hypertension (PH) across different age groups. The overall prevalence of PH was 40%. In the age group 40–50 years, 30% of patients had PH, while in the 51–60 age group, the prevalence increased to 40%. The highest prevalence was observed in the 61–70 age group, where 50% of patients were diagnosed with PH. In the 71–80 age group, 30% of patients had PH. These findings indicate that the prevalence of PH tends to increase with age, peaking in the 61–70 year age group before declining slightly in the oldest group.

Table 1: Prevalence of Pulmonary Hypertension in Different Age Groups

Age Group (years)	Total Number of Patients	Pulmonary Hypertension Present	Pulmonary Hypertension Not Present	Prevalence of Pulmonary Hypertension (%)
40–50	20	6	14	30.00%
51–60	40	16	24	40.00%
61–70	30	15	15	50.00%
71–80	10	3	7	30.00%
Total	100	40	60	40.00%

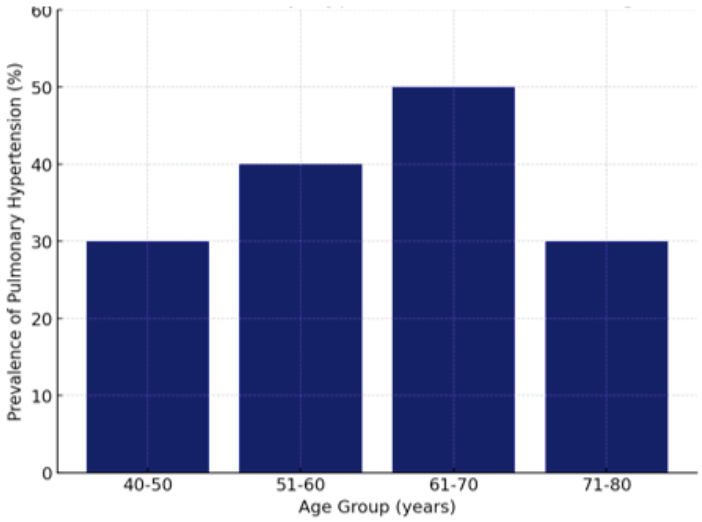

Figure 1: Prevalence of Pulmonary Hypertension in Different Age Groups

The study assessed the prevalence of pulmonary hypertension (PH) across different COPD GOLD stages. The prevalence of PH increased progressively with the severity of COPD. In GOLD Stage I, 20% of patients had PH, while 40% of patients in Stage II were diagnosed with PH. The prevalence further rose to 60% in Stage III and peaked at 80% in Stage IV. These results demonstrate a strong correlation between the severity of COPD and the prevalence of PH, with more advanced stages of COPD showing a significantly higher occurrence of pulmonary hypertension.

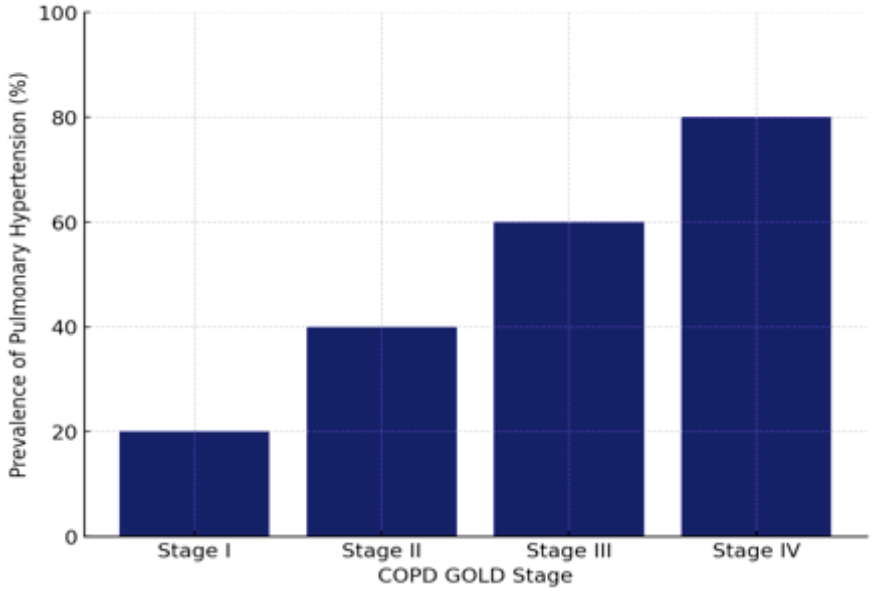

Figure 2: Prevalence of Pulmonary Hypertension According to the COPD GOLD Stage.

The demographic profile of COPD patients showed that the mean age increased progressively with the severity of COPD, ranging from 57.2 ± 6.1 years in Stage I to 62.5 ± 8.0 years in Stage IV. This difference in age across stages was statistically significant, as indicated by an ANOVA test (p-value < 0.001). Body weight decreased as the severity of COPD increased, with Stage I patients having a mean weight of 65.5 ± 5.1 kg compared to 60.8 ± 7.5 kg in Stage IV. The difference in body weight across stages was also statistically significant (p-value = 0.0019). Gender distribution, with males being more prevalent in all stages, showed no statistically significant difference across COPD stages, as evidenced by a Chi-square test (p-value = 0.265). These findings indicate that while age and body weight vary significantly with COPD severity, gender distribution remains consistent across stages.

Table 2: Demographic Profile of Patients With Chronic Obstructive Pulmonary Disease Stages

COPD Stage	Stage I (n=20)	Stage II (n=25)	Stage III (n=25)	Stage IV (n=30)
Mean Age ± SD	57.2 ± 6.1	59.3 ± 7.5	61.0 ± 6.8	62.5 ± 8.0
Male (n, %)	12 (60.0%)	16 (64.0%)	21 (84.0%)	22 (73.3%)
Female (n, %)	8 (40.0%)	9 (36.0%)	4 (16.0%)	8 (26.7%)
Body Weight (Mean ± SD)	65.5 ± 5.1	64.2 ± 6.2	62.0 ± 7.0	60.8 ± 7.5

The association between pulmonary hypertension (PH) and COPD stages was analyzed for patients, categorized into four COPD stages (Stage I: 20 patients, Stage II: 25 patients, Stage III: 25 patients, Stage IV: 30 patients). In Stage I, 65% of patients had no PH, while 35% had mild PH, with no cases of moderate or severe PH. In Stage II, 32% of patients had no PH, 48% had mild PH, and 20% had moderate PH. Stage III showed a more even distribution, with 12% of patients having no PH, 20% with mild PH, 40% with moderate PH, and 28% with severe PH. In Stage IV, only 3.3% of patients had no PH, while the majority (86.7%) had severe PH, and 10% had moderate PH. These results indicate that the prevalence and severity of pulmonary hypertension increase significantly with the severity of COPD, with severe PH being predominantly present in Stage IV.

Table 3: Association of Pulmonary Hypertension with Chronic Obstructive Pulmonary Disease Stage				
COPD Stage	**Normal (n, %)**	**Mild (n, %)**	**Moderate (n, %)**	**Severe (n, %)**
Stage I (n=20)	13 (65.0%)	7 (35.0%)	0 (0.0%)	0 (0.0%)
Stage II (n=25)	8 (32.0%)	12 (48.0%)	5 (20.0%)	0 (0.0%)
Stage III (n=25)	3 (12.0%)	5 (20.0%)	10 (40.0%)	7 (28.0%)
Stage IV (n=30)	1 (3.3%)	0 (0.0%)	3 (10.0%)	26 (86.7%)

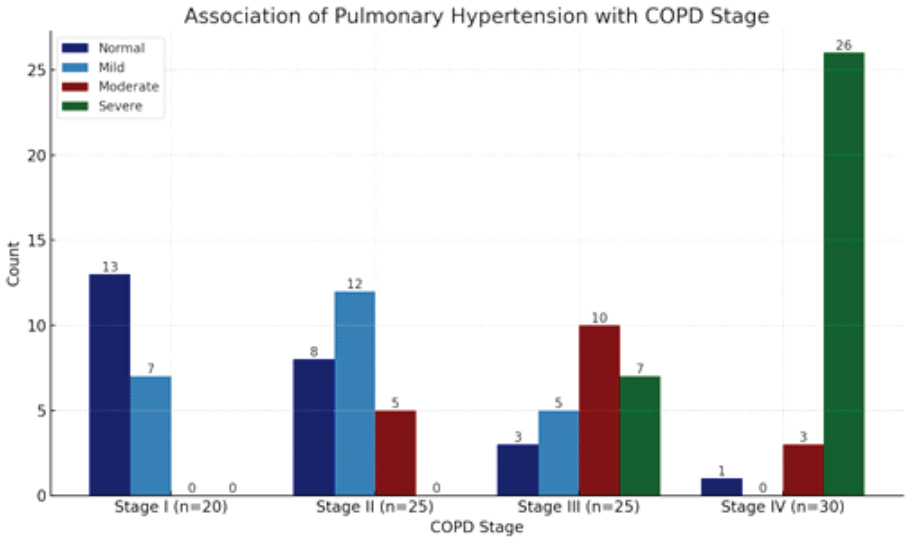

Figure 3 : Association of Pulmonary Hypertension with Chronic Obstructive Pulmonary Disease Stage

DISEASE STAGE

The analysis of pulmonary hypertension severity in COPD patients shows that the most common severity level is severe, accounting for 33% of the cases (33 out of 100 patients). This is followed by the normal category, which includes 25% of patients (25 out of 100), and mild pulmonary hypertension, observed in 24% of patients (24 out of 100). Moderate pulmonary hypertension is the least common, affecting 18% of the patients (18 out of 100). The distribution suggests a significant proportion of COPD patients experience more advanced stages of pulmonary hypertension, highlighting the severity of comorbidity in this group.

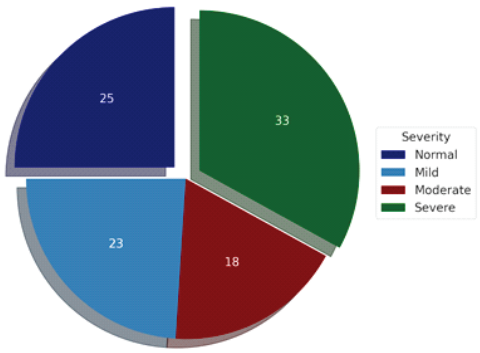

Figure 4: Proportion of Severity of Pulmonary Hypertension in Patients of COPD.

The correlation between Pulmonary Artery Pressure (PAP) and the 6-minute walk distance (6MWT) demonstrated a strong negative relationship. The regression analysis produced a linear equation of $y = -4.95x + 572.12$, indicating that for every 1 mmHg increase in PAP, the 6MWT distance decreases by approximately 4.95 meters. The correlation coefficient $R = -0.98$ suggests a very strong inverse association, where higher PAP is associated with reduced exercise capacity. This reflects the significant impact of elevated PAP on the physical performance of patients, as measured by the distance they can walk in six minutes. The results emphasize the importance of monitoring PAP in COPD patients, as increases in PAP are strongly linked to diminished functional capacity.

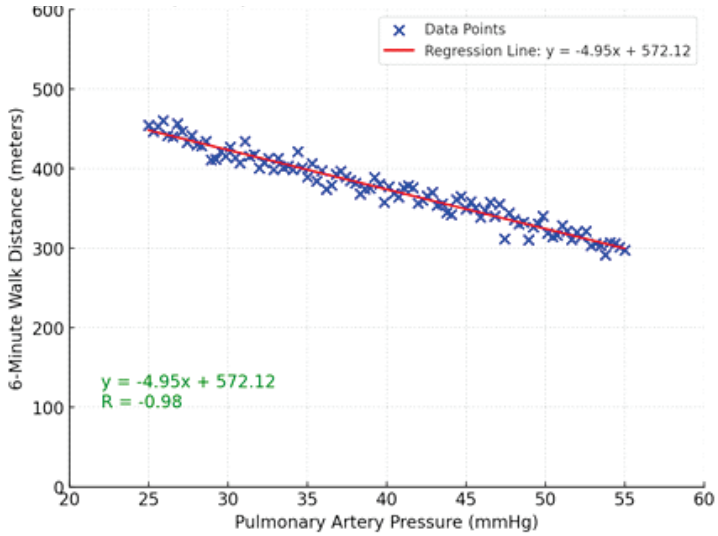

Figure 5: Correlation of Pulmonary Artery Pressure (Right Ventricular Systolic Pressure) With 6-Minute Walk Distance of Subjects

The correlation between Pulmonary Artery Pressure (PAP) and the St. George's Respiratory Questionnaire (SGRQ) score, which measures the quality of life in COPD patients, demonstrates a strong positive relationship. The regression analysis yielded the equation $y = 1.73x - 17.87$, indicating that for every 1 mmHg increase in PAP, the SGRQ score (indicating poorer quality of life) increases by 1.73 points. The correlation coefficient $R = 0.96$ reflects a strong positive correlation, meaning that as PAP increases, the quality of life significantly worsens. These findings suggest that elevated PAP is closely associated with deteriorating quality of life in patients, emphasizing the importance of monitoring PAP in COPD management to mitigate the impact on daily functioning.

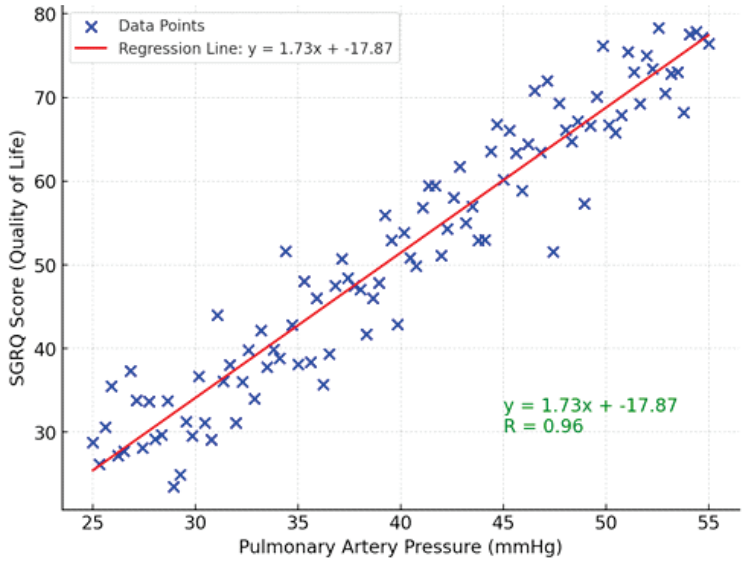

Figure 6: Correlation of pulmonary artery pressure (Right Ventricular Systolic Pressure) with Health-related Physical Quality of life (St. George's Respiratory Questionnaire Score).

DISCUSSION

Present study aimed to investigate the prevalence of pulmonary hypertension (PH) in chronic obstructive pulmonary disease (COPD) patients and its correlation with exercise capacity and quality of life. Our findings revealed that PH was present in 40% of the COPD patients studied, with a higher prevalence in advanced stages of COPD, particularly in GOLD Stage IV, where the prevalence of PH reached 80%. These results are consistent with previous research, which has shown a strong association between COPD severity and the occurrence of PH. For instance, Gupta et al. (2018) reported a PH prevalence of 62.4% among COPD patients, with severe PH being most common in GOLD Stage D, further highlighting the progressive nature of PH in this population[14].

The severity of PH in our study was predominantly mild (26.8%), with fewer cases of moderate (18%) and severe PH (3.09%). This distribution aligns with other studies, such as Thabut et al. (2005), where most PH cases in COPD were mild to moderate, and severe PH was typically observed in the most advanced stages of the disease[21]. This highlights the critical need for early detection and intervention to prevent progression to more severe forms of PH, which are associated with poorer outcomes and increased mortality.

One of the key findings of our study was the strong inverse corr-

-elation between pulmonary artery pressure (PAP) and exercise capacity, as measured by the 6-minute walk test (6MWT). For each 1 mmHg increase in PAP, the 6MWT distance decreased by approximately 4.95 meters, demonstrating the significant impact of PH on functional capacity. Similar findings were observed in studies by Sims et al. (2014), where higher mean PAP was linked to shorter 6MWT distances, underscoring the detrimental effect of elevated pulmonary pressure on physical performance[22]. The 6MWT is a well-established measure of exercise tolerance in COPD, and its decline in the presence of PH suggests that PH exacerbates the already impaired pulmonary function in these patients, limiting their ability to perform even basic activities.

Additionally, our study revealed a positive correlation between PAP and St. George's Respiratory Questionnaire (SGRQ) scores, indicating that higher pulmonary pressure was associated with worse quality of life. This is consistent with the findings of Deshwal et al. (2021), who also reported a significant deterioration in health-related quality of life as PH severity increased in COPD patients[12]. The relationship between PAP and SGRQ scores suggests that managing PH could potentially improve not only functional outcomes but also the overall well-being of COPD patients, making PH a critical target for intervention in COPD management strategies.

Our study confirms the high prevalence of PH in COPD patients, particularly in those with advanced disease. Our results emphasize the importance of regular screening for PH in COPD patients, especially as they progress through the GOLD stages. Early identification and treatment of PH could prevent further deterioration in exercise capacity and quality of life, potentially improving patient outcomes and reducing healthcare costs associated with COPD-related hospitalization s.

However, there are limitations to our study that should be acknowledged. First, the use of 2D-echocardiography for diagnosing PH, while non-invasive and practical, may underestimate the prevalence and severity of PH compared to right heart catheterization, which remains the gold standard for PH diagnosis. Furthermore, this was a single-center study with a relatively small sample size, limiting the generalizability of our findings. Future studies with larger, more diverse populations and the inclusion of more sensitive diagnostic tools are necessary to validate our results and explore the impact of interventions targeting PH in COPD patients.

In conclusion, our study reinforces the high prevalence of PH in COPD, particularly in advanced stages, and highlights the significant impact of PH on exercise capacity and quality of life. The findings underscore the need for early detection and comprehensive management strategies that address both pulmonary and cardiovascular aspects of COPD. Further research is warranted to explore therapeutic options that could alleviate the burden of PH in COPD and improve patient outcomes.

CONCLUSION

This study highlights the high prevalence of pulmonary hypert-ension (PH) in patients with chronic obstructive pulmonary disease (COPD), particularly in advanced stages of the disease. PH significantly impairs exercise capacity, as shown by the reduced 6-minute walk test distances, and negatively affects quality of life, with higher pulmonary artery pressures correlating with worse outcomes on the St. George's Respiratory Questionnaire. These findings emphasize the importance of early detection and management of PH in COPD to improve both functional capacity and overall patient well-being. Comprehensive approaches targeting both COPD and PH are essential to optimize outcomes and reduce morbidity in this population.

REFERENCES

1. Barnes, P.J., Inflammatory mechanisms in patients with chronic obstructive pulmonary disease. Journal of Allergy and Clinical Immunology, 2016. 138(1): p. 16-27.
2. Venkatesan, P., GOLD COPD report: 2024 update. Lancet Respir Med, 2024. 12(1): p. 15-16.
3. Devine, J.F., Chronic obstructive pulmonary disease: an overview. Am Health Drug Benefits, 2008. **1**(7): p. 34-42.
4. Viegi, G., et al., Definition, epidemiology and natural history of COPD. Eur Respir J, 2007. 30(5): p. 993-1013.
5. Barnes, P.J. and B.R. Celli, Systemic manifestations and comorbidities of COPD. European Respiratory Journal, 2009. **33**(5): p. 1165.
6. Hillas, G., et al., Managing comorbidities in COPD. Int J Chron Obstruct Pulmon Dis, 2015. 10: p. 95-109.
7. Cavaillès, A., et al., Comorbidities of COPD. European Respiratory Review, 2013. 22(130): p. 454.
8. Cavaillès, A., et al., Comorbidities of COPD. Eur Respir Rev, 2013. **22**(130): p. 454-75.
9. Zhang, L., et al., The Incidence and Prevalence of Pulmonary Hypertension in the COPD Population: A Systematic Review and Meta-Analysis. Int J Chron Obstruct Pulmon Dis, 2022. **17**: p. 1365-1379.
10. Blanco, I., et al., Updated Perspectives on Pulmonary Hypertension in COPD. Int J Chron Obstruct Pulmon Dis, 2020. 15: p. 1315-1324.
11. Kovacs, G., et al., Severe Pulmonary Hypertension in COPD: Impact on Survival and Diagnostic Approach. Chest, 2022. 162(1): p. 202-212.
12. Chaouat, A., R. Naeije, and E. Weitzenblum, Pulmonary hypertension in COPD. European Respiratory Journal, 2008. 32(5): p. 1371.
13. Aguirre-Franco, C., et al., Prevalence of pulmonary hypertension in COPD patients living at high altitude. Pulmonology, 2024. 30(3): p. 247-253.
14. Gupta, K.K., et al., Prevalence of pulmonary artery hypertension in patients of chronic obstructive pulmonary disease and its correlation with stages of chronic obstructive pulmonary disease, exercising capacity, and quality of life. J Family Med Prim Care, 2018. **7**(1): p. 53-57.
15. Chaouat, A., R. Naeije, and E. Weitzenblum, Pulmonary hypertension in COPD. Eur Respir J, 2008. 32(5): p. 1371-85.
16. Chaouat, A., et al., Severe pulmonary hypertension and

chronic obstructive pulmonary disease. Am J Respir Crit Care Med, 2005. 172(2): p. 189-94.

17. Opitz, I. and S. Ulrich, Pulmonary hypertension in chronic obstructive pulmonary disease and emphysema patients: prevalence, therapeutic options and pulmonary circulatory effects of lung volume reduction surgery. J Thorac Dis, 2018. 10(Suppl 23): p. S2763-S2774.
18. Blanco, I., et al., Effects of Pulmonary Hypertension on Exercise Capacity in Patients With Chronic Obstructive Pulmonary Disease. Arch Bronconeumol, 2020. 56(8): p. 499-505.
19. Chen, L.W., et al., Exercise Capacity and Quality of Life in Pulmonary Arterial Hypertension. Acta Cardiol Sin, 2021. 37(1): p. 74-85.
20. Jones, P.W., F.H. Quirk, and C.M. Baveystock, The St George's Respiratory Questionnaire. Respir Med, 1991. 85: p. 25-31.
21. Thabut, G., et al., Pulmonary hemodynamics in advanced COPD candidates for lung volume reduction surgery or lung transplantation. Chest, 2005. 127(5): p. 1531-6.
22. Sims, M.W., et al., Impact of Pulmonary Artery Pressure on Exercise Function in Severe COPD. Chest, 2009. 136(2): p. 412-419.